IBM Series/1 Communications Capabilities

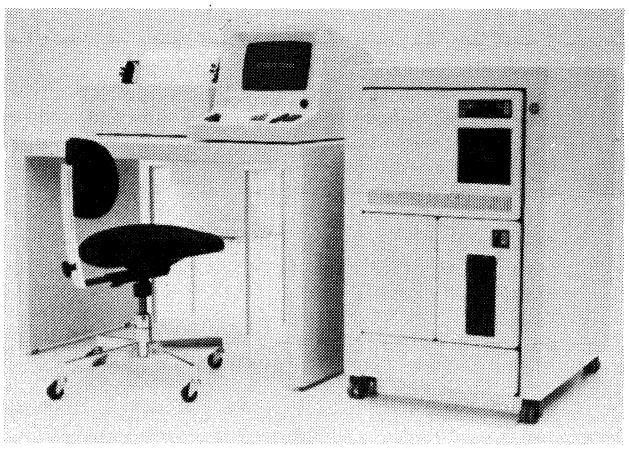
MANAGEMENT SUMMARY

In November 1976, IBM embarked on what was for them a revolutionary endeavor. After long opposing the use of plug-compatible products for larger systems, IBM introduced the Series/1, an "open" system that actually invites and encourages third-party participation for both hardware and software. This philosophy, coupled with special pricing discounts, has also made the Series/1 quite popular with OEMs.

From its inception, the Series/1 product line has provided a flexible, modular approach to small system building that allows customers to tailor the system to their requirements. The April, 1983 unveiling of the 4956 processor family signifies a long life expectancy for the Series/1.

The repertoire of the Series/1's communications capabilities continues to grow. The Series/1 may be used as a front-end processor, a terminal controller, a remote line concentrator, a distributed processing node, an RJE workstation, a communications controller in a local network, a CCITT X.25 packet switching gateway, a robot controller, a videotex processor, or other configuration.

IBM has continually expanded the Series/1's ability to communicate, both within its own architecture, SNA, and with the wide world outside the IBM domain. Within SNA, IBM has added both local and remote network management packages, allowing a Series/1 to perform some network management for a network of Series/1s, and allowing an SNA host to manage a Series/1 network remotely through its front-end processor. Outside the walls, IBM has legitimized the Series/1's X.25 capability by offering it as a licensed program. The Series/1 package, IBM's first concession to the need for X.25 compatibility, was first available as an unpublicized RPQ late in 1980, and caused a small media stir when its existence became public knowledge in mid-1981.



The IBM Series/1 is a system builder's machine; in capable hands, it can be a powerful communications tool. Pictured above is a Series/1 proicessor, display, and printer.

A purchase-only modular small computer system that can be tailored to operate as a remote line concentrator, front-end processor, terminal controller, local network station, packet switching node, or other data communications system.

The top of the line 4956 processor may have up to one megabyte of main memory. Transmission speeds of up to 56K bps in BSC, HDLC, and SDLC connections are supported. In addition, the Series/1 supports asynchronous communications, as well as X.25. Multiple Series/1s may be used to form a local network.

A 4956B with 1M byte of memory, programmable communications subsystem, and interface for 16 asynchronous lines is priced at approximately $41,000, depending on the interfaces used. Terminals, disk storage and other peripherals are, of course, available at additional cost. The RPS Version 6 operating system and necessary communication software may be licensed for a one-time charge of approximately $12,700. Hardware maintenance for such a system is about $216 per month.

CHARACTERISTICS

VENDOR: International Business Machines Corporation, Information Systems Group; National Accounts Division, 1133 Westchester Avenue, White Plains, New York 10604. Telephone (914) 969-1900.

DATE OF ANNOUNCEMENT: Models 4955 C & D—April 1977; Model 4955 E—July 1978; Models 4952 A & B—January 1979; Model 4952 C—January 1981; Model 4955 F—January 1981; Models 4954 A, B, & C—February 1982; Models 4956 B & C—April 1983.

DATE OF FIRST DELIVERY: Models 4955 C & D—September 1977; Model 4955 E—September 1978—Models 4952 A & B—March 1979; Model 4952 C—March 1981; Model 4955 F—March 1981; Model 4954 A, B, & C—March 1982; Models 4956 B & C—July 1983.

NUMBER DELIVERED TO DATE: Approximately 30,000 (all models).

SERVICED BY: IBM.

CONFIGURATION

The IBM Series/1 is a family of small computers marketed as multi-functional processors. The current Series/1 offering consists of four processors with a total of 12 models. The four processors are numbered 4952, 4954, 4955, and 4956.

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TABLE 1. IBM SERIES/1 PROCESSOR CHARACTERISTICS

Feature	4952 A	4952 B	4952 C	4954 A	4954 B	4954 C	4955 C	4955 D	4955 E	4955 F	4956 B	4956 C
Minimum memory (bytes)	32K	32K	32K	64K	64K	64K	32K	32K	64K	128K	256K	256K
Maximum memory (bytes)	128K	128K	128K	256K	256K	256K	64K	128K	256K	512K	1M	1M
Memory increment (bytes)	32K	32K	32K	64K	64K	64K	16K, 32K	16K, 32K	32K, 64K	128K	256K	256K
Available I/O feature slots*	5	14	4	4	13	3	10	7	7	7	13	3
Performance**	1.0	1.0	1.0	2.0	2.0	2.0	3.2	3.3	3.4	3.5	4.0	4.0
Module width (half or full)	Half	Full	Full	Half	Full	Full	Full	Full	Full	Full	Full	Full

*Base chassis only; the number of available slots may be increased with the use of one or more #1310 Multifunction Attachment Features or the #4959 I/O Expansion Units.
**For the purposes of this measurement, the 4952 processor sets the scale. All other performance figures are relative to the 4952.

As one example of the Series/1's versatility, IBM is currently using it as the base system for its commercial videotex offering, SVS/1. The SVS/1 system provides its users with a private videotex system for transmitting and receiving graphics and text over standard telephone lines. The system can support up to 24 simultaneous calls, and a larger number of intermittent calls.

A second example is the Series/1 Local Communications Controller, unveiled by IBM in January 1981, which permits cabling of up to 16 Series/1 processors in a local area network of "ring" configuration so that they may share and exchange files and other resources without host control.

A third example is the Series/1 Audio Distribution System program (#5719-020), which IBM introduced in February 1982, and which permits the Series/1 to be used as a voice store-and-forward message system. Some uses include digitizing voice messages, and simultaneous broadcasting of a single voice transmission to several other Series/1s using this package.

In the future, IBM is expected to add new processors, provide additional programming languages, and even support popular independent operating systems, as well as continuing to increase its communications capabilities.

The Series/1 system comprises a basic processor and I/O expansion slots that may be filled, according to the user's needs, with peripheral interfaces, communication controllers, line interfaces and other capabilities selected from a smorgasbord of printed circuit boards supplied by IBM and independents. IBM offers over 20 communication features from which to choose, ranging from a Synchronous Single Line Control supporting IPL, BSC, HDLC, SDLC, and X.25 at speeds up to 56K bps, to a Programmable Communication Subsystem capable of controlling up to 32 lines of mixed character codes, speeds, and protocols.

The Series/1 can be connected to almost all other IBM computer systems, including the Personal Computer, the Displaywriter, or another Series/1. IBM also supports SDLC communications for Series/1s operating in SNA

The major characteristics that distinguish each model are the maximum allowable memory, the number of available input/output feature (expansion) slots, module (chassis) width, and overall performance.

The 4952 processor is available in three models: the 4952 A, which is a half-width processor module with five available feature slots; the 4952 B, which is a full-width module providing 14 feature slots; and the 4952 C, also a full-width module with four feature slots and 1.2M bytes of integrated diskette storage. All models have a main memory minimum of 32K bytes and a maximum of 128K bytes. The memory is expanded via 32K-byte add-on memory units that plug directly into the main processor card and do not require use of feature slots.

The 4954 processor, like the 4952, is available in three models: the 4954 A, a half-width processor module with four available feature slots; the 4954 B, containing a full-width module and 13 feature slots; and the 4954 C, a full-width module housing three feature slots and 1.2M bytes of integrated diskette storage. All models have a main memory minimum or 64K bytes and a maximum main memory of 256K bytes. The memory is expandable via 64K-byte add-on memory units which plug directly into the processor card and do not engage the feature slots. According to information provided by IBM, the 4954 processors have twice the internal performance of the 4952 family. Performance may be further increased with the use of a floating point option, which also plugs directly into the processor card.

The 4955 processor family is available in four models, all of which are full-width modules:

***Model 4955 C*—has 10 available feature slots, and supports 32K to 64K bytes of main memory, which may be expanded by either 16K- or 32K-byte add-on memory units. Each memory unit requires one feature slot.**

***Model 4955 D*—has seven available feature slots, and supports 32K to 128K bytes of main memory, which may be expanded using either 16K- or 32K-byte add-on memory units. Each memory unit requires one feature slot; a Memory Address Relocation Translator (#6335) is also required when expanding beyond 64K bytes.**

***Model 4955 E*—has seven available feature slots, and supports 64K to 256K bytes of main memory, expandable via 32K- or 64K-byte increments. Each 64K memory unit requires one feature slot; only one 32K-byte memory unit may be used, which must occupy the last feature slot.**

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environments. A System/370 channel attachment allows the Series/1 to attach locally to an IBM mainframe. A multitude of asynchronous and synchronous communication line interfaces allows the Series/1 to support a wide range of IBM and non-IBM terminals.

The Series/1 offers two major operating systems. The Event-Driven Executive (EDX) features predominantly batch-oriented communications activity. However, the popular Yale ASCII Terminal Communication System, which provides 3270 BSC emulation for ASCII terminals, provides support for interactive EDX applications. The Realtime Programming System (RPS), supports the majority of the sophisticated communication attributes of the Series/1.

COMPETITIVE POSITION

As a communications processor, the IBM Series/1 shares its market with several other minicomputers designed for the OEM market. These include systems from Hewlett-Packard, DEC, Data General, Prime, and Perkin-Elmer. Currently, its most serious competitors are DEC's PDP-11 family and Hewlett-Packard's HP-1000. For specific applications, such as protocol conversion or other networking duties, comparisons are hard to draw. As one might expect, the Series/1 sells best for such applications in its "native" environment, the enormous installed base of IBM mainframe users. While it may have difficulty penetrating other minicomputer markets, IBM customer loyalty makes that significant market a virtual "preserve" for the Series/1.

ADVANTAGES AND RESTRICTIONS

Not counting the big mainframes, the Series/1 is IBM's most capable communicator. The wide range of communications hardware and software options sets the limits of its functionality at the limits of the user's imagination and budget. It is especially useful in a "true Blue" IBM environment as a versatile, configurable machine of relatively low cost that is not vulnerable to the "finger-pointing" woes of a multi-vendor environment.

On the other hand, unsophisticated users should be wary. The Series/1 is a system-builder's machine, not a "plug-it-in-and-turn-it-on" solution. For some of its applications, notably protocol conversion, the Series/1 is distinctly overqualified for all but the most sophisticated uses. The Series/1 not only requires fine tuning, it is designed to be fine-tuned. Users who know what to expect, and have both the need and the expertise, will be more than pleased with the Series/1. Users expecting a turnkey system should buy a turnkey system.

USER REACTION

In Datapro's 1983 Network User Servey, twelve users stated that they employ the IBM Series/1 as a communications processor, with a total of 30 machines installed. When asked to rate the Series/1's communications capabilities in nine categories, these user responded with the following ratings:

Model 4955 F—has seven available feature slots, and supports 128K to 512K bytes of main memory, expandle via 128K-byte add-on memory units. Each 128K-byte increment requires one feature slot.

IBM rates the 4955 processor performance as 3.2 to 3.5 times greater than that of the 4952 family. Like the 4954, a floating point is optionally available, but on the 4955, it requires one feature slot.

The 4956 processor, the newest, largest, and most powerful in the Series/1 family, is available in two models. The 4956 B is a full-width processor with 13 available feature slots. The 4956 C is a full-width processor with three available feature slots and an integral 1.2M byte diskette drive. Both models feature 256K bytes of main memory, expandable in 256K byte increments up to 1M bytes. According to IBM, the 4956 processors have four times the internal performance of the 4952 models. A floating point option is available; it does not occupy an I/O feature slot.

Model changes/upgrades are not available on the 4952 or 4954 processors. IBM does not recommend change/upgrades on the 4955 processor, but will field upgrade the Model 4955 E to a 4955 F upon request.

Table 1 provides a profile of each of the current Series/1 models, and compares characteristics of main memory, processors, and I/O slots.

The Series/1 processor itself consists of the microcoded logical unit, the arithmetic unit, and the system control functions. The processor is connected to an I/O bus that IBM calls the I/O Channel. This bus has an addressing capacity of 256 slots for attachment of both internal and external features. Internal features include main memory and floating point. External features include communications controllers, mass storage devices, printers, display units, and sensor options.

Except for the sensor options, all external data processing features have direct memory access for transferring data to and from memory by way of the I/O Channel. Such transfers are done without processor intervention, even though cycles must be stolen to execute the transfers. When the transfers are completed, an interrupt is triggered for processor action. There are four interrupt levels in the Series/1 processors. The user can assign each slot to an interrupt level, thereby assigning the associated attached device to one of four priorities. The devices assigned to the highest priority interrupt will receive processor attention even if a lower priority level device is, at that moment, receiving processor action. To accomplish this, a set of eight general registers, a status register, and an instruction address register are associated with each interrupt level. When a higher priority device causes an interrupt, the processor preserves the status of the lower priority's processing activity in the lower priority's associated registers and handles the higher priority request. The processor then retrieves the information saved in the lower priority's registers and completes the task. A device wanting interrupt processing but having the same priority level as a device currently receiving interrupt processing must await completion of the current processing before receiving attention.

All of the Series/1 models may support one or more #4959 I/O Expansion Units, each of which provides an additional 14 I/O feature slots. The expansion units are cable-connected to the I/O bus of the host processor module. Although there are no predefined limits to the number of expansion units (and I/O controllers) which may be configured with a Series/1, it should be noted that each processor model does in fact have a throughput limit. The limit varies significantly depending on the processor model and memory size, and on

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	Excellent	Good	Fair	Poor	WA*
Overall performance	6	3	2	1	3.2
Ease of installation	1	8	3	0	2.8
Ease of operation	3	6	3	0	3.0
Ease of expansion	5	4	2	1	3.1
Hardware reliability	7	3	2	0	3.4
Quality of vendor's software	2	6	3	1	2.8
Ease of programming	0	8	4	0	2.7
Quality of vendor's maintenance service	3	7	2	0	3.1
Quality of vendor's technical support	4	6	2	0	3.2

*Weighted Average based on a scale of 4.0 for Excellent.

Datapro recently interviewed four of these users by telephone. The four were: two computing service bureaus, a wholesale distributor, and a large resort. All of them use the EDX operating system, suggesting that, while RPS might be more versatile for communications, EDX may be more popular. Two of them use the Series/1 as an intelligent protocol converter under the Yale ASCII Terminal Communications system; one uses the Series/1 as a dial-in terminal concentrator and preprocessor for a data base inquiry system; the fourth uses the Series/1 as an intelligent RJE facility. None of those we interviewed use the Series/1 independently of an IBM host.

Two of our respondents cited the Series/1's reliability as its chief advantage, while two liked its flexibility best. One user praised the ease with which it handles communications, saying that the Series/1 "doesn't appear to be breathing hard" under a full communications load, and that it is "almost too fast a processor" for his application. Another praised its compatibility with the IBM 370-series host.

Two users felt that the Series/1 had no disadvantages whatsoever. One felt that EDL, the EDX system language, was difficult to understand. Another found the processor's 64K byte maximum partition size too small for some applications.

All were pleased with IBM's responsiveness to any problems, and all would recommend the Series/1 to another potential buyer. Two suggested caution, however, warning that the Series/1 is too complex a system for simple turnkey requirements.□

the number and type of I/O device and communications controllers. IBM will generally need to evaluate each desired configuration on an individual basis to determine which processor, and how much memory, will be required to support the configuration. Based on information available to Datapro, it can generally be stated that a high-end 4955 F processor may support no more than three I/O expansion units (a system maximum of 49 I/O feature slots). Information on the I/O expansion of the new 4956 models is not yet available.

In addition to the #4959 I/O Expansion Unit, there is also a Multifunction Attachment feature (#1310) available for all Series/1 processor models, which provides attachment for up to four external devices on the Series/1 while using only one feature slot.

All Series/1 procesors are rack-mountable, except Model 4954 C, which may be installed in the rack, or without the rack enclosure for limited space office requirements. An EIA standard 19-inch mounting rack, the #4997 Rack Enclosure, is provided and comes in two models: the Model 1 is one meter high and holds two full-width modules, the Model 2 is 1.8 meters high and will hold four full-width modules. When one or more of the modules are half-width, the #4540 Rack Mounting Fixture is required. It supports either one or two half-width modules.

COMMUNICATIONS FEATURES

Depending on model, a maximum of 96 communications lines can be attached to a fully expanded Series/1 system. Current communications options include support of the following interfaces: EIA RS-232-C, CCITT V.24, V.35, X.21, X.25 and local attachments. A 20mA and a 60mA current loop Teletype adapter is also available. The protocols/codes supported by the hardware are BSC, SDLC, ASCII, HDLC, PTTC/EBCD, and PTTC/Correspondence. Except for the full-duplex Teletype adapter, only half-duplex lines are supported. BSC, SDLC, and HDLC lines can have speeds up to 56K bps; all other protocols can have speeds up to 9600 bps. The PTTC and Correspondence protocols are compatible with the IBM 2740 Models 1 and 2, and with the IBM 2741.

The features described in the following text are the current communications hardware components which may be implemented in the Series/1. The list does not, however, reflect all of the I/O control devices which may be configured. Only those which support communications are listed. There are additionally, controller boards for mass storage devices (magnetic tape, disk and diskette) and other I/O device controllers (for local device attachment) which will contend with these communications components for available I/O slots. The same is true for physical space in the mounting rack. Rack space is needed for all of the I/O and mass storage modules, in addition to the communications features which are detailed below.

A general communications configuration rule is that no more than 24 communications lines, of any mixture, may be terminated in a single processor or expansion unit. The only exception to this rule is the 4987 Programmable Communications Subsystem, which may terminate up to 32 communications lines and requires only a single processor, or single expansion unit. The subsystem handles its own lines, and does not decrease the line capacity of the processor or expansion unit to which it is attached.

4987 Programmable Communications Subsystem

The 4987 Programmable Communications Subsystem can be implemented on any of the models, and essentially performs as a front-end for the Series/1 processor. It is user-programmable with special software utilities which operate under the Realtime Programming System (RPS).

The subsystem off-loads much of the communications processing from the basic processor, handles varied line speeds, character codes, and protocols, and performs error checking, polling, and synchronization timing. Up to 32 lines can be attached, and they may be a mixture of asynchronous or synchrounous, switched or leased, and point-to-point or multipoint.

The 4987 subsystem occupies a full-width module position in the rack enclosure and requires two adjacent I/O feature slots in either the processor or a #4959 I/O Expansion Unit. The #1300 Programmable Communications Subsystem Controller is a two-card feature which occupies these slots, and is cable-attached to the 4987. It controls the 4987 scanner and up to 16 features (32 lines).

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If the user requires increased throughput for the system, another scanner unit, the #3600 Expansion Scanner, can be added to the subsystem module to handle up to half of the line interfaces. This also requires that a second #1300 Subsystem Controller, occupying two more I/O feature slots be added.

The 4987 Programmable Communications Subsystem has its own family of line interfaces and feature attachments. These include:

- The Half-Duplex DCE Attachment (#4730), which provides for attachment of two independent switched or non-switched, synchronous or asynchronous external modems;
- The Full-Duplex DCE Attachment (#4731), which permits the same external modems to be accessed, but provides one full-duplex line instead of two half-duplex lines;
- The Auto-Call Attachment (#4743), which operates under the same operational restraints as the #4730 and provides an auto-call feature for a Western Electric 801–C or equivalent data set;
- The TTY Current Attachment (#4734), which provides local attachment for TTY compatible devices via half-duplex operation;
- The Data-Phone Digital Service Adapter (#4736), which allows AT&T's DDS service to be accessed in non-switched network via a channel unit at lines speeds of 2400, 4800, and 9600 bps for non-SDLC synchronous transmissions;
- The Asynchronous Local Attachment (#4739), which provides two asynchronous local interfaces for half-duplex transmissions of up to 9600 bps; and
- The Synchronous Local Attachment (#4740), which provides two synchronous interfaces operating under the same transmission rules as the Asynchronous Local Attachment (#4739).

It should be noted that, unlike other Series/1 communications features, transmission speeds for lines attached to the subsystem may not exceed 9600 bps. Other features not supported by the subsystem include SDLC communications, and the ability to down-line load and IPL (Initial Program Load) the system. All of the 4987 adapters and line interfaces are provided with a six-meter long attachment cable.

The 4987 subsystem also supports any of six auto-answer integrated modems accommodating transmission speeds of up to 1200 bps:

Feature #	Transmission Technique	Facility Supported	Special Capabilities
4746	Asynchronous	Switched network	Auto-answer
4747	Asynchronous	Leased line	Switched network back-up with auto-answer
4748	Asynchronous	Leased line	Wrap test
4751	Synchronous	Switched network	Auto-answer, auto-answer test, wrap test, internal clock
4752	Synchronous	Leased line	Switched network back-up with auto-answer, wrap test, internal clock
4753	Synchronous	Leased line	Wrap test, internal clock

An optional feature of the 4987 subsystem is the #4900 Communications Console, which provides operator interface to the subsystem for debugging and problem identification. The console consists of a pluggable function keyboard and a set of displays, which may be switched between two scanners.

A special IBM licensed program, Programmable Communications Subsystem Preparation Facility (5719-CS0), provides the RPS system user with a library of macro instructions which are used to define the line configurations, protocols, tables and other parameters. Output is then linked by the standard RPS program preparation facilities, and is storable on disk for loading into the subsystem. Two other IBM licensed programs, 5719-CS1 and 5719-CS2, provide execution support of the subsystem and run under certain versioins of the RPS operating system.

Multi-Line Feature-Programmable Communications Controller

The #2095 Feature-Programmable 8-Line Communications Control permits the user to define, under program control, the characteristics of up to eight communications lines. The 2095 is a single-board feature which occupies one I/O feature slot of either the Series/1 processor, or a #4959 Expansion Unit.

The 2095 controller requires one or two #2096 Feature-Programmable 4-Line Communications Adapters, each of which provides for the attachment of up to four half-duplex lines. Each of these line adapters also requires an I/O feature slot that must be adjacent to its controller. Therefore, if all eight lines are used within this subsystem, three contiguous I/O slots are required.

Program-selectable communications features for each line are: transmission speed (37.5 to 19.2K bps), asynchronous or synchronous operation, character length (5, 6, 7 or 8 bits per character, plus parity), character code (ASCII or EBCDIC), character parity checking (odd, even or none), one or two synchronization characters, and one or two stop bits. Additionally, the controller can provide auto-answer and modem control functions for either switched or non-switched lines. Any of the lines may be non-switched point-to-point or multipoint, or switched point-to-point.

This system does not significantly off-load communications processing from the host controller, as does the 4987 communications subsystem. While aggregate throughput for the controller is about 64,000 bps, it does not perform such sophisticated functions as device address recognition or polling. These remain the responsibilities of the host processor. It is important to note that while character-synchronous transmission is supported, the controller is incapable of performing CRC checking or generation and cannot, therefore, support BSC communications.

Transmission speed for asynchronous operation is program controlled within two jumper-selectable ranges; 37.5 to 1200 bps, and 300 to 19.2K bps. External clocking is required for synchronous transmission. Interfacing to communications facilities is EIA RS-232-C/CCITT V.24 compatible. An-

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other jumper-selectable option permits 20mA current loop interface.

Other Multi-Line Controllers

Two additional multi-line controllers can be implemented with the Series/1; each occupies one I/O feature slot and controls up to eight communications lines.

The #2091 Asynchronous Communications 8-Line Control feature handles up to eight asynchronous lines and requires one or two #2092 Asynchronous 4-Line Adapters. Each adapter also requires an I/O feature slot adjacent to the controller. Therefore, up to three contiguous I/O slots are required to fully configure this subsystem. The transmission speed of each line is under program control within one of two jumper-selectable ranges which determine the range for all four lines; 37.5 to 1200 bps, or 300 to 2400 bps. Each line may support PTTC/EBCD or PTTC/Correspondence codes. Local asynchronous devices may be attached, as well as external data sets for remote asynchronous devices. Any of the lines may operate in a non-switched point-to-point or multipoint, or in a switched point-to-point mode. For switched lines, a connection may utilize auto-answer, manual call or manual answer. This subsystem does not support IPL of the Series/1 over communications lines.

The #2093 BSC Communications 8-Line Control feature handles up to eight BSC lines with either one or two #2094 BSC 4-Line Adapters. As with the asynchronous subsystem, each adapter also requires an I/O feature slot adjacent to the controller, thereby requiring up to three slots per subsystem. Two of the eight lines may operate at 9600 bps, in which case none of the remaining six may exceed 2400 bps. If only four lines are attached, each may operate at 4800 bps. Internal timing of 600 or 1200 bps is provided automatically for those modems used which do not provide their own clocking. Both ASCII and EBCDIC codes are supported, and interface compatibility is EIA RS-232-C/CCITT V.24. Like the asynchronous controller, any line may operate in a non-switched point-to-point or multipoint, or switched point-to-point mode, and, like the asynchronous controller, the BSC controller does not support down-line IPL of the Series/1.

Single Line Controllers

In addition to the multi-line controllers and subsystems already described, there are currently six single line controllers available for the Series/1, each of which requires one I/O feature slot.

The #7850 Teletypewriter Adapter permits attachment via a single 20/60mA current loop communications line of a Teletype ASR 33, 35 or similar device. With appropriate system configuration, this adapter may be used for IPL of the Series/1. Transmission rate may be selected from 12 speeds ranging from 50 to 9600 bps. Full-duplex transmission is supported.

The #1610 Asynchronous Communications Single Line Control provides for the attachment of a single, half-duplex, asynchronous line. Speed is program selectable from among two jumperable ranges; 37.5 to 1200 bps, and 300 to 9600 bps. Remotely, this feature supports non-switched point-to-point and multipoint operations, or switched point-to-point. Auto-answer facility is also provided. Character codes supported are compatible with IBM 2740 (Models 1 and 2), 2741 terminals, ASCII, and TTY 33/35. The interface is RS-232-C/V.24.

The #2074 BSC Single Line Control supports attachment of one half-duplex BSC communications line. The interface is RS-232-C/V.24, and transmission speed of up to 9600 bps is supported. The unit supports ASCII or EBCDIC character codes, under program control. Internal clocking of 600 or 1200 bps is provided, if external data set does not provide timing. In addition to non-switched point-to-point, multipoint, and switched point-to-point operation, this controller supports down-line IPL of the Series/1 from a remote processor.

The #2075 High-Speed BSC Line Control offers the same features as the #2074 but permits half-duplex transmission at up to 56K bps. Interfacing for a Bell 303 or equivalent data set is provided. IPL of the Series/1 is likewise supported. No more than eight #2075s are permitted on a single Series/1 system.

The #2080 Synchronous High-Speed Single Line Control provides attachment of a single BSC, SDLC, or HDLC communications line via a CCITT/V.35 interface or a local CCITT/X.21 connection. BSC support is provided for half-duplex remote communications at up to 56K bps, or for local connections of up to 1,000 feet (304 meters) via the X.21 interface at speeds of up to 48K bps. Both the ASCII and EBCDIC character sets are supported. SDLC support is provided for half-duplex 9600 bps operation via V.35 or X.21 and also supports both the ASCII and EBCDIC character codes. HDLC support is provided for full-duplex operation at 56K bps speeds via V.35 or 48K bps via X.21, and with the appropriate programmable frame and packet level interfacing software (5799-TCP), complies with CCITT/X.25 procedures in a packet switching network. Remote IPL of the Series/1 can be supported by HDLC, but not by BSC or SDLC, connections.

The #2090 SDLC Single Line Control permits attachment of one half-duplex SDLC line to the Series/1. Interfacing is RS-232-C/V.24, and speeds up to 9600 bps are supported. Internal clocking at either 600 or 1200 bps is provided. Otherwise, an external data set is required. Like the BSC and SDLC controllers, EBCDIC and ASCII codes are supported, but down-line IPL may not be accomplished using SDLC communications. Multipoint and point-to-point operation is also supported.

Local Communications Controller

The #1400 Local Communications Controller provides for the interconnection of up to 16 Series/1 processors using a peer-to-peer ring topology technique with a serial transmission speed of 2M bps, and twinaxial or coaxial cable connection. Maximum length between processors is 5,000 feet (1,524 meters). In each Series/1 in the network, the #1400 Local Communications Controller requires one feature slot and provides direct channel-to-channel communications between that system and the other Series/1s. It allows any terminal attached to one Series/1 processor to access and/or exchange files, share a printer, or utilize other resources assigned to any other Series/1 processor in the network without intervention from a host or master control station. The user may configure Series/1 processors as part of a distributed data processing, distributed applications processing or local area network application and use the capabilities commonly associated with those disciplines.

Other Communications Features

The #7880 Telephone Communication Controller provides control and data transfer for up to four public or private switched telephone exchanges when used with #7881 Single-Line Telephone Communications Adapters. The adapter will answer or originate calls, and generate or detect standard push button phone signals. The #7880 Telephone Communications Controller and the #7881 Telephone Com-

IBM Series/1 Communications Capabilities

TABLE 2. IBM SERIES/1 PROGRAMMABLE COMMUNICATION SUBSYSTEM—LINE INTERFACES*

Facility	Transmission	Feature Number	Number Lines Supported	Speed (bps)	Comments
TTY-Current Loop	Asynchronous	#4734	2	TTY dependent	2- or 4-wire
Local Attachment	Asynchronous	#4739	2	45-1200, 2400, 4800, 9600	—
Leased Line	Asynchronous	#4748	1	45-1200	Integrated Modem
Leased (with Switched Line Backup)	Asynchronous	#4747	1	45-1200	Integrated Modem with Auto Answer
Switched Line	Asynchronous	#4746	1	45-1200	Integrated Modem with Auto Answer
Local Attachment	Synchronous	#4740	2	600, 1200, 2400, 4800, 9600	—
Leased Line	Synchronous	#4753	1	600, 1200	Integrated Modem
Leased (with Switched Line Backup)	Synchronous	#4752	1	600, 1200	Integrated Modem with Auto Answer
Switched Line	Synchronous	#4751	1	600, 1200	Integrated Modem with Auto Answer
DDS Leased	Synchronous	#4736	1	2400, 4800, 9600	—
Auto Call Unit (with EIA RS-366 interface)	—	#4743	1	Determined by external data set	Bell 801 C compatible
Communication Console	—	#4990	—	—	Plugs into subsystem for operator interface

*All interfaces can contain integrated modems, if required. For external modems, there is a #4730 half-duplex Digital Communications Equipment (DCE) attachment which supports two lines and a #4731 full-duplex DCE which supports a single line. DCE attachments may be asynchronous or synchronous, switched or leased, as determined by external modem.

munications Adapter each require one feature slot immediately adjacent to its controller; therefore if all four lines are utilized within this subsystem, five contiguous I/O slots are required.

Voice store and forward capability is available in conjunction with the #7880 and #7881 via the Audio Distribution System (5719-U20) licensed program. Users may record, listen to, or transmit digitized voice messages. Broadcasting a voice message to several Audio Distribution System equipped Series/1s is also possible. The program runs under RPS Version 5 (5719-PC5) with command language facility and requires the PL/1 Transient Library (5719-PL4).

Another optional feature of the Series/1 communications hardware is the #2000 Communications Indicator Panel, which attaches to any single or multi-line controller and does not require an I/O feature slot. The panel consists of eight switches and eight indicator lights with which coded information is displayed showing line operational status. The #2000 CIP is not available for 4954 and 4952 processor models A and C.

A feature providing backup for communications is the #7900 Two-Channel Switch. This feature for the 4959 I/O Expansion Unit provides the capability for switching a set of common I/O devices between two Series/1 processors. The 7900 feature card is plugged into the 4959 and is connected by cable to the I/O channels of two Series/1 processors. Upon failure of the primary processor, the secondary or backup processor receives an interrupt and can be programmed to switch the common I/O. Manual intervention is required when switching back to the primary processor. Manual switching in either direction can be done by the operator.

The Two-Channel Switch console, located on the front panel of the 4959 I/O Expansion Unit, is provided as part of this feature, and provides indicator lights, switches, and keys that allow unit power on/off, manual or backup selection, manual processor selection, manual processor interrupt, channel reset, manual error recovery, and unit status. As a unit, the 7900 is field-installable.

HOST CONNECTION

Channel-to-channel communications between a Series/1 and an IBM System/370 (Models 135-168), 303X, or 4300 Series processor and compatible mainframes is possible with #1200 Channel Attachment feature. This is a single-board component and occupies one I/O feature slot. In addition, a #4993 Termination Enclosure is required, this is a full-width module that is rack-mounted with other Series/1 modules.

The #1200 Controller appears to the host as an IBM 3272 control unit with 32 device addresses. It is handled as a single device interface by the Series/1 processor. Attachment is made to the selector or block multiplexer channel of the host and, when properly configured, allows IPL of the Series/1 from the host system.

Channel attachment cables are not provided with the 4993 unit and must be purchased separately. Up to eight 4993 units (multiple Series/1) may be connected to a System/370 channel. Channel attachment is driven by a licensed program, Series/1-System/370 Channel Attach Program (5719-CA1), which runs under the RPS and EDX operating systems.

IBM Series/1 Communications Capabilities

TABLE 3. IBM SERIES/1 COMMUNICATIONS FEATURES (1)

Feature	I/O Slots Required	Interface	Maximum Number Lines Controlled	Type Communication	Feature Number	Maximum Transmission Speed (bps)	Comments
4987 Programmable (2) Communications Subsystem	2	Adapter Dependent	32	Async/BSC Mixture	#4987 (with #1300 Controller)	9600 per line	Full-Width Module
Feature-Programmable (3) 8-Line Controller	2-3	RS-232-C/V.24 or Current Loop	4/8	Async/Sync Mixture (No BSC)	#2095	37.5 to 19.2K per line	—
With 4-Line Feature-Programmable Line Adapter(s)					#2096		
System/370 Channel Attachment	1	Host Selector or Block Multiplexer Channel	—	3270 Channel Protocol	#1200	—	Requires #4993 Termination Enclosure (Full-Width Module)
Multi-line BSC Controller (3) with 4-Line BSC Line Adapter(s)	2-3	RS-232-C/V.24	4/8	Synchronous	#2093 #2094	9600 per line	—
Multi-line Async Controller (3) with 4-Line Async Line Adapter(s)	2-3	RS-232-C/V.24	4/8	Asynchronous	#2091 #2092	2400 per line	—
Async Line Controller	1	RS-232-C/V.24	1	Asynchronous	#1610	9600	—
BSC Line Controller	1	RS-232-C/V.24	1	Synchronous	#2074	9600	Supports IPL
Synchronous High-Speed Line Controller	1	CCITT/V.35, X.21, & X.25	1	Synchronous, BSC, SDLC or HDLC	#2080	56K	HDLC supports IPL
High-Speed BSC Line Controller	1	CCITT/V.35	1	Synchronous	#2075	56K	Supports IPL, Bell 303 or compatible
Teletypewriter Adapter	1	20/60mA Current Loop	1	Asynchronous	#7850	9600	—
Local Communications Controller	1	Channel-to-Channel	16	Cable-connect	#1400	2M	Ring Topology, IPL
SDLC Controller	1	RS-232-C/V.24	1	Synchronous	#2090	9600	—
Communications Indicator Panel	—	—	—	—	#2000	—	Attaches to Single or Multi-line Controllers

(1) Feature #2010, Power Supply, is generally required if more than two communications features are configured.
(2) See Table 2 for delineation of line adapters and features of 4987 subsystem.
(3) Multi-line controllers require either one or two four-line adapters.

SOFTWARE

The most capable Series/1 operating system for communications is the Realtime Programming System (RPS), a control system through which a user can install, operate, and maintain system programs, application programs, and data. RPS is multiprogramming, multitasking, event-driven, and disk-based. It allows multiple concurrent task operations in the same or different partitions with synchronization and communication between them. Re-entrant programs can be used by more than one task. RPS manages all physical resources—processor, storage, and devices. Its supervisor and data management services provide a controlled interface between application programs and Series/1 hardware.

Six versions of the RPS operating system are available. A profile of communications attributes of the six versions is provided in Table 4.

IBM also offers the Event Driven Executive (EDX) operating system. Primarily intended for general purpose business computing, but popular for communications applications, EDX is also a multiprogramming, multitasking operating system with its own macro assembler programming language. Communications capabilities are not as extensive as those of RPS. However, EDX supports several batch and RJE protocols not available with RPS, such as 2780, 3780 and HASP. A breakdown of the EDX communications support features is provided in Table 5. IBM has announced that Versions 1 through 4 of RPS and Version 2 of EDX will be withdrawn from marketing effective October 1, 1983.

As an alternative to RPS and EDX, IBM offers Control Program Support, which is not an operating system, but rather a series of modules the user can assemble as needed to build an operating system. Control Program Support offers limited bisynchronous communications support through Program #5799-TAF.

RPS has debugging aids to help users to find and correct errors in problem and supervisory programs. Through the interactive debug package, users can display and modify

IBM Series/1 Communications Capabilities

TABLE 4. RPS OPERATING SYSTEM COMMUNICATIONS SUPPORT

Communications Capability Supported	RPS Version					
	1	2	3	4	5	6
Series/1 BSC communications (as a System/3) with an IBM host operating under—						
OS/VS:						
OS/VS 1 (BTAM)	Yes	Yes	Yes	Yes	Yes	Yes
OS/VS2 (BTAM)	Yes	Yes	Yes	Yes	Yes	Yes
OS/VS 1 (TCAM)	No	No	Yes	Yes	Yes	Yes
OS/VS 2 (TCAM)	No	No	Yes	Yes	Yes	Yes
DOS/VS:						
CICS	No	No	Yes	Yes	Yes	Yes
BTAM	No	Yes	Yes	Yes	Yes	Yes
VTAM	No	Yes	Yes	Yes	Yes	Yes
IMS (BTAM)	No	No	Yes	Yes	Yes	Yes
SNA/SDLC line adapter capability	No	No	No	Yes	Yes	Yes
Series/1 BSC communications via feature #1310, #2074/2075, #2093/2094 (as a System/3) with—						
System/32	No	No	Yes**	Yes**	Yes***	Yes***
System/34	No	No	Yes**	Yes**	Yes	Yes
System/23 Datamaster	No	No	No	No	Yes**	Yes**
System/38	No	No	No	No	Yes	Yes
System/3	No	No	No	Yes*	Yes	Yes
other Series/1s	No	Yes**	Yes**	Yes** and multipoint	Yes** and multipoint	Yes** and multipoint
3271, Models 1 and 2	No	No	No	Yes**	Yes	Yes
3274 Controller Model TC and 51C and attached 3270 displays and printers	No	No	No	Yes**	Yes	Yes
3276 Controller Models 1, 2, 3 and 4 with attached 3270 displays and 3289 printer	No	No	No	Yes**	Yes	Yes
5260 Retail System	No	No	Yes**	No	Yes	Yes
3741 Data Entry system	No	No	No	No	Yes	Yes
5280 Programmable terminal	No	No	No	Yes**	Yes	Yes
6670	No	No	No	Yes**	Yes	Yes
Displaywriter	No	No	No	No	Yes***	Yes***
3684 POS unit	No	No	No	Yes**	Yes	Yes
Asynchronous devices supported via features #1610, #2091/2092 and #2095/2096—						
TTY 33/35	Non-switched only	Yes****	Yes****	Yes	Yes	Yes
2740, Model 1	Yes****	Yes****	Yes****	Yes****	Yes****	Yes****
2740, Model 2	No	No	No	Yes****	Yes****	Yes****
2741	No	No	No	Yes****	Yes****	Yes****
3101	No	No	No	No	No	No
System 23 Datamaster	No	No	No	No	Yes	Yes
IBM Personal Computer	No	No	No	No	Yes	Yes
Displaywriter	No	No	No	No	Yes and #1310	Yes and #1310
3101	No	No	No	No	#1310 and #2095/2096 only	#1310 and #2095/2096 only
Downline IPL; BSC only	No	Yes****	Yes****	Yes****	Yes****	Yes****
RJE; BSC or SNA/SDLC	No	No	No	No	Yes****	Yes****
X.21 support	No	No	No	No	No	Yes
X.25 support	No	No	No	No	No	Yes

*Does not support feature #1310.
**Does not support feature #1310 and #2075.
***Does not support feature #2075.
****Does not support feature #2095 and #2096.

registers, processor storage, disk, and diskette contents, as well as set address stops to monitor the status of executing programs.

Two different sets of utilities are available to aid the user in application program development under RPS. These are the Program Preparation Subsystem, and the Base Program Preparation Facilities.

The Program Preparation Subsystem (PPS) provides a general-purpose batch environment and software tools for developing the application programs that run under RPS. The PPS licensed program consists of a Job Stream Processor, Text Editor, Macro Assembler, and Application Builder. These programs execute in the batch partition as task sets under control of RPS.

IBM Series/1 Communications Capabilities

TABLE 5. EDX OPERATING SYSTEM COMMUNICATIONS SUPPORT

Communications Capability Supported	EDX Version			
	1	2	3	4
2780/3780 emulation to host via RJE (HASP, HASP 4, RES, JES 2, JES 3, VM-RSCS)	Yes	Yes	Yes	Yes
Single- and Multiple-Line Controllers:				
#2074/2075 and #2093/2094	Yes	Yes	Yes	Yes
#1610, #2091/2092, #2095/2096, #7850	No	Yes	Yes	Yes
Communicate asynchronously via #1610, #2091/2092, or #2095/2096 to:				
IBM Personal Computer	No	No	Yes	Yes
IBM Displaywriter	No	No	Yes	Yes
System/23 Datamaster	No	No	Yes	Yes
Communicate bisynchronously via #2074 or #2093/2094 to:				
IBM Displaywriter	No	No	Yes	Yes
System/23 Datamaster	No	No	Yes	Yes

The Base Program Preparation Facilities is a set of stand-alone programs designed to facilitate the preparation and coding of Series/1 programs. The four BPP facilities are the Text Editor, Macro Assembler, Application Builder, and Job Stream Processor.

There are additional program products which provide communications support for the RPS operating system. In February 1982, IBM added RJE support (5719-RJ6) for the first time for RPS. The program allows an RPS user to participate in an SNA network or BSC environment as an RJE workstation.

