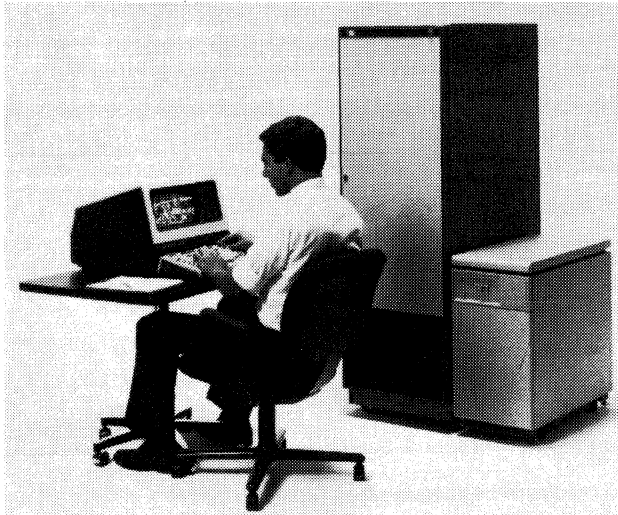


Hewlett-Packard HP 1000 Communications Capabilities



The HP 1000 Model 60, Series E, shown above, with the RTE-6/VM operating system offers large program data capabilities with virtual storage.

MANAGEMENT SUMMARY

The Hewlett-Packard 1000 is a modular board, box, desktop, or cabinet small computer system which may be used as a front-end processor, concentrator, terminal controller or other communication function. Since the inception of the HP 1000 in 1974, Hewlett-Packard has continuously enhanced this product's capabilities with new processors and advanced features.

The product line presently consists of two distinct segments: the more mature E, F, and M Series and the more recent A and L Series. The A and L Series have a different architecture, faster throughput, and better performance than the older processors. The E, F, and M Series of processors is still supported and offers at least as many communications alternatives. Despite the differences, software may be executed on all models without modification.

The L-Series was introduced in March of 1980. This new family offers built-in Direct Memory Access (DMA) and a transfer rate of 2.7 megabytes per second. In a communications environment, this frees the processor from many of the mundane interruptions that take place, and allows the processor to devote more of its valuable machine cycles to communications processing.

HP is moving so quickly, in fact, that they have already replaced the first L-Series processor models with the even faster A-Series, which was introduced in February of 1982. Hewlett-Packard rates the A-Series' speed at one MIPS (millions of instructions per second) or just slightly below the rating for the top-of-line HP 3000 Model 64. The A-Series has a transfer rate of 4.3 million bytes per second and is also equipped with DMA.

A versatile family of small computers that may be used as front-end processors, terminal controllers, or network hosts when teamed with the appropriate hardware interfaces and support software. An HP 1000 may control its own terminal network or may be configured with other HP 1000s and HP 3000s.

Communications capabilities via Hewlett-Packard's Distributed System Network include HP 1000 to 3000, HDLC, X.25, bisynchronous, and asynchronous communications when using DS/1000-IV.

A typical configuration of an HP 1000 Model F, with 256K bytes of memory, 64-megabyte disk, RTE-6/VM operating system, DS/1000-IV communications software, 16 asynchronous ports, and two interface boards, sells for a purchase price of \$60,940. Maintenance is \$347 per month.

CHARACTERISTICS

VENDOR: Hewlett-Packard Company, Information Networks Division, 19420 Homestead Road, Cupertino, California 95014. Telephone (408) 725-8111.

DATE OF FIRST ANNOUNCEMENT: M-Series: Model 2108—May 1974; Model 2112—May 1975; E-Series: Models 2109 and 2113—December 1975; Model 40—May 1978; Model 60—September 1981; F-Series: Models 2111 and 2117—May 1978; Model 45—May 1978; Model 65—September 1981; L-Series: Models 2103 and 2122—March 1980; Model 5—May 1981; A-Series: all models—February 1982.

DATE OF FIRST DELIVERY: M-Series: Model 2108—August 1974; Model 2112—October 1975; E-Series: Models 2109 and 2113—September 1976; Model 40—September 1978; Model 60—September 1981; F-Series: Models 2111 and 2117—August 1978; Model 45—September 1978; Model 65—September 1981; L-Series: Models 2103 and 2122—March 1980; Model 5—May 1981; A-Series: all models—June 1982.