The Communications Manager (formerly called the Communications Monitor) for RPS (5719-CM1) manages the flow of messages from Series/1 to other Series/1s, host processors, and 3270 devices. Version 2 of the RPS Communications Manager (5719-CM2) allows dynamic reconfiguration of a peer-to-peer Series/1 network, with alternate routing in the event of a broken message path; up to 255 message priorities; and operator control of the network from each node, from a central Series/1 node, or from a host system. Version 2 also allows Series/1 emulation of a 3274 terminal control unit under SNA, the attachment of the IBM Personal Computer as an intelligent terminal, support of a 2780/3780 RJE interface, support for X.25 HDLC communications, and support for the RPS Version 6 multiprocessing feature, which allows fault-tolerant Series/1 networking.

The RPS Remote Manager (5719-RM6), a licensed program that runs as an application under the RPS Communications Manager, allows IBM network management programs running on the front-end processor of a host computer to control a Series/1 network remotely. Such network control programs include the Network Communications Control Facility (NCCF) and the Network Problem Determination Application (NPDA). The RPS Remote Manager also supports operator intervention through the Host Command Facility (HFC) from the host site.

Another licensed program, X.25/HDLC Communications Support (5719-HD1) supports communications in both normal response mode and asynchronous balanced mode according to CCITT recommendatioin X.25. Communications are supported at rates up to 56K bps using the high-speed synchronous communications controller (#2080).

The RPS Multiple Terminal Manager (5719-MT3) provides facilities for the management and control of programs executing from a number of IBM 4978 or 4979 display terminals, or from TTY devices. The program also allows the Series/1 to emulate a remotely connected 3270 subsystem over either a BSC or an SDLC connection, and to support IBM 3101 display terminals and 3270 Information Display Systems over a BSC connection. Other devices supported by the Multiple Terminal manager include the IBM Personal Computer (with async communications adapter), the IBM System/23, and the IBM Displaywriter.

RPS Version 5 SNA Extended Support (5719-SN1) provides a high-level user interface across an SNA link, masking the details of SNA protocols from user application programs. The program allows presentation-level communications between Series/1 user programs and host programs running under the CICS/VS or IMS/VS subsystems.

EDX programs include: the Communication Facility (5719-CF1), which is a prerequisite (along with the Local Communications Controller #1400) in order to configure a ring of Series/1s as a local or distributed data processing network; the SNA Support (5719-SX1) interface, which controls the communication path between a Series/1 and a host in addition to handling the required SNA formats, and protocols; SNA RJE (5719-SX2), which allows SNA RJE workstations to transmit their job stream to a host processor; and the EDX Remote Manager (5719-RM1), and Multiple Terminal Manager (5719-MS2), which provide the same functions as their RPS components.

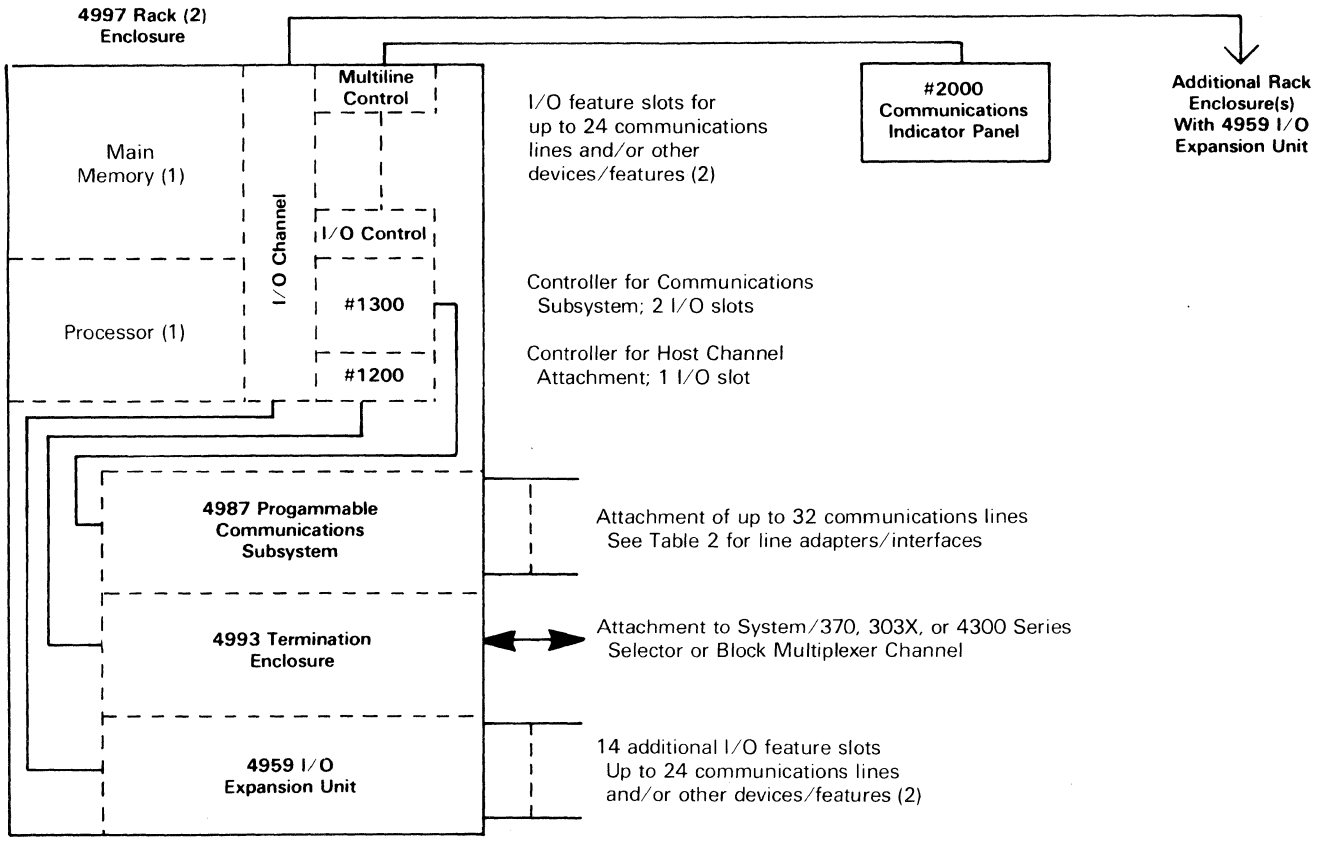
The Yale ASCII Terminal Communications System is a popular, user-developed program that runs under EDX. The system allows up to 32 ASCII terminals, of similar or different configuration, to communicate with an IBM host through the Series/1 as IBM 3270 devices over a BSC connection. The user can define the characteristics of different terminals independently to the system. The system requires at least 64K bytes of storage, at least one #2095 Feature Programmable 8-line Controller, at least one #2096 Feature Programmable 4-line Adapter, a diskette unit, and a suitable local or remote connection to the host.

Several specialized IBM licensed programs support specific communications hardware and functions in the Series/1. These include programs for channel attachment to a host, and for control of the programmable communications subsystem.

The System/370 Channel Attach Program is a licensed program which runs under control of the RPS (Version 3 or higher) and EDX (Version 3 or 4). This program provides the Series/1 user with the ability to communicate with a System/370 (Models 135 through 168), 303X, or 4300 Series and compatibles processor over a selector or block multiplexer channel, when used in conjunction with the #4993 Model 1 Series/1-System/370 Termination Enclo-

IBM Series/1 Communications Capabilities

Communications Configuration



(1) See Table 1 for comparison of processor models and memory capacities.

(2) Number of I/O feature slots will vary depending on model, and for some models, the amount of memory. See Table 3 for communications features and slot requirements. No more than 24 communications lines may terminate in any processor or I/O Expansion Unit.

sure and the Series/1-System/370 Channel Attachment Feature (#1200). The program provides the Series/1 user with the ability to transfer data, under joint consent, between user application programs in the Series/1 and the System/370.

The Programmable Communications Subsystem Preparation Facility is a macro library that supports the generation of controller storage image programs for the Series/1 Programmable Communications Subsystem. This macro library is used with either the Base Program Preparation Facility or the Program Preparation Subsystem. It provides the user with the capability of defining and customizing the total protocol for his or her subsystem. Facilities are provided for implementing communications applications, using communications macro instructions and communications definition macros.

The Programmable Communications Subsystem Execution Support runs under control of RPS and provides the user with an interface to the 4987 Programmable Communications Subsystem. The support consists of execution support macros and a loader utility to load the controller storage image program into controller storage. This program provides basic execution support of the subsystem, and runs under RPS Versions 2 or higher.

The Programmable Communiations Subsystem Extended Execution Support provides more sophisticated support for the subsystem and runs only under RPS Version 4, 5 or 6. It provides read/write level support between the user, the operating system and the communications subsystem. The program additionally enhances the type of terminals supported, and includes the IBM 2741 and several 3270 models (see Table 4).

PRICING

The Series/1 is offered on a purchase-only basis, at prices ranging from approximately $9,500 to $100,000 depending on configuration. Purchase prices include installation and a three-month parts and labor warranty. On-site physical planning is separately priced. On-site support for the Standalone Utilities is provided by an IBM CE at no additional charge.

The Series/1 is not currently available in "packaged" or specially configured systems. Each component is offered on an individually priced basis; thus, the actual price for any particular system is the sum total of every configured unit.

Program products for the Series/1 are available on a 24-month paid-up license basis or for a one-time paid-up license charge. Under either plan, the software remains the property of IBM, subject to the licensing agreement.

IBM Series/1 Communications Capabilities

		Purchase Price	Monthly Maint.
	Processors and Main Storage		
4952A	Processor; half-width module, 32K bytes of memory, 5 I/O feature slots	$ 5,260	$ 29.00
4952B	Processor; full-width module, 32K bytes of memory, 14 I/O feature slots	7,035	64.50
4952C	Processor; full-width module, 32K bytes of memory, integrated 1.2M byte diskette, 4 I/O feature slots	9,720	70.50
4954A	Processor; half-width module, 64K bytes of memory, 4 I/O feature slots	8,810	41.00
4954B	Processor; full-width module, 64K bytes of memory, 13 I/O feature slots	10,105	45.00
4954C	Processor; full-width module, 64K bytes of memory, integrated 1.2M byte diskette, 3 I/O feature slots	12,845	65.00
4955C	Processor; full-width module, 32K bytes of memory, 10 I/O feature slots	9,325	80.00
4955D	Processor; full-width module, 32K bytes of memory, 7 I/O feature slots	9,325	80.00
4955E	Processor; full-width module, 64K bytes of memory, 7 I/O feature slots	10,550	123.00
4955F	Processor; full-width module, 128K bytes of memory, 7 I/O feature slots	13,200	127.00
4956B	Processor; full-width module 256K bytes of memory, 13 I/O feature slots	14,150	37.00
4956C	Processor; full-width module, 256K bytes of memory, integrated 1.2M byte diskette, 3 I/O feature slots	16,855	57.00
6306	Add-on, 4952 processor; 32K bytes	514	2.00
6307	Add-on memory, 4954 processor; 64K bytes	625	2.50
6325	Add-on memory, 4955 Model C and D processors only; 16K bytes	1,160	6.50
6326	Add-on memory, 4955 Model C, D, and E processors only; 32K bytes	1,725	13.50
6327	Add-on memory, 4955 Model E processor only; 64K bytes	2,785	41.00
6328	Add-on memory, 4955 Model F processor only; 128K bytes	1,250	42.00
6330	Add-on memory, 4956 Model B and C processors only; 256K bytes	2,500	16.00
3925	Floating point; 4954 processor	635	2.00
3920	Floating point; 4955 processor	1,490	8.50
6335	Memory address relocation translator; 4955 Model D only	1,010	8.50
	Processor Features		
4540	Rack mounting fixture	68	n/c
4959	Input/output expansion unit	3,290	39.00
4997-1A	Rack enclosure, Model 1	1,130	2.00
4997-2A	Rack enclosure, Model 2	1,510	5.00
4999-1	Battery backup, Model 1	2,470	15.00
4999-2	Battery backup, Model 2	2,440	16.00
4993	Termination Enclosure for Channel Attachment	2,990	23.50
5650	Programmer Console	579	3.00
2000	Communications Indicator Panel	314	3.00
2010	Communications Power Supply	150	3.50
7900	Two-channel switch; plugs into 4959 expansion unit	3,330	8.50
	Communications Features		
1610	Asynchronous communications single-line control	1,360	9.50
1200	S/370 channel attachment controller	2,130	10.50
1400	Local communications controller	3,365	14.50
2074	Bisynchronous single-line communications controller	1,490	11.50
2075	High-speed bisynchronous single-line communications controller	1,730	11.50
2080	High-speed synchronous single-line communications controller	3,310	25.00
2090	SDLC single-line communications controller	1,780	11.50
2091	Asynchronous 8-line communications controller	1,220	9.50
2092	Asynchronous 4-line communications adapter	1,260	19.50
2093	Bisynchronous 8-line communications controller	1,520	9.50
2094	Bisynchronous 4-line communications adapter	1,565	24.50
2095	Feature-programmable 8-line communications controller	1,300	7.00
2096	Feature-programmable 4-line adapter	1,480	20.00

IBM Series/1 Communications Capabilities

7850	Teletypewriter adapter	$ 705	$ 6.00
7880	Telephone communications controller	3,700	7.00
7881	Telephone communications adapter	4,950	48.50
1310	Multifunction attachment feature	2,400	9.00
4987	Programmable communications subsystem—	5,205	45.00
1300	Programmable communications subsystem attachment	3,565	26.00
4990	Communications console	975	2.00
3600	Programmable communications subsystem expansion scanner	2,300	16.50
4730	Half-duplex DCE attachment	426	2.50
4731	Full-duplex DCE attachment	419	2.50
4734	TTY current attachment	700	4.00
4736	Data-Phone digital service adapter	1,132	4.50
4739	Asynchronous local attachment	467	1.50
4740	Synchronous local attachment	492	2.00
4743	Autocall attachment	432	2.50
	Integrated modems:		
4746	1200-bps asynchronous modem, switched network	1,200	7.50
4747	1200-bps asynchronous modem, leased line SNBU	1,330	8.00
4748	1200-bps asynchronous modem, leased line	1,205	7.50
4751	1200-bps synchronous modem with clock, switched network	1,235	7.50
4752	1200-bps synchronous modem with clock, leased line SNBU	1,370	8.00
4753	1200-bps synchronous modem with clock, leased line	1,240	7.50

	Software	Monthly Charge	One-Time Charge
	Licensed Programs		
5719-PC1	Realtime Programming System, Version 1	$ 30.00	$ 1,320
5719-PC2	Realtime Programming System, Version 2	36.00	1,650
5719-PC3	Realtime Programming System, Version 3	48.00	2,090
5719-PC4	Realtime Programming System, Version 4 with Command Language Facility	74.00	3,230
	without Command Language Facilty	57.00	2,475
5719-PC5	Realtime Programming System, Version 5 with Command Language Facility	164.00	4,940
	without Command Language Facility	140.00	4,260
5719-PC6	Realtime Programming System, Version 6 with Multiprocessing Feature	445.00	7,500
	without Multiprocessing Feature	285.00	5,000
5719-XS1	Event Driven Executive (EDX) Basic Supervisor and Emulator, Version 1	21.00	1,055
5719-XS2	Event Driven Executive Basic Supervisor and Emulator, Version 2	28.00	1,368
5719-XS3	Event Driven Executive Basic Supervisor and Emulator, Version 3	37.00	1,440
5719-XS4	Event Driven Executive Basic Supervisor and Emulator, Version 4	124.00	1,900
5719-020	RPS Audio Distribution System	350.00	12,700
5719-CM1	RPS Communications Manager, Version 1	361.09	5,550
5719-CM2	RPS Communications Manager, Version 2	361.00	5,550
5719-CA1	RPS System/370 Channel Attachment Program	26.00	1,305
5719-RJ6	RPS Advanced Remote Job Entry	30.00	1,050
5719-CS0	RPS Programmable Communications Subsystem Preparation Facility	10.00	523
5719-CS1	RPS Programmable Communications Subsystem Execution Support	8.00	351
5719-CS2	RPS Programmable Communications Subsystem Extended Execution Support	25.00	1,200
5719-RM6	RPS SNA Remote Manager	125.00	2,000
5719-HD1	RPS X.25/HDLC Communications Support	139.00	2,500
5719-TGC	RPS Intelligent Workstation (IBM PC) Support	—	150
5719-MT3	RPS Multiple Terminal Manager	30.00	1,050
5719-SN1	RPS Version 5 SNA Extended Support	81.00	2,905
5719-CF1	EDX Communications Facility	55.00	2,200
5719-SX1	EDX Systems Network Architecture	56.00	2,005
5719-SX2	EDX Systems Network Architecture RJE	25.00	1,000
5719-CX1	EDX System/370 Channel Attachment Program	83.00	2,820
5719-RM1	EDX Remote Manager	125.00	2,000
5719-RJ1	EDX Advanced RJE	58.00	1,050
5719-MS2	EDX Multiple Terminal Manager	22.00	983
5796-RBT	Yale ASCII Terminal Communications System	—	143
	Special System		
	SVS/1 Videotex System	—	10,000 ■

IBM Series/1 Data Communications Capabilities

In this report:

Product Summary

Editor's Note
The Series/1 is a mature product. This report serves as a reference edition and will not be updated in the future.

Description
The IBM Series/1, an intelligent communications processing system with an open-ended architecture, can communicate with host systems and personal computers. Series/1 systems handle general-purpose commercial and sensor-based applications in multiprogramming environments. The computer can communicate in both SNA and non-SNA environments. Within SNA, IBM added local and remote network management packages. Outside the SNA world, IBM offers a program that endows the Series/1 with X.25 packet-switching capabilities.

Strengths
Extensive communications capabilities made the Series/1 a favorite for many years. It can act as a front-end processor, remote line concentrator, terminal controller, distributed processing node, RJE workstation, communications controller in a local area network, robot controller, and X.25 packet-switching gateway.

Limitations
Although IBM enhanced the Series/1 over the years by increasing its memory, reducing prices, and increasing processor speeds, advancements in technology have overtaken the product.

Competition
Minicomputer systems from Concurrent Computer Corporation, Data General, Digital Equipment Corporation, Hewlett-Packard, Honeywell, Prime, Texas Instruments, and Wang.

Vendor
International Business Machines Corp. (IBM)
Old Orchard Road
Armonk, NY 10504
Contact your local IBM representative.

Price
Depends on configuration.

Analysis

During the active life cycle of the Series/1, IBM paid close attention to the needs of the market and the ways in which the computer could address them. When computerization reached the factory floor, IBM developed communications programs providing the Series/1 with Manufacturing Automation Protocol (MAP) compatibility. The Manufacturing Automation Protocol Communications Server program allows the Series/1 to communicate and interact with other systems in a manufacturing network. The system supports a subset of the Manufacturing Automation Protocol at the 2.1 level of function; the IEEE Standard 802.4 (token bus local area network) and IEEE 802.2 (logical link control); and the International Organization for Standardization (ISO) protocols.

To link PCs to its larger systems, IBM introduced the IBM Series/1-Personal Computer Interconnect, which includes both hardware, known as the Series/1-PC Channel Attachment feature, and software, the Series/1-PC Connect Program. This offering allows personal computers to use Series/1 resources and to communicate with IBM host systems and local area networks at a data transfer speed of 400K bps. The Series/1-PC Interconnect feature is supported by the RPS and EDX operating systems.

The Series/1-PC Connect Program complements the IBM PC Network Program, giving IBM PC Network users access to Series/1 disks and printers. It also allows PC Network users to communicate with users and programs outside their local area networks. In addition, it provides PC Network SNA 3270 emulation program support through Series/1 communications to the host System/370-based system or Series/1.

Product Strategy

The many enhancements made over the years have expanded the capabilities of the Series/1 systems via a variety of processors, communications features, and software. IBM viewed the Series/1 as an intelligent communications processor rather than a distributed processor or departmental system. This approach did not mean that the Series/1 could not be used as a distributed processor or departmental system, but IBM wanted to stress communications capabilities as the Series/1's strength. A versatile system, the Series/1 can support IBM's PC Network and Token-Ring Network. The Series/1 also offers PC and host connectivity and operates as a natural gateway between the two. Although not regarded as a fault-tolerant system, dual Series/1 processors, connected in a ring, perform fault-tolerant processing.

As communication needs grew in complexity, IBM turned away from the Series/1 and moved toward other areas of development. Expanding the Series/1 family not only involved the expense of new hardware, but also an extensive overhaul of software. Series/1 software is not compatible with any of the other systems offered by IBM.

Competitive Position

Sales of the Series/1 peaked from 1984 to 1985, achieving a growth rate of close to 40 percent higher than 1983 to 1984.

In many ways, the Series/1 competes against its relative, the IBM System/36. The systems overlap, featuring many of the same capabilities, and both systems offer integrated PC models. IBM designed the System/36 as an office system, however, and offers general business packages for it. The Series/1, positioned as a communications and networking system, offers more communications capabilities, such as support of local area networks.

The Series/1 does not lack competition from other manufacturers. Since its strengths spread across several marketing areas, competing systems include Bull (Honeywell) DPS 6 systems, Texas Instruments Business Systems, low end of the Wang VS Series, and Hewlett-Packard HP 3000. As a communications processor, the Series/1 competes with minicomputers from these vendors, plus systems from vendors such as Digital Equipment, Data General, Prime, and Concurrent Computer.

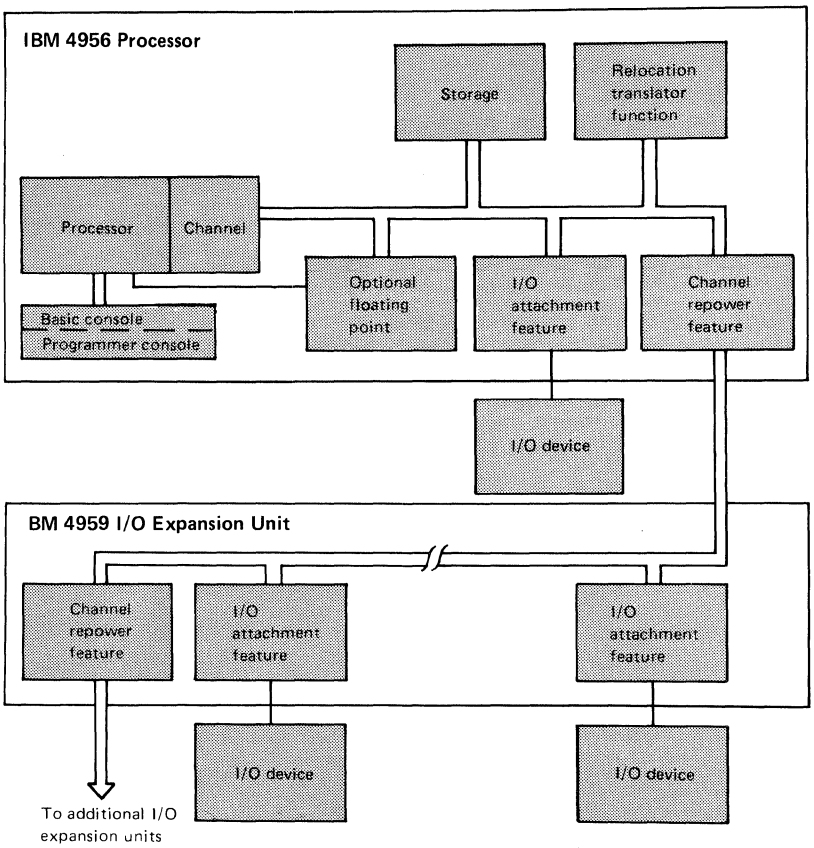


Figure 1.
The Series/1 Processor with 4959 I/O Expansion Unit

The Series/1 4956 processor with a 4959 Input/Output expansion unit. In the Series/1, the data channel acts in a primary/secondary relationship with connected I/O devices with the data channel always being primary.

Characteristics

Models: 5170 Model 496; 4956 Models B10, E10, 61D, E70, G10, H10, J00, K00.

Number Installed to Date: Over 60,000.

Configuration

The IBM Series/1 is a family of small computers marketed as multifunctional processors. The nine models in the Series/1 are based on two processors: 5170 and 4956. The major characteristics distinguishing each model are detailed in Table 1.

The 5170 Model 496 is a Series/1 processor integrated with a PC AT microcomputer. The Series/1 processor offers 256K bytes of memory, expandable to 512K bytes in 128K-byte increments. The PC AT offers 512K bytes of memory and functions as an I/O controller running under the Input/Output Executive system. The 5170 includes a six-port host/terminal attachment card, a 30M-byte fixed disk, a 1.2M-byte diskette drive, a personal computer keyboard, and a serial/parallel adapter. Three feature slots can handle additional functions. A second six-port host/terminal attachment card can support a maximum of eight terminals.

The 4956 models are standard 19-inch, rack-mountable units with 256K or 512K bytes of error checking and correcting (ECC) memory. Models B10 and 61D are expandable to 1M byte. Model E10 is expandable to 2M bytes, in 256K-byte or 512K-byte increments, with 512K bytes directly addressable. Standard features include storage address translator, communications power, and a clock/comparator. The 4956 Model 10B and E10 have up to 13 card slots for data channel features, depending on storage size. The 4956 61D and the 4956 E10 provide a 60M-byte disk, with an optional 1.2M-byte diskette drive and 64K-byte cache memory.

Attachment feature cards allow the attachment of input/output devices to a Series/1 processor. The feature cards mount in the I/O feature locations of a Series/1 processor, 5161 Expansion Unit, 4959 I/O Expansion Unit, or 4965 diskette drive and I/O expansion unit. Series/1 I/O devices attach to the processor through the processor I/O channel. The Series/1 I/O channel accommodates up to 256 devices, each device with a unique address. The actual number of devices that can interface to a processor depends on the available number of slots in the basic chassis and the number of I/O expansion units employed. The Series/1 5170

Table 1. System Comparison

Model	5170 Model 496	4956 Model B10	4956 Model E10	4956 Model 61D
System Characteristics				
Date of introduction	June 1986	1987	1987	1987
Date of first delivery	September 1986	1987	1987	1987
Operating system	EDX; RPS	EDX; RPS	EDX; RPS	EDX; RPS
Upgradable from	Not applicable	Model B	Model E	Model 60D
Upgradable to	Not upgradable	K00	K00	Not applicable
Memory				
Minimum capacity, bytes	256	—	1024K	—
Maximum capacity, bytes	1M Series/1; 512 PC AT	1024K	Up to 2048K	1024K
Type	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS
Cache memory	None	None	None	64K
Cycle time, nanoseconds	—	550	550	550
Bytes fetched per cycle	—	—	—	256
Minimum Disk Storage, bytes	30M fixed	512K	1M	1M basic w/60MB disk
Maximum Disk Storage, bytes	40M	—	—	—
Number of Workstations	8	256	256	256
Communications Protocols	Async; BSC; SDLC	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync

A dash (—) in a column indicates that the information is unavailable from the vendor.

processors occupy one slot. The 4956 processors occupy three slots. The floating-point and storage relocation transfer features occupy one I/O slot each.

Expansion Units: The *5161 Expansion Unit* provides additional configuration flexibility for the 5170 processors. It contains one 10M-byte fixed disk drive and eight option expansion slots.

The *4959 I/O Expansion Unit* provides a maximum of 14 I/O features; it can support user attachment features, integrated communications features, data processing I/O attachment features, or the sensor I/O unit attachment feature.

The *4965 Diskette Drive and I/O Expansion Unit* provides one or two diskette drives and four I/O channel feature positions.

Attachments: The *1310 Multifunction Attachment Feature* is a single-card unit that provides four independent attachment addresses. The first port can be used for local and remote attachments; the other three ports handle local attachments only.

The *4982 Sensor I/O Unit* consists of a power supply, terminator card, and slots for eight sensor I/O feature cards.

The *5250 Information Display System Attachment* consists of two cards that plug into a Series/1 processor or I/O expansion unit. The attachment has four ports to which 5250 units are attached by twinax or coax cabling.

The *1200 System/370 Channel Attachment* provides memory-to-memory communications between a Series/1 processor and any System/370-based processor. The *5200 Series Printer Attachment*, which plugs into a Series/1 processor or I/O expansion unit, can support up to eight printers.

Switches: The *7400 Two-Channel Switch* for the 4959 I/O Expansion Unit enables users to switch a set of common I/O devices between two Series/1 processors.

The *7777 Programmable Two-Channel Switch* enables the Series/1 to switch bidirectionally the 4959 and/or 4965 Model 1 I/O expansion units and their attached devices between processors.

Workstations: The 5170 processor can support up to eight workstations. A 5151 monochrome display or equivalent is required for the 5170 system; the display and keyboard serve as the system console.

The 4956 processors support one to eight workstations per I/O attachment. Additional workstations can be added to the processors through the various I/O expansion devices.

Storage

Disk Storage Units (4956)

4962 Disk Storage Unit requires the 4962 disk storage unit attachment feature to attach to the Series/1. The models with a diskette unit require the 4962 attachment and the 4964 diskette unit attachment feature, which can be plugged into a processor unit or an I/O expansion unit.

Table 1. System Comparison (Continued)

Model	4956 Model E70	4956 Model G10	4956 Model H10	4956 Model J00	4956 Model K00
System Characteristics					
Date of introduction	1987	1987	1987	1987	1987
Date of first delivery	1987	1987	1987	1987	1987
Operating system	EDX; RPS	EDX; RPS	EDX; RPS	EDX; RPS	EDX; RPS
Upgradable from	Model 60	Not applicable	Not applicable	Not applicable	Not applicable
Upgradable to	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Memory					
Minimum capacity, bytes	—	—	—	—	—
Maximum capacity, bytes	1024K	1024K	2048K	2048K	2048K
Type	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS
Cache memory	64K	400K	400K	400K	400K
Cycle time, nanoseconds	550	550	550	360	360
Bytes fetched per cycle	—	—	—	—	—
Minimum Disk Storage, bytes	1024K	—	1024K	—	—
Maximum Disk Storage, bytes	2048K	1024K	2048K	2048K	2048K
Number of Workstations	256	256	256	256	256
Communications Protocols	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync

A dash (—) in a column indicates that the information is unavailable from the vendor.

4963 Disk Subsystem connects to the Series/1 through one disk subsystem attachment (feature 3590), installed in a processor feature location space. Each subsystem has one primary drive and up to three expansion drives. Multiple subsystems can be attached.

4964 Diskette Unit can be attached directly to a processor unit or an I/O expansion unit.

4965 Storage and I/O Expansion Unit provides diskette or disk storage, depending on the model. A 1565 attachment feature is required for attachment to a 4956 Series/1.

4967 Disk Subsystem requires the microprocessor-based 4967 disk subsystem attachment (3595) and one 4967 Model 2CA primary disk unit. It can support up to three 2CB expansion units.

Tape Systems

Users can attach up to eight magnetic tape systems per I/O attachment to the 4956 processors. IBM offers the 4968 auto load streaming magnetic tape unit and the 4969 magnetic tape subsystem for the Series/1. The 4968 attaches to the Series/1 through a tape attachment feature (feature 1220), which can be plugged into a processor or an I/O expansion unit. The 4969 subsystem attaches to the Series/1 through a microprocessor-based 4969 magnetic tape subsystem attachment feature, which can be plugged into the processor or an I/O expansion unit. Each subsystem requires one attachment feature for cycle-steal tape read/write operations.

Printers

Up to two printers, including the 4971 printer and 5152 Graphics Printer, can be attached to the 5170 processors. One of the attached printers must be a 4971; the second can be either a 4791 or 5152.

The 4956 processors support up to eight printers per I/O attachment. Users can add printers through various I/O expansion devices including the 5200 Series Printer Attachment, 4959 I/O Expansion Unit, 4965 Diskette Drive and I/O Expansion Unit, 1310 Multifunction Attachment Feature, 4982 Sensor I/O unit, and 5252 Information Display System Attachment.

Communications Features

1400 Local Communications Controller provides a high-speed, local interconnection of up to 16 Series/1 4956 processors, resulting in the configuration of a Distributed Data Processing (DDP) system.

1610 Asynchronous Single-Line Control controls one half-duplex line operating at speeds of up to 9600 bits per second (bps). It can function as a primary or secondary station.

o2091/2092 Asynchronous 8-Line Control and 4-Line Adapter can control a maximum of eight lines operating in half-duplex mode. Each of these lines can operate at up to 2400 bits per second.

2074 Binary Synchronous Single-Line Control (Medium Speed) controls one half-duplex line, operating at

speeds of up to 9600 bits per second. It can act as a primary (control) or secondary (tributary) station.

2075 Binary Synchronous Single-Line Control (High Speed) controls one half-duplex line, operating at speeds of up to 56,000 bits per second. It can act as a primary or secondary station and can IPL the processor from a host system.

2090 Synchronous Data Line Control (SDLC) Single-Line Control controls one half-duplex line, operating at speeds of up to 9600 bits per second. It operates as either a primary or secondary station.

2093/2094 Binary Synchronous 8-Line Control and 4-Line Adapter control up to eight half-duplex lines. Users achieve the maximum aggregate bit rate by running two lines at 9600 bits per second and six lines at 2400 bits per second.

2095/2096 8-Line Controller/4-Line Adapter are also available. The 2095 controls up to two four-line communications. This eight-line control includes point-to-point or multipoint operations supported with an aggregate controller throughput of 64,000 bytes per second. The 2096 feature is a four-line adapter and provides speeds of up to 1200 bps or 19,200 bps.

4987 Programmable Communications Subsystem consists of the subsystem unit, up to two controller features, and device attachment features. It accommodates up to 32 lines per subsystem, at data rates of 45 to 9600 bps. The 4987 supports point-to-point leased and switched lines or multipoint lines, and handles the communications requirements for standard IBM protocols and nonstandard protocols.

Series/1 to Personal Computer Channel Attachment Feature provides a high-speed (400K bits per second) data path between IBM Personal Computers and the Series/1.

Network Routing Facility provides users of Advanced Communication Function/Network Control Program (ACF/NCP/VS) with a 3705-based message routing facility.

Software

Operating Systems

All models of the Series/1 support two operating systems: Event Driven Executive (EDX) and Realtime Programming System (RPS). Series/1-PC models, operating in PC mode, support DOS.

Event Driven Executive (EDX) supports multiple, independent, time-dependent, and/or event-driven applications with a minimum of interaction. The EDX supervisor overhead can range from 15K bytes of storage for small production systems to over 64K bytes for a complex interactive communications system. The system supports multiple programming languages, including Series/1 Assembler, Cobol, Fortran, and PL/1. EDX also supplies online utilities to support production operations and assist in program development.

Realtime Programming System (RPS) is a full-function operating system for users to develop applications and mixes of applications. It supports realtime operations concurrently with the execution of other batch and online programs. RPS also supports multiple processors and provides a multiprocessing feature system that consists of multiple (2 to 16) Series/1 processors connected by the local communications controller.

Communications Programs

EDX X.25/HDLC Communications Support enables EDX to provide read/write level X.25/HDLC support for the DLC adapter, SDLC single-line control, and synchronous communications single-line control/high speed. Typical applications include protocol conversion and networking.

EDX Communications Controller for System/38 is a resident program that allows a System/38 to communicate with a variety of systems and devices through a Series/1. Additional functions include supporting an SDLC link from System/38 to Series/1 and BSC links from Series/1 to other devices and systems.

EDX Communication Facility manages the flow of information throughout a configuration that can include one or many Series/1s, personal computers, and host computers, plus terminals and printers. It supports communications between Series/1 terminal operators and host programs to which the Series/1 appears as an IBM 3270 Information Display System. It also supports the Series/1-PC connection that gives PCs access to Series/1 disks and printers and to Series/370-based applications.

System/370 Channel Attachment Program is featured in the RPS and EDX operating systems. It enables a Series/1 user to communicate with any System/370-based processor over a selector or block multiplexer channel, when used in conjunction with the 4933 Model 1 Series/1 System/370 Termination Enclosure and the Series/1 System/370 Channel Attachment Feature 1200. The user can transfer data between user application programs in the Series/1 and the System/370.

EDX Systems Network Architecture (SNA) executes as a separate program within the EDX operating system and coordinates all user application program requests for SNA/SDLC communications.

EDX Systems Network Architecture Remote Job Entry (RJE) program is a workstation program for the Series/1 in an SNA network environment. The program enables the user, who has created a job stream via the EDX edit features, to transmit that job stream to a host system for processing. The workstation program also allows the user to query the host computer for system status reports.

EDX Advanced Remote Job Entry program supports BSC and SNA/SDLC host connections and allows the Series/1 installation to conform to the protocol of the host system.

Programmable Communications Subsystem Preparation Facility is a macro library that generates controller storage image programs for the Series/1 Programmable Communications Subsystem.

Programmable Communications Subsystem Execution Support runs under the control of RPS and interfaces the user to the 4987 Programmable Communications Subsystem.

Remote Manager program is featured in the EDX and RPS operating systems. It allows the Series/1 networks to be managed and operated through the Communications and Systems Management programs on IBM host processors (System 30XX and 43XX).

RPS Communications Manager supports line concentration, message routing, terminal control, and distributed processing. One or more Series/1s using the program can manage the flow of information through the network. The Communications Manager supports a variety of terminals and other I/O devices. Users can incorporate support for non-IBM devices through the 4987 programmable communications subsystem.

RPS Advanced Remote Job Entry (ARJE) provides the Series/1 user with RJE support in an SNA/SDLC or BSC environment. The program allows the Series/1 to conform to the protocol required by the host system.

RPS Remote Management Utility consists of RPS Remote Management Utility (BSC protocol) and RPS SNA Remote Management Utility (SDLC protocol). The programs facilitate the operation of a remote Series/1 in a distributed data processing system.

5250 Information Display System Attachment Support program supplies definition and execution time facilities to assist the user in the control of 5250 information display system units, such as attachment initialization, verification test facilities, screen formatting macros, and utility functions.

Series/1-PC Connect runs on an IBM PC/AT/XT. It gives IBM PCs on the IBM PC Network access to Series/1 disks and printers, as well as access to System/370-based applications.

Manufacturing Automation Protocol Communication Server allows the Series/1 to communicate and cooperate with other systems in a MAP network. The program supports a subset of MAP at the 2.1 level, IEEE Standard 802.4 and 802.2, and ISO protocols.

Equipment Prices

		Rental Price ($)	Purchase Price ($)
4956 MV/FIX/PN			
A0X	MV/FIX/PN	447	8,810
A00	MV/FIX/PN	447	3,290
B0X	Non-SIU processor, 256KB	1,265	12,500
B1X	1MB, 13 I/O slots	1,320	15,150
C0X	Non-SIU processor, 256KB	1,500	17,690
C10	1MB, 3 I/O slots	1,500	—
E0X	Non-SIU processor, 13 I/O slots	1,460	16,500
E1X	1MB (2MB max.), 13 I/O slots	1,525	17,570
E6X	Non-SIU processor, 6 I/O slots	2,380	22,500
E7X	1MB (2MB max.), 6 I/O slots	2,165	24,850
G1X	40MB or 72MB disk, 1.2MB diskette	1,790	20,000
H1X	40MB or 72MB disk, 1.2MB diskette	2,005	22,420
J0P	Series/1 processor	2,555	25,350
J0X	2MB, 40MB or 72MB disk, 1.2MB diskette	2,555	25,350
J00	2MB, 40MB or 72MB disk, 1.2MB diskette	2,555	25,350
K0X	2MB, 14 I/O locations	2,115	23,040
31D	1MB, 6 I/O slots, 30MB disk	2,075	—
61X	1MB, 6 I/O slots, 60MB disk	2,215	22,420

■

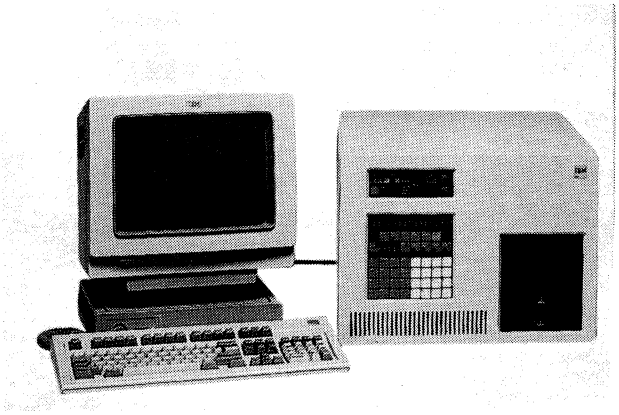
IBM Series/1 Data Communications Capabilities

datapro ANALYSIS

UPDATE: *While some feel that IBM is clinging to an antiquated architecture in the Series/1, continuing interest in the system as a communications processor as well as its large installed base would seem to prove these doubters wrong. Last year, IBM introduced new models in the 4956 Series. While the large installed base warrants a report on the Series/1, product activity has slowed, as IBM concentrates heavily on communications and connectivity issues and related equipment. This will be the last update of this report; however, it will remain in the books as a reference edition.*

The IBM Series/1 is an intelligent communications processing system offering an open-ended architecture. Communicating with host systems as well as Personal Computers, the Series/1 systems are designed to handle general-purpose, commercial, and sensor-based applications in a multiprogramming environment.

The IBM Series/1's communications capabilities are extensive. The Series/1 acts as a front-end processor, a remote line concentrator, a terminal controller, a distributed processing node, an RJE workstation, a communications controller in a local area network, a CCITT X.25 packet-switching gateway, a robot controller, and in several other communications-oriented applications.



The IBM Series/1 is a modular unit that fits into a rack enclosure, or it can be used as a standalone unit.

VENDOR: International Business Machines Corporation (IBM), Old Orchard Road, Armonk, New York 10504. Contact your local IBM representative.
IN CANADA: IBM Canada Limited, Markham, 3500 Steeles Avenue East, Markham, Ontario L3R 2Z1.
MODEL(S): IBM Series/1—5170 Model 496; 4956 Models B10, E10, 61D, E70, H10, H10, J00, K00.
FUNCTION: Various communications functions are possible, including front-end processor.
COMPETITION: Minicomputer systems from Concurrent Computer Corporation, Data General, Digital Equipment Corporation, Hewlett-Packard, Honeywell, Prime, Texas Instruments, and Wang.
PRICING: Depends upon configuration.

REPORT HIGHLIGHTS: **PAGE**

IBM has continually expanded the Series/1's communications capabilities, both within SNA and in the world outside IBM's domain. Within SNA, IBM has added both local and remote network management packages, allowing a Series/1 to perform some network management for a network of Series/1s, and allowing an SNA host to manage a Series/1 network remotely through its front-end processor. Outside of the SNA world, IBM offers a licensed program that gives the Series/1 X.25 packet-switching capabilities.

IBM developed communications programs providing the Series/1 with Manufacturing Automation Protocol (MAP) compatibility. The Manufacturing Automation Protocol Communications Server program allows Series/1s to communicate and cooperate with other systems in a manufacturing network. The system supports a subset of the Manufacturing Automation Protocol at the 2.1 level of function; the IEEE Standard 802.4 (token bus local area

REFERENCE EDITION: This is a mature product. No significant further developments are anticipated, but because of its importance int he history of the industry, coverage is being continued. No future updates are planned.

IBM Series/1 Data Communications Capabilities

network) and IEEE 802.2 (logical link control); and the International Organization for Standardization (ISO) protocols.

The Series/1 5170 Model 496 consists of a Series/1 integrated with an IBM PC AT. The 5170 includes a Series/1 microprocessor with 256K bytes of storage expandable to 1M bytes, and a PC AT processor with 512K bytes of memory. Also included with the system is a 30M-byte fixed disk, a 1M-byte diskette, a Personal Computer keyboard, a serial/parallel adapter, and a six-port host/terminal attachment card allowing attachment of four RS-422-attached terminals and providing two RS-232-C asynchronous ports. The PC operates as an I/O controller. A second six-port host/terminal attachment card is available for the 5170 processor, providing support for a maximum of eight terminals.

Three feature slots on the 5170 accommodate additional functions. The system operates either as a Series/1 or as a Personal Computer, but not simultaneously. In fact, because the XT and AT processors function as I/O controllers when in Series/1 mode, the 5170 must be rebooted to operate as a PC unit. Performance is dependent on the number and type of devices attached, the operating characteristics selected for those devices, and the types of applications programs being used. The 5170 system performs Series/1 floating-point instructions, but at a reduced speed. A Monochrome Display or equivalent is required for the 5170; the display and keyboard serve as the system console. The 5170 supports up to two printers, one of which must be a 4971; the second can be either a 4791 or 5152. Asynchronous, BSC, or SDLC communications lines are also supported. The system operates under the Realtime Programming System (RPS) V.7 or Event Driven Executive (EDX) V.5 in Series/1 mode and under DOS R.2.1 (XT) or 3.0 (AT) in PC mode.

In its efforts to link PCs to its larger systems, IBM introduced the IBM Series/1-Personal Computer Interconnect, which includes both hardware, known as the Series/1-PC Channel Attachment feature, and software, the Series/1-PC Connect Program. This offering allows Personal Computers to utilize the Series/1 resources and to communicate with IBM host systems and local area networks at a data transfer speed of 400K bits per second (bps). The Series/1-PC Interconnect feature is supported by RPS and EDX.

The Series/1-PC Connect Program complements the IBM PC Network Program, giving IBM PC Network users access to Series/1 disks and printers. It also allows PC Network users to communicate with other users and programs outside their own local area network. In addition, it provides PC Network SNA 3270 emulation program support through Series/1 communications to the host System/370-based system or Series/1.

IBM continues to maintain the 4956 models of the Series/1 family. The 4956 processor is mounted on support rails (fixed) in an IBM 4997 or EIA standard 19-inch rack enclosure. Error checking and correcting (ECC) memory is standard. Other features of the 4956 include full program compatibility, storage address translation for up to eight address spaces, and pluggable floating point with both single- and double-precision arithmetic.

The 4956 Model B10 offers processor storage up to 1024K bytes. Directly addressable storage is 512K bytes. Storage over 512K bytes is available for use as high-performance secondary storage. An optional full-function console with lock and segmentation register display/store is also offered.

The Series/1 4956 Model E10 is an extension of the 4956 Model B and reportedly offers internal performance approximately 50 percent greater than that of the 4956 Model B10. The basic 4956 Model E10 processing unit contains the processor; 512K-byte basic storage, plus optional 256K-byte and 512K-byte storage cards for a maximum of 2M bytes of storage; 13 I/O slots; error checking and correcting; enclosure; and power. The 4956 Model E10 is field upgradable from the 4956 Model B10.

The 4956 Model 61D unit incorporates two major auxiliary devices, 60M-byte disk, and an optional 1.2M-byte diskette drive. An optional 64K-byte microprocessor-driven cache is also available which, according to IBM, has disk throughput acceleration potential of 50 to 200 percent, depending upon the application. Model 61D also features error detecting and correcting capabilities.

The 4956 E70 unit offers 1024K bytes of processor storage expandable to 2048K bytes. Optional 256K-byte, 512K-byte, or 1024K-byte increments are available. The unit may be rack mounted or mounted in a standalone enclosure. Sixteen address spaces are available for software. Address Resolution and Indirect Branch instructions offer EDL Acceleration capability. An optional 64K-byte cache, with throughput acceleration potential, is optional on the E70.

The 4956 G10 and H10 have 1024K bytes of processor storage available, with the Model H10 offering additional storage up to 2048K bytes. Error checking and correcting storage is also available. Eight address spaces are found on the G10, and sixteen are available on the H10. The H10 also offers Address Resolution and Indirect Branch instructions for EDL Acceleration capability. The models contain a 5.25-inch diskette drive, one 40M-byte fixed disk drive, and cache storage up to 400K bytes.

The 4956 J00 has 2048K bytes of processor storage, along with error checking and correction storage. Sixteen address spaces are available for software and eight for I/O. The unit offers seven I/O card sockets. Cache storage for 400K bytes is included in the unit, as are one 5.25-inch

IBM Series/1 Data Communications Capabilities

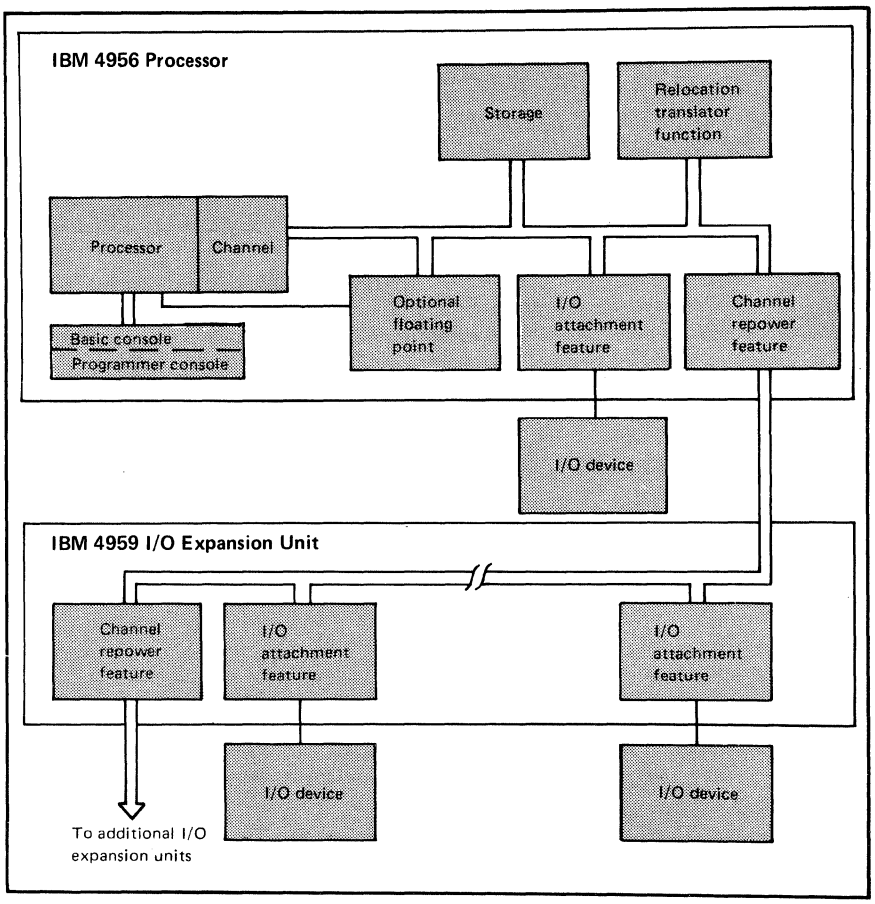


Figure 1. The Series/1 4956 processor with a 4959 Input/Output expansion unit. In the Series/1, the data channel acts in a primary-secondary relationship with connected I/O devices with the data channel always being primary.

diskette and one 40M-byte fixed disk drive. The 4956 Model K00 includes most of the features found in the J00 unit but offers 14 I/O card sockets.

The 4956 Series/1 is considered a modular "mix and match" system with the user determining the equipment, programming, and service modules required. The units can either fit into an IBM 4997 rack enclosure or EIA standard 19-inch rack or be mounted in standalone enclosures, depending upon the model. I/O device attachment is supported by means of I/O feature cards installed in available slots either in the processor or an I/O expansion unit. Up to 256 individual devices, both standard and custom built, may be addressed by the Series/1 4956 processors.

Up to 16 processors can be connected on a high-speed ring. In addition to local ring-connected processors, many of the Series/1 capabilities can be provided to geographically distributed Series/1s by using communications lines. Series/1 systems are capable of utilizing packet switched networks. Communications features are contained in feature cards that plug into the processor I/O channel or the 4987 programmable communications unit. The communications attachment feature cards include a synchronous (SDLC) adapter, binary synchronous (BSC) adapter, asynchronous (ACC) adapter, X.25 network communications adapter, and feature-programmable communications adapter. The Series/1 also supports three local area networks: the yet-to-be-introduced Industrial Network, the PC Network, and the Token-Ring Network.

As mentioned earlier, Series/1 software provides a wide range of communications support, including X.21, X.25, SNA, and RJE. The software allows the system to act, variously, as a network node, a communications controller, a distributed processing system, or a standalone system.

PRODUCT EVALUATION

The many enhancements made over the years have expanded the dimensions of the Series/1 systems. A variety of processors, communications features, and software is now available. IBM sees the Series/1 as an intelligent communications processor rather than as a distributed processor or departmental system. This is not to say that it cannot be used as such, but that communications capabilities are the Series/1's strength. An example of the system's versatility in communications is its support of three local area networks—the PC Network, the Token-Ring Network, and the unannounced Industrial Network. The Series/1 also offers both PC and host connectivity and operates as a natural gateway between the two.

IBM Series/1 Data Communications Capabilities

The entry-level desktop Series/1-PC models offer users a low-cost, entry-level solution and, because it can be operated as either a Series/1 or a PC, an overwhelming amount of software is available. The drawback is that the small amount of memory available on the Series/1-PC models (512K bytes) restricts the applications software that can be run. Another disadvantage is that the Series/1-PC models cannot be hardware upgraded to the high-end models; there is, however, software portability. Also, because the PC controls the I/O functions of the system, only PC peripherals can be attached to the Series/1-PC models. In addition, the PC models cannot be used as LAN servers.

The prices, flexibility, reliability, and the modularity of the Series/1 are all advantages. Another advantage is that, while not considered a fault-tolerant system, dual Series/1 processors can be connected in a ring to provide fault-tolerant processing.

Although the Series/1-PC models cannot be upgraded, a good growth path is provided throughout the Series/1 4956 models. Expanding out of the family, however, entails not only the expense of new hardware, but also the expense of software reconfiguration—Series/1 software is not compatible with any of the other systems offered by IBM.

IBM's future direction for the Series/1 includes further price reductions, increased memory—to 1M bytes on the PC models, and increased memory, as well as faster processor speeds at the high end of the Series/1 family.

MARKET POSITION

The Series/1 continues to be one of IBM's best-sellers, with an installed base of nearly 60,000. The system sales growth rate accelerated from 6 percent in 1982/1983 to close to 40 percent in 1984/1985. In fact, 1985 was the biggest year in the life of the Series/1.

The Series/1 technology has progressed from using six processor boards to using a half-inch silicon chip on the Series/1-PC models. Presently, 64K-bit memory is used, but IBM is in the process of testing 256K-bit technology for use in the near future.

The Series/1 can be considered competition to its sister system, the IBM System/36. The systems overlap, featuring many of the same capabilities, and both systems offer integrated PC models. The System/36 is more of an office system, however, and offers more general business packages; whereas the Series/1, positioned as a communications and networking system, offers more communications capabilities, such as support of three types of local area networks.

The Series/1, however, is not lacking in competition from other manufacturers. Since its strengths spread across several marketing areas in addition to communications, including distributed processing, manufacturing, and sales/distribution, competing systems include the Honeywell DPS 6 systems, the Texas Instruments Business Systems, the low end of the Wang VS Series, and the Hewlett-Packard HP 3000. As a communications processor, the Series/1 competes with minicomputers from the above-mentioned vendors, plus systems from vendors such as Digital Equipment Corporation, Data General, Prime, and Concurrent.

The Series/1 cost factor is a crucial issue; IBM has reduced processor costs, and rivals will be hard pressed to match the resulting price/performance ratio.

TABLE 1. SYSTEM COMPARISON

MODEL	5170 Model 496	4956 Model B10	4956 Model E10	4956 Model 61D
SYSTEM CHARACTERISTICS				
Date of introduction	June 1986	1987	1987	1987
Date of first delivery	September 1986	1987	1987	1987
Operating system	EDX; RPS	EDX; RPS	EDX; RPS	EDX; RPS
Upgradable from	Not applicable	Model B	Model E	Model 60D
Upgradable to	Not upgradable	K00	K00	Not applicable
MEMORY				
Minimum capacity, bytes	256	—	1024K	—
Maximum capacity, bytes	1M Series/1; 512 PC AT	1024K	Up to 2048K	1024K
Type	MOSFET; SAMOS: NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS
Cache memory	None	None	None	64K
Cycle time, nanoseconds	—	550	550	550
Bytes fetched per cycle	—	—	—	256
MINIMUM DISK STORAGE	30MB fixed	512KB	1MB	1MB basic w/60MB disk
MAXIMUM DISK STORAGE	40MB	—	—	—
NUMBER OF WORKSTATIONS	8	256	256	256
COMMUNICATIONS PROTOCOLS	Async; BSC; SDLC	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync

A dash (—) in a column indicates that the information is unavailable from the vendor.

IBM Series/1 Data Communications Capabilities

SPECIFICATIONS

MODELS: 5170 Model 496; 4956 Models B10, E10, 61D, E70, G10, H10, J00, K00.
DATE ANNOUNCED: 5170—1986, 4956—1987.
DATE FIRST INSTALLED: 5170—1987, 4956—1987.
NUMBER INSTALLED TO DATE: 60,000+.
DISTRIBUTION: IBM.

CONFIGURATION

The IBM Series/1 is a family of small computers marketed as multifunctional processors. The current Series/1 offering consists of two processors in a total of nine models. The processors are the 5170 and the 4956. The major characteristics distinguishing each model are detailed in Table 1.

The Series/1-PC processor includes the 5170 Model 496. The other Series/1 processors include the 4956 with Models B10, E10, 61D, E70, G10, H10, J00, and K00.

The 5170 Model 496 is a Series/1 processor integrated with a PC AT microprocessor. The Series/1 processor offers 256K bytes of memory that can be expanded to 512K bytes in 128K-byte increments. The PC AT offers 512K bytes of memory and functions as an I/O controller running under the Input/Output Executive system. The 5170 includes a six-port host/terminal attachment card, a 30M-byte fixed disk, a 1M-byte diskette, a personal computer keyboard, and a serial/parallel adapter. Three feature slots are available for additional functions. A second six-port host/terminal attachment card is available, providing support for a maximum of eight terminals.

The 4956 models are standard 19-inch, rackmountable units and offer either 256K bytes or 512K bytes of basic storage with error checking and correcting (ECC). Models B10 and 61D are expandable to 1024K bytes. Model E10 is expandable to 2M bytes, in 256K-byte or 512K-byte increments with 512K bytes directly addressable. The storage address translator, communications power, and a clock/
comparator are standard features. The 4956 Model 10B and E10 have up to 13 card slots available for data channel features, depending on storage size. The 4956 61D and the 4956 E10 provide a 60M-byte disk, with an optional 1.2M-byte diskette drive and a 64K-byte cache.

Attachment feature cards allow the attachment of input/output devices to a Series/1 processor. The feature cards mount in the I/O feature locations of a Series/1 processor, 5161 Expansion Unit, 4959 I/O Expansion Unit, or 4965 Diskette Drive and I/O Expansion Unit. Series/1 I/O devices are attached to the processor through the processor I/O channel. The Series/1 I/O channel accommodates up to 256 devices, each device having a unique address. The actual number of devices that can be attached to a processor depends on the available number of slots in the basic chassis and the number of I/O expansion units employed. The Series/1 5170 processors occupy one slot. The 4956 processors occupy three slots. The floating-point and storage relocation transfer features occupy one I/O slot each.

The *5161 Expansion Unit* provides additional configuration flexibility for the 5170 processors. It contains one 10M-byte fixed disk drive and eight option expansion slots.

The *4959 I/O Expansion Unit* provides a maximum of 14 I/O features. Any user attachment features, integrated

TABLE 1. SYSTEM COMPARISON (Continued)

MODEL	4956 Model E70	4956 Model G10	4956 Model H10	4956 Model J00	4956 Model K00
SYSTEM CHARACTERISTICS					
Date of introduction	1987	1987	1987	1987	1987
Date of first delivery	1987	1987	1987	1987	1987
Operating system	EDX; RPS	EDX; RPS	EDX; RPS	EDX; RPS	EDX; RPS
Upgradable from	Model 60	Not applicable	Not applicable	Not applicable	Not applicable
Upgradable to	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
MEMORY					
Minimum capacity, bytes	—	—	—	—	—
Maximum capacity, bytes	1,024K	1,024K	2,048K	2,048K	2,048K
Type	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS
Cache memory	64K	400K	400K	400K	400K
Cycle time, nanoseconds	550	550	550	360	360
Bytes fetched per cycle	—	—	—	—	—
MINIMUM DISK STORAGE	1,024KB	—	1,024KB	—	—
MAXIMUM DISK STORAGE	2,048KB	1,024KB	2,048KB	2,048KB	2,048KB
NUMBER OF WORKSTATIONS	256	256	256	256	256
COMMUNICATIONS PROTOCOLS	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync

A dash (—) in a column indicates that the information is unavailable from the vendor.

IBM Series/1 Data Communications Capabilities

communications features, data processing I/O attachment features, or the sensor I/O unit attachment feature may be installed in each 4959 I/O Expansion Unit. Optionally, a maximum of five Channel Repower units (feature 1565) may be added. This feature repowers the I/O channel along a chain of I/O expansion units. The 1565 must be installed on the 4956 processors for any 4959 Expansion Units attached and on all 4959 units when another 4959 follows.

The *4965 Diskette Drive and I/O Expansion Unit* provides one or two diskettes and four available I/O channel feature positions.

The *1310 Multifunction Attachment Feature* is a single-card unit that provides four independent attachment addresses. The first port can be used for both local and remote attachments, while the remaining three ports are designed for local attachments only. Both local and remote interfaces allow data rates of up to 9600 bits per second. The 1310 provides interfaces for the 3101 Display Terminal and the 4975 Printer (local). For remote devices, asynchronous or bisynchronous communications can be selected through device initialization software in the operating system, and a single communications line is made available to the applications programs.

The *4982 Sensor I/O Unit* consists of a power supply, terminator card, and slots for eight sensor I/O feature cards. The 4982 attaches sensor user processes to the IBM Series/1 computers via the 4982 attachment feature.

The *5250 Information Display System Attachment* consists of two cards that plug into a Series/1 processor or I/O expansion unit. The attachment provides four ports to which 5250 units are attached by means of twinax or coax cabling. The maximum length of the twinax cable is 5,000 feet; for the coax cable, 2,000 feet. A maximum of seven printer units, in any combination, can be attached to any single port. A maximum of eight 5250 units may be connected to the attachment feature; each 5251 and 5256 counts as one, the 5252 counts as two.

The *1200 System/370 Channel Attachment* provides memory-to-memory communications between a Series/1 processor and any System/370-based processor. An optional feature allows the host system to IPL an attached Series/1 processor.

The *7400 Two-Channel Switch* is a feature for the 4959 I/O Expansion Unit that provides the capability to switch a set of common I/O devices between two Series/1 processors.

The *7777 Programmable Two-Channel Switch* provides the Series/1 with the capability of bidirectionally switching the 4959 and/or 4965 Model 1 I/O expansion units and their attached devices between processors.

The *5200 Series Printer Attachment* plugs into a Series/1 processor or I/O expansion unit. Up to eight printers can be connected to the attachment.

Up to eight workstations are supported on the 5170 processor. A 5151 Monochrome Display or equivalent is required for the 5170 system; the display and keyboard serve as the system console.

The 4956 processors support one to eight workstations per I/O attachment. Additional workstations can be added to the processors through the various I/O expansion devices.

Additional disk storage units can be attached to the 4956 system, which includes the following:

The 4962 Disk Storage Unit requires the 4962 disk storage unit attachment feature to attach to the Series/1. The models with a diskette unit require both the 4962 attachment and the 4964 diskette unit attachment feature, which can be plugged into either a processor unit or an I/O expansion unit.

The 4963 disk subsystem is attached to the Series/1 through one disk subsystem attachment (feature 3590) installed in a processor feature location space such as a 4965 storage and I/O expansion unit. Each subsystem has one primary drive and may have up to three expansion drives. Multiple subsystems may be attached.

The 4964 is a diskette unit that can be attached directly to either a processor unit or an I/O expansion unit.

The 4965 storage and I/O expansion unit provides either diskette storage or disk storage, depending on the model. A 1565 attachment feature is required for attachment to a 4956 Series/1.

The 4967 disk subsystem requires the microprocessor-based 4967 disk subsystem attachment (3595) and one 4967 Model 2CA primary disk unit and can have up to three 2CB expansion units.

Up to eight magnetic tape systems per I/O attachment can be attached to the 4956 processors. The 4968 auto load streaming magnetic tape unit and the 4969 magnetic tape subsystem are available for the Series/1. The 4968 attaches to the Series/1 through a tape attachment feature (feature 1220), which can be plugged into either a processor or an I/O expansion unit. The 4969 subsystem attaches to the Series/1 through a microprocessor-based 4969 magnetic tape subsystem attachment feature, which can be plugged into either the processor or an I/O expansion unit. One attachment feature, which allows for cycle-steal tape read/write operations, is required for each subsystem.

Up to two printers, including the 4971 printer and 5152 Graphics Printer, can be attached to the 5170 processors.

One of the attached printers must be a 4971; the second can be either a 4791 or 5152. The 5152 is not supported in the Series/1 mode.

The 4956 processors support up to eight printers per I/O attachment. Additional printers can be added through various I/O expansion devices including the 5200 Series Printer Attachment, the 4959 I/O Expansion Unit, the 4965 Diskette Drive and I/O Expansion Unit, the 1310 Multifunction Attachment Feature, the 4982 Sensor I/O unit, and the 5252 Information Display System Attachment.

COMMUNICATIONS FEATURES

The following communications devices are available for the Series/1.

The *1400 Local Communications Controller* provides a high-speed, local interconnection of up to 16 Series/1 4956 processors, resulting in the configuration of a Distributed Data Processing (DDP) system. A microcontroller and associated circuitry provide for cycle stealing, control buffers, and error handling. The "peer-to-peer" full-duplex protocol is transmitted via twinaxial cable, connecting processors at a maximum distance of 5,000 feet.

The *1610 Asynchronous Single-Line Control* provides circuitry for controlling one half-duplex line operating at speeds of up to 9600 bits per second (bps). It can be used as either a primary or secondary station. The 1610 makes no provision for station-address recognition; therefore, when used as a secondary station on a multipoint network, the software must provide the capability to recognize station addresses. No IPL capability is provided.

The *2091/2092 Asynchronous 8-Line Control and 4-Line Adapter* can control a maximum of eight lines operating in half-duplex mode. Each of these lines can operate at up to 2400 bits per second. No IPL capability is provided.

The *2074 Binary Synchronous Single-Line Control (Medium Speed)* provides circuitry for controlling one half-duplex line, operating at speeds of up to 9600 bits per second. It can be used as either a primary (control) or secondary (tributary) station and has the capability to IPL the processor from a host system.

The *2075 Binary Synchronous Single-Line Control (High Speed)* provides circuitry for controlling one half-duplex line, operating at speeds of up to 56,000 bits per second. It can be used as either a primary or secondary station and has the capability to IPL the processor from a host system. This feature is for use in leased-line applications only.

The *2090 Synchronous Data Line Control (SDLC) Single-Line Control* provides circuitry for controlling one half-duplex line, operating at speeds of up to 9600 bits per second. It operates as either a primary or secondary station. The ability to IPL from a host system is not provided.

The *2093/2094 Binary Synchronous 8-Line Control and 4-Line Adapter* control up to eight half-duplex lines. The maximum aggregate bit rate is achieved by running two lines at 9600 bits per second and six lines at 2400 bits per second. The capability to IPL from a host system is not provided.

The *2095/2096 8-Line Controller/4-Line Adapter* are also available. The 2095 provides the control circuitry for up to two four-line communications. This eight-line control includes point-to-point or multipoint operations which are supported with an aggregate controller throughput of 64,000 bytes per second. The 2096 feature is a four-line adapter and provides speeds of 37.5 bytes per second to 1200 bps, or 300 bps to 19,200 bps. Choice of synchronous or asynchronous operation is provided. Echo-plex operation; choice of five, six, seven, or eight bits per character; odd, even, or no parity checking/generation; stop-bit length of 1 or 2; and change-of-direction (COD) character recognition are included.

The *4987 Programmable Communications Subsystem* consists of the subsystem unit, up to two controller features, and device attachment features. It accommodates up to 32 lines per subsystem at data rates of 45 to 9600 bps. The 4987 supports point-to-point leased and switched lines or multipoint lines and handles the communications requirements for standard IBM protocols and nonstandard protocols. A special communications-oriented instruction set allows many communications functions to be performed outside the Series/1 processor.

The *Series/1 to Personal Computer Channel Attachment Feature* provides a high-speed (400K bits per second) data path between IBM Personal Computers and the Series/1, enabling PC users to utilize Series/1 resources and to communicate with IBM host systems and local area networks through the Series/1.

Network Routing Facility is designed to provide users of Advanced Communication Function/Network Control Program (ACF/NCP/VS) with a 3705-based message routing facility. The Network Routing Facility resides in an IBM 3705 Communication Controller with ACF/NCP/VS and routes messages between supported devices without the use of host processor resources. The Network Routing Facility features support for the 3650 Data Communications Terminal; multiple message routing options selectable by the user; user exits allowing customized routing, editing, and error processing; continuation of terminal routing in the event of a host failure; and detection of abnormal conditions with reporting to the host ACF/VTAM.

IBM Series/1 Data Communications Capabilities

SOFTWARE

OPERATING SYSTEMS: All models of the Series/1 support two operating systems: the Event Driven Executive (EDX) and the Realtime Programming System (RPS). A standalone program support option is also available. For the Series/1-PC models operating in the PC mode, the Disk Operating System (DOS) is supported.

The *Event Driven Executive (EDX)* supports multiple, independent, time-dependent, and/or event-driven applications with a minimum of interaction. The EDX supervisor overhead can range from 15K bytes of storage for small production systems to over 64K bytes for a complex interactive communications system. The system supports multiple programming language options, including Series/1 Assembler, Cobol, Fortran, and PL/1. EDX also provides online utilities to support production operations and assist in program development, such as text editors, debugging aids, screen format builders, remote management, and remote job entry facilities. Highlights of the system include the following:

- Initiation of application programs from a user terminal, by another program, or by outside events, such as IPL or a sensor-input interrupt.
- Execution of job streams of applications in a batch-like manner.
- Concurrent use of programs.
- Spooling.
- Application program use of any available main storage area at the time of invocation.
- Management of storage in eight partitions with crosspartition services, providing for information transfer.
- X.21 Circuit Switched support.

The *Realtime Programming System (RPS)* provides a full-function operating system to users who wish to develop applications and mixes of applications with moderate to high complexity. It provides operating system functions to support realtime operations concurrently with the execution of other batch and online programs. RPS also supports multiple processors and provides a multiprocessing feature system that consists of multiple (2 to 16) Series/1 processors connected by the local communications controller. Highlights include the following:

- Storage management and task set management
- Data management
- Timer services
- Interrupt handler
- Event services
- Queuing services
- Command-language processor
- Device management
- Communications support
- SNA support
- X.25 SNA support

The *Disk Operating System (DOS)* provides support for the Series/1-PC processors while operating in the PC mode only. The 5170 is supported by DOS Version 3.0. DOS is a general-purpose diskette operating system that supports single-user interactive and batch processing.

A *Standalone Program Support* program is also offered for users who wish to develop an application without using either of the two Series/1 operating systems. This provides the option of creating a highly tailored and specialized solution in which the application and system control functions are integrated by the program. A base program preparation facility allows a programmer to translate Assembler-language source statements into Series/1 object code. A group of control program support packages provides components from which a tailored operating system and application environment can be built.

COMMUNICATIONS PROGRAMS: The following communications support programs are provided by IBM and are supported by either the RPS or EDX operating systems:

EDX X.25/HDLC Communications Support extends the IBM Series/1 EDX to provide read/write level X.25/HDLC support for the DLC adapter, SDLC single-line control, and the synchronous communications single-line control/high speed. Typical functions of user applications based on the EDX X.25/HDLC Communications Support are protocol conversion (to enable nonpacket-mode terminals on a Series/1 to communicate with a packet switched data network) and networking (where X.25 or HDLC is being used as the communications protocol between Series/1s).

The *EDX Communications Controller for System/38* is a resident program that allows a System/38 to communicate to a variety of systems and devices through a Series/1. Functions include SDLC link from System/38 to Series/1; BSC links from Series/1 to other devices and systems; and support for System/38 to communicate with other systems.

IBM Series/1 Data Communications Capabilities

The *EDX Communication Facility* manages the flow of information throughout a configuration that may include one or many Series/1, Personal Computers, and host computers, plus terminals and printers. It can be used for communications between Series/1 terminal operators and host programs to which the Series/1 appears as an IBM 3270 Information Display System. It also supports the Series/1-PC connection providing PCs with access to Series/1 disks and printers and to Series/370-based applications. It includes aids for the development of application programs, which can communicate with terminal operators or host programs, or supply other functions required in an installation. Communications with a host may be over a leased or switched BSC line operating in multipoint mode; an SNA connection; or a channel attachment. Communications between Series/1s may be over a leased or switched BSC line operating in point-to-point or multipoint mode or over a local communications controller.

System/370 Channel Attach Program is provided for both the RPS and EDX operating systems. This program provides the Series/1 user with the ability to communicate with any System/370-based processor over a selector or block multiplexer channel, when used in conjunction with the 4933 Model 1 Series/1 System/370 Termination Enclosure and the Series/1 System/370 Channel Attachment Feature 1200. The program provides the Series/1 user with the ability to transfer data, under joint consent, between user application programs in the Series/1 and the System/370.

EDX Systems Network Architecture (SNA) executes as a separate program within the EDX operating system and coordinates all user application program requests for SNA/SDLC communications. The basic operations of the systems network architecture (SNA) support involves establishing communications with the host subsystem, including message recovery/resynchronization assistance; transmitting messages to and receiving messages from the host subsystem; and terminating communications with the host subsystem.

The *EDX Systems Network Architecture Remote Job Entry (RJE)* program is a workstation program for the Series/1 in an SNA network environment. The program enables the user, who has created a job stream via the EDX edit features, to transmit that job stream to a host system for processing. Upon completion, the output from the job stream is normally sent back to the workstation for printing and/or punching. The workstation program also allows the user to query the host computer for system status reports.

The *EDX Advanced Remote Job Entry* program supports both BSC and SNA/SDLC host connections and allows the Series/1 installation to conform to the protocol required by the host system. The BSC option provides a multileaving RJE (MRJE) workstation over a point-to-point (switched or nonswitched) connection. The SDLC option provides an SNA RJE workstation over a point-to-point (switched or nonswitched) or multipoint connection.

The *Programmable Communications Subsystem Preparation Facility* is a macro library used to support the generation of controller storage image programs for the Series/1 Programmable Communications Subsystem. This macro library is used with either the Base Program Preparation Facility or the Program Preparation Subsystem. It provides the user with the capability of defining and customizing the total protocol for his or her subsystem. Facilities are provided for implementing communications applications, using communications macroinstructions and communications definition macros.

The *Programmable Communications Subsystem Execution Support* runs under the control of RPS and provides the user with an interface to the 4987 Programmable Communications Subsystem. The support consists of execution support macros and a loader utility to load the controller storage image program into controller storage.

The *Remote Manager* program is available for both the EDX and RPS operating systems and allows the Series/1 networks to be managed and operated through the Communications and Systems Management programs available on IBM host processors (System 30XX and 43XX). The Remote Manager on each Series/1 in the network is designed to support centralized control and problem determination using the following host Communications and System Management programs: Network Communications Control Facility (NCCF); Network Problem Determination Application (NPDA); Host Command Facility (HCF); and Distributed Systems Executive (DSX).

The *RPS Communications Manager* supports line concentration, message routing, terminal control, and distributed processing. One or more Series/1s using the program can be installed to manage the flow of information through the network. The Communications Manager supports a variety of terminals and other I/O devices. Support for non-IBM devices can be incorporated through the use of the 4987 programmable communications subsystem. The Communications Manager also allows users to add applications of their own to the network control base support.

RPS Advanced Remote Job Entry (ARJE) provides the Series/1 user with RJE support in an SNA/SDLC or BSC environment. The program allows the Series/1 to conform to the protocol required by the host system. The BSC option features the Series/1 as a multitasking RJE (MRJE) workstation over a point-to-point (switched or nonswitched) connection. The SDLC option features the Series/1 as an SNA RJE workstation over a point-to-point or multipoint connection.

The *RPS Remote Management Utility* consists of two programs, the RPS Remote Management Utility (BSC

protocol) and the RPS SNA Remote Management Utility (SDLC protocol); these programs facilitate the operation of a remote Series/1 in a distributed data processing system.

The *5250 Information Display System Attachment Support* program provides definition and execution time facilities to assist the user in the control of 5250 information display system units. Functions provided are attachment initialization, verification test facilities, screen formatting macros, and utility functions.

The *Series/1-PC Connect* is a Series/1 program that runs on an IBM Personal Computer, IBM Personal Computer XT, or IBM Personal Computer AT. It supports the Series/1-PC Channel Attachment feature. The Series/1-PC Connect provides IBM Personal Computers on the IBM PC Network with access to Series/1 disks and printers, as well as access to System/370-based applications from the IBM PC Network. Series/1-PC Connect is supported by RPS Version 7.1.

The *Manufacturing Automation Protocol Communication Server* allows the Series/1 to communicate and cooperate with other systems in a MAP network. The program supports a subset of MAP at the 2.1 level, IEEE Standard 802.4 and 802.2, and International Organization for Standardization (ISO) protocols.

PRICING

The Series/1 is offered on a purchase-only basis, at prices ranging from approximately $10,000 to over $100,000, depending upon configuration. Purchase prices include installation and a three-month parts and labor warranty. On-site physical planning is separately priced. On-site support for the Standalone Utilities is provided by a customer engineer at no additional charge.

The discount schedule for Series/1-PC processors is as follows:

Quantity of Eligible Machines	Volume Purchase Discount (%)
20- 49	12
50-149	16
250-499	24
500-999	27
1,000 or more	30

The discount schedule for Series/1 4956 processors is as follows:

Quantity of Eligible Machines	Volume Purchase Discount (%)
5- 9	7
10-19	10
20-34	17
35-49	22
50 or more	28

The majority of Series/1 programs are offered with the option of a continuous monthly charge or a onetime charge with future payments waived. Under either payment option, the licensed program remains the property of IBM and is subject to the provision of the Agreement for IBM Licensed Programs. For most Series/1 software offerings, there is a onetime process charge to cover the cost of distribution of basic machine-readable material, including service updates.

The Series/1 4956 models are supported nationwide by trained IBM customer service representatives who will install the Series/1 and perform extensive tests and diagnostics. The customer service representatives are backed by a nationwide parts distribution network and are equipped with a variety of portable diagnostic tools to pinpoint trouble areas. Customer service representatives are available 24 hours a day, 7 days a week to help solve any problems that may occur during or after installation.

Support for the Series/1-PC models is provided by the IBM Personal Computing Assistance Center Support to a location designated by the customer as their Technical Support Location. IBM allows up to three members of the customer's Technical Support Location staff to be trained to assist in the installation, testing, and use of both the hardware and software of the Series/1-PC models. Customer Carry-In Repair (CCR) is provided during the three-month warranty period. A warranty option is also available which provides for IBM On-site Repair (IOR). Maintenance service providing IOR and CCR is also available.

Programming support and advice and assistance in the development and writing of tailored operating systems and applications programs are available under a systems engineering contract.

IBM offers a variety of self-study and classroom training courses on the operation of the Series/1 system. The courses are geared for different levels of personnel, including systems support, programming, and operations staff.

IBM Series/1 Data Communications Capabilities

EQUIPMENT PRICES

		Purchase Price ($)	Monthly Maint. ($)
5170 Processor			
5170	Model 496 Series/1-PC/AT System Unit/Keyboard	10,695	—
0210	30MB fixed-disk drive	1,795	156
0206	High-capacity diskette drive	275	—
0207	Dual-sided diskette drive	225	—
3629	6-port terminal/host attachment card	750	—
0215	Serial/parallel adapter	150	—
1003	64KB memory module kit	20	—
1204	Binary Synchronous Communications adapter	240	—
1205	SDLC Communications adapter	240	—
4900	Monochrome Display & Printer adapter	250	—
5612	Printer cable	45	—
4956 Processors			
4956	Model B10	13,120	37
4956	Model E10	15,220	58
4956	Model 61D	19,420	108
4956	Model E70	21,520	131
4956	Model G10	17,320	68
4956	Model H10	19,420	78
4956	Model J00	24,150	68
4956	Model K00	19,950	37
1465	Channel repower	577	—
2000	Communications indicator panel	275	3
3925	Floating-Point	770	2
3926	Floating-Point	770	2
4100	Diskette drive	1,610	11
4520	Standalone enclosure	408	—
5655	Programmer console	902	3
6330	Storage addition (256K bytes)	1,750	—
6331	Storage addition (512K bytes)	3,505	54
6334	Storage addition (1024K bytes)	3,500	10
6400	Cache—64K bytes	2,535	15
4110	Diskette drive (G10 & H10)	495	8
4115	2nd disk drive (G10 & H10)	2,520	21
4116	3rd disk drive (G10 & H10)	2,520	21
4521	Standalone enclosure	451	—
COMMUNICATIONS			
4987	Programmable Communications Subsystem	5,725	46
1300	Programmable Communications Subsystem Controller	2,740	29
3600	Programmable Communications Subsystem	2,300	18
2074	BSC single-line control	1,390	—
2075	BSC single-line control/high speed	1,520	—
2080	Synchronous communications single-line control/high speed	3,640	28
2090	Synchronous data link control single-line control	1,415	—
2093	BSC 8-line control	1,495	—
2094	BSC 4-line adapter	1,375	27
2091	Asynchronous communications 8-line control	1,340	—
2092	Asynchronous communications 4-line adapter	1,385	21
2095	Feature-programmable multiline 8-line communications control	1,430	7
2096	Feature-programmable multiline 4-line communications control	1,345	22
D40000	X.25 Multiline controller	2,805	67
D40001	X.25 Multiline line card	2,560	67 □

IBM Series/1 Data Communications Capabilities

MANAGEMENT SUMMARY

UPDATE: *IBM has renewed its commitment to the Series/1 in the past year and has enhanced it to the point that it is calling it the new Series/1. The many enhancements include two entry-level processor models, the 4950 and the 5170; the 4971 printer; and the Series/1-Personal Computer Interconnect. IBM has also enhanced the two existing operating systems, as well as added a new communications program, the Manufacturing Automation Protocol Communications Server program. IBM also withdrew two models from the market, the 4954C and 4956C processors.*

The repertoire of the IBM Series/1's communications capabilities continues to grow. The Series/1 may be used as a front-end processor, a remote line concentrator, a terminal controller, a distributed processing node, an RJE workstation, a communications controller in a local area network, a CCITT X.25 packet-switching gateway, a robot controller, and in several other communications-oriented applications.

IBM has continually expanded the Series/1's ability to communicate, both within SNA, and in the world outside IBM's domain. Within SNA, IBM has added both local and remote network management packages, allowing a Series/1 to perform some network management for a network of Series/1s, and allowing an SNA host to manage a Series/1 network remotely through its front-end processor. Outside of the SNA world, IBM offers a licensed program providing the Series/1 with X.25 packet-switching capabilities.

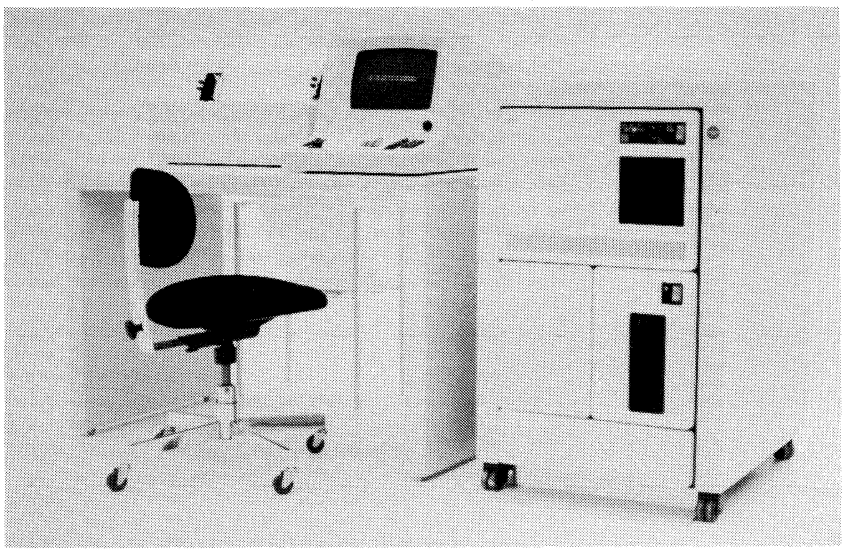
The latest of IBM's communications programs provides the Series/1 with MAP protocol compatibility. The Manufacturing Automation Protocol (MAP) Communications Server program allows Series/1s to communicate and cooperate with other systems in a manufacturing network. The system supports a subset of the Manufacturing Automation

The IBM Series/1 is an intelligent communications processing system offering an open-ended architecture. Communicating with host systems as well as Personal Computers, the Series/1 systems are designed to handle general-purpose, commercial, and sensor-based applications in a multiprogramming environment. As a communications-oriented processor, the Series/1 can function as a remote line concentrator, front-end processor, terminal controller, local network station, packet-switching node, or several other types of data communications systems.