NUMBER DELIVERED TO DATE: 40,000 HP 1000 computers; over 5,500 HP 1000 DSN nodes.

SERVICED BY: Hewlett-Packard Company.

CONFIGURATION

The HP 1000 processor family consists of the A, E, F, L, and M Series, which are offered in a variety of configurations to meet specific customer requirements. The E, F, and M families have a different architecture than that of the A and L processor families. Consequently, many of the communication/terminal and other interfaces apply only to either the E, F, and M Series or the A and L Series of processors.

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▷ The HP 1000 product line may be expanded or adapted for communications use by adding interface boards to input/output slots, the available number of which varies from model to model. In another effort to free the main processor from low-level tasks, Hewlett-Packard has also been methodically upgrading many of these interface boards. All of the new ones and some of the mature ones now include their own intelligence and memory to relieve potential burdens from the processor. Some are even user programmable.

Distributed Systems Network (DSN) is the communications convention that has been established among Hewlett-Packard computers. Under DSN, HP systems may exchange information across Hewlett-Packard product lines.

The HP 1000 software package which enables DSN cross-computer communications is known as DS/1000-IV. This software supports all communications activity. It may be used to link an HP 1000 at data rates as high as 57,600 bits per second to an HP 3000 as a front-end processor or to interact with remote 3000s. Under DS/1000-IV and with appropriate interfacing, X.25 Level 1 and 2 gateways are provided. With software feature 91751A, the additional software support for X.25 Level 3 packet switching is also able to be achieved. HDLC protocol support and multipoint interchange with terminals may also be established under DS/1000-IV's direction.

A characteristic of HP 1000 communications is modularity and extreme flexibility. Even though the communications software is loaded in the same machine running applications software, the communications software is segregated, permitting the user to modify communications functions without disturbing the applications. This is very similar to arrangements found in much larger mainframes and is not only true for the software which drives the HP 1000 in communications with other processors, but also for the software that links a single terminal to the 1000. A single support package is available, for example, which facilitates the handling of all multipoint terminals.

A peer relationship may also exist between HP 1000s acting as nodes. Each node is capable of initiating or responding to a remote processor's signal, such as a request for a file transfer. DS/1000-IV in a nodal arrangement allows for configuration of ring, star, or other topologies.

The HP 1000 performs under the supervision of six current operating systems, as outlined in Tables 1 and 3. The two that offer the greatest memory, disk file, and communications support are the RTE-A.1 for the A-Series and RTE-6/VM for the E, F, or M Series. Software written on obsolete operating systems within the product line may still be executed by the current versions.

The result of these continuing enhancements is a powerful small computer that a user may optimize for various

▶ The HP 1000 processors are mounted in standard 19-inch racks along with the operator panel and chassis. The packaged system models offer both an upright cabinet and a desk-mounted configuration.

Depending upon model, each HP 1000 processor model offers a certain number of I/O slots as standard:

- A-Series Processor 2197—13 I/O slots; Processor 2186A—three I/O slots; Processor 2186B—four I/O slots; Processors 2196 and 2137A—16 I/O slots; Processor 2156A—18 I/O slots; Processor 2136A—three I/O slots; and Processor 2136B—five I/O slots.
- E-Series Processors 2176 and 2178—11 I/O slots; Processor 2109—nine I/O slots; and Processor 2113—14 I/O slots.
- F-Series Processors 2179 and 2177—10 I/O slots; Processor 2111—nine I/O slots; and Processor 2117—14 I/O slots.
- L-Series Processors 2122A and 2142A—three I/O slots; Processor 2142B—four I/O slots; Processor 2103—eight I/O slots; and Processor 2122B—five I/O slots.
- M-Series Processor 2108—nine I/O slots; Processor 2112—14 I/O slots.

E, F, and M Series Processors

In addition to the standard slots, there are two 16 I/O slot extenders allowed per processor. This yields a maximum, for example, of 42 I/O slots on the F-Series 2179 processor. Communications devices and line adapters must contend with peripherals, but not add-on memory units, for I/O slot space. Generally, each device requires one I/O slot; however, some of the communication interfaces require more than one slot. Table 2 shows the number of slots required by each line interface.

There are two I/O mechanisms common to the E, F, and M Series processors: programmed I/O, and Direct Memory Access (DMA). DMA channels, such as those used for communications links to remote processors, access the host through an optional Dual-Channel Port Controller (DCPC). The DCPC contains all necessary logic to control DMA transfer for multiple devices. This arrangement avoids the need for redundant DMA control logic in each individual I/O controller. DMA data transfers, once the DCPC has been initialized by the program, proceed automatically. Programmed I/O, on the other hand, permits the computer to manipulate the data as it is transferred, and to do other work between interrupts.

The E, F, and M Series use a vectored priority interrupt system which has over 54 distinct interrupt (priority) levels. The top four levels are devoted to power failure, parity checking, memory protection, and then DMA transfers via the DCPC. The remaining 50 levels are assigned to all other I/O devices and communications interfaces. With M-Series processors, the maximum programmed I/O transfer rate is 91K bytes per second. The DMA transfer rate is 1.23 megabytes per second. In comparison, the E and F Series feature a programmed I/O transfer rate of 384K bytes per second, and over 2 megabytes per second via DMA.

Table 1 compares the various HP 1000 Series models including memory range, number of I/O slots, and operating system compatibility.

A and L Series Processors

In addition to the standard slots, the L-Series processors can utilize up to two, five, 10, or 16 I/O slot extenders. The A-

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communication tasks by selecting the appropriate hardware interfaces and support software. So impressive are the HP 1000's communications qualities that Hewlett-Packard now estimates that 12 percent of the 40,000 HP 1000 processors now installed are found performing a major dedicated communications activity. □

► Series chassis may not be extended beyond the standard number of I/O slots. Communication interfaces, peripherals, and memory add-ons require one slot each.

Like the E, F, and M Series, the A and L Series have dual I/O mechanisms, Direct Memory Access and programmed I/O. Unlike the E, F, and M Series, which require an optional DCPC for multiple DMA transfers, the A and L Series processors use faster CMOS memory and have their own microprocessors dedicated for DMA control as a standard feature. Programmed I/O is also possible and allows the computer to manipulate data transfers on an interrupt basis. The A-Series transfer rate is 4.3 megabytes per second via DMA. The L-Series transfer rate is 2.7 megabytes per second for DMA.

COMMUNICATIONS INTERFACES

Hewlett-Packard offers a choice of asynchronous communications interfaces, asynchronous multiplexers, and synchronous communications interfaces to be used in conjunction with Distributed Systems/1000-IV software support. All will work with any operating system generic to the processor family unless specifically noted. Most may only be used with either the E, F, and M Series or the A and L Series.

E, F, and M Series Interfaces

The interfaces compatible with the E, F, and M Series processors include:

- **12889A HARD-WIRED SERIAL INTERFACE:** This is a non-intelligent special-purpose high-speed serial asynchronous interface for direct (point-to-point) data communications between two HP 1000 Series computers. At a distance of 1,000 feet the maximum data rate can be 250K bits per second; at 2,000 feet this data rate is halved. The feature is a single card, with data transmission taking place in one of four modes: program to program, program to DCPC, DCPC to program, or DCPC to DCPC. Included are automatic data acknowledgement (handshaking hardware), cyclic redundancy check (CRC) hardware for generation, transmission, and processing, and a 6-bit hardware address recognition circuit. The CRC uses a 15th degree polynomial. A pair of 75-ohm coaxial cables (30220A) functions as a unidirectional pair of transmission lines for fast turnaround. The cable is optically isolated at the receiving end, enabling long-distance transmission with a low probability of errors due to common-mode noise or ground-level shifting. Software support is provided by DS/1000-IV.
- **12826B PROGRAMMABLE SERIAL INTERFACE:** This Z-80 based intelligent device may be used to perform the same serial asynchronous tasks as the 12889A. However, unlike the 12889A, on which functions are implemented in firmware, this interface allows the user to program its functions to meet specific requirements.
- **12792A 8-CHANNEL ASYNCHRONOUS MULTIPLEXER:** This unit provides EIA or CCITT interfacing for up to eight asynchronous, full-duplex RS-232-C compatible devices. User-selectable data rates may be selected on an individual line basis up to 19.2K bps for a single channel, or up to 9600 bps when all eight channels

are used. Selectable data rates are: 50, 75, 110, 134.5, 150, 300, 1200, 1800, 2400, 3600, 4800, 9600, and 19.2K bps. Each of the eight channels has two 254-byte transmit and two 254-byte receive buffers. An RS-232-C 8-junction panel (12828A) is available to provide direct EIA 25 pin standard connection.