FUNCTION: Various communications functions are possible, including front-end processor.
HOST COMPUTERS SUPPORTED: IBM mainframes, including the S/370.
ARCHITECTURE SUPPORTED: SNA.
OPERATING SOFTWARE: The Realtime Programming System (RPS) and Event Driven Executive (EDX) operating systems support communications programs on the Series/1.
COMPETITION: Minicomputer systems from Data General, Digital Equipment Corporation, Hewlett-Packard, Honeywell, Perkin-Elmer, Prime, Texas Instruments, and Wang.
PRICE: $5,750 to $22,500 per processor.

CHARACTERISTICS

VENDOR: International Business Machines Corporation (IBM), Old Orchard Road, Armonk, NY 10504. Contact



The Series/1 as shown, includes a low-boy rack enclosure housing the processor and a 4964 diskette unit. The 120-cps 4974 printer is shown at left. The 1,920-character 4979 display station is also shown.

IBM Series/1 Data Communications Capabilities

CHART A. SYSTEM COMPARISON

MODEL	4950 Models A&B	5170 Model 495	4954 Models B&C	4954 Model 30D	4954 Model 60D
SYSTEM CHARACTERISTICS					
Date of introduction	March 1985	March 1985	February 1982	—	July 1984
Date of first delivery	July 1985	November 1985	—	—	September 1984
Operating system	EDX; RPS	EDX; RPS	EDX; RPS	EDX; RPS	EDX; RPS
Upgradable from	Not applicable	Not applicable	4952	—	4954
Upgradable to	Not upgradable	Not upgradable	4956	4954-60D	4956-60E
MIPS	—	—	—	—	—
Relative performance (based on a rating of the 4954 at 1.0)	—	—	1.0	1.0	2.0
MEMORY					
Minimum capacity, bytes	256	256	64K	64K	256K
Maximum capacity, bytes	512K Series/1; 256K PC AT	512K Series/1; 512 PC AT	256K	256K	1024K
Type	MOSFET; SAMOS: NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS
Cache memory	None	None	None	64K	64K
Cycle time, nanoseconds	210 (PC mode)	—	1.4	1.4	—
Bytes fetched per cycle	—	—	—	—	—
INPUT/OUTPUT CONTROL					
Number of channels	—	—	—	—	—
High-speed buses	—	—	—	—	—
Low-speed buses	—	—	—	—	—
MINIMUM DISK STORAGE	320KB (Model A) 10MB (Model B)	20MB Fixed; 1MB diskette	9.3MB	30MB	60MB
MAXIMUM DISK STORAGE	20MB (Model A); 30MB (Model B)	40MB	800MB	800MB	800MB
NUMBER OF WORKSTATIONS	4	8	256	256	256
COMMUNICATIONS PROTOCOLS	Async; BSC; SDLC	Async; BSC; SDLC	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync

A dash (—) in a column indicates that the information is unavailable from the vendor.

Protocol at the 2.1 level of function; the IEEE Standard 802.4 (token bus local area network) and IEEE 802.2 (logical link control); and the International Standards Organization (ISO) protocols.

In addition to the new communications program, IBM has added two new entry-level models to the Series/1 processor line. The new entry-level Series/1 4950 is a specially designed Series/1 integrated with a PC XT. It is available in two models, with each consisting of a Series/1 microprocessor with 256KB of memory, which can be increased to a maximum of 512K bytes in 128K-byte increments; a PC XT microprocessor with 256K bytes of memory; a PC keyboard; and an RS-422 host/terminal attachment card that supports up to four display stations. The Series/1 microprocessor executes the Series/1 programs, and the PC XT microprocessor controls the input/output functions. The 4950 Model A includes a 10M-byte fixed disk plus a 320K-byte diskette drive, while Model B includes only the 320K-byte diskette drive. If additional storage or optional attachments are required, the appropriate IBM 5161 expansion unit must be attached.

The 5170 Model 475 consists of a Series/1 integrated with an IBM PC AT. According to IBM, performance of the 5170 is two to three times better than that of the 4950. The 5170 includes a Series/1 microprocessor with 256K bytes of storage expandable to 512KB in 128KB increments, and a PC AT processor with 512KB of memory. Also included with the system is a 20MB fixed disk, a 1MB diskette, a Personal Computer keyboard, a serial/parallel adapter, and a six-port host/terminal attachment card allowing attachment of four RS-422-attached terminals and providing two RS-232-C asynchronous ports. The PC microprocessor op-

your local IBM representative. In Canada: IBM Canada Limited, Markham, 3500 Steeles Avenue East, Markham, Ontario, L3R 2Z1 Canada.

DATE OF ANNOUNCEMENT: April 1977.

DATE OF FIRST DELIVERY: September 1977.

NUMBER DELIVERED TO DATE: Approximately 60,000.

SERVICED BY: IBM.

CONFIGURATION

The IBM Series/1 is a family of small computers marketed as multifunctional processors. The current Series/1 offering consists of four processors with a total of 13 models. The processors are the 4950 and 5170 entry-level models, and the 4954 and 4956 models. The major characteristics that distinguish each model are detailed in Table 1.

The Series/1-PC processors include the 4950 with Models A and B and the 5170 Model 495. The other Series/1 processors include the 4954 with Models B, 30D, and 60D, and the 4956 with Models B, E, 30D, 60D, and 60E.

The 4950 system unit is an IBM Series/1 integrated with a specially designed IBM Personal Computer XT. Both models (A and B) contain a Series/1 microprocessor and a PC XT microprocessor implemented on a chip (the PC XT processor is based on the Intel 8088 microprocessor). The Series/1 processor provides 256KB of memory that can be increased to 512KB in 128KB increments, and uses either the Realtime Programming System (RPS) or Event Driven Executive (EDX) operating system. The PC XT processor offers 256KB of memory, and functions as an I/O controller running under the Input/Output Executive software program (the Input/Output Executive includes a software-based disk cache). The standard system includes a PC keyboard, a host/terminal attachment card, a 10MB fixed

IBM Series/1 Data Communications Capabilities

CHART A. SYSTEM COMPARISON (Continued)

MODEL	4956 Models B&C	4956 Model E	5956 Model 30D	4956 Model 60D	4956 Model 60E
SYSTEM CHARACTERISTICS					
Date of introduction	—	October 1984	—	July 1984	October 1984
Date of first delivery	—	December 1984	—	September 1984	December 1984
Operating system	EDX; RPS	EDX; RPS	EDX; RPS	EDX; RPS	EDX; RPS
Upgradable from	1954	4954	—	4954-60D	4954-30D and 60D
Upgradable to	4956-E	—	60D	4956-60E	—
MIPS	—	—	—	—	—
Relative performance (based on a rating of the 4954 at 1.0)	2.0	4.0	—	2.0	4.0
MEMORY					
Minimum capacity, bytes	256K	512K	256K	256K	512K
Maximum capacity, bytes	1024K	2MB	1MB	1024K	2MB
Type	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS	MOSFET; SAMOS; NMOS
Cache memory	None	None	64K	64K	64K
Cycle time, nanoseconds	550	—	—	—	—
Bytes fetched per cycle	—	—	—	—	—
INPUT/OUTPUT CONTROL					
Number of channels	—	—	—	—	—
High-speed buses	—	—	—	—	—
Low-speed buses	—	—	—	—	—
MINIMUM DISK STORAGE	9.3MB	9.3MB	30MB	60MB	60MB
MAXIMUM DISK STORAGE	800MB	800MB	800MB	800MB	800MB
NUMBER OF WORKSTATIONS	256	256	256	256	256
COMMUNICATIONS PROTOCOLS	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync	SDLC; BSC; ACC; Sync

A dash (—) in a column indicates that the information is unavailable from the vendor.

erates as an I/O controller. A second six-port host/terminal attachment card is available for the 5170 processor, providing support for a maximum of 8 terminals.

Three feature slots are available on both the 4950 and 5170 systems for additional functions. Both systems can also operate either as a Series/1 or as a Personal Computer, but not simultaneously. In fact, because the XT and AT processors function as I/O controllers when in Series/1 mode, the systems must be rebooted to operate as a PC unit. Performance is dependent on the number and type of devices attached, the operating characteristics selected for those devices, and the types of applications programs being used. The 4950 and 5170 systems can perform Series/1 floating-point instructions, but at a reduced speed. A 5151 Monochrome Display, or equivalent, is required for both the 4950 and 5170 systems; the display and keyboard serve as the system console. Both systems support up to two printers of which one must be a 4971; the second can be either a 4791 or 5152. Asynchronous, BSC, or SDLC communications lines are also supported. The systems operate under the Realtime Programming System (RPS) V.7 or Event Driven Executive (EDX) V.5 in Series/1 mode, and under DOS R.2.1 (XT) or 3.0 (AT) in PC mode.

In its efforts to link PCs to its larger systems, IBM announced the IBM Series/1-Personal Computer Interconnect, which includes both the hardware, known as the Series/1-PC Channel Attachment feature, and the software, the Series/1-PC Connect Program. This offering allows Personal Computers to utilize the Series/1 resources and to communicate with IBM host systems and local area networks at a data transfer speed of 400K bits per second (bps). The Series/1-PC Interconnect feature is presently supported by RPS Version 7.1; it will reportedly be available under EDX in the near future.

disk (Model A only), a 320KB diskette drive, and three feature slots for additional functions.

The 5170 Model 495 is a Series/1 processor integrated with a PC AT microprocessor (the PC AT processor is an Intel 80286 microprocessor). The Series/1 processor offers 256KB of memory that can be expanded to 512KB in 128KB increments. The PC AT offers 512KB of memory, and, like the 4950, the PC AT functions as an I/O controller running under the Input/Output Executive system. The 5170 includes a six-port host/terminal attachment card, a 20MB fixed disk, a 1MB diskette, a personal computer keyboard, and a serial/parallel adapter. Three feature slots are available for additional functions. A second six-port host/terminal attachment card is available, providing support for a maximum of 8 terminals.

The 4954 models are standard 19-inch, rack-mountable models offering 64K bytes of basic storage, expandable to 256K bytes in 64K-byte increments by adding storage addition modules. The 4954 Model B has 13 card slots available for data channel features. The 4954 30D has six card slots, a 30MB disk, an optional 1.2MB diskette drive, and a 64KB cache. The 4954 60D provides a 60MB disk, an optional 1.2MB diskette drive, and a 64KB cache.

The 4956 models are also standard 19-inch, rack-mountable, and offer either 256KB or 512KB of basic storage with error checking and correcting (ECC). Models B, 30D, and 60D are expandable to 1024KB. Models E and 60E are expandable to 2MB, in 256KB or 512KB increments with 512KB directly addressable. The storage address translator, communications power, and a clock/comparator are standard features. The 4956 Model B has up to 13 card slots available for data channel features, depending on storage size. The 4956 30D provides a 30MB disk with six card slots; the 4956 60D and the 4956 E provide a 60MB disk, with an optional 1.2MB diskette drive and 64KB cache. The 4956 E offers 13 card slots; the 4956 60E offers six card slots.

Attachment feature cards provide for the attachment of input/output devices to a Series/1 processor. The feature

IBM Series/1 Data Communications Capabilities

The Series/1-PC Connect Program complements the IBM PC Network Program, giving IBM PC Network users access to Series/1 disks and printers. It also allows PC Network users to communicate with other users and programs outside their own local area network. In addition, it provides PC Network SNA 3270 emulation program support through Series/1 communications to the host System/370-based system or Series/1.

The RPS and EDX operating systems have both been enhanced to support the new Series/1 system models.

IBM continues to maintain the previous 4954 and 4956 models of the Series/1 family. The 4954 is offered in three models featuring a CPU, 64K bytes of main memory, a storage address translation function, a basic console, a clock/comparator, and a power supply that includes communications power. Memory is expandable to 256K bytes in 64K-byte increments. The number of I/O attachments varies; the Model B supports 13 feature positions, and the Model 30D or 60D processor supports six I/O feature positions. Optional features include a plug-in, floating-point capability and a programmer console, which is mounted in the front of the unit to provide data entry/display functions to the programmer. The 4954 Models 30D and 60D provide a capacity of 30MB and 60MB, respectively, of disk storage.

The 4956 processor is designed for mounting on support rails (fixed) in an IBM 4997 or EIA standard 19-inch rack enclosure. Error checking and correcting (ECC) memory is standard. Other features of the 4956 include full program compatibility, storage address translation for up to eight address spaces, and pluggable floating point with both single- and double-precision arithmetic.

The 4956 Model B reportedly provides twice the internal speed of the 4954 through a channel speed of 2.4MB per second. Maximum storage is one megabyte. Directly addressable storage is 512KB. Storage over 512KB is available for use as high-performance secondary storage. An optional full-function console with lock and segmentation register display/store is also offered.

The Series/1 4956 Model E is an extension of the 4956 Model B and reportedly offers internal performance approximately 50 percent greater than the 4956 Model B. The basic 4956 Model E processing unit contains the processor; 512K bytes basic storage, plus optional 256K-byte and 512K-byte additional storage cards for a maximum of 2MB storage; 13 I/O slots; error checking and correcting; enclosure; and power. The 4956 Model E is field-upgradable from the 4956 Model B.

The Model 30D is an integrated package, which includes either of the two processors (the 4954 or 4956) and one expansion unit (the 4965 Storage and I/O Expansion Unit). It includes a 30MB disk, an optional 1.2MB diskette, and an optional 64KB cache. The Model 30D also features extensive error recovery procedures, self-diagnostics, and pluggable high-frequency power supply. Any attachment card or feature that can be plugged into the 4954 or 4956 cards mount in the I/O feature locations of a Series/1 processor, 5161 Expansion Unit, 4959 I/O Expansion Unit, or 4965 Diskette Drive and I/O Expansion Unit. Series/1 I/O devices are attached to the processor through the processor I/O channel. The Series/1 I/O channel accommodates up to 256 devices, with each device having a unique address. The actual number of devices that can be attached to a processor depends on the available number of slots in the basic chassis and the number of I/O expansion units employed. The Series/1 4950 and 5170 processors occupy one slot. The 4954 and 4956 processors occupy three slots. And the floating-point and storage relocation transfer features occupy one I/O slot each.

The *5161 Expansion Unit* provides additional configuration flexibility for the 5950 and 5170 processors. It contains one 10MB fixed disk drive and eight option expansion slots.

The *4959 I/O Expansion Unit* provides a maximum of 14 I/O features. Any user attachment features, integrated communications features, data processing I/O attachment features, and the sensor I/O unit attachment feature may be installed in each 4959 I/O Expansion Unit. Optionally, a maximum of five Channel Repower units (feature 1565) may be added. This feature repowers the I/O channel along a chain of I/O expansion units. The 1565 must be installed on the 4954 and 4956 processors for any 4959 Expansion Units attached, and on all 4959 units when another 4959 follows.

The *4965 Diskette Drive and I/O Expansion Unit* provides one or two diskettes and four available I/O channel feature positions.

The *1310 Multifunction Attachment Feature* is a single-card unit that provides four independent attachment addresses. The first port can be used for both local and remote attachments, while the remaining three ports are designed for local attachments only. Both local and remote interfaces allow data rates of up to 9600 bits per second. The 1310 provides interfaces for the 3101 Display Terminal and the 4975 Printer (local). For remote devices, asynchronous or bisynchronous communications can be selected through device initialization software in the operating system, and a single communications line is made available to the applications programs.

The *4982 Sensor I/O Unit* consists of a power supply, terminator card, and slots for eight sensor I/O feature cards. The 4982 attaches sensor user processes to the IBM Series/1 computers via the 4982 attachment feature.

The *5250 Information Display System Attachment* consists of two cards that plug into a Series/1 processor or I/O expansion unit. The attachment provides four ports to which 5250 units are attached by means of twinax or coax cabling. The maximum length of the twinax cable is 5,000 feet; for the coax cable, 2,000 feet. A maximum of seven printer units, in any combination, can be attached to any single port. The maximum number of 5250 units that may be connected to the attachment feature is eight; each 5251 and 5256 counts as one, the 5252 counts as two.

The *1200 System/370 Channel Attachment* provides memory-to-memory communications between a Series/1 processor and any System/370-based processor. An optional feature allows the host system to IPL an attached Series/1 processor.

The *7400 Two-Channel Switch* is a feature for the 4959 I/O Expansion Unit that provides the capability for switching a set of common I/O devices between two Series/1 processors.

The *7777 Programmable Two-Channel Switch* provides the Series/1 with the capability of bidirectionally switching the

IBM Series/1 Data Communications Capabilities

processor, or the 4959 or 4965 expansion units, can also be plugged into the Model 30D. Main storage capacity is 512KB to 1024KB.

The 4954 and 4956 Model 60D processors and the 4965 storage and I/O unit incorporates two major auxiliary devices, one 60MB disk, and an optional 1.2MB diskette drive. An optional 64KB microprocessor-driven cache is also available, which, according to IBM, has disk throughput acceleration potential of 50 to 200 percent, depending upon the application. Model 60D also features error detecting and correcting capabilities.

The 4956 Model 60E is an integrated package containing the processor and storage provided in the Model E; it is reportedly 50 percent faster than the 4956 Models 30D and 60D. The 60E is an extension of the Model 60D and offers a 60MB integrated disk, maximum storage of 2MB (1MB is directly addressable and 1MB is secondary), six I/O slots, an optional 1.2MB diskette, and an optional 64KB microprocessor-controlled cache for the disk. The 4956 Model 60E is field-upgradable from the 4956 30D or 60D.

The 4954 and 4956 Series/1s are considered a modular "mix and match" system with the user determining the modules required—equipment, programming, and service. The units can either fit into an IBM 4997 rack enclosure or EIA standard 19-inch rack, or be mounted in standalone enclosures, depending on the model. I/O device attachment is supported by means of I/O feature cards installed in available slots either in the processor or an I/O expansion unit. Up to 256 individual devices, both standard and custom built, may be addressed by the Series/1 4954 and 4956 processors.

Up to 16 processors can be connected on a high-speed ring. In addition to local ring-connected processors, many of the Series/1 capabilities can be provided to geographically distributed Series/1s by using communication lines. Series/1 capabilities provide the ability to utilize packet switched networks. Communications features are contained in feature cards that plug into the processor I/O channel or the 4987 programmable communication unit. The communications attachment feature cards include a synchronous (SDLC adapter), binary synchronous (BSC) adapter, Asynchronous (ACC) adapter, X.25 network communications adapter, and feature-programmable communications adapter. The Series/1 also supports three local area networks: the yet-to-be-introduced Industrial Network, the PC Network, and the Token-Ring Network.

As we mentioned earlier, Series/1 software provides a wide range of communications support, including X.21, X.25, SNA, and RJE. The software allows the system to act, variously, as a network node, a communications controller, a distributed processing system, or a standalone system.

COMPETITIVE POSITION

The Series/1 continues to be one of IBM's best sellers with an installed base of nearly 60,000. The system sales accelerated from a 6 percent growth rate in 1982/1983 to close to a

4959 and/or 4965 Model 1 I/O expansion units and their attached devices between processors.

The *5200 Series Printer Attachment* plugs into a Series/1 processor or I/O expansion unit. Up to eight printers can be connected to the attachment.

Up to four workstations are supported on the 4950 processors, and up to eight are supported on the 5170 processor. A 5151 Monochrome Display, or equivalent, is required for both the 4950 and 5170 systems; the display and keyboard serve as the system console.

The 4954 and 4956 processors support one to eight workstations per I/O attachment. Additional workstations can be added to the 4954 and 4956 processors through the various I/O expansion devices.

Additional disk storage can be added to the 4950 and 5170 systems through the 5161 Expansion Unit. The 5161 Expansion Unit can provide up to two 10MB fixed disk drives and eight option slots (two of which are populated).

Additional disk storage units can be attached to the 4954 and 4956 systems, which include the following:

The 4962 Disk Storage Unit requires the 4962 disk storage unit attachment feature to attach to the Series/1. The models with a diskette unit require both the 4962 attachment and the 4964 diskette unit attachment feature, which can be plugged into either a processor unit or an I/O expansion unit.

The 4963 disk subsystem is attached to the Series/1 through one disk subsystem attachment (feature 3590) installed in a processor feature location space, a 4959 I/O expansion unit, or 4965 storage and I/O expansion unit. Each subsystem has one primary drive and may have up to three expansion drives. Multiple subsystems may be attached.

The 4964 is a diskette unit that can be attached directly to either a processor unit or an I/O expansion unit.

The 4965 storage and I/O expansion unit provides either diskette storage or disk storage, depending on the model. A 1565 attachment feature is required for attaching to a 4954 or 4956 Series/1.

The 4967 disk subsystem requires the microprocessor-based 4967 disk subsystem attachment (3595), and one 4967 Model 2CA primary disk unit, and can have up to three 2CB expansion units.

Up to eight magnetic tape systems per I/O attachment can be attached to the 4954 and 4956 processors. The 4968 autoload streaming magnetic tape unit and the 4969 magnetic tape subsystem are available for the Series/1. The 4968 attaches to the Series/1 through a tape attachment feature (feature 1220), which can be plugged into either a processor or an I/O expansion unit. The 4969 subsystem attaches to the Series/1 through a microprocessor-based 4969 magnetic tape subsystem attachment feature, which can be plugged into either the processor or an I/O expansion unit. One attachment feature, which allows for cycle-steal tape read/write operations, is required for each subsystem.

Up to two printers can be attached to the 4950 and 5170 processors, which include the 4971 printer and 5152 Graphics Printer. One of the attached printers must be a 4971; the second can be either a 4791 or 5152. The 5152 is not supported in the Series/1 mode.

The 4954 and 4956 processors support up to eight printers per I/O attachment. Additional printers can be added through various I/O expansion devices such as the 5200

IBM Series/1 Data Communications Capabilities

40 percent growth rate in 1984/1985. In fact, 1985 was the biggest year in the life of the Series/1.

The Series/1 has progressed in technology from using six processor boards to using a half-inch silicon chip on the Series/1-PC models. Presently, 64K-bit memory is being used, but IBM is in the process of testing 256K-bit technology for use in the near future.

One can see the Series/1 actually competing with its sister system, the IBM Series/36. Both systems overlap, featuring many of the same capabilities, and both systems offer integrated PC models. However, the System/36 is more of an office system and offers more general business packages; whereas the Series/1, seen as a communications and networking system, offers more communications capabilities, such as its support of three types of local area networks.

The Series/1, however, is not lacking in competition from other manufacturers. Since its strengths spread across several marketing areas, including distributed processing, manufacturing, and sales/distribution, as well as communications, competing systems include the Honeywell DPS 6 systems, the Texas Instruments Business Systems, the low end of the Wang VS Series, and the Hewlett-Packard HP 3000. As a communications processor, the Series/1 competes with minicomputers from the above-mentioned vendors, plus vendors such as Digital Equipment Corporation, Data General, Prime, and Perkin-Elmer.

The Series/1 cost factor is a crucial issue; IBM has recently reduced processor costs, and rivals will be hard-pressed to match the resulting price/performance ratio.

ADVANTAGES AND RESTRICTIONS

The many enhancements made in the past year expand the dimensions of the Series/1 systems. A broader range of processors, communications features, and software is now available. IBM sees the Series/1 as an intelligent communications processor rather than as a distributed processor or departmental system. This is not to say that it cannot be used as such, but that communications capabilities are the Series/1's strength. An example of the system's versatility in communications is its support of three local area networks—the PC Network, the new Token-Ring Network, and the unannounced Industrial Network. The Series/1 also offers both PC and host affinity and operates as a natural gateway between the two.

The new entry-level desktop Series/1-PC models offer users a low-cost, entry-level solution, and because it can be operated as either a Series/1 or a PC (not simultaneously), an overwhelming amount of software is available. The drawback is that the small amount of memory available on the Series/1-PC models restricts the applications software to a 512KB limitation. Another disadvantage is that the Series/1-PC models cannot be hardware upgraded to the high-end models; however, there is software portability. Also, because the PC controls the I/O functions of the system, only PC peripherals can be attached to the Series/1-

Series Printer Attachment, the 4959 I/O Expansion Unit, the 4965 Diskette Drive and I/O Expansion Unit, the 1310 Multifunction Attachment Feature, the 4982 Sensor I/O unit, and the 5252 Information Display System Attachment.

COMMUNICATIONS FEATURES

The following communications devices are available for the Series/1.

The *1400 Local Communications Controller* provides a high-speed, local interconnection of up to 16 Series/1 4954 and 4956 processors, resulting in the configuration of a Distributed Data Processing (DDP) system. A microcontroller and associated circuitry provide for cycle stealing, control buffers, and error handling. The "peer-to-peer" full-duplex protocol is transmitted via twinaxial cable, connecting processors at a maximum distance of 5,000 feet.

The *1610 Asynchronous Single-Line Control* provides circuitry for controlling one half-duplex line operating at a speed of up to 9600 bits per second (bps). It can be used as either a primary station or a secondary station. The 1610 makes no provision for station-address recognition; therefore, when used as a secondary station on a multipoint network, the software must provide the ability to recognize station addresses. No IPL capability is provided.

The *2091/2092 Asynchronous 8-Line Control and 4-Line Adapter* can control a maximum of eight lines operating in half-duplex mode. Each of these lines can operate at up to 2400 bits per second. No IPL capability is provided.

The *2074 Binary Synchronous Single-Line Control (Medium Speed)* provides circuitry for controlling one half-duplex line, operating at a speed of up to 9600 bits per second. It can be used as either a primary (control) or a secondary (tributary) station, and has the ability to IPL the processor from a host system.

The *2075 Binary Synchronous Single-Line Control (High Speed)* provides circuitry for controlling one half-duplex line, operating at a speed of up to 56,000 bits per second. It can be used as either a primary or secondary station, and has the ability to IPL the processor from a host system. This feature is for use in leased-line applications only.

The *2090 Synchronous Data Line Control (SDLC) Single-Line Control* provides circuitry for controlling one half-duplex line, operating at a speed of up to 9600 bits per second. It operates as either a primary or secondary station. The ability to IPL from a host system is not provided.

The *2093/2094 Binary Synchronous 8-Line Control and 4-Line Adapter* control up to eight half-duplex lines. The maximum aggregate bit rate is achieved by running two lines at 9600 bits per second and six lines at 2400 bits per second. The ability to IPL from a host system is not provided.

The *2095/2096 8-Line Controller/4-Line Adapter* are also available. The 2095 provides the control circuitry for up to two 4-line communications. This 8-line control includes point-to-point or multipoint operations which are supported with an aggregate controller throughput of 64,000 bytes per second. The 2096 feature is a 4-line adapter and provides speeds of 37.5 bytes per second (BPS) to 1200 bps, or 300 bps to 19,200 bps. Choice of synchronous or asynchronous operation is provided. Included are Echo-plex operation; choice of 5, 6, 7, or 8 bits per character; odd, even, or no parity checking/generation; stop-bit length of 1 or 2; and change-of-direction (COD) character recognition.

The *4987 Programmable Communications Subsystem* consists of the subsystem unit, up to two controller features, and device attachment features. It accommodates up to 32 lines

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PC models. In addition, the PC models cannot be used as LAN servers.

IBM has again decreased the price of four models: the 4956 B, 4956 30D, 4956 60D, and the 4956 60E. The lower cost, flexibility, reliability, and the modularity of the Series/1 are all system advantages. Another advantage is that while not considered a fault-tolerant system, dual Series/1 processors can be connected in a ring to provide for fault-tolerant processing.

Although the Series/1-PC models cannot be upgraded, a good growth path is provided throughout the Series/1 4954 and 4956 models. However, to expand out of the family would entail not only the expense of all new hardware, but also the expense of software reconfiguration, for the Series/1 software is not compatible with any of the other systems offered by IBM.

IBM's future direction for the Series/1 includes additional cost reductions, increased memory to 1MB on the PC models, and increased memory as well as faster processor speeds at the high-end of the Series/1 systems.

USER REACTION

When Datapro conducted its 1985 Computer User Survey, 11 users of the Series/1 responded. The systems had an average life of 13.6 months. Seven of the respondents polled were first-time computer users, four converted from other manufacturers' systems.

The types of industries represented in the survey include manufacturing (two responses), education (two responses), and one response each for retail/wholesale, engineering, insurance, service bureau, and utilities. The principal applications performed on the systems were accounting/billing (six users), payroll/personnel (five users), sales distribution (two users), manufacturing (two users), order processing (two users), and one response each for education, engineering, mathematics/statistics, insurance, purchasing, and process control. The main source of applications programs were in-house personnel (eight users), followed by independent suppliers (four users), and contract programming (three users).

When asked how many local workstations are supported by their Series/1, three users answered between 1 and 5, and eight answered between 6 and 15. With regard to remote workstation/terminals supported, two answered 1 to 5, two answered 6 to 15, and one answered 31 to 60. Only four of the respondents use a data base management system, five don't plan to add a data base management system at all, and one plans to add one in the near future. Only one of the users is presently using integrated office automation functions; the other 10 don't plan to add such functions in the near future. The most frequently employed programming languages used on the systems were Cobol (two users), Assembler (one user), Fortran (one user), and the balance of respondents used other languages. Only four of the users plan to acquire expansions to their present hardware in 1985, and four plan to add data communications facilities.

per subsystem at data rates of 45 to 9600 bps. The 4987 supports point-to-point leased and switched lines or multipoint lines and handles the communications requirements for standard IBM protocols and nonstandard protocols. A special communications-oriented instruction set allows many communications functions to be performed outside the Series/1 processor.

The *Series/1 to Personal Computer Channel Attachment Feature* provides a high-speed (400K bits per second) data path between IBM Personal Computers and the Series/1, enabling users to utilize Series/1 resources and to communicate with IBM host systems and local area networks through the Series/1.

Network Routing Facility is designed to provide users of Advanced Communication Function/Network Control Program (ACF/NCP/VS) with a 3705-based message routing facility. The Network Routing Facility resides in an IBM 3705 Communication Controller with ACF/NCP/VS and routes messages between supported devices without the use of host processor resources. The Network Routing Facility features support for the 3650 Data Communications Terminal; multiple message routing options selectable by the user; user exits allowing customized routing, editing, and error processing; continuation of terminal routing in the event of a host failure; and detection of abnormal conditions with reporting to the host ACF/VTAM.

SOFTWARE

OPERATING SYSTEMS: All models of the Series/1 support two operating systems: the Event Driven Executive (EDX) and the Realtime Programming System (RPS). A third operating system, the Interactive Executive (IX) is supported by the 5956 processors only; it does not support communications applications, however. A standalone program support option is also available. For the Series/1-PC models operating in the PC mode, the Disk Operating System (DOS) is supported.

The *Event Driven Executive (EDX)* supports multiple, independent, time-dependent, and/or event-driven applications with a minimum of interaction. The EDX supervisor overhead can range from 15KB of storage for small production systems to over 64K bytes for a complex interactive communications system. The system supports multiple programming language options, including Series/1 Assembler, Cobol, Fortran, and PL/1. EDX also provides online utilities to support production operations and assist program development, such as text editors, debugging aids, screen format builders, remote management, and remote job entry facilities. Highlights of the system include the following:

- Initiation of application programs from a user terminal, by another program, or by outside events, such as IPL or a sensor-input interrupt.
- Execution of job streams of applications in a batch-like manner.
- Concurrent use of programs.
- Spooling.
- Application program use of any available main storage area at the time of invocation.
- Management of storage in eight partitions with crosspartition services, providing for information transfer.
- X.21 Circuit Switched support.

The *Realtime Programming System (RPS)* provides a full-function operating system to users who wish to develop

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When asked if the system did what they expected it to do, nine answered yes and one was undecided. Nine of the users also said they would recommend the system to other users, one said they would not, and one was undecided.

The 11 users polled rated the Series/1 as follows:

	Excellent	Good	Fair	Poor	WA*
Ease of operation	5	4	2	0	3.3
Reliability of mainframe	6	5	0	0	3.6
Reliability of peripherals	5	5	0	0	3.6
Maintenance service:					
Responsiveness	6	3	2	0	3.4
Effectiveness	6	5	0	0	3.6
Technical support:					
Troubleshooting	3	4	2	0	3.1
Education	2	5	2	1	2.8
Documentation	3	5	1	1	3.0
Manufacturers software:					
Operating system	4	5	0	0	3.4
Compiler & assemblers	1	8	0	0	3.1
Application programs	1	5	0	0	3.2
Ease of programming	2	4	3	0	2.9
Ease of conversion	0	3	1	2	2.2
Overall satisfaction	2	6	1	0	3.1

*Weighted Average based on a scale of 4.0 for Excellent.

To further evaluate the performance of the Series/1, we conducted the following telephone interviews with four survey respondents in November 1985.

The first user we talked to represented an insurance firm in the Northeast. His company's Series/1 4955 is used for accounting and insurance applications, and supports 10 local workstations, six remote workstations, and 384KB of memory. Prior to purchasing the system, the user looked at several systems, which included Wang and Hewlett-Packard, but chose the Series/1 because of IBM's reputation and the availability of software better suited for his needs. The user is happy with the system, listing the system advantages as ease of use, high reliability, and exceptional hardware support from IBM (the software was third-party supplied). He feels the system's disadvantage is that the processing speed is slow.

The user's company is planning to expand its data communications facilities by adding more remote units, and by going from 4-channel to 8-channel multiplexers. Expansion from the 4955 to the 4956 E is also being considered.

The second user contacted represented a service bureau in the Midwest using the Series/1 Model 4956 E for applications that include accounts receivable, payroll, inventory, order entry, general ledger, and income tax processing. The system supports seven local workstations and 768KB of memory. The original Series/1 system was selected back in 1979 over the IBM System/34 because of its open-ended architecture. The open-ended architecture, along with reliability (very little downtime), was about the only advantage this user could mention. He stated, "The installation of any hardware changes is very difficult, and the operating system is atrocious, with bad documentation." The user was happy with the technical support—when he could get it.

applications and mixes of applications with moderate to high complexity. It provides operating system functions to support realtime operations concurrently with the execution of other batch and online programs. RPS also supports multiple processors and provides a multiprocessing feature system that consists of multiple (2 to 16) Series/1 processors connected by the local communications controller. Highlights include the following:

- **Storage management and task set management**
- **Data management**
- **Timer services**
- **Interrupt handler**
- **Event services**
- **Queuing services**
- **Command language processor**
- **Device management**
- **Communications support**
- **SNA support**
- **X.25 SNA support**

The *Disk Operating System (DOS)* provides support for the Series/1-PC processors while operating in the PC mode only. The 4950 processor is supported by DOS Version 2.1, and the 5170 is supported by DOS Version 3.0. DOS is a general-purpose diskette operating system that supports single-user interactive and batch processing.

A *Standalone Program Support* program is also offered for users who wish to develop an application without using either of the two Series/1 operating systems. This provides the option of creating a highly tailored and specialized solution where the application and system control functions are integrated by the program. A base program preparation facility allows a programmer to translate Assembler language source statements into Series/1 object code. A group of control program support packages provides components from which a tailored operating system and application environment can be built.

COMMUNICATIONS PROGRAMS: The following communications support programs are provided by IBM and are supported by either the RPS or EDS operation systems:

***EDX X.25/HDLC Communications Support* extends the IBM Series/1 EDX to provide read/write level X.25/HDLC support for the DLC adapter, SDLC single-line control, and the synchronous communications single-line control/high speed. Typical functions of user applications based on the EDX X.25/HDLC Communications Support are protocol conversion (to enable nonpacket-mode terminals on a Series/1 to communicate with a packet switched data network) and networking (where X.25 or HDLC is being used as the communication protocol between Series/1s).**

The *EDX Communications Controller for System/38* is a resident program that allows a System/38 to communicate to a variety of systems and devices through a Series/1. Functions include SDLC link from System/38 to Series/1; BSC links from Series/1 to other devices and systems; and support for System/38 to communicate with other systems.

***EDX Communication Facility:* Manages the flow of information throughout a configuration that may include one or many Series/1, Personal Computers, and host computers,**

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However, support was not always available to him because he had purchased the 4956 E from a third-party dealer. This transaction was handled in this manner because the user stated he could not get satisfactory service from the IBM representative when attempting to upgrade to the 4956 E, and did not realize that a purchase from a third party would affect his support from IBM. (The third-party dealer has since gone out of business.) The user has since purchased software and a memory upgrade directly from IBM, but said even that did not help his support situation. Because of the third-party system purchase, the user said he could not get any 800-line support, and that a broken code problem was the only time he was able to call IBM support at Boca Raton, Florida. When he did get through to Boca Raton, he said the support was excellent. He stated that IBM's solution to his problems was to switch to a System/36 or /38, but that since the software is not compatible, his present investment is too great and the cost to convert is to expensive. The user feels the Series/1 is a technical machine and that it must have a technically competent person to operate it.

When asked if he plans to expand the system in the future, the user stated that he would upgrade when a new high-end processor was introduced. Expansion plans for the near future included adding modems and terminals at remote sites, more memory, and more peripherals.

The third user was with an engineering/scientific firm also located in the Midwest. This company's Series/1 4955 is used strictly for mathematical and statistical applications. When asked why his firm purchased the Series/1 for engineering applications, the user said that he bought prior to the micro/engineering workstation age, and that at the time, he wanted a system that was capable of supporting both accounting and engineering applications (he has since dropped the accounting applications). He said his firm also chose the system because of good local support, and because it could be used on a timesharing basis providing a remote link, using Fortran, to engineering packages located on a mainframe. His other reason was that the Series/1 is a multitasking system capable of running several jobs at a time. The user credited the system as being reliable with limited problems over the five-to-six-year span the system has been in-house. When asked if he was happy with the support, he said, "Yes, especially the hardware support; the software support is just so-so." He feels the major problem with the system is the memory limitation.

The fourth user worked for a Northeast manufacturing firm that used the Series/1 4955 for accounting, order processing and inventory, payroll and personnel, sales and distribution, and data entry. The system supports four local workstations, several remote workstations, and 384KB of memory. The user, like most other users, feels the Series/1 hardware is very reliable. His only complaint with the software is that there is a discrepancy between two of their software packages, (IDES II and Yale ASCII). Each software system, operating alone, works well with the Series/1 and the operating system, but will not work in conjunction with each other. He also felt that hardware and software growth could only be within the Series/1 family, because

plus terminals and printers. It can be used for communication between Series/1 terminal operators and host programs to which the Series/1 appears as an IBM 3270 Information Display System. It also supports the Series/1-PC connection providing PCs with access to Series/1 disks and printers and to Series/370-based applications. It includes aids for the development of application programs, which can communicate with terminal operators or host programs, or supply other functions required in an installation. Communication with a host may be over a leased or switched BSC line operating in multipoint mode; an SNA connection; or a channel attachment. Communications between Series/1s may be over a leased or switched BSC line operating in point-to-point or multipoint mode, or over a local communications controller.

System/370 Channel Attach Program **is provided for both the RPS and EDX operation systems. This program provides the Series/1 user with the ability to communicate with any System/370-based processor over a selector or block multiplexer channel, when used in conjunction with the 4933 Model 1 Series/1 System/370 Termination Enclosure and the Series/1 System/370 Channel Attachment Feature 1200. The program provides the Series/1 user with the ability to transfer data, under joint consent, between user application programs in the Series/1 and the System/370.**

EDX Systems Network Architecture (SNA) **executes as a separate program within the EDX operating system and coordinates all user application program requests for SNA/SDLC communications. The basic operations of the systems network architecture (SNA) support involves establishing communications with the host subsystem, including message recovery/resynchronization assistance; transmitting messages to and receiving messages from the host subsystem; and terminating communications with the host subsystem.**

The *EDX Systems Network Architecture Remote Job Entry (RJE)* program is a workstation program for the Series/1 in an SNA network environment. The program enables the user, who has created a job stream via the EDX edit features, to transmit that job stream to a host system for processing. Upon completion, the output from the job stream is normally sent back to the workstation for printing and/or punching. The workstation program also allows the user to query the host computer for system status reports.

The *EDX Advanced Remote Job Entry* program supports both BSC and SNA/SDLC host connections, and allows the Series/1 installation to conform to the protocol required by the host system. The BSC option provides a multileaving RJE (MRJE) workstation over a point-to-point (switched or nonswitched) connection. The SDLC option provides an SNA RJE workstation over a point-to-point (switched or nonswitched) or multipoint connection.

The *Programmable Communications Subsystem Preparation Facility* is a macro library used to support the generation of controller storage image programs for the Series/1 Programmable Communications Subsystem. This macro library is used with either the Base Program Preparation Facility or the Program Preparation Subsystem. It provides the user with the capability of defining and customizing the total protocol for his or her subsystem. Facilities are provided for implementing communications applications, using communications macroinstructions and communications definition macros.

The *Programmable Communications Subsystem Execution Support* runs under the control of RPS and provides the user with an interface to the 4987 Programmable Communications Subsystem. The support consists of execution support macros and a loader utility to load the controller storage image program into controller storage.

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there is no relation to any other IBM product, and that major conversion will be required when his company outgrows the product. □

The *Remote Manager* program is available for both the EDX and RPS operating systems, and allows the Series/1 networks to be managed and operated through the Communications and Systems Management programs available on IBM host processors (System 30XX and 43XX). The Remote Manager on each Series/1 in the network is designed to support centralized control and problem determination using the following host Communications and System Management programs: Network Communications Control Facility (NCCF); Network Problem Determination Application (NPDA); Host Command Facility (HCF); and Distributed Systems Executive (DSX).

The *RPS Communications Manager* supports line concentration, message routing, terminal control, and distributed processing. One or more Series/1s using the program can be installed to manage the flow of information through the network. The Communications Manager supports a variety of terminals and other I/O devices. Support for non-IBM devices can be incorporated through the use of the 4987 programmable communications subsystem. The Communications Manager also allows users to add applications of their own to the network control base support.

RPS Advanced Remote Job Entry (ARJE) provides the Series/1 user with RJE support in an SNA/SDLC or BSC environment. The program allows the Series/1 to conform to the protocol required by the host system. The BSC option features the Series/1 as a multitasking RJE (MRJE) workstation over a point-to-point (switched or nonswitched) connection. The SDLC option features the Series/1 as an SNA RJE workstation over a point-to-point or multipoint connection.

The *RPS Remote Management Utility* consists of two programs, the RPS Remote Management Utility (BSC protocol) and the RPS SNA Remote Management Utility (SDLC protocol); these programs facilitate the operation of a remote Series/1 in a distributed data processing system.

The *5250 Information Display System Attachment Support* program provides definition and execution time facilities to assist the user in the control of 5250 information display system units. Functions provided are attachment initialization, verification test facilities, screen formatting macros, and utility functions.

The *Series/1-PC Connect* is a Series/1 program that runs on an IBM Personal Computer, IBM Personal Computer XT, or IBM Personal Computer AT. It supports the Series/1-PC Channel Attachment feature. The Series/1-PC Connect provides IBM Personal Computers on the IBM PC Network with access to Series/1 disks and printers, as well as access to System/370-based applications from the IBM PC Network. Series/1-PC Connect is supported by RPS Version 7.1.

The *Manufacturing Automation Protocol Communication Server* allows the Series/1 to communicate and cooperate with other systems in a MAP (Manufacturing Automation Protocol) network. The program supports a subset of MAP at the 2.1 level, IEEE Standard 802.4 and 802.2, and International Standards Organization (ISO) protocols.

PRICING

The Series/1 is offered on a purchase-only basis, at prices ranging from approximately $5,750 to over $100,000, depending on the configuration. Purchase prices include installation and a three-month parts and labor warranty. On-site physical planning is separately priced. On-site support for the Standalone Utilities is provided by a customer engineer at no additional charge.

The discount schedule for Series/1-PC processors is as follows:

Quantity of Eligible Machines	Volume Purchase Discount Percent
20-49	12%
50-149	16%
250-499	24%
500-999	27%
1,000 or more	30%

The discount schedule for Series/1 4954 and 4956 processors is as follows:

Quantity of Eligible Machines	Volume Purchase Discount Percent
5-9	7%
10-19	10%
20-34	17%
35-49	22%
50 or more	28%

The majority of Series/1 programs are offered with an option of a continuous monthly charge or a onetime charge with future payments waived. Under either payment option, the licensed program remains the property of IBM and is subject to the provision of the Agreement for IBM Licensed Programs. For most Series/1 software offerings, there is a onetime process charge to cover the cost of distribution of basic machine-readable material, including service updates.

The Series/1 4954 and 4956 models are supported nationwide by trained IBM customer service representatives who will install the Series/1 and perform extensive tests and diagnostics. The customer service representatives are backed by a countrywide parts distribution network, and are equipped with a variety of portable diagnostic tools to pinpoint trouble areas. Customer service representatives are available 24 hours a day, 7 days a week to help solve any problems that may occur during or after installation.

Support for the Series/1-PC models is provided by the IBM Personal Computing Assistance Center Support to a location designated by the customer as their Technical Support Location. IBM allows up to three members of the customers Technical Support Location staff to be trained to assist in the installation, testing, and use of both the hardware and software of the Series/1-PC models. Customer Carry-In Repair (CCR) is provided during the three-month warranty period. A warranty option is also available which provides for IBM On-site Repair (IOR). Maintenance service providing IOR and CCR is also available.

Programming support and advice and assistance in the development and writing of tailored operating systems and applications programs are available under a systems engineering contract.

IBM offers a variety of self-study and classroom training courses on the operation of the Series/1 system. The courses are geared for different levels of personnel, including systems support, programming, and operations staff.

IBM Series/1 Data Communications Capabilities

EQUIPMENT PRICES

		Purchase Price ($)	Monthly Maint. ($)
PROCESSORS AND MAIN STORAGE			
5170	Model 495 Series/1-PC/AT System Unit/Keyboard	8,895	—
4950	Model A Series/1-PC/XT System Unit/Keyboard	5,750	—
	Model B Series/1-PC/XT System Unit/Keyboard	7,605	—
4954B	Processor; full-width module, 64K bytes basic memory, 13 I/O feature slots	8,500	45.00
495430D	4954 Model 30D, full-width module, 32KB basic memory, 6 I/O feature slots, disk	17,800	79.00
485460D	4954 Model 60D	19,800	98.00
4956B	Processor; full-width module, 256KB basic memory, and 13 I/O feature slots	12,500	37.00
4956C	Processor; full-width module, diskette drive, 256KB basic memory, and 3 I/O feature slots	16,855	57.00
4956E	Processor, full-width module, 512KB basic memory, 13 I/O slots	16,500	59.00
495630D	4956 Model 30D, full-width module, 256KB of memory, 6 I/O slots, disk	21,700	75.00
495660D	4956 Model 60D	18,500	102.00
495660E	4956 Model 60E, 512KB of memory, 6 I/O feature slots	22,500	126.00
6307	64KB Storage Addition Card for the 4954 processor	625	2.50
6330	256KB Storage Addition Card for the 4956 processor	1,595	16.00
6331	512KB Storage Addition Card for Model 30D	3,190	48.00
6332	512KB Basic Storage Expansion for Model 30D	1,595	32.00
6333	512KB Storage Addition Card for the 4956 processor	3,750	48.00
COMMUNICATIONS			
1204	Binary Synchronous Communications Adapter	240	—
1205	SDLC Communications Adapter	240	—
1300	Programmable communications subsystem controller	2,495	26.00
1400	Local communications controller	3,365	14.50
1610	Asynchronous communications single-line control	1,360	9.50
2000	Communications indicator panel	250	3.00
2010	Communications power; 4955 only	150	3.00
2074	BSC single-line control	1,265	11.50
2075	BSC single-line control/High speed	1,385	11.50
2080	Synchronous Single Line Control/High speed	3,310	25.00
2090	SDLC single-line control	1,290	11.50
2091	Asynchronous communications 8-line control	1,220	9.50
2092	Asynchronous communications 4-line adapter	1,260	19.50
2093	BSC 8-line control	1,360	9.50
2094	BSC 4-line adapter	1,250	24.50
2095	Feature-programmable multiline communications; 8-line control	1,300	7.00
2096	Feature-programmable multiline communications; 4-line adapter	1,225	20.00
4730	Half-duplex DCE attachment	426	2.50
4731	Full-duplex DCE attachment	419	2.50
4734	TTY-current attachment	700	4.00
4736	Data-Phone digital service adapter	1,132	4.50
4739	Asynchronous local attachment	467	1.50
4740	Synchronous local attachment	492	2.00
4743	Autocall attachment	432	2.50
4746	1200 bps asynchronous modem, switched network	1,200	7.50
4747	1200 bps asynchronous modem, leased line SNBU	1,330	8.00
4748	1200 bps asynchronous modem, leased line	1,205	7.50
4751	1200 bps synchronous modem with clock, switched network	1,235	7.50
4752	1200 bps synchronous modem with clock, leased line SNBU	1,370	8.00
4753	1200 bps synchronous modem with clock, leased line	1,240	7.50
4940	Multiplexer, read relay	850	12.00
4950	Multiplexer, solidstate	934	7.00
4987	Programmable communications subsystem, Model 1	5,205	45.00
4990	Communications console, Model 1	975	2.00
7850	Teletypewriter adapter	705	6.00

NC—No charge.

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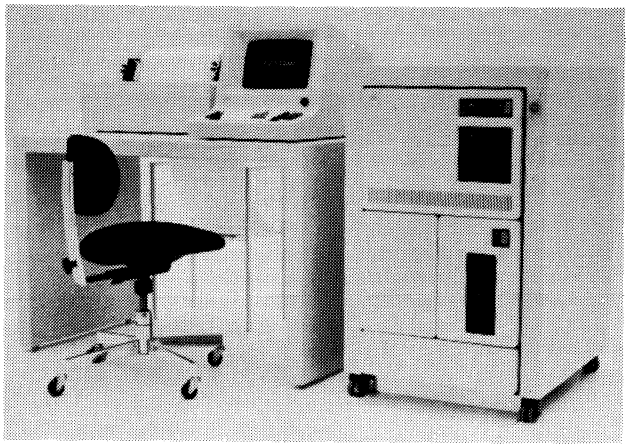
SOFTWARE PRICES

		Monthly Charge ($)	Onetime Charge ($)
LICENSED PROGRAMS			
5719-PC5	Realtime Programming System, Version 5, with Command Language Facility	175	4,940
5719-PC6	Version 6, with Command Language Facility	476	7,500
	Version 6 without Command Language Facility	304	5,000
5719-XS1	EDX Supervisor and Emulator, Version 1	26	1,055
5719-XS3	Version 3 (Basic)	47	1,440
5719-XS4	Version 4	132	1,900
5719-XJ5	EDX Version 5 for Series/1 4950 System	—	750
5719-XS5	Series/1 EDX Basic Supervisor and Emulator	158	2,200
5719-CA1	System/370 Channel Attachment	33	1,305
5719-CF1	EDX Communications Facility	63	2,200
5719-CF2	Series/1 EDX Communications Facility, Version 2	167	2,500
5719-CM1	Communications Monitor for Series/1	174	5,515
5719-CM2	Communications Manager	386	5,550
5719-CN1	Series/1-PC Connect, Version 1	—	400
5719-CS0	Program Communications Subsystems Preparation Facility	12	523
5719-CS2	Program Communications Subsystem Extended Execution Support	32	1,200
5719-CX1	EDX System/370 Channel Attachment	105	2,820
5719-HD1	Series 1/Realtime X.25/HDLC Communications Support	148	2,500
5719-HD2	EDX X.25/HDLC Communications Support	139	2,500
5719-RJ1	EDX Advanced Remote Job Entry	62	1,050
5719-RJ6	RPS Advanced Remote Job Entry	34	1,050
5719-RM1	EDX Remote Manager	133	2,000
5719-RM6	RPS Remote Manager	125	2,000
5719-SN1	RPS Version 5 SNA Extended Support	103	2,905
5719-SX1	EDX Systems Network Architecture (SNA)	71	2,005
5719-SX2	Systems Network Architecture (SNA) RJE	32	1,000
5719-TA1	5250 Info Display System Attachment Support	33	1,290
5719-XT1	EDX Manufacturing Automation Protocol Application Server	321	4,500
5719-XT2	RPS Manufacturing Automation Protocol Communications Server	679	9,500
5798-ZZC	EDX Communication Facility	40	—
5798-ZZF	Series/1 Communication Controller for System/38	250	—
5799-TEF	SNA Remote Management Utility	9	220

■

IBM Series/1 Communications Capabilities



IBM has gradually released enhancements which currently make the Series/1 a powerful communications tool. Pictured above is a Series/1 processor, display, and printer.

A purchase-only modular small computer system that can be tailored to operate as a remote line concentrator, front-end processor, terminal controller, local network station, packet switching node, or other data communications system.

The top of the line 4955 F may have up to 512K of main memory, and support up to 96 communication lines. Transmission speeds of up to 56K bps in BSC connections and up to 9600 bps in SDLC applications are supported. In addition, the Series/1 supports asynchronous communications, as well as X.25 packet switching. Multiple Series/1s may be used to form a local network.

A 4955 F with 512K of memory, programmable communications subsystem, and interface for 16 asynchronous and bisynchronous lines is priced at $40,920. Terminals, disk storage and other peripherals are, of course, available at additional cost. The RPS Version 5 operating system and necessary communication software may be licensed for a one-time charge of approximately $11,000. Maintenance for such a system is about $370 per month.

MANAGEMENT SUMMARY

In November 1976, IBM embarked on what was for them a revolutionary endeavor. After long opposing the use of plug-compatible products for larger systems, IBM introduced the Series/1, an "open" system that actually invites and encourages third-party participation for both hardware and software. This philosophy, coupled with special pricing discounts, has also made the Series/1 quite popular with OEMs.

From its inception, the Series/1 product line has provided a flexible, modular approach to small system building that allows customers to tailor the system to their requirements. The February 1982 unveiling of the 4954 processor family signifies a long life expectancy for the Series/1, despite its relative maturity.

IBM has continued to support the product with the addition of communication-intensive devices, so the Series/1 may be used as a front-end processor, a terminal controller, a remote line concentrator, a distributed processing node, an RJE workstation, a communications controller in a local network, CCITT X.25 packet switching gateway or other communications-oriented configuration. In the future, IBM is expected to add new low- and high-end processors, provide additional programming languages, introduce robot control, and even support popular independent operating systems, as well as continuing to increase its communications capabilities.

The Series/1 is comprised of a basic processor with I/O expansion slots served "a la carte." The empty slots may be filled, according to the user's needs, with peripheral interfaces, communication controllers, line interfaces, and other capabilities selected from a smorgasbord of PC

CHARACTERISTICS

VENDOR: International Business Machines Corporation, Information Systems Group; National Accounts Division, 1133 Westchester Avenue, White Plains, New York 10604. Telephone (914) 969-1900.

DATE OF ANNOUNCEMENT: Models 4955 C & D—April 1977; Model 4955 E—July 1978; Models 4952 A & B—January 1979; Model 4952 C—January 1981; Model 4955 F—January 1981; Models 4954 A, B, & C—February 1982.

DATE OF FIRST DELIVERY: Models 4955 C & D—September 1977; Model 4955 E—September 1978; Models 4952 A & B—March 1979; Model 4952 C—March 1981; Model 4955 F—March 1981; Model 4954 A, B, & C—March 1982.

NUMBER DELIVERED TO DATE: Approximately 30,000 (all models).

SERVICED BY: IBM.

CONFIGURATION

The IBM Series/1 is a family of small computers marketed as multi-functioning processors. The current Series/1 offering consists of three processors with a total of 10 models. The three processors are numbered 4952, 4954 and 4955. The major characteristics which distinguish each model are the maximum allowable memory, the number of available input/output feature (expansion) slots, module (chassis) width size, and overall performance.

The 4952 processor is available in three models: the 4952 A, which is a half-width processor module with five available

IBM Series/1 Communications Capabilities

TABLE 1. IBM SERIES/1 PROCESSOR CHARACTERISTICS

FEATURE	4952 A	4952 B	4952 C	4954 A	4954 B	4954 C	4955 C	4955 D	4955 E	4955 F
Minimum Memory (Bytes)	32K	32K	32K	64K	64K	64K	32K	32K	64K	128K
Maximum Memory (Bytes)	128K	128K	128K	256K	256K	256K	64K	128K	256K	512K
Memory Increments (Bytes)	32K	32K	32K	64K	64K	64K	16K, 32K	16K, 32K	32K, 64K	128K
Available I/O Feature Slots*	5	14	4	4	13	3	10	7	7	7
Performance**	1.0	1.0	1.0	2.0	2.0	2.0	3.2	3.3	3.4	3.5
Module Size (Half- or Full-Width)	Half	Full	Full	Half	Full	Full	Full	Full	Full	Full

*Base chassis only; the number of available slots may be increased via the use of one or more #1310 Multifunction Attachment Features or the #4959 I/O Expansion Units.
**For the purposes of this measurement, the 4952 processor sets the scale. All other performance figures are relative to the 4952.

boards supplied by IBM and independents. There are well over 20 communication features from which to choose from IBM, ranging from a Synchronous Single Drive Control supporting IPL, BSC, HDLC, SDLC, and X.25 at speeds up to 56K bps, to a Programmable Communication Subsystem capable of controlling up to 32 lines of mixed character sets, speeds, and protocols. A System/370 channel attachment allows the Series/1 to act as a front-end processor for an IBM mainframe.

In January of 1981, IBM unveiled the Series/1 Local Communications Controller, which permits cabling of up to 16 Series/1 processors in a local area network configuration so that they may share and exchange files and other resources without host intervention.

In February 1982, IBM also introduced the Audio Distribution System program (5719-020) which permits the Series/1 to be used as a voice store-and-forward message system. Some uses include digitizing voice messages for later transmission, unattended recording of voice messages, and simultaneous broadcasting of a single voice transmission to several other Series/1s using this package.

Data communications support allows the Series/1 to be connected to almost all other IBM computer systems, including the Personal Computer, the Displaywriter, or another Series/1. IBM also supports SDLC communications for Series/1s operating in SNA environments. IBM recently added HDLC communications and CCITT X.25 packet switching support. A multitude of asynchronous, bisynchronous, and synchronous communication line interfaces allows the Series/1 to support a wide range of IBM and non-IBM terminals.

The Series/1 offers three major operating systems. The Control Program Support (CPS) system provides very limited communications support. The Event-Driven Executive (EDX) features predominantly batch-oriented communications activity. The third, Realtime Programming System (RPS), supports the majority of the sophisticated communication attributes of the Series/1 and is the operating system most applicable to this report.

feature slots; the 4952 B, which is a full-width module providing 14 feature slots; and the 4952 C, also a full-width module with four feature slots and 1.2M bytes of integrated diskette storage. All models have a main memory minimum of 32K bytes and a maximum of 128K bytes. The memory is expanded via 32K-byte add-on memory units that plug directly into the main processor card and do not require use of feature slots.

The 4954 processor, like the 4952, is available in three models: the 4954 A, a half-width processor module with four available feature slots; the 4954 B, containing a full-width module and 13 feature slots; and the 4954 C, a full-width module housing three feature slots and 1.2M bytes of integrated diskette storage. All models have a main memory minimum of 64K bytes and a maximum main memory of 256K bytes. The memory is expandable via 64K-byte add-on memory units which plug directly into the processor card and do not engage the feature slots. According to information provided by IBM, the 4954 processors have twice the internal performance of the 4952 family. Performance may be further increased with the use of a floating point option, which also plugs directly into the processor card.

The 4955 processor family is available in four models, all of which are full-width modules:

***Model 4955 C*—has 10 available feature slots, and supports 32K to 64K bytes of main memory, which may be expanded using either 16K- or 32K-byte add-on memory units. Each memory unit requires one feature slot.**

***Model 4955 D*—has seven available feature slots, and supports 32K to 128K bytes of main memory, which may be expanded using either 16K- or 32K-byte add-on memory units. Each memory unit requires one feature slot; a Memory Address Relocation Translator (#6335) is also required when expanding beyond 64K bytes.**

***Model 4955 E*—has seven available feature slots, and supports 64K to 256K bytes of main memory, expandable via 32K- or 64K-byte increments. Each 64K memory unit requires one feature slot; only one 32K-byte memory unit may be used, which must occupy the last feature slot.**

***Model 4955 F*—has seven available feature slots, and supports 128K to 512K bytes of main memory, expandable via 128K-byte add-on memory units. Each 128K-byte increment requires one feature slot.**

IBM rates the 4955 processor performance as 3.2 to 3.5 times greater than that of the 4952 family. Like the 4954, a floating point is optionally available, but on the 4955, it requires a feature slot.

IBM Series/1 Communications Capabilities

USER REACTION

Datapro contacted five firms in telephone interviews conducted in February 1982. Each is using one or more Series/1s in communications applications for a total of 13 systems. All but one of the systems has been installed for at least 18 months. Uses include message switching, terminal control, front-end processing, and remote line concentration. All use IBM's system software, plus either internally developed or externally purchased application software.

	Excellent	Good	Fair	Poor	WA*
Overall performance	0	5	0	0	3.0
Ease of installation	3	2	0	0	3.6
Throughput	2	2	1	0	3.2
Hardware reliability	4	1	0	0	3.8
Promptness of maintenance	5	0	0	0	4.0
Quality of maintenance	5	0	0	0	4.0
Operating system	0	1	4	0	2.2
Manufacturer's technical support	1	3	1	0	3.0

*Weighted Average based on 4.0 for Excellent.

As reflected in the above responses, IBM's legendary reputation for service is still being maintained today. One user praised the Series/1 as being able to "talk to anything," and regarded the system as an outstanding communication device. Another cited it for being "flexible and modular," and yet another lauded its "excellent communication line capability."

The consensus opinion seemed to be the operating systems have caused a modicum of dissatisfaction. One user acknowledged large differences between versions in a single operating system and advises allowing a new version to mature before "jumping at a new release." Four of the interviewees also applauded the IBM "hot line" to Boca Raton, Florida, and the ability of the support staff there "to duplicate and solve any problem;" however, three were disturbed over the lack of top-flight local support.

All users indicated they would buy their Series/1 again if faced with that decision, and would recommend it to others.□

Model changes/upgrades are not available on the 4952 or 4954 processors. IBM does not recommend change/upgrades on the 4955 processor, but will field upgrade the Model 4955 E to a 4955 F upon request.

Table 1 provides a profile of each of the current Series/1 models, and compares characteristics of main memory, processors, and I/O slots.

The Series/1 processor itself consists of the microcoded logical unit, the arithmetic unit, and the system control functions. The processor is connected to an I/O bus that IBM calls the I/O Channel. This bus has an addressing capacity of 256 slots for attachment of both internal and external features. Internal features include main memory and floating point. External features include communications controllers, mass storage devices, printers, display units, and sensor options.

Except for the sensor options, all external data processing features have direct memory access for transferring data to and from memory by way of the I/O Channel. Such transfers are done without processor intervention, even though cycles must be stolen to execute the transfers. When the transfers are completed, an interrupt is triggered for processor action. There are four interrupt levels in the Series/1 processors. The user can assign each slot to an interrupt level, thereby assigning the associated attached device to one of four priorities. The devices assigned to the highest priority interrupt will receive processor attention even if a lower priority level device is, at that moment, receiving processor action. To accomplish this, a set of eight general registers, a status register, and an instruction address register is associated with each interrupt level. When a higher priority device causes an interrupt, the processor preserves the status of the lower priority's processing activity in the lower priority's associated registers and handles the higher priority request. The processor then retrieves the information saved in the lower priority's registers and completes the task. A device wanting interrupt processing but having the same priority level as a device currently receiving interrupt processing must await completion of the current processing before receiving attention.

All of the Series/1 models may support one or more #4959 I/O Expansion Units, each of which provides an additional 14 I/O features slots. The expansion units are cable-connected to the I/O bus of the host processor module. Although there are no predefined limits to the number of expansion units (and I/O controllers) which may be configured with a Series/1, it should be noted that each processor model does in fact have a throughput limit. The limit varies significantly depending on the processor model and memory size, and on the number and type of I/O device and communications controllers. IBM will generally need to evaluate each desired configuration on an individual basis to determine which processor, and how much memory, will be required to support the configuration. Based on information available to Datapro, it can generally be stated that a high-end 4955 F processor may support no more than three I/O expansion units (a system maximum of 49 I/O feature slots).

In addition to the #4959 I/O Expansion Unit, there is also a Multifunction Attachment feature (#1310) available for all Series/1 processor models, which provides attachment for up to four external devices on the Series/1 while utilizing only one feature slot.

All Series/1 processors are rack-mounted, except Model 4954 C, which may be installed in the rack, or without the rack enclosure for limited space office environments. An EIA standard 19-inch mounting rack, the #4997 Rack Enclosure, is provided and comes in two models: the Model 1 is one meter high and holds two full-width modules, the Model 2 is 1.8 meters high and will hold four full-width modules. When one or more of the modules are half-width, the #4540 Rack Mounting Fixture is required. It supports either one or two half-width modules.

COMMUNICATIONS FEATURES

Depending on model, a maximum of 96 communications lines can be attached to a fully expanded Series/1 system. Current communications options include support of the following interfaces: EIA RS-232-C, CCITT V.24, V.35, X.21, X.25 and local attachments. A 20mA and a 60mA current loop Teletype adapter is also provided. The protocols/codes supported by the hardware are: BSC, SDLC, ASCII, HDLC, PTTC/EBCD, and PTTC/Correspondence. Except for the full-duplex Teletype adapter, only half-duplex lines are supported. BSC lines can have speeds up to 56K bps; all other protocols can have speeds up to 9600 bps. The PTTC and Correspondence protocols are

IBM Series/1 Communications Capabilities

TABLE 2. IBM SERIES/1 PROGRAMMABLE COMMUNICATION SUBSYSTEM—LINE INTERFACES*

Facility	Transmission	Feature Number	Number Lines Supported	Speed (bps)	Comments
TTY-Current Loop	Asynchronous	#4734	2	TTY dependent	2- or 4-wire
Local Attachment	Asynchronous	#4739	2	45-1200, 2400, 4800, 9600	—
Leased Line	Asynchronous	#4748	1	45-1200	Integrated Modem
Leased (with Switched Line Backup)	Asynchronous	#4747	1	45-1200	Integrated Modem with Auto Answer
Switched Line	Asynchronous	#4746	1	45-1200	Integrated Modem with Auto Answer
Local Attachment	Synchronous	#4740	2	600, 1200, 2400, 4800, 9600	—
Leased Line	Synchronous	#4753	1	600, 1200	Integrated Modem
Leased (with Switched Line Backup)	Synchronous	#4752	1	600, 1200	Integrated Modem with Auto Answer
Switched Line	Synchronous	#4751	1	600, 1200	Integrated Modem with Auto Answer
DDS Leased	Synchronous	#4736	1	2400, 4800, 9600	—
Auto Call Unit (with EIA RS-366 interface)	—	#4743	1	Determined by external data set	Bell 801 C compatible
Communication Console	—	#4990	—	—	Plugs into subsystem for operator interface

*All interfaces can contain integrated modems, if required. For external modems, there is a #4730 half-duplex Digital Communications Equipment (DCE) attachment which supports two lines and a #4731 full-duplex DCE which supports a single line. DCE attachments may be asynchronous or synchronous, switched or leased, as determined by external modem.

compatible with the IBM 2740 Models 1 and 2, and with the IBM 2741.

The features described in the following text are the current communications hardware components which may be implemented in the Series/1. The list does not, however, reflect all of the I/O control devices which may be configured. Only those which support communications are delineated. There are additionally, controller boards for mass storage devices (magnetic tape, disk and diskette) and other I/O device controllers (for local device attachment) which will contend with these communications components for available I/O slots. The same is true for physical space in the mounting rack. Rack space is needed for all of the I/O and mass storage modules, in addition to the communications features which are detailed below.

A general communications configuration rule is that no more than 24 communications lines, of any mixture, may be terminated in a single processor or expansion unit. The only exception to this rule is the 4987 Programmable Communications Subsystem, which may terminate up to 32 communications lines and requires only a single processor, or single expansion unit. The subsystem handles its own lines, and does not decrease the line capacity of the processor or expansion unit to which it is attached.

4987 Programmable Communications Subsystem

The 4987 Programmable Communications Subsystem can be implemented on any of the models, and essentially performs as a front-end for the Series/1 processor. It is user-programmable with special software utilities which operate under the Realtime Programming System (RPS).

The subsystem off-loads much of the communications processing from the basic processor, handles varied line speeds, character codes, and protocols, and performs error checking, polling, and synchronization timing. Up to 32 lines can be attached, and they may be a mixture of asynchronous and synchronous, switched or leased, and point-to-point or multipoint.

The 4987 subsystem occupies a full-width module position in the rack enclosure and requires two adjacent I/O feature slots in either the processor or a #4959 I/O Expansion Unit. The #1300 Programmable Communications Subsystem Controller is a two-card feature which occupies these slots, and is cable-attached to the 4987. It controls the 4987 scanner and up to 16 features (32 lines).

If the user requires increased throughput for the system, another scanner unit, the #3600 Expansion Scanner, can be added to the subsystem module to handle up to half of the line interfaces. This also requires that a second #1300 Subsystem Controller, occupying two more I/O feature slots be added.

The 4987 Programmable Communications Subsystem has its own family of line interfaces and feature attachments. These include:

- The Half-Duplex DCE Attachment (#4730), which provides for attachment of two independent switched or non-switched, synchronous or asynchronous external modems;
- The Full-Duplex DCE Attachment (#4731), which permits the same external modems to be accessed, but provides one full-duplex line instead of two half-duplex lines;
- The Auto-Call Attachment (#4743), which operates under the same operational restraints as the #4730 and provides an auto-call feature for a Western Electric 801-C or equivalent data set;

IBM Series/1 Communications Capabilities

TABLE 3. IBM SERIES/1 COMMUNICATIONS FEATURES (1)

Feature	I/O Slots Required	Interface	Maximum Number Lines Controlled	Type Communication	Feature Number	Maximum Transmission Speed (bps)	Comments
4987 Programmable (2) Communications Subsystem	2	Adapter Dependent	32	Async/BSC Mixture	#4987 (with #1300 Controller)	9600 per line	Full-Width Module
Feature-Programmable (3) 8-Line Controller	2-3	RS-232-C/V.24 or Current Loop	4/8	Async/Sync Mixture (No BSC)	#2095	37.5 to 19.2K per line	—
With 4-Line Feature-Programmable Line Adapter(s)					#2096		
System/370 Channel Attachment	1	Host Selector or Block Multiplexer Channel	—	3270 Channel Protocol	#1200	—	Requires #4993 Termination Enclosure (Full-Width Module)
Multi-line BSC Controller (3) with 4-Line BSC Line Adapter(s)	2-3	RS-232-C/V.24	4/8	Synchronous	#2093 #2094	9600 per line	—
Multi-line Async Controller (3) with 4-Line Async Line Adapter(s)	2-3	RS-232-C/V.24	4/8	Asynchronous	#2091 #2092	2400 per line	—
Async Line Controller	1	RS-232-C/V.24	1	Asynchronous	#1610	9600	—
BSC Line Controller	1	RS-232-C/V.24	1	Synchronous	#2074	9600	Supports IPL
Synchronous High-Speed Line Controller	1	CCITT/V.35, X.21, & X.25	1	Synchronous, BSC, SDLC or HDLC	#2080	56K	HDLC supports IPL
High-Speed BSC Line Controller	1	CCITT/V.35	1	Synchronous	#2075	56K	Supports IPL, Bell 303 or compatible
Teletypewriter Adapter	1	20/60mA Current Loop	1	Asynchronous	#7850	9600	—
Local Communications Controller	1	Channel-to-Channel	16	Cable-connect	#1400	2M	Ring Topology, IPL
SDLC Controller	1	RS-232-C/V.24	1	Synchronous	#2090	9600	—
Communications Indicator Panel	—	—	—	—	#2000	—	Attaches to Single or Multi-line Controllers

(1) Feature #2010, Power Supply, is generally required if more than two communications features are configured.
(2) See Table 2 for delineation of line adapters and features of 4987 subsystem.
(3) Multi-line controllers require either one or two four-line adapters.

- **The TTY Current Attachment (#4734), which provides local attachment for TTY compatible devices via half-duplex operation;**
- **The Data-Phone Digital Service Adapter (#4736), which allows AT&T's DDS service to be accessed in non-switched network via a channel unit at line speeds of 2400, 4800 and 9600 bps for non-SDLC synchronous transmissions;**
- **The Asynchronous Local Attachment (#4739), which provides two asynchronous local interfaces for half-duplex transmissions of up to 9600 bps; and**
- **The Synchronous Local Attachment (#4740), which provides two synchronous interfaces operating under the same transmission rules as the Asynchronous Local Attachment (#4739).**

It should be noted that, unlike other Series/1 communications features, transmission speeds for lines attached to this subsystem may not exceed 9600 bps. Other features not supported by the subsystem include SDLC communications, and the ability to down-line load and IPL (Initial Program Load) the system. All of the 4987 adapters and line interfaces are provided with a six-meter long attachment cable.

The 4987 subsystem also supports any of six auto-answer integrated modems accommodating transmission speeds of up to 1200 bps:

Feature #	Transmission Technique	Facility Supported	Special Capabilities
4746	Asynchronous	Switched network	Auto-answer
4747	Asynchronous	Leased line	Switched network back-up with auto-answer
4748	Asynchronous	Leased line	Wrap test

IBM Series/1 Communications Capabilities

4751	Synchronous	Switched network	Auto-answer, auto-answer test, wrap test, internal clock
4752	Synchronous	Leased line	Switched network back-up with auto-answer, wrap test, internal clock
4753	Synchronous	Leased line	Wrap test, internal clock

An optional feature of the 4987 subsystem is the #4900 Communications Console, which provides operator interface to the subsystem for debugging and problem identification. The console consists of a pluggable function keyboard and a set of displays, which may be switched between two scanners.

A special IBM licensed program, Programmable Communications Subsystem Preparation Facility (5719-CS0), provides the RPS system user with a library of macro instructions which are used to define the line configurations, protocols, tables and other parameters. Output is then linked by the standard RPS program preparation facilities, and is storable on disk for loading into the subsystem. Two other IBM licensed programs, 5719-CS1 and 5719-CS2, provide execution support of the subsystem and run under certain versions of the RPS operating system.

Multi-Line Feature-Programmable Communications Controller

The #2095 Feature-Programmable 8-Line Communications Control is another communications feature, which permits the user to define, under program control, the characteristics of up to eight communications lines. The 2095 is a single-board feature which occupies one I/O feature slot of either the Series/1 processor, or a #4959 Expansion Unit.

The 2095 controller requires one or two #2096 Feature-Programmable 4-Line Communications Adapters, each of which provides for the attachment of up to four half-duplex lines. Each of these line adapters also requires an I/O feature slot that must be adjacent to its controller. Therefore, if all eight lines are utilized within this subsystem, three contiguous I/O slots are required.

The communications features which are program-selectable for each line are: transmission speed (37.5 to 19.2K bps), asynchronous or synchronous operation, character length (5, 6, 7 or 8 bits per character, plus parity), character code (ASCII or EBCDIC), character parity checking (odd, even or none), one or two synchronization characters, and one or two stop bits. Additionally, the controller can provide functions of auto-answer and modem control for either switched or non-switched lines. Any of the lines may be non-switched point-to-point or multipoint, or switched point-to-point.

This system does not significantly off-load communications processing from the host processor, as does the 4987 communications subsystem. While aggregate throughput for the controller is about 64,000 bps, it does not perform sophisticated functions such as device address recognition or polling. These remain the responsibilities of the host processor. It is important to note that while character-synchronous transmission is supported, the controller is incapable of performing CRC checking or generation and cannot, therefore, support BSC communications.

Transmission speed for asynchronous operation is program controlled within two jumper-selectable ranges; 37.5 to 1200 bps, and 300 to 19.2K bps. External clocking is required for synchronous transmission. Interfacing to communications facilities is EIA RS-232-C/CCITT V.24 compatible. Another jumper-selectable option permits 20mA current loop interface.

Other Multi-Line Controllers

Two additional multi-line controllers can be implemented with the Series/1; each occupies one I/O feature slot and controls up to eight communications lines.

The #2091 Asynchronous Communications 8-Line Control feature handles up to eight asynchronous lines and requires one or two #2092 Asynchronous 4-Line Adapters. Each adapter also requires an I/O feature slot adjacent to the controller. Therefore, up to three contiguous I/O slots are required to fully configure this subsystem. The transmission speed of each line is under program control within one of two jumper-selectable ranges which determine the range for all four lines; 37.5 to 1200 bps, or 300 to 2400 bps. Each line may support PITC/EBCD or PTTC/Correspondence codes. Local asynchronous devices may be attached, as well as external data sets for remote asynchronous devices. Any of the lines may operate in a non-switched point-to-point or multipoint, or in a switched point-to-point mode. For switched lines, a connection may utilize auto-answer, manual call or manual answer. This subsystem does not support IPL of the Series/1 over communications lines.

The #2093 BSC Communications 8-Line Control feature handles up to eight BSC lines with either one or two #2094 BSC 4-Line Adapters. As with the asynchronous subsystem, each adapter also requires an I/O feature slot adjacent to the controller, thereby requiring up to three slots per subsystem. Two of the eight lines may operate at 9600 bps, in which case none of the remaining six may exceed 2400 bps. If only four lines are attached, each may operate at 4800 bps. Internal timing of 600 or 1200 bps is provided automatically for those modems used which do not provide their own clocking. Both ASCII and EBCDIC codes are supported, and interface compatibility is EIA RS-232-C/CCITT V.24. Like the asynchronous controller, any line may operate in a non-switched point-to-point or multipoint, or switched point-to-point mode, and, like the asynchronous controller, the BSC controller does not support down-line IPL of the Series/1.

Single Line Controllers

In addition to the multi-line controllers and subsystems already described, there are currently six single line controllers available for the Series/1, each of which requires one I/O feature slot.

The #7850 Teletypewriter Adapter permits attachment via a single 20/60mA current loop communications line of a Teletype ASR 33, 35 or similar device. With appropriate system configuration, this adapter may be used for IPL of the Series/1. Transmission rate may be selected from 12 speeds ranging from 50 to 9600 bps. Full-duplex transmission is supported.

The #1610 Asynchronous Communications Single Line Control provides for the attachment of a single, half-duplex, asynchronous line. Speed is program selectable from among two jumperable ranges; 37.5 to 1200 bps, and 300 to 9600 bps. Remotely, this feature supports non-switched point-to-point and multipoint operations, or switched point-to-point. Auto-answer facility is also provided. Character codes supported are compatible with IBM 2740 (Models 1 and 2), 2741 terminals, ASCII, and TTY 33/35. The interface is RS-232-C/V.24.

The #2074 BSC Single Line Control supports attachment of one half-duplex BSC communications line. The interface is RS-232-C/V.24, and transmission speed of up to 9600 bps is supported. The unit supports ASCII or EBCDIC character codes, under program control. Internal clocking of 600 or

IBM Series/1 Communications Capabilities

1200 bps is provided, if external data set does not provide timing. In addition to non-switched point-to-point, multipoint, and switched point-to-point operation, this controller supports down-line IPL of the Series/1 from a remote processor.

The #2075 High-Speed BSC Line Control offers the same features as the #2074 except permits half-duplex transmission at up to 56K bps. Interfacing for a Bell 303 or equivalent data set is provided. IPL of the Series/1 is likewise supported. No more than eight #2075s are permitted on a single Series/1 system.

The #2080 Synchronous High-Speed Single Line Control provides attachment of a single BSC, SDLC, or HDLC communications line via a CCITT/V.35 interface or a local CCITT/X.21 connection. BSC support is provided for half-duplex remote communications at up to 56K bps, or for local connections of up to 1,000 feet (304 meters) via the X.21 interface at speeds of up to 48K bps. Both the ASCII and EBCDIC character sets are supported. SDLC support is provided for half-duplex 9600 bps operation via V.35 or X.21 and also supports both the ASCII and EBCDIC character codes. HDLC support is provided for full-duplex operation at 56K bps speeds via V.35 or 48K bps via X.21, and with the appropriate programmable frame and packet level interfacing software (5799-TCP), complies with CCITT/X.25 procedures in a packet switching network. Remote IPL of the Series/1 can be supported by HDLC, but not by BSC or SDLC, connections.

The #2090 SDLC Single Line Control permits attachment of one half-duplex SDLC line to the Series/1. Interfacing is RS-232-C/V.24, and speeds up to 9600 bps are supported. Internal clocking at either 600 or 1200 bps is provided. Otherwise, an external data set is required. Like the BSC and SDLC controllers, EBCDIC and ASCII codes are supported, but down-line IPL may not be accomplished using SDLC communications. Multipoint and point-to-point operation is also supported.

Local Communications Controller

The #1400 Local Communications Controller provides for the interconnection of up to 16 Series/1 processors using a peer-to-peer ring topology technique with a serial transmission speed of 2M bps, and twinaxial or coaxial cable connection. Maximum length between processors is 5,000 feet (1,524 meters). In each Series/1 in the network, the #1400 Local Communications Controller requires one feature slot and provides direct channel-to-channel communications between that system and the other Series/1s. It allows any terminal attached to one Series/1 processor to access and/or exchange files, share a printer, or utilize other resources assigned to any other Series/1 processor in the network without intervention from a host or master control station. The user may configure Series/1 processors as part of a distributed data processing, distributed applications processing or local area network application and use the capabilities commonly associated with those disciplines.

Other Communications Features

The #7880 Telephone Communication Controller provides control and data transfer for up to four public or private switched telephone exchanges when used with #7881 Single-Line Telephone Communications Adapters. The adapter will answer or originate calls, and generate or detect standard push button phone signals. The #7880 Telephone Communications Controller and the #7881 Telephone Communications Adapter each require one feature slot immediately adjacent to its controller; therefore if all four lines are utilized within this subsystem, five contiguous I/O slots are required.

Voice store and forward capability is available in conjunction with the #7880 and #7881 via the Audio Distribution System (5719-U20) licensed program. Users may record, listen to, or transmit voice digitized messages. Broadcasting a voice message to several Audio Distribution System equipped Series/1s is also possible. The program runs under RPS Version 5 (5719-PC5) with command language facility and requires the PL/1 Transient Library (5719-PL4).

Another optional feature of the Series/1 communications hardware is the #2000 Communications Indicator Panel, which attaches to any single or multi-line controller and does not require an I/O feature slot. The panel consists of eight switches and eight indicator lights with which coded information is displayed showing line operational status. The #2000 CIP is not available for 4954 and 4952 processor models A and C.

A feature providing backup for communications is the #7900 Two-Channel Switch. This feature for the 4959 I/O Expansion Unit provides the capability for switching a set of common I/O devices between two Series/1 processors. The 7900 feature card is plugged into the 4959 and is connected by cable to the I/O channels of two Series/1 processors. Upon failure of the primary processor, the secondary or backup processor receives an interrupt and can be programmed to switch the common I/O. Manual intervention is required when switching back to the primary processor. Manual switching in either direction can be done by the operator.

The Two-Channel Switch console, located on the front panel of the 4959 I/O Expansion Unit, is provided as part of this feature, and provides indicator lights, switches, and keys that allow unit power on/off, manual or backup selection, manual processor selection, manual processor interrupt, channel reset, manual error recovery, and unit status. As a unit, the 7900 is field-installable.

HOST CONNECTION

Channel-to-channel communications between a Series/1 and an IBM System/370 (Models 135-168), 303X, or 4300 Series processor and compatible mainframes is possible with #1200 Channel Attachment feature. This is a single-board component and occupies one I/O feature slot. In addition, a #4993 Termination Enclosure is required, this is a full-width module that is rack-mounted with other Series/1 modules.

The #1200 Controller appears to the host as an IBM 3272 control unit with 32 device addresses. It is handled as a single device interface by the Series/1 processor. Attachment is made to the selector or block multiplexer channel of the host and, when properly configured, allows IPL of the Series/1 from the host system.

Channel attachment cables are not provided with the 4993 unit and must be purchased separately. Up to eight 4993 units (multiple Series/1) may be connected to a System/370 channel. Channel attachment is driven by a licensed program, Series/1-System/370 Channel Attach Program (5719-CA1), which runs under the RPS and EDX operating systems.

SOFTWARE

The most communications-oriented operating system of the Series/1 is the Realtime Programming System (RPS), a control system through which a user can install, operate, and maintain system programs, application programs, and data. RPS is multiprogramming, multitasking, event-driven, and disk-based. It allows multiple concurrent task operations in the same or different partitions with synchronization and communication between them. Re-entrant programs can be used by more than one task. RPS manages all physical resources—processor, storage, and devices. Its supervisor and data management services provide a controlled interface between application programs and Series/1 hardware.