- **12920B 16-CHANNEL ASYNCHRONOUS MULTIPLEXER:** This interface provides EIA or CCITT interfacing for up to 16 full-duplex asynchronous devices of up to 2400 bps on any channel. The 12920B is compatible with Bell 103A and 212A or equivalent modems and the Bell 801C or equivalent auto dial unit. This unit may be used with any E, F, or M Series processor running under any operating system except RTE-6/VM.
- **12825A AND 12794B HDLC NETWORK INTERFACES:** This unit allows direct connection of an E, F, or M Series processor to a full-duplex HDLC channel using DS/1000-IV network software. This intelligent interface provides 16K of RAM for message buffering. The 12794B provides the same capabilities using a modem interface instead of direct connect.
- **12250A X.25 NETWORK INTERFACE:** This interface allows system or terminal to access private or public CCITT X.25 packet switched networks when accompanied by the prerequisite 91751A X.25 software support package. The 12250A provides connection via RS-232-C with maximum data rates of 19.2K bps for public data network connections and 57.6K bps for private point-to-point communications. An X.25 network may be entered via DS/1000-IV or through user-developed software. Compatible modems are Bell-type 201, 208, 209, and 212 data sets.
- **12834A AND 12793B BINARY SYNCHRONOUS INTERFACES:** This unit manages a bisynchronous communication link between an HP 1000 Series E, F, or M and an HP 3000 computer system when both systems are operating in a DS/1000-IV environment. It supports full- or half-duplex modems at rates of up to 57,600 bps. It provides 16K of on-board RAM for buffering and CRC-16 error checking. The 12793B interface provides the same capabilities as the 12834A using a modem interface instead of direct connect. Both of these interfaces are not designed for general purpose BSC use, but strictly as HP 1000 to HP 3000 computer system links.
- **12830A DATA LINK SLAVE INTERFACE:** This interface allows an E, F, and M Series computer to act as a host to a slave computer in a multipoint asynchronous or bisynchronous connection. This intelligent Z-80 based unit supports asynchronous data rates of up to 19.2K bps.
- **12967A SYNCHRONOUS COMMUNICATIONS INTERFACE:** This is a half-duplex synchronous interface with reverse channel capability that is programmable in HP assembly language and operates with Bell-type 201, 203, 208 or equivalent data sets. Under program control are parity generation/checking (odd, even, or none) and data set status monitoring for interrupt (for any character with one masking instruction). The choice of a synchronization character is switch-selectable, and the character length is fixed at eight bits. The unit's maximum data rate is 19.2K bps. The 12967A has a 2-character buffer. No LRCC or CRCC checking or special character recognition is provided. A user-written driver, programmed in assembly language, is required to run this interface in a real-time computer system.
- **12618A SYNCHRONOUS COMMUNICATIONS INTERFACE:** This is a full-duplex synchronous interface that operates with Bell 201, 203, or 208-type modems. The interface is programmable in HP assembly language and

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Communications Capabilities

TABLE 1. HP 1000 PROCESSOR MODEL COMPARISON

HP 1000 Model	Processor Type	Basic System Main Memory (Bytes)	Maximum System Memory (Bytes)	Standard I/O Slots	Operating System Support
2103L	L-Series	64K	512K	8	RTE-L, XL
2122A	L-Series	64K	512K	3	RTE-L, XL
2122B	L-Series	64K	512K	5	—
2109E	E-Series	64K	640K	9	RTE-IVB
2113E	E-Series	128K	1280K	14	RTE-IVB
2111F	F-Series	64K	640K	9	—
2117F	F-Series	128K	640K	14	—
2108M	M-Series	64K	640K	9	RTE-IV
2112M	M-Series	128K	1280K	14	RTE-IV
2156A	A-Series	128K	3M	18	RTE-A.1
2137A	A-Series	128K	3M	16	RTE-A.1
HP 1000 Packaged Systems*					
Model 5 (2142A)	L-Series	128K	512K	3	RTE-XL
Model 5 (2142B)	L-Series	128K	512K	4	RTE-XL
Model 6 (2136A)	A-Series	128K	512K	3	RTE-A.1
Model 6 (2136B)	A-Series	128K	512K	5	RTE-A.1
Model 6 (2186A)	A-Series	128K	512K	3	RTE-A.1
Model 6 (2186B)	A-Series	128K	512K	4	RTE-A.1
Model 16 (2196A)	A-Series	128K	512K	20	RTE-A.1
Model 16 (2196B)	A-Series	128K	512K	20	RTE-A.1
Model 17 (2197A)	A-Series	256K	4M	13	RTE-A.1
Model 17 (2197B)	A-Series	256K	4M	13	RTE-A.1
Model 40 (2176C)	E-Series	128K	2048K	11	RTE-IVB
Model 40 (2176D)	E-Series	128K	2048K	11	RTE-IVB
Model 45 (2177C)	F-Series	128K	2048K	10	RTE-IVB
Model 45 (2177D)	F-Series	128K	2048K	10	RTE-IVB
Model 60 (2178A)	E-Series	256K	2048K	11	RTE-IVB
Model 60 (2178B)	E-Series	256K	2048K	11	RTE-IVB
Model 65 (2179A)	F-Series	256K	2048K	10	RTE-IVB
Model 65 (2179B)	F-Series	256K	2048K	10	RTE-IVB

*Processor designations A and C are upright cabinet configurations; B and D are desktop configurations.

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offers program-selectable character length (1 to 8 bits), choice of synchronization character, parity generation and checking (odd, even, or none), and special character recognition of any character provided by the program. The interface operates in either full- or half-duplex mode at a maximum data rate of 9600 bits per second. The 12618A has a 2-character buffer, and can attach modems via EIA or CCITT interfaces. Software support is provided by the RJE/1000 software.

- **12589A AUTOMATIC DIALER INTERFACE:** This EIA or CCITT interface can be used with any M-Series computer that is equipped for asynchronous or synchronous data communications, and includes a Bell 801 A or C or equivalent automatic dialing unit.
- **12771A COMPUTER SERIAL INTERFACE:** This is a 2-card interface that forms a complete, hard-wired hardware communications link between two HP 1000 computer systems equipped with the 91740A/B DS/1000 Network Software-Firmware Package or 91750A DS/1000-IV network software package, and managed by the RTE-IV B, IV E or RTE-6/VM operating systems.

Errors detected in the hardware word parity check on the 12771A board and in the longitudinal or diagonal parity checks on the blocks received are corrected by retransmission. Transmission speeds are user-selected by jumper on each interface card to correspond with the cable length used, as tabulated below. Software overhead will slow down network throughput rates:

Cable Length, feet	Max. Transmission Speed, bytes per second
0-600	60,606
600-1200	38,460
1200-2000	22,222
2000-3000	12,048
3000-4000	22,222
4000-5400	12,048
5400-7300	6,288
7300-10000	3,214

- **12773A COMPUTER MODEM INTERFACE:** Provides for interconnection of E, F, and M Series computer systems in a DS/1000 network using full-duplex modems. The interface is supported by the 91740A/B Network Software-Firmware Package or 91750A DS/1000-IV and is compatible with the EIA RS-232-C and CCITT V.24 interfaces with full-duplex operation. The transmission link is full-duplex over switched (direct distance dial) or private (leased) common-carrier telephone lines. Modems may have automatic answering capability. Transmission is in bit-serial, synchronous, or asynchronous mode, depending on the modem used. Asynchronous data transfer rates of 75, 150, 300, 600, or 1200 bps are possible. Synchronous rates depend on the modem selected.

The user may select from several modems, including the Bell-type 103A, 201C, 202T, 208A, and 209A or compatible data sets.