IBM Series/1 Communications Capabilities

TABLE 4. RPS OPERATING SYSTEM COMMUNICATIONS SUPPORT

Communications Capability Supported	RPS Version				
	1	2	3	4	5
	feature attachment/line controller # supported				
Series/1 BSC communications (as a System/3) with an IBM host operating under—					
OS/VS:					
OS/VS 1 (BTAM)	Yes	Yes	Yes	Yes	Yes
OS/VS 2 (BTAM)	Yes	Yes	Yes	Yes	Yes
OS/VS 1 (TCAM)	No	No	Yes	Yes	Yes
OS/VS 2 (TCAM)	No	No	Yes	Yes	Yes
DOS/VS:					
CICS	No	No	Yes	Yes	Yes
BTAM	No	Yes	Yes	Yes	Yes
VTAM	No	Yes	Yes	Yes	Yes
IMS (BTAM)	No	No	Yes	Yes	Yes
SNA/SDLC line adapter capability	No	No	No	Yes	Yes
Series/1 BSC communications via feature #1310, #2074/2075, #2093/2094 (as a System/3) with—					
System/32	No	No	Yes**	Yes**	Yes***
System/34	No	No	Yes**	Yes**	Yes
System/23 Datamaster	No	No	No	No	Yes**
System/38	No	No	No	No	Yes
System/3	No	No	No	Yes*	Yes
other Series/1s	No	Yes**	Yes**	Yes** and Multipoint	Yes** and Multipoint
3271, Models 1 and 2	No	No	No	Yes**	Yes
3275, Models 1 and 2	No	No	No	Yes**	Yes
3274 Controller Model TC and 51C and attached 3270 displays and printers	No	No	No	Yes**	Yes
3276 Controller Models 1, 2, 3 and 4 with attached 3270 displays and 3289 printer	No	No	No	Yes**	Yes
5260 Retail System	No	No	Yes**	No	Yes
3741 Data Entry system	No	No	No	No	Yes
5280 Programmable terminal	No	No	No	Yes**	Yes
6670	No	No	No	Yes**	Yes
Displaywriter	No	No	No	No	Yes***
3684 POS unit	No	No	No	Yes**	Yes
Asynchronous devices supported via features #1610, #2091/2092 and #2095/2096—					
TTY 33/35	Non-switched only	Yes****	Yes****	Yes	Yes
2740, Model 1	Yes****	Yes****	Yes****	Yes****	Yes****
2740, Model 2	No	No	No	Yes****	Yes****
2741	No	No	No	Yes****	Yes****
3101	No	No	No	No	No
System 23 Datamaster	No	No	No	No	Yes
IBM Personal Computer	No	No	No	No	Yes
Displaywriter	No	No	No	No	Yes and #1310
3101	No	No	No	No	#1310 and #2095/2096 only
Downline IPL; BSC only	No	Yes****	Yes****	Yes****	Yes****
RJE; BSC or SNA/SDLC	No	No	No	No	Yes****

*Does not support feature #1310.
**Does not support feature #1310 and #2075.
***Does not support feature #2075.
****Does not support feature #2095 and #2096.

Five versions of the RPS operating system are available and IBM encourages the user to employ the version that best supports the functions needed. A profile delineating the varying communications attributes of the five RPS versions is provided in Table 4.

IBM also offers the Event Driven Executive (EDX) operating system. Primarily intended for general purpose business computing, the EDX is also a multiprogramming, multitasking operating system that has its own macro-assembler programming language. Communications capabilities are not as extensive as those of the RPS operating system, however, the EDX supports several batch and RJE protocols not available on RPS, such as 2780, 3780 and HASP. A breakdown of the EDX communications support features is provided in Table 5.

Another operating system, Control Program Support, offers

IBM Series/1 Communications Capabilities

limited bisynchronous communications support through Program #5799-TAF.

RPS has debugging aids to help users to find and correct errors in problem and supervisory programs. Through the interactive debug package, users can display and modify registers, processor storage, disk, and diskette contents, as well as set address stops to monitor the status of executing programs.

Two different sets of utilities are available to aid the user in application program development under RPS. These are the Program Preparation Subsystem, and the Base Program Preparation Facilities.

The Program Preparation Subsystem (PPS) provides a general-purpose batch environment and software tools for developing the application programs that run under RPS. The PPS licensed program consists of a Job Stream Processor, Text Editor, Macro Assembler, and Application Builder. These programs execute in the batch partition as task sets under control of RPS.

The Base Program Preparation Facilities is a set of standalone programs designed to facilitate the preparation and coding of Series/1 programs. The four BPP facilities are the Text Editor, Macro Assembler, Application Builder, and Job Stream Processor.

There are additional program products which provide communications support for the RPS operating system. In February 1982, IBM added RJE support (5719-RJ6) for the first time on the RPS. The program allows an RPS user the ability to participate in an SNA network or BSC environment as an RJE workstation.

The communications monitor for RPS (5719-CM1) manages the flow of messages from Series/1 to other Series/1s, host processors, and 3270 devices. Another RPS monitor (5799-TCX) performs similar functions, but supports slightly fewer 3270 devices.

EDX programs include: the Communication Facility (5719-CF1), which is a prerequisite (along with the Local Communications Controller #1400) in order to configure a ring of Series/1s as a local or distributed data processing network; the SNA Support (5719-SX1) interface, which controls the communication path between a Series/1 and a host in addition to handling the required SNA formats, and protocols; and SNA RJE (5719-SX2), which allows SNA RJE workstations to transmit their job stream to a host processor.

Several specialized IBM licensed programs support specific communications hardware and functions in the Series/1. These include programs for channel attachment to a host, and for control of the programmable communications subsystem.

The System/370 Channel Attach Program is a licensed program which runs under control of the RPS (Version 3 or higher) and EDX (Version 3). This program provides the Series/1 user with the ability to communicate with a System/370 (Models 135 through 168), 303X, or 4300 Series and compatibles processor over a selector or block multiplexer channel, when used in conjunction with the #4993 Model 1 Series/1-System/370 Termination Enclosure and the Series/1-System/370 Channel Attachment Feature (#1200). The program provides the Series/1 user with the ability to transfer data, under joint consent, between user application programs in the Series/1 and the System/370.

The Programmable Communications Subsystem Preparation Facility is a macro library that is used to support the generation of controller storage image programs for the Series/1 Programmable Communications Subsystem. This macro library is used with either the Base Program Preparation Facility or the Program Preparation Subsystem. It provides the user with the capability of defining and customizing the total protocol for his or her subsystem. Facilities are provided for implementing communications applications, using communications macro instructions and communications definition macros.

The Programmable Communications Subsystem Execution Support runs under control of RPS and provides the user with an interface to the 4987 Programmable Communications Subsystem. The support consists of execution support macros and a loader utility to load the controller storage image program into controller storage. This program provides basic execution support of the subsystem, and runs under RPS Versions 2 or higher.

The Programmable Communications Subsystem Extended Execution Support provides more sophisticated support for the subsystem and runs only under RPS Version 4 or 5. It provides read/write level support between the user, the operating system and the communications subsystem. The program additionally enhances the type of terminals supported, and includes the IBM 2741 and several 3270 models (see Table 4).

PRICING

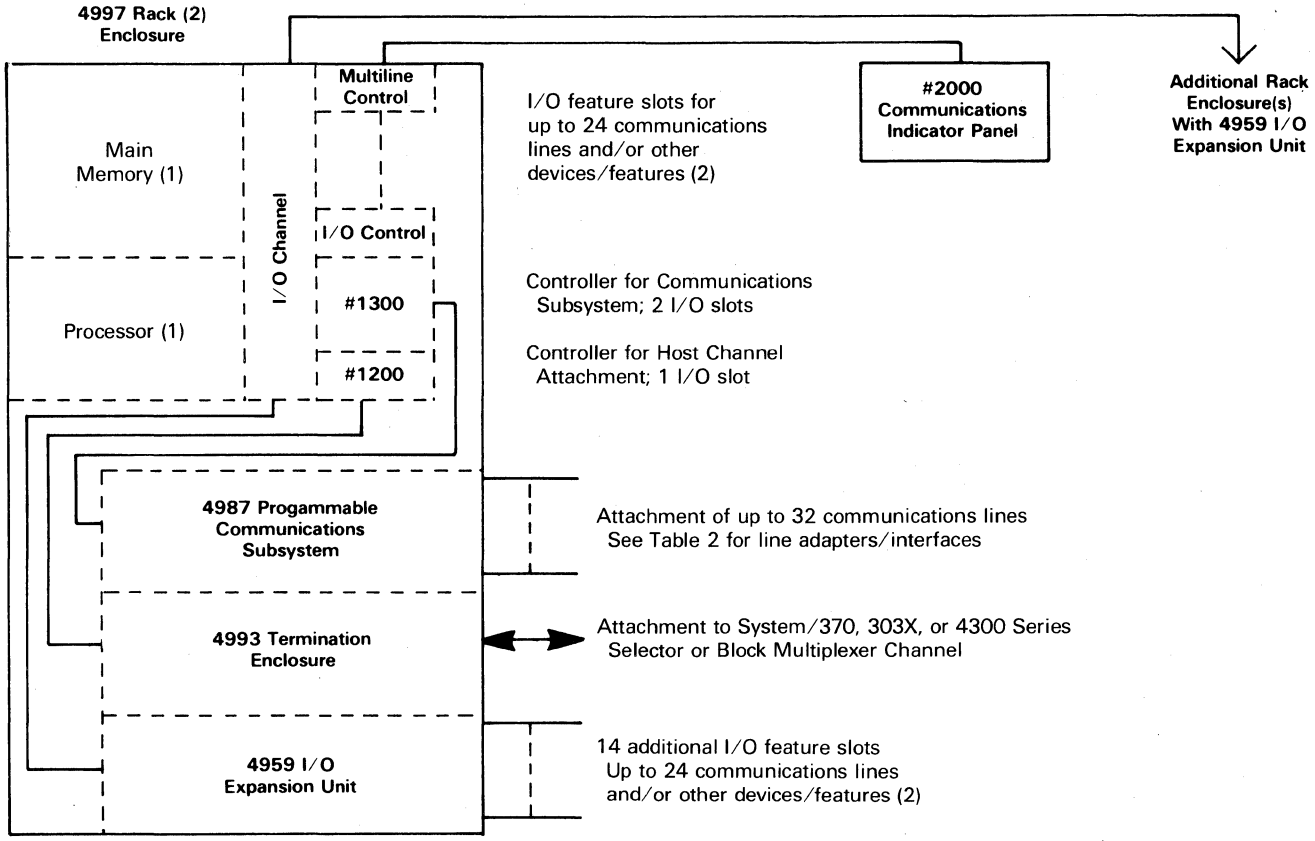
The Series/1 is offered on a purchase-only basis, at prices ranging from approximately $9,500 to $100,000 depending on configuration. Purchase prices include installation and a three-month parts and labor warranty. On-site physical planning is separately priced. On-site support for the Standalone Utilities is provided by a IBM CE at no additional charge.

TABLE 5. EDX OPERATING SYSTEM COMMUNICATIONS SUPPORT

Communications Capability Supported	EDX Version		
	1	2	3
2780/3780 emulation to host via RJE (HASP, HASP 4, RES, JES 2, JES 3, VM-RSCS)	Yes	Yes	Yes
Single- and Multiple-Line Controllers:			
#2074/2075 and #2093/2094	Yes	Yes	Yes
#1610, #2091/2092, #2095/2096, #7850	No	Yes	Yes
Communicate asynchronously via #1610, #2091/2092, or #2095/2096 to:			
IBM Personal Computer	No	No	Yes
IBM Displaywriter	No	No	Yes
System/23 Datamaster	No	No	Yes
Communicate bisynchronously via #2074 or #2093/2094 to:			
IBM Displaywriter	No	No	Yes
System/23 Datamaster	No	No	Yes

IBM Series/1 Communications Capabilities

Communications Configuration



(1) See Table 1 for comparison of processor models and memory capacities.

(2) Number of I/O feature slots will vary depending on model, and for some models, the amount of memory. See Table 3 for communications features and slot requirements. No more than 24 communications lines may terminate in any processor or I/O Expansion Unit.

The Series/1 is not currently available in "packaged" or specially configured systems. Each component is offered on an individually priced basis; thus, the actual price for any particular system is the sum total of every configured unit.

Program products for the Series/1 are available on a 24-month paid-up license basis or for a one-time paid-up license charge. Under either plan, the software remains the property of IBM, subject to the licensing agreement.

IBM Series/1 Communications Capabilities

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
PROCESSORS AND MAIN STORAGE			
4952A	Processor; half-width module, 32K bytes of memory, 5 I/O feature slots	$ 5,260	$29.00
4952B	Processor; full-width module, 32K bytes of memory, 14 I/O feature slots	7,035	64.50
4952C	Processor; full-width module, 32K bytes of memory, integrated 1.2M bytes of floppy disk, 4 I/O feature slots	9,720	70.50
4954A	Processor; half-width module, 64K bytes of memory, 4 I/O feature slots	8,810	41.00
4954B	Processor; full-width module, 64K bytes of memory, 13 I/O feature slots	10,105	45.00
4954C	Processor; full-width module, 64K bytes of memory, integrated 1.2M bytes of floppy disk, 3 I/O feature slots	12,845	65.00
4955C	Processor; full-width module, 32K bytes of memory, 10 I/O feature slots	9,325	87.00
4955D	Processor; full-width module, 32K bytes of memory, 7 I/O feature slots	9,325	87.00
4955E	Processor; full-width module, 64K bytes of memory, 7 I/O feature slots	10,550	133.00
4955F	Processor; full-width module, 128K bytes of memory, 7 I/O feature slots	13,200	127.00
6306	Storage addition, 4952 processor; 32K bytes	514	2.00
6307	Add-on memory, 4954 processor; 64K bytes	1,095	2.50
6325	Add-on memory, 4955 Model C and D processors only; 16K bytes	1,160	6.50
6326	Add-on memory, 4955 Model C, D, and E processors only; 32K bytes	1,725	13.50
6327	Add-on memory, 4955 Model E processor only; 64K bytes	2,785	41.00
6328	Add-on memory, 4955 Model F processor only; 128K bytes	3,520	42.00
3925	Floating point; 4954 processor	635	2.00
3920	Floating point; 4955 processor	1,490	8.50
6335	Memory address relocation translator; 4955 Model D only	1,010	8.50
PROCESSOR FEATURES			
4540	Rack mounting fixture	68	n/c
4959	Input/output expansion unit	3,290	39.00
4997-1A	Rack enclosure, Model 1	1,130	2.00
4997-2A	Rack enclosure, Model 2	1,510	5.00
4999-1	Battery backup, Model 1	2,470	15.00
4999-2	Battery backup, Model 2	2,440	16.00
4993	Termination Enclosure for Channel Attachment	3,435	23.50
5650	Programmer Console	579	3.50
2000	Communications Indicator Panel	314	3.50
2010	Communications Power Supply	150	3.50
7900	Two-channel switch; plugs into 4959 expansion unit	3,330	8.50
COMMUNICATIONS FEATURES			
1610	Asynchronous communications single-line control	1,360	10.50
1200	S/370 channel attachment controller	2,730	11.50
1400	Local communications controller	4,370	16.00
2074	Bisynchronous single-line communications controller	1,490	12.50
2075	High-speed bisynchronous single-line communications controller	1,730	12.50
2080	High-speed synchronous single-line communications controller	3,310	27.00
2090	SDLC single-line communications controller	1,780	12.50
2091	Asynchronous 8-line communications controller	1,220	10.50
2092	Asynchronous 4-line communications adapter	1,260	21.00
2093	Bisynchronous 8-line communications controller	1,520	10.50
2094	Bisynchronous 4-line communications adapter	1,565	26.50
2095	Feature-programmable 8-line communications controller	1,730	7.50
2096	Feature-programmable 4-line adapter	1,970	22.00
7850	Teletypewriter adapter	705	6.50
7880	Telephone communications controller	3,700	7.50
7881	Telephone communications adapter	4,950	52.50
1310	Multifunction attachment feature	2,400	10.00
4987	Programmable communications subsystem—	5,205	45.00
1300	Programmable communications subsystem attachment	3,565	28.50
4990	Communications console	975	2.00
3600	Programmable communications subsystem expansion scanner	2,300	16.50
4730	Half-duplex DCE attachment	426	2.50
4731	Full-duplex DCE attachment	419	2.50
4734	TTY current attachment	700	4.00
4736	Data-Phone digital service adapter	1,132	4.50
4739	Asynchronous local attachment	467	1.50
4740	Synchronous local attachment	492	2.00
4743	Autocall attachment	432	2.50

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EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
	Integrated modems:		
4746	1200-bps asynchronous modem, switched network	$ 1,200	$ 7.50
4747	1200-bps asynchronous modem, leased line SNBU	1,330	8.00
4748	1200-bps asynchronous modem, leased line	1,205	7.50
4751	1200-bps synchronous modem with clock, switched network	1,235	7.50
4752	1200-bps synchronous modem with clock, leased line SNBU	1,370	8.00
4753	1200-bps synchronous modem with clock, leased line	1,240	7.50

SOFTWARE PRICES

		Monthly Charge	One-Time Charge
LICENSED PROGRAMS			
5719-PC1	Realtime Programming System, Version 1	$25.00	$1,320
5719-PC2	Realtime Programming System, Version 2	32.00	1,650
5719-PC3	Realtime Programming System, Version 3	40.00	2,090
5719-PC4	Realtime Programming System, Version 4		
	with Command Language Facility	62.00	3,230
	without Command Language Facility	48.00	2,475
5719-PC5	Realtime Programming System, Version 5		
	with Command Language Facility	126.00	4,940
	without Command Language Facility	108.00	4,260
5719-XS1	Event Driven Executive (EDX)		
	Basic Supervisor and Emulator, Version 1	21.00	1,055
5719-XS2	Event Driven Executive		
	Basic Supervisor and Emulator, Version 2	28.00	1,368
5719-XS3	Event Driven Executive		
	Basic Supervisor and Emulator, Version 3	37.00	1,440
5719-020	RPS Audio Distribution System	350.00	12,700
5719-PL4	RPS PL/1 Transient Library	28.00	1,370
5719-CM1	RPS Communications Monitor	139.00	5,515
5719-CA1	RPS System/370 Channel Attachment Program	26.00	1,305
5719-RJ6	RPS Advanced Remote Job Entry	30.00	1,050
5719-CS0	RPS Programmable Communications Subsystem Preparation Facility	10.00	523
5719-CS1	RPS Programmable Communications Subsystem Execution Support	8.00	351
5719-CS2	RPS Programmable Communications Subsystem Extended Execution Support	25.00	1,200
5799-TCX	RPS Communications Monitor	100.00	4,960
5799-TEF	RPS SNA Remote Management Utility	9.00	220
5719-CF1	EDX Communications Facility	55.00	2,200
5719-SX1	EDX Systems Network Architecture	51.00	2,005
5719-SX2	EDX Systems Network Architecture RJE	25.00	1,000
5719-CX1	EDX System/370 Channel Attachment Program	76.00	2,820
5799-TAF	Bisynchronous Communications Control Command Program Support Module	120.00	—
5799-TCP	Packet Network Support	*	*

*Request for Price Quote Program (PRPQ)—Price and availability must be determined by IBM.■

IBM Series/1 Communications Capabilities

MANAGEMENT SUMMARY

Since IBM's introduction of the Series/1 in 1976, announcement of enhanced features (hardware, software, peripherals and new models) has become almost a weekly occurrence, both by IBM and many independent vendors.

The Series/1 represented a deviation from IBM's traditional product marketing. Unlike most other IBM processor models, the Series/1 was, and still is, marketed on a purchase-only basis, with the exception of a special rental plan available only to educational institutions. Software for Series/1 remains completely unbundled. and options are so numerous that a user can tailor a Series/1 system to meet virtually any specific environment. While application packages are limited, many software utility modules are available which support user program development.

The Series/1 is currently available in three processor families with a total of 11 models. Main memory was limited to a maximum of 128K bytes until last year when IBM announced a high-end model which supports up to 256K bytes. Other recent announcements have included a magnetic tape subsystem, which expands mass storage capabilities beyond the disk and diskette units previously available, support for locally-attached 5250 terminal devices, and several software file and utility packages.

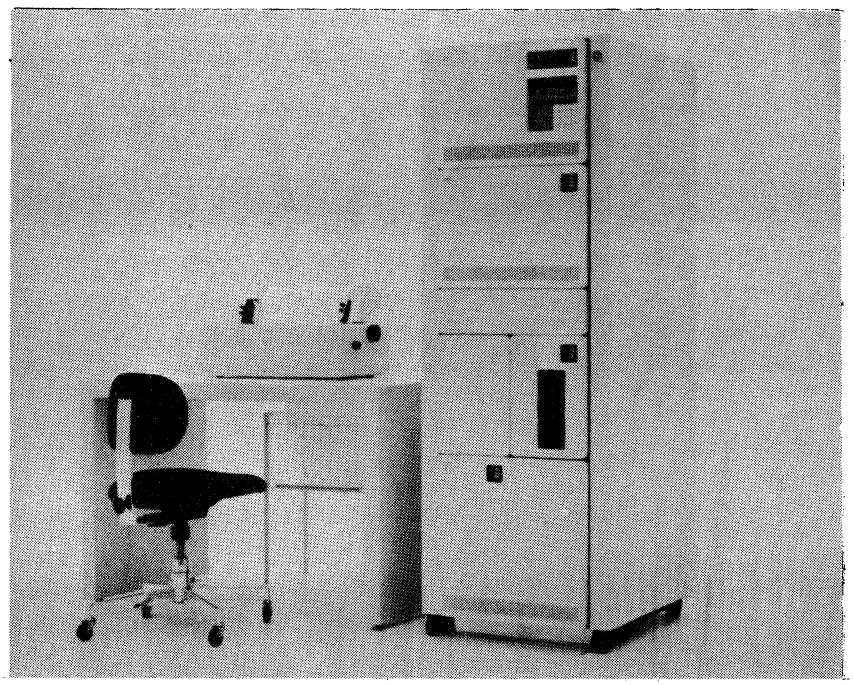
This report addresses the communications capabilities of the Series/1, an extensive set of hardware and software modules which has also seen consistent and recurring ➢

A modular minicomputer system which can be employed as a channel-attached front-end communications processor, a remote concentrator, or as a distributed or stand-alone processor.

A physical maximum of up to 96 half-duplex communications lines can be attached per system. Asynchronous and SDLC communications are supported to 9600 bps; BSC to 56K bps. Main memory can be expanded to 256K bytes, and rigid disk, diskette and magnetic tape storage units are available. Other peripherals and I/O devices may include keyboard/displays, line and serial printers, and teleprinters.

Software is completely unbundled. Four versions of the basic operating system and two special-purpose operating systems are available, along with numerous utilities for user program development.

The Series/1 is available on a purchase-only basis. A model 5-C, with 128K bytes of memory, 9-megabyte disk storage unit, programmable communications subsystem, and interface for 16 asynchronous and BSC lines can be purchased for $46,950, with a monthly maintenance cost of $487. Typical software for such a system can be licensed for about $150 per month.



Depicted at left is a typical Series/1 configuration. A 4955 processor module is mounted at the top of the rack, with a 4959 I/O Expansion Unit immediately below. At the bottom is a non-removable Disk Storage Unit, and a half-width Diskette Unit above it. On the table is a 120 cps printer.

IBM Series/1 Communications Capabilities

TABLE 1. IBM SERIES/1 MODEL CHARACTERISTICS

Feature	Model Type 2		Model Type 3				Model Type 5				
	4952 A	4952 B	4953 A	4953 B	4953 C	4953 D	4955 A	4955 B	4955 C	4955 D	4955 E
Module Size (Half-Full Width)	Half	Full	Half	Full	Half	Full	Full	Full	Full	Full	Full
Minimum Memory (bytes)	32K	32K	16K	16K	32K	32K	16K	16K	32K	32K	64K
Maximum Memory (bytes)	128K	128K	64K	64K	64K	64K	64K	128K	64K	128K	256K
Memory Increment (bytes)	32K	32K	16K	16K	16K or 32K	16K or 32K	16K	16K	32K	32K	64K
Average Instruction Time (Microseconds)	9.4	9.4	7.4	7.4	7.4	7.4	6.6	6.6	6.6	6.6	6.6
Available I/O Feature Slots	5	14	4	13	4	13	8	3	10	7	7
—If Maximum * Memory	5	14	1	10	3	12	8	3	10	7	7

*Additional memory modules for 4952 plug into processor board; for 4953, I/O feature slots are required; for 4955, special storage locations accommodate additional memory modules exclusive of I/O feature slots.

enhancement. Last year, for example, IBM introduced the Series/1 channel attachment feature, making it possible to utilize the Series/1 as a specialized front-end processor to System/370 and 303X mainframes. Other software and hardware modules permit the Series/1 to be implemented as a remote data concentrator, or as a remote batch or RJE workstation with a host. Still other configurations permit the Series/1 to be utilized as a loosely-connected distributed or stand-alone processor system. Networking support is available for communications to another Series/1 or System/3, /32 or/34. Additionally in May 1979, IBM delivered the capability for the Series/1 to support SDLC communications, and serve as a fully supported node in an SNA environment.

There are presently three different operating systems available from IBM for the Series/1. Two of these, the Control Program Support (CPS) system and the Event Driven Executive (EDX) system, are designed for small and specialized Series/1 configurations, and are not supportive of elaborate communications. For example, neither of these supports host channel attachment, SDLC communications, or the 4987 Programmable Communications Subsystem, (which is essentially a communications front end for the Series 1). A third, the Realtime Programming System (RPS), is supportive of all of the Series/1 communications features, and is the operating system which is primarily discussed in this report.

The Series/1 is comprised of a basic processor with a number of plug-in I/O slots (which vary depending on the model). The user may select, from a vast array of options, the memory additions, I/O device and communications controllers which are to be configured. There are over 20 communications features from which to choose, ranging from a single-line BSC adapter to a programmable communications subsystem capable of controlling up to 32 lines of mixed character codes, speeds and protocols.

A high-end Series/1 can support the attachment of up to 96 communications lines which can accommodate

CHARACTERISTICS

VENDOR: International Business Machines Corporation; General Systems Division; 5775 Glenridge Drive N.E., Atlanta, Georgia 30301. Telephone (404) 238-3000.

DATE OF ANNOUNCEMENT: 1976—Model Type 3 (A and B), Model Type 5 (A and B); 1977—Model Type 3 (C and D), Model Type 5 (C and D); 1978—Model Type 5 (E); 1979—Model Type 2 (A and B).

DATE OF FIRST DELIVERY: 1976—Model Type 3 (A and B), Model Type 5 (A and B); 1977—Model Type 3 (C and D), Model Type 5 (C and D); 1978—Model Type 5 (E); 1979— Model Type 2 (A and B).

NUMBER DELIVERED TO DATE: Information not available.

SERVICED BY: IBM.

CONFIGURATION

The Series/1 is a family of minicomputers marketed as multi-function processors. The current Series/1 offering consists of three processor types with a total of 11 models. The three processor types are called the Model Type 2, the Model Type 3 and the Model Type 5 after the last digit in their feature numbers; 4952, 4953, and 4955, respectively. The major characteristics which distinguish each model type are the cycle time, the maximum allowable memory, the I/O bussing arrangement, and physical size (width).

The Model Type 2 processors have the slowest cycle time (an average instruction execution time of 9.4 microseconds), and a maximum main memory storage size of 128K bytes. It is available in two models; the 4952-A, which is a half-width processor module with five available I/O feature slots, and the 4952-B, a full-width module with 14 I/O feature slots. Additional storage modules of 32K bytes plug directly into the processor card and, unlike the other model types, do not require I/O feature slots.

The Model Type 3 has a cycle time of 8.0 microseconds, a maximum main memory storage size of 64K bytes, and a single I/O bus. There are four models available; the 4953-A and the 4953-C, which are half-width processor modules with four I/O feature slots each, and the 4953-B and 4953-D, which are full-width modules and each have 14 available I/O slots. The basic A and B models contain 16K bytes of main memory, expandable to 64K bytes in 16K-byte increments.

IBM Series/1 Communications Capabilities

TABLE 2. IBM SERIES/1 PROGRAMMABLE COMMUNICATION SUBSYSTEM—LINE INTERFACES*

Facility	Transmission	Feature Number	Number Lines Supported	Speed (bps)	Comments
TTY-Current Loop	Asynchronous	#4704	2	TTY dependent	2- or 4-wire
Local Attachment	Asynchronous	#4709	2	45-1200, 2400, 4800, 9600	—
Leased Line	Asynchronous	#4718	1	45-1200	Integrated Modem
Leased (with Switched Line Backup)	Asynchronous	#4717	1	45-1200	Integrated Modem with Auto Answer
Switched Line	Asynchronous	#4716	1	45-1200	Integrated Modem with Auto Answer
Local Attachment	Synchronous	#4710	2	600, 1200, 2400, 4800, 9600	—
Leased Line	Synchronous	#4723	1	600, 1200	Integrated Modem
Leased (with Switched Line Backup)	Synchronous	#4722	1	600, 1200	Integrated Modem with Auto Answer
Switched Line	Synchronous	#4721	1	600, 1200	Integrated Modem with Auto Answer
DDS Leased	Synchronous	#4706	1	2400, 4800, 9600	—
Auto Call Unit (with EIA RS 366 interface)	—	#4713	1	Determined by external data set	Bell 801 C compatible
Communication Console	—	#4990	—	—	Plugs into subsystem for operator interface

*All interfaces contain integrated modems (data sets), if required. For external modems, there is a #4700 DCE attachment which supports two lines; asynchronous or synchronous, switched or leased, determined by external modem.

asynchronous or SDLC communications at up to 9600 bps, and BSC lines to 56K bps. Specified BSC lines can be used for down-line loading and up-line dumping of the Series/1.

Communications with another Series/1 or System/3, /32 or /34 processor typically uses a point-to-point BSC protocol, with the Series/1 emulating a System/3. Remote communications with a host 370 or 303X is also BSC, except that SDLC may now be used with an appropriately-configured host (via a 370X with NCP). When channel-attached, the Series/1 uses IBM 3272 control unit commands. Connection is made to either the selector or byte multiplexer channel.

Among terminals supported are the IBM 2740 and teletypewriter devices via asynchronous communications lines. Special software permits BSC support of several 3270 terminal models. Switched, leased and multipoint line arrangements are widely supported. With SDLC communications, the Series/1 appears to the SNA host and network as a cluster controller node.□

The basic C and D models contain 32K bytes, also expandable to 64K bytes in either 16K- or 32K-byte increments. Each additional memory module added occupies one of the I/O feature slots, and therefore decreases the number of slots available for I/O device controllers. With maximum memory, the A, B, C and D models offer 1, 10, 3 and 12 I/O slots respectively.

The Model Type 5 processors offer the fastest cycle time (6.6 microseconds) and the most main memory storage (up to 256K bytes). The five Type 5 processor models also feature a second I/O bus that gives the processor higher priority access to memory. This, in fact, gives these models an operation speed about three times faster than the Type 3 models, even though there is only a 20 percent difference in the logical unit cycle time. There are five 4955 models; A, B, C, D and E, and all are full-width processor modules offering 8, 3, 10, 7 and 7 I/O feature slots, respectively. The A and B models contain a basic 16K bytes of main memory, expandable to 64K bytes in the A, and to 128K bytes in the B in 16K-byte increments. The C and D offer a basic 32K bytes, expandable to 64K in the C and to 128K in the D in 32K byte increments. The E model offers a basic 64K bytes of memory, expandable to 256K bytes in 64-byte increments. Additional slots for expanded memory modules are included with all the Type 5 processor models, exclusive of the I/O feature slots. Expansion of any of the Type 5 models to a maximum memory configuration will not reduce the number of I/O feature slots available.

Table 1 provides a profile of each of the current Series 1 models, and compares characteristics of main memory, processors and I/O slots.

The Series 1 processor, itself, consists of the microcoded logical unit, the arithmetic unit, and the system control functions. The processor is connected to an I/O bus that GSD calls the I/O Channel. This bus has an addressing capacity of 256 slots for attachment of both internal and external features. Internal features include main memory and floating point. External features include the Communications Controllers, mass storage devices, printers, display units, and sensor options.

Without exception, all external data processing features have direct memory access for transferring data to and from memory by way of the I/O Channel. (Sensor-based options do not have direct memory access.) Such transfers are done

IBM Series/1 Communications Capabilities

TABLE 3. IBM SERIES/1 COMMUNICATIONS FEATURES (1)

Feature	I/O Slots Required	Interface	Maximum Number Lines Controlled	Type Communication	Feature Number	Maximum Transmission Speed (bps)	Comments
4987 Programmable (2) Communications Subsystem	2	Adapter Dependent	32	Async/BSC Mixture	4987 (with #1300 Controller)	9600 per line	Full-Width Module
Feature-Programmable (3) Multiline Controller	2-3	RS-232C/V.24 or Current Loop	4/8	Async/Sync Mixture (No BSC)	#2905	37.5 to 19.2K per line	—
With 4-Line Feature-Programmable Line Adapter(s)					#2906		
System/370 Channel Attachment	1	Host Selector or Block Multiplexer Channel	—	3270 Channel Protocol	#1200	—	Requires #4993 Termination Enclosure (Full-Width Module)
Multiline BSC Controller (3) with 4-Line BSC LIne Adapter(s)	2-3	RS-232C/V.24	4/8	Synchronous	#2093 #2094	9600 per line	—
Multiline Async Controller (3) with 4-line Async Line Adapter(s)	2-3	RS-232C/V.24	4/8	Asynchronous	#2091 #2092	2400 per line	—
Async Line Controller	1	RS-232C/V.24	1	Asynchronous	#1610	9600	—
BSC Line Controller	1	RS-232C/V.24	1	Synchronous	#2074	9600	Supports IPL
High-Speed BSC Line Controller	1	CCITT V.35	1	Synchronous	#2075	56K	Supports IPL, Bell 303 or compatible
Teletypewriter Adapter	1	20/60 mA Current Loop	1	Asynchronous	#7850	9600	—
SDLC Controller	1	RS-232C/V.24	1	Synchronous	#2090	9600	—
Communications Indicator Panel	—	—	—	—	#2000	—	Attaches to Single or Multi-line Controllers

(1) Feature #2010, Power Supply, is generally required if more than two communications features are configured.
(2) See Table 2 for delineation of line adapters and features of 4987 subsystem.
(3) Multiline controllers require either one or two four-line adapters.

without processor intervention even though cycles must be stolen to execute the transfers. When the transfers are completed, an interrupt is triggered for processor action. There are four interupt levels in the Series 1 processors. The user can assign each slot to an interrupt level, thereby assigning the associated attached device to one of four priorities. The devices assigned to the highest priority interrupt will receive processor attention even if a lower priority level device is, at that moment, receiving processor action. To accomplish this, a set of eight general registers, a status register, and an instruction address register is associated with each interrupt level. When a higher priority device causes an interrupt, the processor preserves the status of the lower priority's processing activity in the lower priority's associated registers and handles the higher priority request. The processor then retrieves the information saved in the lower priority's registers and completes the task. A device wanting interrupt processing but having the same priority level as a device currently receiving interrupt processing must await completion of the current processing before receiving attention.

All of the Series/1 models may support one or more #4959 I/O Expansion Units, each of which provides an additional 14 I/O features slots. The expansion units are cable connected to the I/O bus of the host host processor module. Although there are no predefined limits to the number of expansion units (and I/O controllers) which may be configured with a Series 1, it should be noted that each processor model does in fact have a throughput limit. The limit varies significantly depending on the processor model and memory size, and on the number and type of I/O device and communications controllers. IBM will generally need to evaluate each desired configuration on an individual basis to determine which processor, and how much memory, will be required to support the configuration. Based on information available to Datapro, it can generally be stated that a high-end 4955-E processor may support no more than three I/O expansion units (a system maximum of 59 I/O feature slots).

All Series/1 modules mount in a #4997 Rack Enclosure, which is an EIA standard 19-inch mounting rack. Two models are available; the Model 1 is one meter high and holds two full-width modules, the Model 2 is 1.8 meters high and will hold four full-width modules. When one or more of the modules are half-width, the #4540 Rack Mounting Fixture is required. It supports either one or two half-width modules.

COMMUNICATIONS FEATURES

Depending on model, a maximum of 96 communications lines can be attached to a fully expanded Series/1 system. Current communications options include support of the following interfaces: EIA RS232C, CCITT V.24 and V.35, and local attachments. A 20 mA and a 60 mA current loop Teletype adapter is also provided. The protocols/codes supported by the hardware are: BSC, SDLC, PTTC/EBCD, and PTTC/Correspondence. Except for the full-duplex Teletype adapter, only half-duplex lines are supported. BSC lines can have speeds up to 56K bps; all other protocols can have speeds up to 9600 bps. The PTTC and Correspondence protocols are compatible with the IBM 2740 Models 1 and 2, and with the IBM 2741.

The features described in the following text are the current communications hardware components which may be

IBM Series/1 Communications Capabilities

implemented in the Series/1. The list does not, however, reflect all of the I/O control devices which may be configured. Only those which support communications are delineated. There are additionally, controller boards for mass storage devices (magnetic tape, disk and diskette) and other I/O device controllers (for local device attachment) which will contend with these communications components for available I/O slots. The same is true for physical space in the mounting rack. Rack space is needed for all of the I/O and mass storage modules, in addition to the communications features which are detailed below.

A general communications configuration rule is that no more than 24 communications lines, of any mixture, may be terminated in a single processor or expansion unit. The only exception to this rule is the 4987 Programmable Communications Subsystem, which may terminate up to 32 communications lines and requires only a single processor, or single expansion unit. The subsystem handles its own lines, and does not decrease the line capacity of the processor or expansion unit to which it is attached.

4987 Programmable Communications Subsystem

The 4987 Programmable Communications Subsystem can be implemented on any of the models, and essentially performs as a front end for the Series/1 processor. It is user-programmable with special software utilities which operate under the Realtime Programming System (RPS).

The subsystem off-loads much of the communications processing from the basic processor, handles varied line speeds, character codes and protocols, and performs error checking, polling and synchronization timing. Up to 32 lines can be attached, and they may be a mixture of asynchronous and synchronous, switched or leased, and point-to-point or multipoint.

The 4987 subsystem occupies a full-width module position in the rack enclosure and requires two adjacent I/O feature slots in either the processor or a #4959 I/O Expansion Unit. The #1300 Programmable Communications Subsystem Controller is a two-card feature which occupies these slots, and is cable-attached to the 4987. It controls the 4987 scanner and up to 16 features (32 lines).

If the user requires increased throughput for the system, another scanner unit, the #3600 Expansion Scanner, can be added to the subsystem module to handle up to half of the line interfaces. This also requires that a second #1300 subsystem controller, occupying two more I/O feature slots be added.

The 4987 subsystem has its own family of line interfaces and feature attachments. These include a full-duplex attachment (#4701) which combines two half-duplex lines into a single, full-duplex connection, and a #4713 Autocall Attachment. Ten line adapters are currently offered, each of which provides for a half-duplex line attachment. Table 2 provides a characteristic comparison of these interfaces and adapters. It should be noted that, unlike other Series/1 communications features, transmission speeds for lines attached to this subsystem may not exceed 9600 bps. Other features not supported by the subsystem include SDLC communications, and the ability to down-line load and IPL the system. All of the 4987 adapters and line interfaces are provided with a six-meter long attachment cable.

An optional feature of the 4987 subsystem is the #4990 Communications Console, which provides operator inteface to the subsystem for debugging and problem identification. The console consists of a pluggable function keyboard and a set of displays, which may be switched between two scanners.

A special IBM licensed program, Programmable Communications Subsystem Preparation Facility (5719-CSO), provides the RPS system user with a library of macro instructions which are used to define the line configurations, protocols, tables and other parameters. Output is then linked by the standard RPS program preparation facilities, and is storable on disk for loading into the subsystem. Two other IBM licensed programs, 5719-CS1 and 5719-CS2, provide execution support of the subsystem and run under certain versions of the RPS operating system.

Multi-Line Feature-Programmable Communications Controller

The #2095 Feature-Programmable 8-Line Communications Control is another recently-announced communications feature, which permits the user to define, under program control, the characteristics of up to eight communications lines. The 2095 is a single-board feature which occupies one I/O feature slot of either the Series/1 processor, or a #4959 expansion unit.

The 2095 controller requires one or two #2096 Feature-Programmable 4-Line Communications Adapters, each of which provides for the attachment of up to four half-duplex lines. Each of these line adapters also requires an I/O feature slot that must be adjacent to its controller. Therefore, if all eight lines are utilized within this subsystem, three contiguous I/O slots would be required.

The communications features which are program-selectable for each line are: transmission speed (37.5 to 19.2K bps), asynchronous or synchronous operation, character length (5, 6, 7 or 8 bits per character, plus parity), character code (ASCII or EBCDIC), character parity checking (odd, even or none), one or two synchronization characters, and one or two stop bits. Additionally, the controller can provide functions of auto-answer and modem control for either switched or non-switched lines. Any of the lines may be non-switched point-to-point or multipoint, or switched point-to-point.

This system does not significantly off-load communications processing from the host processor, as does the 4987 communications subsystem. While aggregate throughput for the controller is about 64,000 bps, it does not perform sophisticated functions such as device address recognition or polling. These remain the responsibilities of the host processor. It is important to note that while character-synchronous transmission is supported, the controller is incapable of performing CRC checking or generation and cannot, therefore, support BSC communications.

Transmission speed for asynchronous operation is program controlled within two jumper-selectable ranges; 37.5 to 1200 bps, and 300 to 19.2K bps. External clocking is required for synchronous transmission. Interface to communications facilities is EIA RS-232C/CCITT V.24. Another jumper-selectable option permits 20mA current loop interface.

Other Multiline Controllers

Two additional multiline controllers can be implemented with the Series/1; each occupying one I/O feature slot and controlling up to eight communications lines.

The #2091 Asynchronous Communications 8-Line Control feature handles up to eight asynchronous lines with either one or two #2092 Asynchronous 4-Line Adapters. Each adapter also requires an I/O feature slot adjacent to the controller. Therefore, up to three contiguous I/O slots would be required to fully configure this subsystem. The transmission speed of each line is under program control within one of two jumper-selectable ranges; 37.5 to 1200 bps, or 300 to 2400 bps. Each line may support PITC/EBCD or

IBM Series/1 Communications Capabilities

PTTC/Correspondence codes. Local asynchronous devices may be attached, as well as external data sets for remote asynchronous devices. Any of the lines may operate in a non-switched point-to-point or multipoint, or in a switched point-to-point mode. For switched lines, a connection may utilize auto-answer, manual call or manual answer. This subsystem does not support IPL of the Series/1 over communications lines.

The #2093 BSC Communications 8-Line Control feature handles up to eight BSC lines with either one or two #2094 BSC 4-Line Adapters. As with the asynchronous subsystem, each adapter also requires an I/O feature slot adjacent to the controller, thereby requiring up to three slots per subsystem. Two of the eight lines may operate at 9600 bps, in which case none of the remaining six may exceed 2400 bps. If only four lines are attached, each may operate at 4800 bps. Both ASCII and EBCDIC codes are supported, and interface compatibility is EIA RS-232C/CCITT V.24. Like the asynchronous controller, any line may operate in a non-switched point-to-point or multipoint, or switched point-to-point mode. However, neither the asynchronous nor the BSC controllers support down-line IPL of the Series/1.

Single Line Controllers

In addition to the multiline controllers and subsystems already described, there are currently five single line controllers available for the Series/1, each of which requires one I/O feature slot.

The #7850 Teletypewriter Adapter permits attachment via a single 20/60 mA Current Loop communications line of a Teletype ASR 33, 35 or similar device. With appropriate system configuration, this adapter may be used for IPL of the Series 1. Transmission rate may be selected from 12 speeds ranging from 50 to 9600 bps. Full-duplex transmission is supported.