Error detected in the hardware word parity check on the 12773A board and in the longitudinal or diagonal parity checks on the blocks received are corrected by retransmission.

A and L Series Interfaces

Available on the A and L Series processors are several asynchronous and synchronous interfaces and an asynchronous multiplexer as follows:

- **12040A 8-CHANNEL ASYNCHRONOUS MULTIPLEXER:** This unit provides EIA RS-232-C and RS-423-A or CCITT V.24 interfacing for up to eight asynchronous full-duplex devices. Selectable data rates are 50, 75, 110, 134.5, 150, 300, 1200, 1800, 2400, 3600, 4800, 9600, or 19,200 bps. Each of the eight channels has two 254-byte transmit and two 254-byte receive buffers. The optional 12828A panel provides RS-232-C pin connection for all eight ports.
- **12044A AND 12007A HDLC DIRECT CONNECT INTERFACES:** This unit allows direct connection to full-duplex HDLC protocol from an A or L Series processor using DS/1000-IV network software. The 12007A provides the same capabilities but permits the use of a modem instead of a direct connection.
- **12075A X.25 NETWORK INTERFACE:** This interface allows the system to access private or public CCITT X.25 packet switched networks (except during forced cold load) when accompanied by the prerequisite 91751A X.25 software support package. Connection is made via RS-232-C with maximum data rates of 19.2K bps for public data network connections and 57.6K bps for private point-to-point communications. An X.25 network may be entered via DS/1000-IV or user developed software. Compatible modems are Bell-type 201, 208, 209, and 212 data sets.
- **12005B ASYNCHRONOUS INTERFACE:** This unit provides EIA RS-232-C, RS-422, RS-423, and RS-449 serial interfacing for half- or full-duplex compatible devices. Selectable data rates of 50, 75, 110, 134.5, 150, 300, 600, 900, 1200, 1800, 2400, 3600, 4800, 7200, and 9600 bps. The connection may be either local via cable or remote with use of a Bell 103 or equivalent modem. This interface includes built-in DMA capability that is designed for use on Series A and L processors only.
- **12042B PROGRAMMABLE SERIAL INTERFACE:** This Z-80 based intelligent device may be used to perform the same serial asynchronous tasks as the 12005B except that this interface is not embedded with firmware. Instead, the user may program this interface to meet specific requirements.
- **12082A AND 12073A BINARY SYNCHRONOUS INTERFACES:** This unit manages a bisynchronous communication link between an HP 1000 Series A or L system and an HP 3000 computer when both systems are operating in a DS/1000-IV environment. It supports full- or half-duplex modems at rates of up to 57,600 bps. It uses 16K of on-board RAM for buffering and CRC-16 error checking. The 12073A provides the same capabilities as the 12082A using a modem interface instead of direct connect. These interfaces are not designed for general purpose BSC use, but strictly for HP 1000 to HP 3000 computer system links.
- **12072A DATA LINK SLAVE INTERFACE:** This interface allows A and L Series processors to act as a host to a slave computer in a multipoint asynchronous or bisynchronous connection. The Z-80 based unit supports asynchronous data rates of up to 19.2K bps.

TERMINAL INTERFACES

- **12966A ASYNCHRONOUS COMMUNICATIONS INTERFACE:** The 12966A is the most capable of HP's single-line terminal asynchronous interfaces. It has a 128-character buffer and also a 256-character special character memory that can be used to set an interrupt flag whenever one of the 256 characters is received. The interface also has flags to indicate buffer status. The 12966A is programmed in HP's assembly language for one of 15 selectable data rates ranging from 50 to 9600 bits per second (these are also