The #1610 Asynchronous Communications Single Line Control provides for the attachment of a single, half-duplex, asynchronous line. Speed is program selectable from among two jumperable ranges; 37.5 to 1200 bps, and 300 to 9600 bps. Remotely, this feature supports non-switched point-to-point and multipoint operations, or switched point-to-point. Character codes supported are compatible with IBM 2740 (Models 1 and 2) and 2741 terminals. Interface is RS-232C/V.24.

The #2704 BSC Single Line Control supports attachment of one half-duplex BSC communications line. Interface is RS-232C/V.24 and transmission speed of up to 9600 bps is supported. The unit supports ASCII or EBCDIC character codes, under program control. Internal clocking of 600 or 1200 bps is provided, if external data set does not provide timing. In addition to non-switched point-to-point, multipoint and switched point-to-point operation, this controller supports down-line IPL of the Series/1 from a remote processor.

The #2075 High-Speed BSC Line Control offers the same features as the #2074 except permits half-duplex transmission at up to 56K bps. Interface for Bell 303 or equivalent data set is provided. IPL of the Series/1 is likewise supported.

The #2090 SDLC Single Line Control permits attachment of one, half-duplex SDLC line to the Series/1. Interface is also RS-232C/V.24, and speed of up to 9600 bps is supported. Internal clocking at either 6700 or 1200 bps is provided. Otherwise, an external data set is required. Like the BSC controllers, EBCDIC and ASCII codes are supported, but down-line IPL may not be accomplished using SDLC communications. Multipoint and point-to-point operation is also supported.

Other Communications Features

Another optional feature of the Series/1 communications hardware is the #2000 Communications Indicator Panel, which attaches to any single or multiline controller and does not require an I/O feature slot. The panel consists of eight switches and eight indicator lights with which coded information is displayed showing line operational status.

A feature providing backup for communications is the #7900 Two-Channel Switch. This feature for the 4959 I/O Expansion Unit provides the capability for switching a set of common I/O devices between two Series/1 processors. The 7900 feature card is plugged into the 4959 and is connected by cable to the I/O channels of two Series/1 processors. Upon failure of the primary processor, the secondary or backup processor receives an interrupt and can be programmed to switch the common I/O. Manual intervention is required when switching back to the primary processor. Manual switching in either direction can be done by the operator.

The Two-Channel Switch console, located on the front panel of the 4959 I/O Expansion Unit, is provided as part of this feature, and provides indicator lights, switches, and keys that allow unit power on/off, manual or backup selection, manual processor selection, manual processor interrupt, channel reset, manual error recovery, and unit status. As a unit, the 7900 is field-installable.

HOST CONNECTION

Channel to channel communications between a Series/1 and an IBM System/370, 303X is possible with #1200 Channel Attachment feature. This is a single-board component and occupies one I/O feature slot. In addition, a 4993 Termination Enclosure is required which is a full-width module rack-mounted with other Series/1 modules.

The #1200 controller acts to the host 370 as an IBM 3272 control unit with 32 device addresses. It is handled as a single device interface by the Series/1 processor. Attachment is made to the selector or block multiplexer channel of the host and, when properly configured, allows IPL of the Series/1 from the host system.

Channel attachment cables are not provided with the 4993 unit and must be purchased separately. Up to eight 4993 units (multiple Series/1) may be connected to a System/370 channel. Channel attachment is driven by a licensed program, Series/1-System 370 Channel Attach Program (5719-CA1), which runs under the RPS operating system.

SOFTWARE

The basic operating system of the Series/1 is the Realtime Programming System (RPS), a control system through which a user can install, operate, and maintain system programs, application programs, and data. RPS is multiprogramming, multitasking, event-driven, and disk-based. It allows multiple concurrent task operations in the same or different partitions with synchronization and communication between them. Re-entrant programs can be used by more than one task. Announced in April 1977, RPS manages all physical resources—processor, storage, and devices. Its supervisor and data management services provide a controlled interface between application programs and Series/1 hardware.

RPS Version 2 provides all the facilities of Version 1 plus system support for the IBM Disk Storage Unit Models 3 and 4 with a capacity of 13,926,240 bytes. This permits more program and data storage for users with large program libraries and/or data files. RPS Version 2 also provides storage support beyond 64K bytes using storage overlays,

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TABLE 4. RPS OPERATING SYSTEM COMMUNICATIONS SUPPORT

Feature	Version 1	Version 2	Version 3**	Version 4
Minimum Memory Required (bytes)	48K	48K	64K	64K
Maximum Memory Supported (bytes)	64K	128K	256K	256K
Host System/370 Communications Supported—				
Channel Attachment	No	No	Yes	Yes
OS/VS BTAM; BSC	Yes	Yes	Yes	Yes
DOS BTAM; BSC	No	Yes	Yes	Yes
OS/VS TCAM; BSC	No	No	Yes	Yes
OS/VS ACF/TCAM, VTAM; SDLC	No	No	No	Yes
To Other Series/1	No	Yes Point-to-Point	Yes Point-to-Point	Yes Point-to-Point Multipoint*
To System/32, 34; BSC	No	No	Yes	Yes
To System/3; BSC	No	Yes	Yes	Yes
Communications Features Supported—				
Programmable Comm. Subsystem	No	Yes	Yes	Yes
Down-line IPL; BSC	No	Yes	Yes	Yes
SNA; SDLC Line Adapter	No	No	No	Yes
Feature-Programmable Multiline Controller	No	No	No	Yes
Terminals Supported—				
Teletype ASR 33/35; Async	Non-Switched	Switched	Switched	Switched* Non-Switched
IBM 2740, Model 1; Async	Point-to-Point	Point-to-Point	Point-to-Point	Point-to-Point* Multipoint
IBM 2740, Model 2; Async	No	No	No	Multipoint*
IBM 2741; Async	No	No	No	Yes*
IBM 3271, Models 1 and 2; BSC	No	No	No	Yes*
IBM 3275; BSC	No	No	No	Yes*

* Requires 4987 Communications Subsystem with Extended Support Software.
**Requires 4955 Processor.

automated device backup for printers and a teletypewriter, IPL and dumping of a remote Series/1 by a host Series/1 using BSC communications, and use of the basic level for communications operations.

Versions 3 and 4 of the Realtime Programming System further enhances its capabilities. Version 3 provides support for the Series/1 Program Preparation Subsystem (PPS). Version 4 (scheduled for release in February 1979) offers support for the 4963 Disk Subsystem and the 4966 Diskette Magazine Unit, plus communications support for additional terminals. Systems Network Architecture (SNA) support and the capability for either a single or multiple address space environment are also provided.

RPS has debugging aids to help users to find and correct errors in problem and supervisory programs. Through the interactive debug package, users can display and modify registers, processor storage, disk, and diskette contents, as well as set address stops to monitor the status of executing programs.

According to GSD, all four versions of RPS are available, and the user is encouraged to employ the version that best supports his needs. Each provides varying degrees of communications functionality. A profile of the communications support characteristics of the RPS versions is provided in Table 4.

Two different sets of utilities are available to aid the user in application program development under RPS. These are the Program Preparation Subsystem, and the Base Program Preparation Facilities.

The Program Preparation Subsystem (PPS) provides a general-purpose batch environment and software tools for developing the application programs that run under RPS. The PPS licensed program consists of a Job Stream Processor, Text Editor, Macro Assembler, and Application Builder. These programs execute in the batch partition as task sets under control of RPS.

The Base Program Preparation Facilities is a set of stand-alone programs designed to facilitate the preparation and coding of Series/1 programs. The four BPP facilities are the Text Editor, Macro Assembler, Application Builder, and Job Stream Processor.

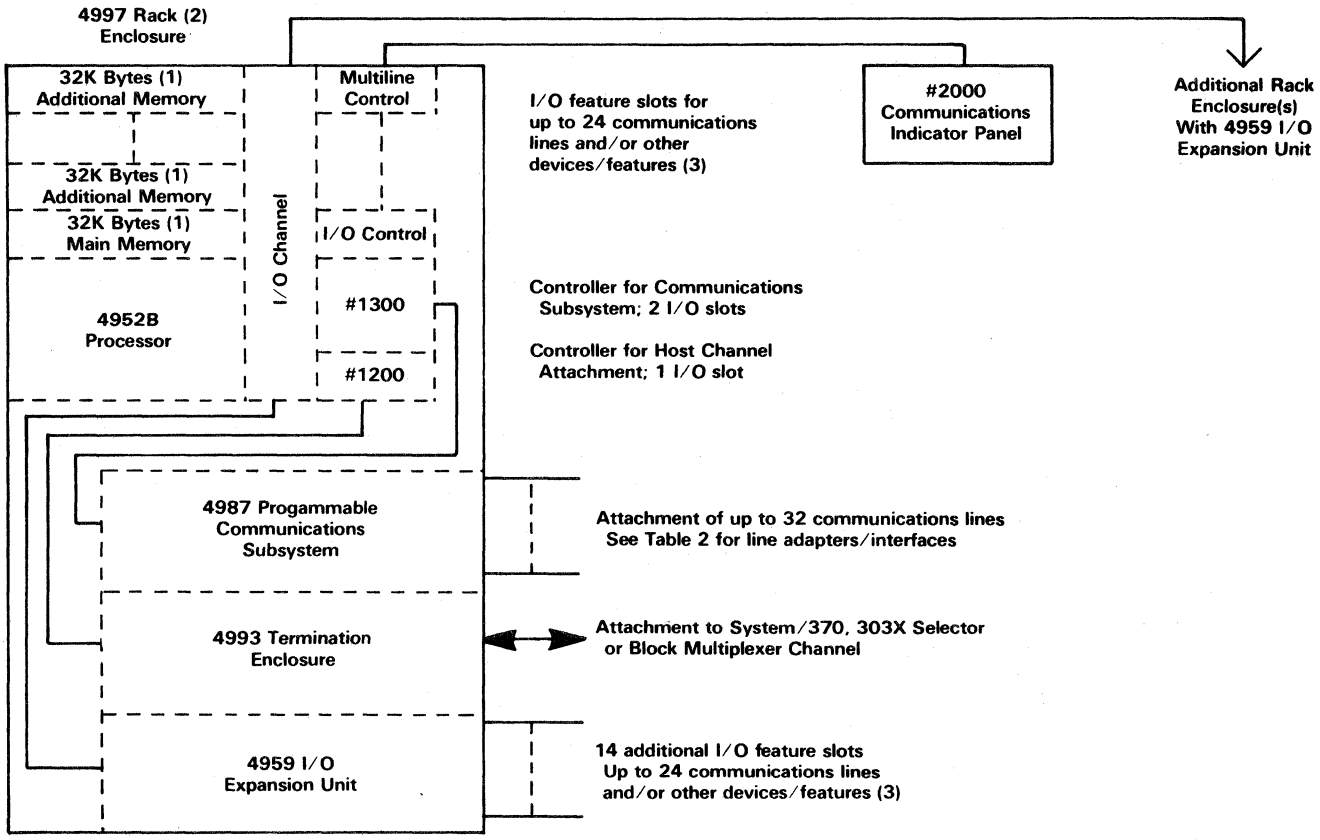
Several specialized IBM licensed programs support specific communications hardware and functions in the Series/1. These include programs for channel attachment to a host, and for control of the programmable communications subsystem.

The System/370 Channel Attach Program is a licensed program which runs under control of the Realtime Programming System (RPS) Version 3 or 4, this program provides the Series/1 user with the ability to communicate with a System/370 (Models 135 through 168) or 303X processor over a selector or block multiplexer channel, when used in conjunction with the 4933 Model 1 Series/1-System/370 Termination Enclosure and the Series/1-System/370 Channel Attachment Feature 1200. The program provides the Series/1 user with the ability to transfer data, under joint consent, between user application programs in the Series/1 and the System/370.

The Programmable Communications Subsystem Preparation Facility is a macro library that is used to support the generation of controller storage image programs for the Series/1 Programmable Communications Subsystem. This macro library is used with either the Base Program

IBM Series/1 Communications Capabilities

Communications Configuration
Processor Model Type 2
4952 Model B



(1) With 4952B processor, up to four additional 32K-byte memory modules may be added to basic 32K bytes for system maximum of 128K bytes. See Table 1 for comparison of processor models and memory capacities.

(2) Model 1 supports two full-width modules; Model 2 supports four.

(3) Number of I/O feature slots will vary depending on model, and for some models, the amount of memory. See Table 3 for communications features and slot requirements. No more than 24 communications lines may terminate in any processor or I/O Expansion Unit.

Preparation Facility or the Program Preparation Subsystem. It provides the user with the capability of defining and customizing the total protocol for his subsystem. Facilities are provided for implementing communications applications, using communications macro instructions and communications definition macros.

The Programmable Communications Subsystem Execution Support runs under control of RPS and provides the user with an interface to the 4987 Programmable Communications Subsystem. The support consists of execution support macros and a loader utility to load the controller storage image program into controller storage. This program provides basic execution support of the subsystem, and runs under versions 2, 3 and 4 of RPS.

The Programmable Communications Subsystem Extended Execution Support provides more sophisticated support for the subsystem and runs only under RPS Version 4. It provides read/write level support between the user, the operating system and the communications subsystem. The program additionally enhances the type of terminals supported, and includes the IBM 2741 and several 3270 models (see Table 4).

There are additionally program products which load in a host 370, and provide support for the Series/1. Two licensed programs are currently available; one for MVS/VTAM hosts and another for MVS/TCAM hosts. Support permits data retrieval, storage access and RJE operations between the host and the Series/1.

PRICING

The Series/1 is offered on a purchase-only basis, at prices ranging from approximately $9,500 to $100,000 depending on configuration. Purchase prices include installation and a three-month parts and labor warranty. On-site physical planning is separately priced. On-site support for the Stand-Alone Utilities is provided by a GSD CE at no additional charge.

The Series/1 is not currently available in "packaged" or specially configured systems. Each component is offered on an individually priced basis; thus, the actual price for any particular system is the sum total of every configured unit.

Progam products for the Series/1 are available on a 24-month paid-up license basis or for a one-time paid-up license charge. Under either plan, the software remains the property of IBM, subject to the licensing agreement.

IBM Series/1 Communications Capabilities

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
PROCESSORS AND MAIN STORAGE			
4952A	Processor, half-width module, 32K bytes of memory, 5 I/O feature slots	$5,060	$26.50
4952B	Processor, full-width module, 32K bytes of memory, 14 I/O feature slots	6,765	58.00
4953A	Processor; half-width module, 16K bytes of memory, 4 I/O feature or storage slots	4,800	80.00
4953B	Processor; full-width module, 16K bytes of memory, 13 I/O feature of storage slots	5,715	73.50
4953C	Processor; half-width module, 32K bytes of memory, 4 I/O feature or storage slots	5,915	88.00
4953D	Processor; full-width module, 32K bytes of memory, 13 I/O feature or storage slots	6,835	83.00
4955A	Processor; full-width module, 16K bytes of memory, 8 I/O feature slots	7,465	76.50
4955B	Processor; full-width module, 16K bytes of memory, 3 I/O feature slots	7,465	76.50
4955C	Processor; full-width module, 32K bytes of memory, 10 I/O feature slots	8,970	87.00
4955D	Processor; full-width module, 32K bytes of memory, 7 I/O feature slots	8,970	87.00
4955E	Processor; full-width module, 32K bytes of memory, 7 I/O feature slots	10,150	133.00
6306	Storage addition, 4952 processor; 32,768 bytes	495	1.50
6315	Storage addition, 4953 processor; 16,384 bytes	1,410	6.50
6316	Storage addition, 4953 Model C and D processors only; 32,768 bytes	1,885	16.00
6325	Storage additon, 4955 processor; 16,384 bytes	1,160	6.50
6326	Storage addition, 4955 Model C and D processors only; 32,768 bytes	1,725	13.50
6327	Storage addiion, 4955 Model E processor only; 65,536 bytes	2,785	41.00
PROCESSOR FEATURES			
4540	Rack mounting fixture	65	NC
4959	Input/output expansion unit	3,165	39.00
4997-1A	Rack enclosure, Model 1	1,090	2.00
4997-2A	Rack enclosure, Model 2	1,455	5.00
4999-1	Battery backup, Model 1	2,375	15.00
4999-2	Battery backup, Model 2	2,350	16.00
4993	Termination Enclosure for Channel Attachment	3,305	20.50
5650	Programmer console	557	3.50
2000	Communications Indicator Panel	302	3.50
2010	Communications Power Supply	145	3.50
7900	Two-channel switch; plugs into 4959 expansion unit	3,205	8.50
COMMUNICATIONS FEATURES			
1300	Programmable communications subsystem controller	3,430	28.50
1610	Asynchronous communications single-line control	1,310	10.50
1200	S/370 Channel attachment controller	2,625	11.50
2074	BSC single-line control	1,435	12.50
2075	BSC single-line control/high-speed	1,665	12.50
7850	Teletype Adapter	678	6.50
2090	SDLC single-line control	1,715	12.50
2091	Asynchronous communications 8-line control	1,175	10.50
2092	Asynchronous communications 4-line adapter	1,215	21.00
2093	BSC 8-line control	1,465	10.50
2094	BSC 4-line adapter	1,505	26.50
2095	Feature-programmable 8-line communications control	1,665	7.50
2096	Feature-programmable 4-line adapter	1,895	22.00
4987	Programmable communications subsystem	5,005	41.00
4990	Communications console	938	2.00
3600	Programmable communications subsystem expansion scanner	2,215	15.00
4700	Half duplex DCE attachment	630	3.50
4701	Full duplex DCE attachment	521	3.00
4704	TTY current attachment	806	5.00
4706	Data-Phone digital service adapter	1,200	5.00
4709	Asynchronous local attachment	661	2.50
4710	Synchronous local attachment	686	3.00
4713	Autocall attachment	635	3.50
4716	1200-bps asynchronous modem, switched network	1,265	8.00
4717	1200-bps asynchronous modem, leased line SNB4	1,455	9.00
4718	1200-bps aysnchronous modem, leased line	1,265	8.00
4721	1200-bps synchronous modem with clock, switched network	1,300	8.00
4722	1200-bps synchronous modem with clock, lease line SNBU	1,490	9.00
4723	1200-bps synchronous modem with clock, leased line	1,300	8.00

IBM Series/1 Communications Capabilities

SOFTWARE PRICES

		Monthly Charge*	One-Time Charge*
LICENSED PROGRAMS			
5719-PC1	Realtime Programming System, Version 1	$22.00	$1,320
5719-PC2	Realtime Programming System, Version 2	28.00	1,650
5719-PC3	Realtime Programming System, Version 3	35.00	2,090
5719-PC4	Realtime Programming System, Version 4	42.00	2,475
5719-AS1	Program Preparation Subsystem, Version 1	20.00	1,210
5719-AS2	Program Preparation Subsystem, Version 2	22.00	1,325
5719-AS3	Program Preparation Subsystem, Version 3	24.00	1,450
5719-PA1	Base Program Preparation Facilities	99.00	2,375
5719-CS0	Programmable Communications Subsystem Preparation Facility	8.00	550
5719-CS1	Programmable Communications Subsystem Execution Support	7.00	369
5719-CS2	Programmable Communications Subsystem Extended Execution Support	22.00	1,265
5719-CA1	System/370 Channel Attach Program	23.00	1,375
5719-ED1	Series/1 Structured Programming Facility; 51370 Compatiblity	231.00	—
5719-CR1	SPF Application Program; for MVS/VTAM hosts; OS/VS2	231.00	—
5719-CR2	SPF Application Program; for MVS/TCAM hosts; OS/VS2	231.00	—
FIELD-DEVELOPED PROGRAMS			
5798-NNQ	System/370 Program Preparation Facilities for Series/1	598.00**	—

*All Licensed Programs will be licensed under the Agreement for IBM Licensed Programs for a monthy charge or, in lieu thereof, a one-time charge. Under either payment option, the Licensed Program remains the property of IBM and is subject to the provisions of the Agreement for IBM Licensed Programs. If the monthly charge option is chosen, credit will be accrued during a continuous license period toward the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Paid-up license credits are not transferrable to other customers or between licenses, whether they are for programs that have a different program number or the same program number.

**Charges waived after 24 months.■

IBM Series/1 Communications Capabilities

Update

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
PROCESSORS AND MAIN STORAGE			
4952A	Processor, half-width module, 32K bytes of memory, 5 I/O feature slots	$4,600	$24.00
4952B	Processor, full-width module, 32K bytes of memory, 14 I/O feature slots	6,150	52.50
4953A	Processor; half-width module, 16K bytes of memory, 4 I/O feature or storage slots	4,800	80.00
4953B	Processor; full-width module, 16K bytes of memory, 13 I/O feature of storage slots	5,715	73.50
4953C	Processor; half-width module, 32K bytes of memory, 4 I/O feature or storage slots	5,915	88.00
4953D	Processor; full-width module, 32K bytes of memory, 13 I/O feature or storage slots	6,835	83.00
4955A	Processor; full-width module, 16K bytes of memory, 8 I/O feature slots	6,790	76.50
4955B	Processor; full-width module, 16K bytes of memory, 3 I/O feature slots	6,790	76.50
4955C	Processor; full-width module, 32K bytes of memory, 10 I/O feature slots	8,155	87.00
4955D	Processor; full-width module, 32K bytes of memory, 7 I/O feature slots	8,155	87.00
4955E	Processor; full-width module, 32K bytes of memory, 7 I/O feature slots	9,230	133.00
6306	Storage addition, 4952 processor; 32,768 bytes	450	1.50
6315	Storage addition, 4953 processor; 16,384 bytes	1,285	6.50
6316	Storage addition, 4953 Model C and D processors only; 32,768 bytes	1,715	16.00
6325	Storage additon, 4955 processor; 16,384 bytes	1,055	6.50
6326	Storage addition, 4955 Model C and D processors only; 32,768 bytes	1,570	13.50
6327	Storage addiion, 4955 Model E processor only; 65,536 bytes	2,535	41.00
PROCESSOR FEATURES			
4540	Rack mounting fixture	59	NC
4959	Input/output expansion unit	2,880	39.00
4997-1A	Rack enclosure, Model 1	993	2.00
4997-2A	Rack enclosure, Model 2	1,375	5.00
4999-1	Battery backup, Model 1	2,160	15.00
4999-2	Battery backup, Model 2	2,140	16.00
4993	Termination Enclosure for Channel Attachment	3,005	18.00
5650	Programmer console	507	3.50
2000	Communications Indicator Panel	275	3.50
2010	Communications Power Supply	132	3.50
7900	Two-channel switch; plugs into 4959 expansion unit	2,915	8.50
COMMUNICATIONS FEATURES			
1300	Programmable communications subsystem controller	3,120	28.50
1610	Asynchronous communications single-line control	1,195	10.50
1200	S/370 Channel attachment controller	2,390	11.50
2074	BSC single-line control	1,305	12.50
2075	BSC single-line control/high-speed	1,515	12.50
7850	Teletype Adapter	617	6.50
2090	SDLC single-line control	1,560	12.50
2091	Asynchronous communications 8-line control	1,070	10.50
2092	Asynchronous communications 4-line adapter	1,105	21.00
2093	BSC 8-line control	1,335	10.50
2094	BSC 4-line adapter	1,370	26.50
2095	Feature-programmable 8-line communications control	1,515	7.50
2096	Feature-programmable 4-line adapter	1,725	22.00
4987	Programmable communications subsystem	4,550	41.00
4990	Communications console	853	2.00
3600	Programmable communications subsystem expansion scanner	1,850	15.00
4700	Half duplex DCE attachment	573	3.50
4701	Full duplex DCE attachment	474	3.00
4704	TTY current attachment	733	5.00
4706	Data-Phone digital service adapter	1,095	5.00
4709	Asynchronous local attachment	601	2.50
4710	Synchronous local attachment	624	3.00
4713	Autocall attachment	578	3.50
4716	1200-bps asynchronous modem, switched network	1,050	8.00
4717	1200-bps asynchronous modem, leased line SNB4	1,325	9.00
4718	1200-bps aysnchronous modem, leased line	1,050	8.00
4721	1200-bps synchronous modem with clock, switched network	1,185	8.00
4722	1200-bps synchronous modem with clock, lease line SNBU	1,355	9.00
4723	1200-bps synchronous modem with clock, leased line	1,185	8.00

IBM Series/1 Communications Capabilities

SOFTWARE PRICES

		Monthly Charge*	One-Time Charge*
LICENSED PROGRAMS			
5719-PC1	Realtime Programming System, Version 1	$20.00	$1,200
5719-PC2	Realtime Programming System, Version 2	25.00	1,500
5719-PC3	Realtime Programming System, Version 3	32.00	1,900
5719-PC4	Realtime Programming System, Version 4	38.00	2,250
5719-AS1	Program Preparation Subsystem, Version 1	18.00	1,104
5719-AS2	Program Preparation Subsystem, Version 2	20.00	1,208
5719-AS3	Program Preparation Subsystem, Version 3	22.00	1,320
5719-PA1	Base Program Preparation Facilities	90.00	2,160
5719-CS0	Programmable Communications Subsystem Preparation Facility	8.00	500
5719-CS1	Programmable Communications Subsystem Execution Support	6.00	336
5719-CS2	Programmable Communications Subsystem Extended Execution Support	20.00	1,150
5719-CA1	System/370 Channel Attach Program	21.00	1,250
5719-ED1	Series/1 Structured Programming Facility; 51370 Compatiblity	210.00**	—
5719-CR1	SPF Application Program; for MVS/VTAM hosts; OS/VS2	210.00**	—
5719-CR2	SPF Application Program; for MVS/TCAM hosts; OS/VS2	210.00**	—
FIELD-DEVELOPED PROGRAMS			
5798-NNQ	System/370 Program Preparation Facilities for Series/1	520.00**	—

*All Licensed Programs will be licensed under the Agreement for IBM Licensed Programs for a monthy charge or, in lieu thereof, a one-time charge. Under either payment option, the Licensed Program remains the property of IBM and is subject to the provisions of the Agreement for IBM Licensed Programs. If the monthly charge option is chosen, credit will be accrued during a continuous license period toward the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Paid-up license credits are not transferrable to other customers or between licenses, whether they are for programs that have a different program number or the same program number.

**Charges waived after 24 months.■

Update

IBM Series/1 Communications Capabilities

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
PROCESSORS AND MAIN STORAGE			
4952A	Processor, half-width module, 32K bytes of memory, 5 I/O feature slots	$4,600	$23.00
4952B	Processor, full-width module, 32K bytes of memory, 14 I/O feature slots	6,150	50.00
4953A	Processor; half-width module, 16K bytes of memory, 4 I/O feature or storage slots	4,800	76.00
4953B	Processor; full-width module, 16K bytes of memory, 13 I/O feature of storage slots	5,715	70.00
4953C	Processor; half-width module, 32K bytes of memory, 4 I/O feature or storage slots	5,915	84.00
4953D	Processor; full-width module, 32K bytes of memory, 13 I/O feature or storage slots	6,835	79.00
4955A	Processor; full-width module, 16K bytes of memory, 8 I/O feature slots	6,790	73.00
4955B	Processor; full-width module, 16K bytes of memory, 3 I/O feature slots	6,790	73.00
4955C	Processor; full-width module, 32K bytes of memory, 10 I/O feature slots	8,155	83.00
4955D	Processor; full-width module, 32K bytes of memory, 7 I/O feature slots	8,155	83.00
4955E	Processor; full-width module, 32K bytes of memory, 7 I/O feature slots	12,120	127.00
6306	Storage addition, 4952 processor; 32,768 bytes	450	1.00
6315	Storage addition, 4953 processor; 16,384 bytes	1,285	6.00
6316	Storage addition, 4953 Model C and D processors only; 32,768 bytes	1,715	15.00
6325	Storage additon, 4955 processor; 16,384 bytes	1,055	6.00
6326	Storage addition, 4955 Model C and D processors only; 32,768 bytes	1,570	13.00
6327	Storage addiion, 4955 Model E processor only; 65,536 bytes	2,535	39.00
PROCESSOR FEATURES			
4540	Rack mounting fixture	59	NC
4959	Input/output expansion unit	2,640	37.00
4997-1A	Rack enclosure, Model 1	910	2.00
4997-2A	Rack enclosure, Model 2	1,215	5.00
4999-1	Battery backup, Model 1	1,985	15.00
4999-2	Battery backup, Model 2	1,965	16.00
4993	Termination Enclosure for Channel Attachment	2,755	17.00
5650	Programmer console	507	3.00
2000	Communications Indicator Panel	275	3.00
2010	Communications Power Supply	132	3.00
7900	Two-channel switch; plugs into 4959 expansion unit	2,675	8.00
COMMUNICATIONS FEATURES			
1300	Programmable communications subsystem controller	3,120	27.00
1610	Asynchronous communications single-line control	1,195	10.00
1200	S/370 Channel attachment controller	2,390	11.00
2074	BSC single-line control	1,305	12.00
2075	BSC single-line control/high-speed	1,515	12.00
7850	Teletype Adapter	617	6.00
2090	SDLC single-line control	1,560	12.00
2091	Asynchronous communications 8-line control	1,070	10.00
2092	Asynchronous communications 4-line adapter	1,105	20.00
2093	BSC 8-line control	1,335	10.00
2094	BSC 4-line adapter	1,370	25.00
2095	Feature-programmable 8-line communications control	1,515	7.00
2096	Feature-programmable 4-line adapter	1,725	21.00
4987	Programmable communications subsystem	4,170	41.00
4990	Communications console	782	2.00
3600	Programmable communications subsystem expansion scanner	1,850	15.00
4700	Half duplex DCE attachment	525	3.50
4701	Full duplex DCE attachment	435	3.00
4704	TTY current attachment	672	5.00
4706	Data-Phone digital service adapter	1,005	5.00
4709	Asynchronous local attachment	551	2.50
4710	Synchronous local attachment	572	3.00
4713	Autocall attachment	530	3.50
4716	1200-bps asynchronous modem, switched network	1,060	8.00
4717	1200-bps asynchronous modem, leased line SNB4	1,215	9.00
4718	1200-bps aysnchronous modem, leased line	1,060	8.00
4721	1200-bps synchronous modem with clock, switched network	1,090	8.00
4722	1200-bps synchronous modem with clock, lease line SNBU	1,245	9.00
4723	1200-bps synchronous modem with clock, leased line	1,090	8.00

IBM Series/1 Communications Capabilities

SOFTWARE PRICES

		Monthly Charge*	One-Time Charge*
LICENSED PROGRAMS			
5719-PC1	Realtime Programming System, Version 1	$20.00	$1,200
5719-PC2	Realtime Programming System, Version 2	25.00	1,500
5719-PC3	Realtime Programming System, Version 3	32.00	1,900
5719-PC4	Realtime Programming System, Version 4	38.00	2,250
5719-AS1	Program Preparation Subsystem, Version 1	18.00	1,104
5719-AS2	Program Preparation Subsystem, Version 2	20.00	1,208
5719-AS3	Program Preparation Subsystem, Version 3	22.00	1,320
5719-PA1	Base Program Preparation Facilities	90.00	2,160
5719-CS0	Programmable Communications Subsystem Preparation Facility	8.00	500
5719-CS1	Programmable Communications Subsystem Execution Support	6.00	336
5719-CS2	Programmable Communications Subsystem Extended Execution Support	20.00	1,150
5719-CA1	System/370 Channel Attach Program	21.00	1,250
5719-ED1	Series/1 Structured Programming Facility; 51370 Compatiblity	210.00**	—
5719-CR1	SPF Application Program; for MVS/VTAM hosts; OS/VS2	210.00**	—
5719-CR2	SPF Application Program; for MVS/TCAM hosts; OS/VS2	210.00**	—
FIELD-DEVELOPED PROGRAMS			
5798-NNQ	System/370 Program Preparation Facilities for Series/1	520.00**	—

*All Licensed Programs will be licensed under the Agreement for IBM Licensed Programs for a monthy charge or, in lieu thereof, a one-time charge. Under either payment option, the Licensed Program remains the property of IBM and is subject to the provisions of the Agreement for IBM Licensed Programs. If the monthly charge option is chosen, credit will be accrued during a continuous license period toward the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Paid-up license credits are not transferrable to other customers or between licenses, whether they are for programs that have a different program number or the same program number.

**Charges waived after 24 months.■

IBM Series/1 Communications Capabilities

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
PROCESSORS AND MAIN STORAGE			
4952A	Processor, half-width module, 32K bytes of memory, 5 I/O feature slots	$4,600	$23.00
4952B	Processor, full-width module, 32K bytes of memory, 14 I/O feature slots	6,150	50.00
4953A	Processor; half-width module, 16K bytes of memory, 4 I/O feature or storage slots	4,575	76.00
4953B	Processor; full-width module, 16K bytes of memory, 13 I/O feature of storage slots	5,445	70.00
4953C	Processor; half-width module, 32K bytes of memory, 4 I/O feature or storage slots	5,635	84.00
4953D	Processor; full-width module, 32K bytes of memory, 13 I/O feature or storage slots	6,510	79.00
4955A	Processor; full-width module, 16K bytes of memory, 8 I/O feature slots	6,470	73.00
4955B	Processor; full-width module, 16K bytes of memory, 3 I/O feature slots	6,470	73.00
4955C	Processor; full-width module, 32K bytes of memory, 10 I/O feature slots	7,770	83.00
4955D	Processor; full-width module, 32K bytes of memory, 7 I/O feature slots	7,770	83.00
4955E	Processor; full-width module, 32K bytes of memory, 7 I/O feature slots	11,550	127.00
6306	Storage addition, 4952 processor; 32,768 bytes	450	1.00
6315	Storage addition, 4953 processor; 16,384 bytes	1,225	6.00
6316	Storage addition, 4953 Model C and D processors only; 32,768 bytes	1,635	15.00
6325	Storage additon, 4955 processor; 16,384 bytes	1,055	6.00
6326	Storage addition, 4955 Model C and D processors only; 32,768 bytes	1,570	13.00
6327	Storage addiion, 4955 Model E processor only; 65,536 bytes	2,535	39.00
PROCESSOR FEATURES			
4540	Rack mounting fixture	57	NC
4959	Input/output expansion unit	2,640	37.00
4997-1A	Rack enclosure, Model 1	910	2.00
4997-2A	Rack enclosure, Model 2	1,215	5.00
4999-1	Battery backup, Model 1	1,985	15.00
4999-2	Battery backup, Model 2	1,965	16.00
4993	Termination Enclosure for Channel Attachment	2,755	17.00
5650	Programmer console	483	3.00
2000	Communications Indicator Panel	262	3.00
2010	Communications Power Supply	126	3.00
7900	Two-channel switch; plugs into 4959 expansion unit	2,675	8.00
COMMUNICATIONS FEATURES			
1300	Programmable communications subsystem controller	2,975	27.00
1610	Asynchronous communications single-line control	1,140	10.00
1200	S/370 Channel attachment controller	2,280	11.00
2074	BSC single-line control	1,245	12.00
2075	BSC single-line control/high-speed	1,445	12.00
7850	Teletype Adapter	588	6.00
2090	SDLC single-line control	1,490	12.00
2091	Asynchronous communications 8-line control	1,020	10.00
2092	Asynchronous communications 4-line adapter	1,055	20.00
2093	BSC 8-line control	1,275	10.00
2094	BSC 4-line adapter	1,305	25.00
2095	Feature-programmable 8-line communications control	1,445	7.00
2096	Feature-programmable 4-line adapter	1,645	21.00
4987	Programmable communications subsystem	4,170	41.00
4990	Communications console	782	2.00
3600	Programmable communications subsystem expansion scanner	1,850	15.00
4700	Half duplex DCE attachment	525	3.50
4701	Full duplex DCE attachment	435	3.00
4704	TTY current attachment	672	5.00
4706	Data-Phone digital service adapter	1,005	5.00
4709	Asynchronous local attachment	551	2.50
4710	Synchronous local attachment	572	3.00
4713	Autocall attachment	530	3.50
4716	1200-bps asynchronous modem, switched network	1,060	8.00
4717	1200-bps asynchronous modem, leased line SNB4	1,215	9.00
4718	1200-bps aysnchronous modem, leased line	1,060	8.00
4721	1200-bps synchronous modem with clock, switched network	1,090	8.00
4722	1200-bps synchronous modem with clock, lease line SNBU	1,245	9.00
4723	1200-bps synchronous modem with clock, leased line	1,090	8.00

IBM Series/1 Communications Capabilities

SOFTWARE PRICES

		Monthly Charge*	One-Time Charge*
LICENSED PROGRAMS			
5719PC1	Realtime Programming System, Version 1	$20.00	$1,200
5719-PC2	Realtime Programming System, Version 2	25.00	1,500
5719-PC3	Realtime Programming System, Version 3	32.00	1,900
5719-PC4	Realtime Programming System, Version 4	38.00	2,250
5719-AS1	Program Preparation Subsystem, Version 1	18.00	1,104
5719-AS2	Program Preparation Subsystem, Version 2	20.00	1,208
5719-AS3	Program Preparation Subsystem, Version 3	22.00	1,320
5719-PA1	Base Program Preparation Facilities	90.00	2,160
5719-CS0	Programmable Communications Subsystem Preparation Facility	8.00	500
5719-CS1	Programmable Communications Subsystem Execution Support	6.00	336
5719-CS2	Programmable Communications Subsystem Extended Execution Support	20.00	1,150
5719-CA1	System/370 Channel Attach Program	21.00	1,250
5719-ED1	Series/1 Structured Programming Facility; 51370 Compatiblity	210.00**	—
5719-CR1	SPF Application Program; for MVS/VTAM hosts; OS/VS2	210.00**	—
5719-CR2	SPF Application Program; for MVS/TCAM hosts; OS/VS2	210.00**	—
FIELD-DEVELOPED PROGRAMS			
5798-NNQ	System/370 Program Preparation Facilities for Series/1	520.00**	—

*All Licensed Programs will be licensed under the Agreement for IBM Licensed Programs for a monthy charge or, in lieu thereof, a one-time charge. Under either payment option, the Licensed Program remains the property of IBM and is subject to the provisions of the Agreement for IBM Licensed Programs. If the monthly charge option is chosen, credit will be accrued during a continuous license period toward the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Paid-up license credits are not transferrable to other customers or between licenses, whether they are for programs that have a different program number or the same program number.

**Charges waived after 24 months.

***Charges waived after 12 months.■

IBM Series/1 Communications Capabilities

EQUIPMENT PRICES

		Purchase Price	Monthly Maint.
PROCESSORS AND MAIN STORAGE			
4952A	Processor, half-width module, 32K bytes of memory, 5 I/O feature slots	$4,600	$23.00
4952B	Processor, full-width module, 32K bytes of memory, 14 I/O feature slots	6,150	50.00
4953A	Processor; half-width module, 16K bytes of memory, 4 I/O feature or storage slots	4,360	76.00
4953B	Processor; full-width module, 16K bytes of memory, 13 I/O feature of storage slots	5,190	70.00
4953C	Processor; half-width module, 32K bytes of memory, 4 I/O feature or storage slots	5,370	84.00
4953D	Processor; full-width module, 32K bytes of memory, 13 I/O feature or storage slots	6,200	79.00
4955A	Processor; full-width module, 16K bytes of memory, 8 I/O feature slots	6,165	73.00
4955B	Processor; full-width module, 16K bytes of memory, 3 I/O feature slots	6,165	73.00
4955C	Processor; full-width module, 32K bytes of memory, 10 I/O feature slots	7,400	83.00
4955D	Processor; full-width module, 32K bytes of memory, 7 I/O feature slots	7,400	83.00
4955E	Processor; full-width module, 32K bytes of memory, 7 I/O feature slots	11,000	127.00
6306	Storage addition, 4952 processor; 32,768 bytes	450	1.00
6315	Storage addition, 4953 processor; 16,384 bytes	1,170	6.00
6316	Storage addition, 4953 Model C and D processors only; 32,768 bytes	1,560	15.00
6325	Storage additon, 4955 processor; 16,384 bytes	1,580	6.00
6326	Storage addition, 4955 Model C and D processors only; 32,768 bytes	2,350	13.00
6327	Storage addiion, 4955 Model E processor only; 65,536 bytes	3,800	39.00
PROCESSOR FEATURES			
4540	Rack mounting fixture	55	NC
4959	Input/output expansion unit	2,515	37.00
4997-1A	Rack enclosure, Model 1	870	2.00
4997-2A	Rack enclosure, Model 2	1,160	5.00
4999-1	Battery backup, Model 1	1,895	18.00
4999-2	Battery backup, Model 2	1,875	18.00
4993	Termination Enclosure for Channel Attachment	2,625	17.00
5650	Programmer console	460	3.00
2000	Communications Indicator Panel	250	3.00
2010	Communications Power Supply	120	3.00
7900	Two-channel switch; plugs into 4959 expansion unit	2,550	8.00
COMMUNICATIONS FEATURES			
1300	Programmable communications subsystem controller	2,835	27.00
1610	Asynchronous communications single-line control	1,090	10.00
1200	S/370 Channel attachment controller	2,175	11.00
2074	BSC single-line control	1,190	12.00
2075	BSC single-line control/high-speed	1,380	12.00
7850	Teletype Adapter	560	6.00
2090	SDLC single-line control	1,420	12.00
2091	Asynchronous communications 8-line control	975	10.00
2092	Asynchronous communications 4-line adapter	1,005	20.00
2093	BSC 8-line control	1,215	10.00
2094	BSC 4-line adapter	1,245	35.00
2095	Feature-programmable 8-line communications control	1,380	7.00
2096	Feature-programmable 4-line adapter	1,570	21.00
4987	Programmable communications subsystem	3,975	41.00
4990	Communications console	745	2.00
3600	Programmable communications subsystem expansion scanner	1,765	15.00
4700	Half duplex DCE attachment	500	3.50
4701	Full duplex DCE attachment	415	3.00
4704	TTY current attachment	640	5.00
4706	Data-Phone digital service adapter	960	5.00
4709	Asynchronous local attachment	525	2.50
4710	Synchronous local attachment	545	3.00
4713	Autocall attachment	505	3.50
4716	1200-bps asynchronous modem, switched network	1,010	8.00
4717	1200-bps asynchronous modem, leased line SNB4	1,160	9.00
4718	1200-bps aysnchronous modem, leased line	1,010	8.00
4721	1200-bps synchronous modem with clock, switched network	1,040	8.00
4722	1200-bps synchronous modem with clock, lease line SNBU	1,190	9.00
4723	1200-bps synchronous modem with clock, leased line	1,040	2.00

IBM Series/1 Communications Capabilities

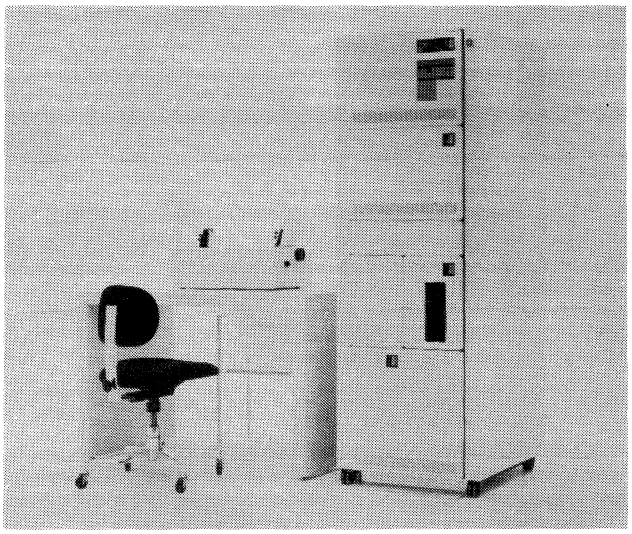
SOFTWARE PRICES

		Monthly Charge*	One-Time Charge*
LICENSED PROGRAMS			
5719PC1	Realtime Programming System, Version 1	$20.00	$1,200
5719-PC2	Realtime Programming System, Version 2	25.00	1,500
5719-PC3	Realtime Programming System, Version 3	32.00	1,900
5719-PC4	Realtime Programming System, Version 4	38.00	2,250
5719-AS1	Program Preparation Subsystem, Version 1	18.00	1,104
5719-AS2	Program Preparation Subsystem, Version 2	20.00	1,208
5719-AS3	Program Preparation Subsystem, Version 3	22.00	1,320
5719-PA1	Base Program Preparation Facilities	90.00	2,160
5719-CS0	Programmable Communications Subsystem Preparation Facility	8.00	500
5719-CS1	Programmable Communications Subsystem Execution Support	6.00	336
5719-CS2	Programmable Communications Subsystem Extended Execution Support	20.00	1,150
5719-CA1	System/370 Channel Attach Program	21.00	1,250
5719-ED1	Series/1 Structured Programming Facility; 51370 Compatiblity	210.00**	—
5719-CR1	SPF Application Program; for MVS/VTAM hosts; OS/VS2	210.00**	—
5719-CR2	SPF Application Program; for MVS/TCAM hosts; OS/VS2	210.00**	—
FIELD-DEVELOPED PROGRAMS			
5798-NNQ	System/370 Program Preparation Facilities for Series/1	520.00	6,240

*All Licensed Programs will be licensed under the Agreement for IBM Licensed Programs for a monthy charge or, in lieu thereof, a one-time charge. Under either payment option, the Licensed Program remains the property of IBM and is subject to the provisions of the Agreement for IBM Licensed Programs. If the monthly charge option is chosen, credit will be accrued during a continuous license period toward the one-time charge at the rate of 50% of the monthly charge up to a maximum of 50% of the one-time charge. Paid-up license credits are not transferrable to other customers or between licenses, whether they are for programs that have a different program number or the same program number.

**Charges waived after 24 months.■

IBM Series 1 Communications Capabilities



The Series 1 shown above is a Model Type 5. The bottom section of the processor cabinet houses the Fixed Disk Storage Unit. Immediately above that unit is a two-compartment section. The right-hand compartment houses a Diskette Unit and the other section is used for sensor-based options. On the table is the 120 cps printer.

Minicomputer hardware that can be used as a data processor, a communications processor, or a sensor-based processor.

Up to 72 half-duplex communications lines can be attached. Asynchronous, BSC, SDLC, and PTTC interfaces are supported. Full-duplex mode is supported only for current loop teletypewriter arrangements.

The only operations software available is a basic operating system. Programs are written in a Macro Assembler language.

A typical Model Type 5 with 24 asynchronous lines, 64K bytes of memory and a Diskette Unit can be purchased for $24,380. The monthly charge for a maintenance contract is $345. The monthly license fee of the operating system, assembler, and related utilities is $105.50. After twenty-four months, the license fee charge is waived.

Datapro is of the opinion that IBM will eventually supply operating software. Whether the software will support distributed data processing is another question. The software direction Series 1 takes could help solidify the path many network architectures adopt.

MANAGEMENT SUMMARY

Using classical minicomputer architecture, the two Series 1 processors (Model Types 3 and 5) are competitive contenders for use on networks dedicated to distributed data processing. Such processors must be able to handle a variety of communications line interfaces, offer mass storage for distributed data bases, and be mini-priced. While the current types of communications lines supported are limited, nothing in the architecture prevents offering interfaces for all types of lines. Disk and diskette storage attachable to a Series 1 is quite sufficient for sizeable data bases, and Series 1 hardware pricing is in the proper range.

The absence of adapters for parallel data transfer reinforces the supposition that the designers of the Series 1 intended for it to be used in a distributed fashion as opposed to being used as a slave to a larger computer. In the master/slave network approach, larger computers control activities and maintain centralized data bases. Such an approach is representative of the System 360/370 networking approach marketed by IBM's Data Processing Division (DPD). This approach has been codified as part of IBM's network architecture ground rules, Systems Network Architecture.

Why should the Series 1 communications approach be in question? Doesn't the software that drives a Series 1 tell the story? Incomprehensibly, the software does not exist. Only a bare-subsistance type of operating system is offered with the hardware. This restricts the use of the Series 1 to the do-it-yourself users. Since small users cannot afford the luxury of developing their own software ▷

CHARACTERISTICS

VENDOR: International Business Machines Corporation, General Systems Division, 5775 Glenridge Drive N.E., Atlanta, Georgia 30301. Telephone (404) 256-7000.

DATE OF ANNOUNCEMENT: November 1976.

DATE OF FIRST DELIVERY: November 1976.

NUMBER DELIVERED TO DATE: Information not available.

SERVICED BY: IBM.

CONFIGURATION

The Series 1 is a family of minicomputers marketed as general-purpose data processors, as communications processors, and as sensor-based processors. The current Series 1 offering consists of two processor types, each obtainable in two models. The two processor types are called the Model Type 3 and the Model Type 5 after the last digit in their feature numbers, which are 4953 and 4955. The major characteristics that distinguish each model are the cycle time, the maximum allowable memory, and the I/O bussing arrangement.

The Model Type 3 has a cycle time of 800 nanoseconds, a maximum main memory storage size of 64K bytes, and a single I/O bus. The processor and all I/O devices have access to main memory via an I/O bus. The Model Type 5 has a ▷

IBM Series 1 Communications Capabilities

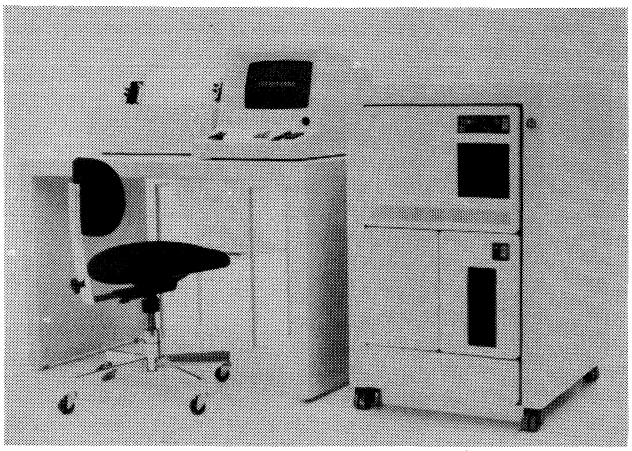
and since large users are better served by standardization, Datapro is convinced that IBM will eventually provide software to drive the Series 1 as both a data processor and as a communications processor. Most likely, in typical IBM fashion, the software will evolve. If this is the case, the network approach that the Series 1 will espouse may not reflect current distributed processing practice.

One could argue that the General Systems Division (GSD) of IBM was chosen to market the Series 1 because it would be free of the DPD's commitment to master/slave networks, and, therefore, inclined towards distributed data processing. Such an argument may be barking up the wrong presumption. The marketing rationale may be simply a reaction to the aggressive, highly-responsive marketplace wherein minicomputers are sold. This is not to say that DPD is not aggressive or responsive. But DPD, by virtue of its size, must operate in a more rigid environment; to do otherwise would invite chaos. GSD is leaner, less encumbered, and better poised to be responsive. For instance, should it become necessary, it is conceivable that GSD will give discounts to volume purchasers. The ramifications to such an action by DPD makes such action by that division impossible to conceive. Even the home of GSD symbolically represents a relatively more responsive organization. GSD is located in a vibrant city of the rapidly growing southeast. By contrast, DPD is located deep in establishment country of the established northeast.

GSD is offering the Series 1 and options in the standard IBM fashion. Basic configurations are offered to which the user can add features. This approach gives greater flexibility than offering a pre-established mix of features.

The communications interfaces do not include support for full-duplex lines (except for current-loop teletypewriter networks). There seems to be no reason for this limitation other than lack of an immediate demand by potential Series 1 users.

For the purchaser that can accurately identify his memory requirements, the Model Type 5 processor is a better



The half-width Series 1 chassis provides mounting for the Model 4953-A Processor and for the Diskette Unit. On the table are the 120 cps printer and the Display Station.

cycle time of 660 nanoseconds, a maximum allowable main memory storage size of 128K bytes, and a second I/O bus that gives the processor higher priority access to memory. The latter characteristic enables the Model Type 5 to operate at about three times faster than the Model Type 3 despite only a 20 percent difference in the logical unit cycle time.

Depending on Model, a maximum of from 56 to 72 communications lines can be attached to a fully expanded Series 1 system. Current communications options include six Communications Controller Interfaces for support of the following interfaces: EIA RS232C, CCITT V.24 and V.35, and local attachments. A 20 mA and a 60 mA current loop Teletype adapter is also provided. The protocols/codes supported by the hardware are: BSC, SDLC, PTTC/EBCD, and PTTC/Correspondence. Except for the full-duplex Teletype adapter, only half-duplex lines are supported. BSC lines can have speeds up to 56K bps; all other protocols can have speeds up to 9600 bps. The PTTC and Correspondence protocols are compatible with the IBM 2740 Models 1 and 2, and with the IBM 2741.

SERIES 1 ARCHITECTURE

The Series 1 processor, itself, consists of the microcoded logical unit, the arithmetic unit, and the system control functions. The processor is connected to an I/O bus that GSD calls the I/O Channel. This bus has an addressing capacity of 256 slots for attachment of both internal and external features. Internal features include main memory and floating point. External features include the Communications Controllers, mass storage devices, printers, display units, and sensor options.

Without exception, all external data processing features have direct memory access for transferring data to and from memory by way of the I/O Channel. (Sensor-based options do not have direct memory access.) Such transfers are done without processor intervention even though cycles must be stolen to execute the transfers. When the transfers are completed, an interrupt is triggered for processor action. There are four interrupt levels in the Series 1 processors. The user can assign each slot to an interrupt level, thereby assigning the associated attached device to one of four priorities. The devices assigned to the highest priority interrupt will receive processor attention even if a lower priority level device is, at that moment, receiving processor action. To accomplish this, a set of eight general registers, a status register, and an instruction address register is associated with each interrupt level. When a higher priority device causes an interrupt, the processor preserves the status of the lower priority's processing activity in the lower priority's associated registers and handles the higher priority request. The processor then retrieves the information saved in the lower priority's registers and completes the task. A device wanting interrupt processing but having the same priority level as a device currently receiving interrupt processing must await completion of the current processing before receiving attention.

Within the processor cabinet of the Model Type 3, a standard or full-width chassis can be mounted. In a Model Type 3 processor cabinet with a full-width chassis, the I/O Channel can physically accommodate attachment of 14 devices. One of the 14 slots is used to attach the 16K bytes of main memory that is standard with all models. The remaining 13 slots can be used for additional memory or for I/O devices. The 4953-B is a standard, full-width Model 3 and is pictorially represented in the accompanying Series 1 Bussing Structure diagram. The 4953-A has a chassis about half the size necessary to contain the 14-slot I/O Channel. This half-width version contains 5 slots. One slot is used to attach the 16K bytes of main memory, leaving 4 slots for additional memory or I/O devices.

Although all the Model Type 5's have a standard 14 slots in the processor cabinet, they are not all used on the I/O

IBM Series 1 Communications Capabilities

TABLE 1. IBM SERIES 1 AT A GLANCE

	Model Type 3		Model Type 5	
Processor model	4953-A	4953-B	4955-A	4955-B
Maximum allowable memory	64K bytes	64K bytes	64K bytes	128K bytes
Processor cycle time (nanoseconds)	800	800	660	660
Available slots in processor cabinet for attachments with 16K bytes of memory	4	13	8	3
Available slots in processor cabinet for attachments with maximum allowable memory	1	10	8	3
Number of 14-slot expansion chassis attachable	2	2	3	3
For fully expanded system with maximum memory:				
Number of I/O slots available	29	38	50	45
Number of communications lines physically attachable	56	72	72	66

buy than the Model 3. Costing only 20 percent more, the Model Type 5 is three times faster than the Model Type 3. Curiously, the monthly maintenance on a Model Type 5 is a dollar cheaper than on a Model Type 3.

Since the Series 1 can support sensor-based attachments along with communications lines, this minicomputer can be used to supply data to larger computers as a by-product of controlling a process.

In the final analysis, until the software arrives, the potential of this orthodox minicomputer hardware is unknown.□

Channel bus. Some of the slots are utilized by the second bus, the Memory Channel. The Memory Channel is restricted to attachment of memory increments. The I/O Channel is restricted to attachment of I/O devices and internal devices other than memory.

In order for I/O devices to transfer data into memory without processor intervention, a connection is needed between the two buses. To accomplish this, two slots are sacrificed. The Series 1 Bussing Structure diagram shows, pictorially, how data is transferred between the I/O Channel and the Memory Channel.

While the two shaded slots (representing the connection between the two buses) provide transfer of data between the two channels, they restrict contention for memory access to one I/O device at a time. The result is that when the processor is also contending for memory access, it has to fight only one I/O device at a time. In effect, the processor can never be more than second on line for access to memory. This is quite a different story than what can happen in the Model Type 3. There, the processor has to buck all the I/O traffic to obtain access to memory. High I/O activity could cause the processor to wait. In the Model Type 5, by having better access to memory, the processor could be accomplishing productive work while the I/O devices pour forth their electronic words into memory and visa versa. The effect to the I/O devices is nil, but the effect to the total system in terms of throughput is dramatic.

The number of the available 12 slots given to the Memory Channel and to the I/O Channel must be pre-set depending on the maximum amount of memory to be added to the system. If the system is to have a 128K bytes capacity, 8 slots must be assigned to the Memory Channel. This leaves four slots for the I/O Channel. One of the four slots must be used for the Storage Address Relocation Translator, a feature required when memory is in excess of 64K bytes. The three remaining slots can be used for I/O devices. Expansion Units would be required for attachment of additional I/O devices. The Model 4955-B is offered with the slots arranged in this manner. The Model 4955-A is arranged with four slots used for memory and eight slots available for I/O devices.

SERIES 1 PROCESSORS

Each of the four basic models include 16K bytes of MOS storage, power failure detect/auto restart, base power, and 4 priority interrupt levels. Every model permits expansion of main memory in 16K bytes increments. Each model, with certain limitations, permits addition of Expansion Units for adding more attachments than permitted in the basic unit.

***The Model Type 3 Processor* currently consists of two offerings: the 4953-A and the 4953-B.**

The basic *4953-A* permits the use of only five slots on the I/O Channel. This limitation is due to the chassis of this model being one-half the width of the standard Series 1 chassis. The maximum memory permitted on this model is 64K bytes and four of the five slots are required to achieve the maximum memory. This permits the attachment of only one other device to the basic processor cabinet. The addition of an Expansion Unit permits attachment of more devices. The Model Type 3 permits attachment of two Expansion Units. Each Expansion Unit is a chassis providing attachment of up to 14 devices. The chassis are housed in a separate cabinet that can contain two chassis. The Channel Repower feature is required for each Expansion Unit attached. Of course, if the basic 16K memory is sufficient, four slots would be available for other attachments.

The basic *4953-B* includes 14 slots for attachment of internal and external features. As with the 4953-A, up to three memory increments can be added for a maximum of 64K bytes. This model can also have 28 more slots available for device attachment by the addition of 2 Expansion Units.

Following the pattern of the Model Type 3, the *Model Type 5 Processor* has two offerings: the 4955-A and the 4955-B.

The basic *4955-A* provides for attaching 8 non-memory devices and 3 increments of memory above the basic 16K memory module. The non-memory and memory slots cannot be interchanged. Maximum memory, when the three memory slots are used, is 64K bytes.

The basic *4955-B* provides for attaching 4 non-memory devices and 7 increment of memory above the basic 16K memory module. Memory on this model, therefore can reach 128K bytes. When the memory size exceeds 64K bytes, one of the four non-memory slots must be used for the Storage Address Relocation Translator feature. This feature must be attached to the slot with the lowest address.

IBM Series 1 Communications Capabilities

TABLE 2. COMMUNICATIONS CONTROLLER INTERFACE AND TELETYPE ADAPTER*

Line Interface Type	Controller Type	Timing	Speed, bps	Max. per chassis Controllers	Max. per chassis Lines**	Feature Number	Remarks
EIA RS232C/CCITTV.24 or Local Attachment	Single-Line	Async.	37.5-1200; 300-9600	14	14	#1610	Supports PTTC/EBCDIC or Correspondence codes for IBM 2740-1/-2 and 2741.
EIA RS232C/CCITTV.24	8-Line	Async.	37.5-1200 300-9600	3	24	#2091	See #1610; requires #2092 4-Line Adapter.
		Sync.	Up to 9600	14	14	#2074***	Supports EBCDIC, ASCII and unrestricted binary code; can be used for remote IPL.
		Sync.	Up to 2400	6	24	#2093***	Requires 4-Line Adapter, #2094.
			Up to 4800	4	16		
			Up to 9600	2	8		
	Single Line SDLC	Sync.	Up to 9600	14	14	#2090***	
Bell 303, CCITT V.35	Single Line BSC High speed	Sync.	Up to 56K	8	8	#2075	Can be used for remote IPL.
ASR33.35, Current Loop	Teletypewriter Adapter	Async.	50 to 9600	14	14	#7850	Full-duplex.

*All controllers except the High Speed BSC Single-Line Controllers can handle multi-point and both switched and non-switched point-to-point links. The High Speed BSC Controller can handle multi-point and non-switched point-to-point. All Controllers support only half-duplex lines.
**Limitation applies to the Processor Cabinet and each Expansion Unit. The Model 3 can have 2 Expansion Units; Model 5 can have 3 Units. The Processor Cabinet does not have sufficient I/O slots to reach the single line allowable maximum.
***Provides internal clocking.

Floating point is available for the Model Type 5 as an attachable device to the I/O Channel. When employed, floating point must be physically attached to the slot that is adjacent to the processor, providing the shortest electrical distance for between the processor and the floating point feature's processor. This feature provides 32-bit single precision and 64-bit double precision arithmetic plus conversion between binary and floating point data formats.

CONNECTION TO HOST COMPUTER

Attachment of a Series 1 processor to a host computer must be via communications lines. No adapters for parallel data transfer are offered at this time.

Employing the Series 1 as a front-end to a host would require the user to write the code to drive the front-end and to interface properly with the host access method.

TRANSMISSION SPECIFICATIONS

Six Communications Controller Interfaces are offered to support the following line interfaces: EIA RS232C, CCITT V.24, CCITT V.35, and Bell 303. Each of the six interfaces occupy one slot on the I/O Channel. Table 1, Communications Controller Interfaces and Teletype Adapter, lists the six interfaces; their line speeds; and configuration interface limitations. The number of communications lines the system can support based on line interface, line speed and the interface features selected, can be derived using the table. The Processor Cabinet and each Expansion Unit can not contain more than 24 communications lines of any mix.

An adapter to interface with a 20 mA or 60 mA current loop for ASR 33/35 teletypewriters is also offered. The adapter supports full-duplex mode lines, while the interfaces currently support only half-duplex lines.

The synchronous Communications Controller Interfaces support BSC protocol up to 56K bps and SDLC protocol up to 9600 bps. All controllers except the High Speed BSC Single Line Controller can handle multi-point and both switched and non-switched point-to-point links. The High Speed BSC Controller can handle multi-point and non-switched point-to-point links. All of the controllers except the High Speed BSC Controller support auto answer and auto dial. The BSC protocol lines can be used to IPL (load) the Series 1 remotely.

Two of the interfaces support more than one line. These two interfaces, the 8-line Asynchronous, and the 8-line BSC, require Line Adapters. The 8-line Asynchronous Interface requires one or two 4-Line Line Adapters, Feature #2092. The 8-line BSC Interface requires one or two 4-Line Line Adapters, Feature #2094.

A Communications Indicator Panel feature can be attached to a controller interface. The feature permits visual display of the status and conditions of the line. When the controller is an eight-line controller, a select switch on the feature permits monitoring each of the eight lines, one line at a time. The feature permits manual setting of a modem being monitored to Data Set Ready, Clear to Send, or Transmit/Receive Data conditions.

The Communications Power feature is required on any full-width Series 1 processor when a Communications Controller Interface is attached.

SOFTWARE

The essence (Task Management) of an operating system is supplied as a sub-set of the Control Program Support software package. The user is expected to append additional code to arrive at an installation operating system. Task Management provides the following functions: Task Dispatcher, Basic Overlay Support, Timer Support, and Supervisor Call.

Task Dispatcher permits the user to initiate parallel tasks. This function also coordinates their execution. The Basic Overlay Support function controls overlaying segments of coding in memory as required by the application programs. The Timer Support function provides a time counter to supply user programs with time intervals or to trigger the start of user programs at specified time intervals. The Supervisor Call function provides user program interface with the Task Management support functions.

Error Logging of Machine errors is another function provided under the Control Program Support package along

IBM Series 1 Communications Capabilities

with Task Management and the DP I/O Support. The latter controls reading and writing for the disk, diskette, operator station, and printer.

The Base Program Preparation Facilities software includes a Text Editor, a Macro Assembler, and a Linkage Editor. The Text Editor is used to enter and modify source data and to include existing macros into the program. The Macro Assembler is used to assemble the source programs. The object code from the Macro Assembler is put into executable form by the Linkage Editor. Also included in the Base Program Preparation Facilities package are a series of standalone utility programs including IPL bootstrap and loader from various mass storage devices, copy and dump programs, and patch routines.

MASS STORAGE

Mass storage includes a non-removable disk unit and a diskette unit. The non-removable Disk Storage Unit can contain 9,308,160 bytes of data storage accessed by moving heads. An optional 122,880 bytes of storage can be accessed by fixed heads. Another option is a 0.5 megabyte diskette as an integral part of the non-removable Disk Storage Unit. The Disk Storage Unit Attachment feature is required to attach up to two Disk Storage Units to one slot of the I/O Channel. If the integrated diskette is included in the Disk Storage Unit, the Diskette Unit Attachment feature is also required, occupying another slot.

Head movement time for the disk averages 40 milliseconds with an average rotational delay of 10.1 milliseconds. The disk has two data heads, one on each side of the disk. There are 303 data tracks under each head, 60 sectors per track and 256 bytes per sector.

The Diskette Unit is a drive for a floppy disk that can contain 492K, 568K, or 606K bytes of data with a respective blocking size of 128, 256, or 512 bytes per sector. There are 26 sectors per track and 74 data trades per diskette. The Diskette Unit Attachment feature is required to attach one Diskette Unit to one slot of the I/O Channel. The average single track access time is 5 milliseconds. Rotational delay averages 83.8 milliseconds, and the head setting time is 35 milliseconds.

OTHER COMPONENTS AND FEATURES

The operator console can be a teletypewriter connected to an I/O Channel slot by the Teletype Adapter.

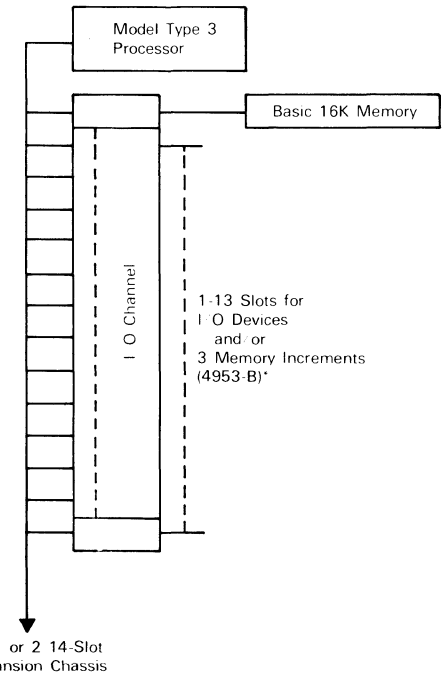
A table top, 120 character-per-second, matrix printer is offered. Up to 132 characters per line can be printed at a spacing of 10 characters per inch. The Print Attachment feature is required to attach the printer to one slot of the I/O Channel. This bi-directional printer can accommodate continuous forms from 3 to 14 inches wide, or cut forms from 3 to 15 inches wide.

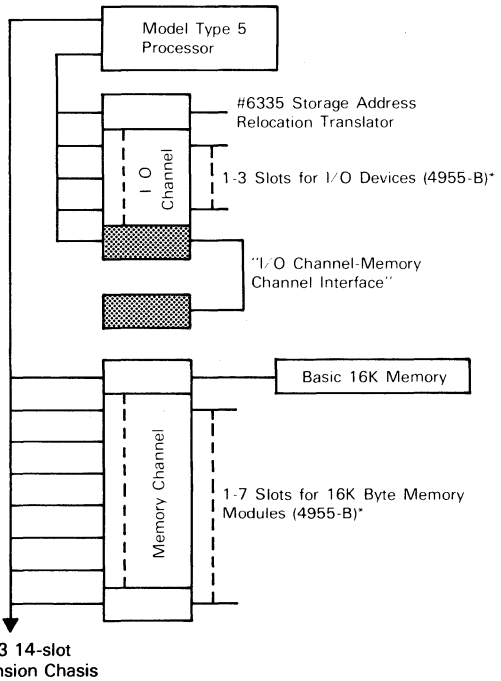
A 1920-character table top Display Station is offered with a 66 key keyboard. The CRT screen displays 24 lines of 80 characters per line. The Display Station Attachment feature is required to attach the station to one slot of the I/O Channel.

A sensor input/output unit with eight sensor I/O feature cards per unit is available. The Sensor I/O Unit Attachment feature is required to attach the sensor unit to one slot of the I/O Channel.

A Programmer Console with a hexadecimal key pad, display lights, and the capability to stop on an error or on a specified address. The console can also be used for data entry. Only one Programmer Console can be attached to a Series 1 because the console is attached directly to the processor and does not occupy a slot of the I/O Channel.

SERIES 1 BUSSING STRUCTURE





*The 4953-A processor is similar except that only four additional slots are provided with the half-width chassis.

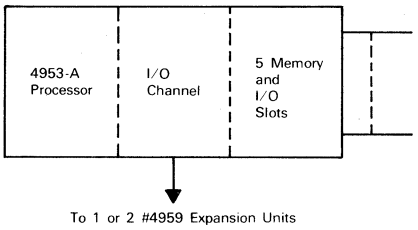
*1-8 I/O device slots plus 1-3 memory increment slots are provided by 4955-A Processor.

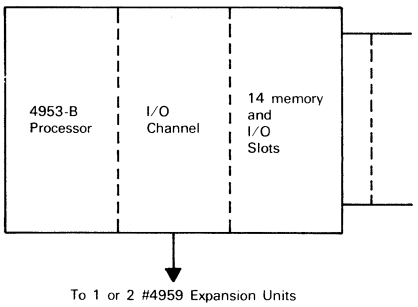
The processor and all I/O devices have access to memory through the 14-slot I/O channel bus on an equal priority basis. By splitting the 14 slot bus into two busses as shown above, the processor and all I/O devices still have access to memory (through the Memory Channel). The priority balance, however has shifted. All the I/O devices combined have the same priority as the processor. Therefore, the processor can never be more than second on line for access to memory. This arrangement nulified use of two slots.

IBM Series 1 Communications Capabilities

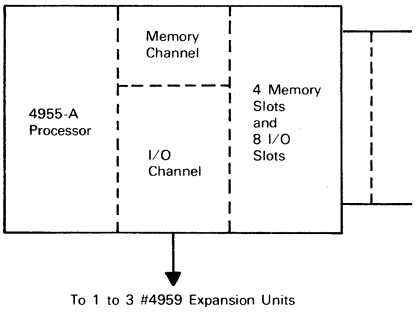
CONFIGURATION

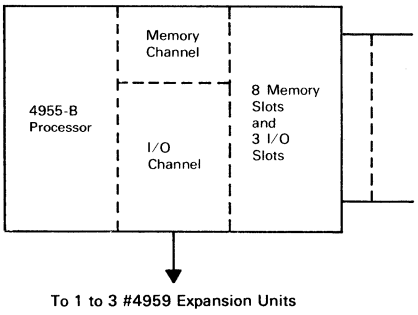
Model Type 3 Processors





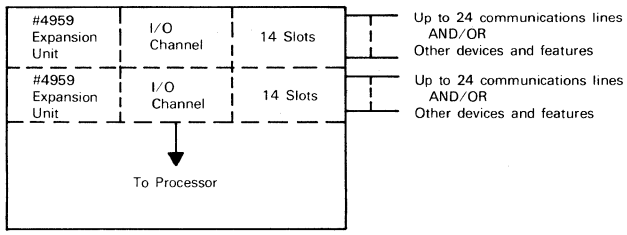
Model Type 5 Processors



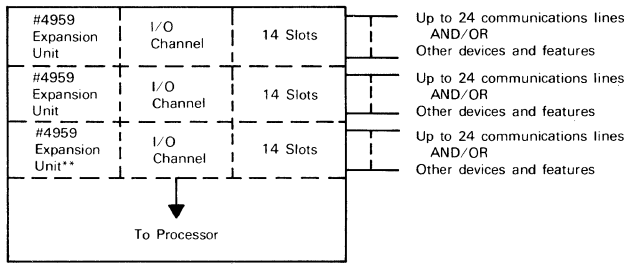


Expansion Chassis

4997 Model 1 A or B* Rack Enclosure



4997 Model 2 A or B* Rack Enclosure



*B Enclosures are decorative versions of A enclosures.
**Third #4959 Expansion Unit cannot be added if #1999 Battery Back Up Unit is included.

IBM Series 1 Communications Capabilities

The Timer feature provides two timers. Each timer can be programmed so that a "one" is added to a counter everytime a specified time interval has elapsed; this interval is called a frequency precision. When the counter reaches a pre-determined number, the timer program will trigger an interrupt and reset the counter to zero. The maximum number the counter can contain is 32,767. The frequency precision or time interval between the addition of "one" to the counter can be set at one or more microseconds. This interval also represents the maximum deviation of the time expected when the interrupt is triggered. An external source can also be used for the frequency precision.

A Customer Direct Program Control Adapter feature provides for attachment of up to 16 customer devices for direct customer programatic control of data transfer. Each device can transfer up to 16 bit words. A Customer Access Panel feature is necessary for the foreign devices.

For sensor-based systems, an Integrated Digital I/O Non-Isolated feature for 32 input and 32 output points is offered. The Customer Access Panel feature is also required for this feature.

A Battery Backup Unit feature is available. The unit operates from the user-supplied batteries and chargers. When this unit is used with the Model 5, only two Expansion Units can be added to the system.

PRICING

The Series 1 is available on a purchase basis only. A maintenance contract is available on a monthly charge basis per feature. Software is offered on a monthly license fee arrangement; after twenty-four months, the fee is waived. The equipment has a three month warranty. Initial installation is without charge.

		Purchase Price	Monthly Maint.
4953-A	Model 3 Processor 16K, 3 slots	4,360	80
4953-B	Model 3 Processor 16K, 13 slots	5,190	78
4955-A	Model 5 Processor 16K, 8 I/O Slots	6,165	77
4955-B	Model 5 Process 16K, 3 I/O slots	6,165	77
4997-1A	Expansion Rack Enclosures 2 units	870	2
4997-2A	Expansion Rack Enclosure, 4 units	1,160	5
4997-1B	Expansion Rack Enclosure, 2 units decorative	1,025	2
4997-2B	Expansion Rack Enclosure, 4 units decorative	1,315	5
4959	I/O Expansion Unit	2,515	37
	COMMUNICATIONS CONTROLLER INTERFACES		
1610	Single-Line, Asynchronous	1,090	17
2091	8-Line, Asynchronous	975	13
2074	Single-Line, BSC	1,190	19
2093	8-Line, BSC	1,215	13
2090	Single-Line, SDLC	1,420	19
2075	Single-Line, BSC, High Speed	1,380	21
7850	Teletype Adapter	560	11
	LINE ADAPTERS & COMMUNICATIONS RELATED FEATURES		
2092	4-Line, Asynchronous (for #2091)	1,005	30
2094	4-Line, BSC (for #2093)	1,245	35
2010	Communications Power	120	3
2000	Communications Indicator Panel	250	3
	MEMORY		
6325	16,384 bytes of memory for Model 5	1,750	8
6315	16,384 bytes of memory for Model 3	1,510	10
6335	Storage Address Relocation Translator	805	9
	DISK AND DISKETTE STORAGE		
3580	Disk Storage Unit Attachment for #4962	815	8
4962-1	Disk Storage Unit; 9,308,160 bytes	6,895	44
4962-1F	Disk Storage Unit; 9,308,160 bytes plus 122,880 bytes fixed head storage	7,760	60
4962-2	Disk Storage Unit; 9,308,160 bytes plus 492,544 bytes diskette storage	8,575	60
4962-2F	Disk Storage Unit; 9,308,160 bytes plus 122,880 bytes fixed head storage and 492,544 bytes diskette storage	9,440	76
3581	Diskette Unit Attachment for #4964	730	8
4964	Diskette Unit	2,410	17
	OTHER PERIPHERALS		
3585	Display Station Attachment for #4979	955	10
4979	Display Station	1,735	25
5620	Printer Attachment for #4974	930	3.50
4974	Printer, 120 cps	4,450	54
5650	Programmer Console	460	6

IBM Series 1 Communications Capabilities

		Purchase Price	Monthly Maint.
	PROCESSOR OPTIONS		
7840	Timers	570	4
5430	Customer Direct Program Control Adapter	660	11
3920	Floating Point, Model 5 only	1,190	11
1999	Battery Backup Unit	1,895	18
1565	Channel Repower	520	2
1590	Customer Access Panel	180	—
	SENSOR BASED COMPONENTS		
1560	Integrated Digital I/O Non-isolated	825	14
6305	Sensor I/O Unit Attachment for #4982	650	11
4982	Sensor I/O Unit	1,655	11
	CABLES		
2055	Teletypewriter	52	0.50
2056	Asynchronous Local Attachment	47	0.50
2057	EIA Data set	70	0.50
2058	BSC/High Speed	125	0.50
2059	Teletypewriter Cust. Access Panel	40	0.50
2060	BSCV.35/High Speed DDN	122	0.50

		Monthly License Fee*
	SOFTWARE	
	Control Program Support	15.50
	Base Program Preparation Facilities	90.00

*Fee waived after 24 months.■

IBM Series 1
New Product Announcement

Five months after the introduction of the Series 1 hardware, IBM has introduced the software necessary to drive the equipment both as a data processor and as a communications processor.

Datapro's Series 1 write-up in the April 1977 supplement pointed out that the absence of Series 1 software was incomprehensible, and that IBM would eventually provide software to drive the minicomputer. While we expected such capabilities in the near future, we did not expect an announcement as the supplement was being printed. Along with the introduction of a real-time operating system, and two compilers, IBM announced enhancements to the existing bare-subsistance software (Control Program Support), especially for handling communications lines. Four additional processor models, a display station, and a printer were introduced along with the new software.

From a network standpoint, Series 1 software now supports a BSC protocol communications interface with a System/370, and a System/3-compatible interface; no other inter-processor arrangements are directly supported. Further communications announcements will be necessary to determine the scope and the direction of network configurations and capabilities that Series 1 will support.

SOFTWARE

Real-Time Programming System

The new Series 1 operating system is called The Real-Time Programming System (RPS); it is a multiprogramming, multitasking, event-driven, disk-based operating system for both real-time and batch processing. Up to 64K bytes of memory can be divided into multiple fixed partitions. One job stream of one or more application programs (task sets) can be run sequentially in each partition. The program operating in a partition can operate in a multitask mode with tasks competing for processor cycles based on their task priority. The capability to roll-out and roll-in programs in a partition is provided.

Task sets, or job streams, can be event-driven and triggered by external interrupt, time of day, time interval, operator request, or program request.

The operating system must reside on a disk while the user program library can be on disk or diskette.

Asynchronous communications lines and Binary Synchronous communications lines are supported by the operating system communications supervisory routines. The communications routines support lines attached to IBM 2740 Model 1 Communications Terminal to Teletype terminals, and to an IBM System/370, using OS/VS1 or OS/VS2 BTAM. Switched and non-switched arrangements are supported. Multi-point arrangements are not supported; only point-to-point hook-ups are supported.

RPS supports all of the Communications Controller Interfaces and the peripherals offered for the Series 1.

The minimum hardware configuration for communications systems that use RPS is: 48K bytes of memory, an IBM 4962 Disk unit, an IBM 4962 Diskette unit, and an operator console.

A Program Preparation Subsystem is available and can operate concurrently with production programs in other partitions. The subsystem includes:

- Job Stream Processor—Provides an easy-to-use command language for initiating one, or a stream of batch jobs.
- Text Editor—Offers a variety of commands to create, display, and modify text modules; can be operated in an interactive or non-interactive mode.
- Macro Assembler.
- Application Builder—Converts one or more object programs into an executable load module to operate as a task set in a partition.

IBM Series 1
New Product Announcement

A Mathematical and Functional Subroutine Library package is offered to supply frequently used subroutines. Included are such mathematical functions as sine, cosine, logarithms and exponentials, etc. Routines for conversion between EBCDIC data format and Series 1 data format are included. All subroutines are re-entrant.

Compilers

A PL/1 compiler is offered for general purpose programming and offers the general capabilities provided by FORTRAN, COBOL, and ALGOL. The compiler is designed for use by business, industrial, and scientific application users and is a subset of the American National Standards Programming Language PL/1 (ANSI X3.53-1976).

A FORTRAN IV compiler is offered for the Series 1 that meets most of the American National Standard FORTRAN (X3.9-1966) standards.

Standalone Utilities

Several routines are offered for start up and maintenance, but cannot be run concurrently with other applications. The routines include System Build, Initialization, Copy, Patch, Dump, Bootstrap/IPL, and Error Logging.

Control Program Support Enhancements

Prior to the new software offerings, Series 1 minimum operating software support was the Control Program Support system. The system included a Task Dispatcher, Basic Overlay Support, Timer Support, and Supervisor Call Support.

With the use of the Extension II enhancement, the Control Program Support system now provides data editing, EBCDIC/Binary conversion, Time/date Reference, and Task Scheduling. With the use of the Extension I enhancement, I/O queuing, data file integrity, and buffer pooling functions are added. With the 4978 Display Station Control Program Support enhancement, read and write support for the IBM 4978-1 is provided.

The Binary Synchronous Communications Control Program Support enhancement provides support for Binary Synchronous Communications Interfaces including point-to-point operation, transparent read/write, auto answer, trace facilities, System/3 compatibility, and error logging to disk or diskette.

The Indexed Access Method Control Program Support enhancement provides indexed storage of data on disk or diskette units.

The new software announcements give existing Series 1 users a workable set of operating system elements.

The new (and old) user now can have a more comprehensive operating system, two compilers, and more utilities. The scheduled availabilities and costs for each package are listed below:

	One-time Charge	Monthly Charge	Availability
Realtime Programming System	$1,200	$20	10/28/77
Program Preparation Subsystem	1,104	18	10/28/77
PL/1 and Subroutine Library	3,072	51	4/28/77
FORTRAN IV and Subroutine Library	1,152	19	10/28/77
Mathematical and Functional Subroutine Library	408	7	10/28/77
Standalone Utilities	NC	NC	10/28/77
Control Program Support Extensions II	—	1.50	7/29/77
Control Program Support Extensions I	—	1.50	7/29/77
Display Station Control Program Support	—	1.50	7/29/77
BSC Control Programs Support	—	3.50	10/14/77
Indexed Access Method Control Program Support	—	5.00	10/14/77

Control Program Support enhancement charges are waived after twenty-four months. For the other packages, users electing to pay a monthly charge will accrue up to 50 percent of the charge towards outright payment. Accrued credits cannot exceed 50 percent of the one-time charge payment.

HARDWARE

One additional processor model was introduced to complement each of the original four models offered in the Series 1 line. Prior to this announcement, only 16K-byte memory increments could be attached to the Series 1; each increment occupied one bus slot. The four new models offer users 32K-byte increments, each occupying one slot. The result is that more slots are available for other attachments. In the chart below, the new models are shown in bold type.

Two models of a free standing, impact line printer were also introduced: the 150-line per minute 4973-1, and the 400-line-per minute 4973-2. The Model 1 printer can be purchased for $8,625; the Model 2, for $12,425. Monthly maintenance is $5 per month for both models. A table-top CRT with a moveable keyboard, the 4073 Display Station, is available with a 1920 character screen. A two keyboard model is also offered. The Display Station can be purchased for $1,320.□

A SECOND GLANCE AT SERIES 1

	Model Type 3				Model Type 5			
	Half-width Chassis		Full-width Chassis		Full-width Chassis			
Processor:								
Model	**4953-C**	4953-A	**4953-D**	4953-B	**4955-C**	4955-A	**4955-D**	4955-B
Cycle time, nsec	**800**	800	**800**	800	**660**	660	**660**	660
Memory, bytes:								
Minimum	**32K**	16K	**32K**	16K	**32K**	16K	**32K**	16K
Maximum	**64K**	64K	**64K**	64K	**64K**	64K	**128K**	128K
Increment	**32K**	16K	**32K**	16K	**32K**	16K	**32K**	16K
Basic cabinet I/O slots with:								
Min. Memory	**4**	4	**13**	13	**10**	8	**7**	3
Max. Memory	**2**	1	**12**	10	**10**	8	**7**	3
No. of 14-slot Expansion Chassis attachable	**2**	2	**2**	2	**3**	3	**3**	3
Fully expanded system:								
I/O slots with max. memory	**30**	29	**40**	38	**52**	50	**49**	45
No. of Comm. lines physically attachable	**64**	56	**72**	72	**96**	96	**96**	88
Processors:								
Purchase Price	**$5,870**	$4,360	**$6,700**	$5,190	**$7,915**	$6,165	**$7,915**	$6,165
Monthly Maint.	**88**	80	**88**	78	**87**	77	**87**	77
Memory Increments:								
Purchase Price	**2,425**	1,510	**2,425**	1,510	**2,850**	1,750	**2,850**	1,750
Monthly Maint.	**22**	10	**22**	10	**14**	8	**14**	8