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TABLE 2. LINE INTERFACES

Communications Supported	Timing	Mode	No. Lines Supported	Maximum Line Speed (bps)	Model Number	Number I/O Slots Required	Bell-Compatible Modems Supported	Series Supported	Remarks
Local Interprocessor Connections: To other HP 1000 To HP 3000	—	—	1	62.5K at 600 ft. 250K at 1000 ft.	12771A	1	N/A	E, F, M	—
	—	—	1		12889A	1	N/A	E, F, M	—
To Remote HP 1000	Async. or Sync.	Half- or Full-Duplex	1	Up to 1200 (Async.) Up to 19.2K (Sync.)	12773A	1	103, 201, 202, 208, 209	E, F, M	—
Remote Synchronous, Including IBM BSC	Sync.	Half- or Full-Duplex	1	Up to 9600	12618A	2	201, 203, 208, 209	E, F, M	Emulates IBM 2780 BSC to IBM host Emulates IBM 2780 BSC to IBM host
	Sync.	Half- Duplex	1	Up to 19.2K	12967A	1	201, 203, 208, 209	E, F, M	
Local Terminal Connections	—	—	1	Up to 9600	12880A	1	N/A	E, F, M	—
Remote Multipoint Terminals	Async.	Half-Duplex	1	Up to 9600	12790A	1	103, 201, 202, 208, 209	E, F, M	Support up to 32 Terminals/Line
Single Remote Terminals	Async.	Full-Duplex	1	Up to 300	12966A	1	103, 202	E, F, M	Buffered Interface
	Async.	Half- or Full-Duplex	1	Up to 9600	12968A	1	103, 202	E, F, M	Non-Buffered
	Async.	Half- or Full-Duplex	1	Up to 9600	12587B	1	103, 202	M only	—
	Async.	Half-Duplex	1	Up to 2400	12531C	1	103	E, F, M	20 mA or EIA/CCITT Interface
	Async.	Half-Duplex	1	Up to 9600	12531D	1	103	E, F, M	20 mA or EIA/CCITT Interface
16-Line Terminal Multiplexer	Async.	Half- or Full-Duplex	16	Up to 2400	12920B	3	103, 212, 801, 202	E, F, M	300 bps/Line, if at Full Capacity may not be used with RTE-6/VM
Auto-Call Unit Interface	—	—	1	—	12589A	—	801 Series	M only	—
8-Channel Asynchronous Multiplexer	Async.	Full-Duplex	8	19.2K	12792A	1	N/A	E, F, M	9600 bps at Full Capacity
HDLN Network Interface	Sync.	Full-Duplex	1	257K	12825A	1	N/A	E, F, M	Intelligent
HDLN Network Modem Interface	Sync.	Full-Duplex	1	257K	12794B	1	201, 208, 209	E, F, M	Intelligent
Bisynchronous Interface	Sync.	Half-Duplex	1	57.6K	12834A	1	N/A	E, F, M	—
Bisynchronous Modem Interface	Sync.	Half-Duplex	1	57.6K	12793B	1	201, 208, 209	E, F, M	Intelligent
Data Link Slave Interface	Async.	Half-Duplex	1	19.2K	12830A	1	N/A	E, F, M	—
8-Channel Multiplexer	Async.	Full-Duplex	8	19.2K	12040A	1	N/A	A, L	—
HDLN Network Interface	Sync.	Full-Duplex	1	257K	12044A	1	N/A	A, L	—
HDLN Modem Interface	Sync.	Full-Duplex	1	257K	12007A	1	201, 208, 209	A, L	—
Asynchronous Interface	Async.	Half- or Full-Duplex	1	9600	12005B	1	103	A, L	Intelligent
Data Link Slave Interface	Async.	Half-Duplex	1	19.2K	12072A	1	N/A	A, L	—
RS-232-C Panel	Async.	Full- or Half-Duplex	8	—	12828A	0	—	All Series	—
X.25 Network Interface	Async.	Full-Duplex	1	57.6K	12250A	1	201, 208, 209, 212	E, F, M	Intelligent
X.25 Network Interface	Async.	Full-Duplex	1	57.6K	12075A	1	201, 208, 209, 212	A, L	Intelligent
Programmable Serial Interface	Async.	Full- or Half-Duplex	1	9600	12042B	1	103	A, L	Intelligent and User Programmable
Bisynchronous Interface	Sync.	Half-Duplex	1	57.6K	12082A	1	N/A	A, L	—
Bisynchronous Modem Interface	Sync.	Half-Duplex	1	57.6K	12073A	1	201, 208, 209	A, L	—
Programmable Serial Interface	Async.	Half- or Full-Duplex	1	9600	12826B	1	103	E, F, M	Intelligent and User Programmable

Hewlett-Packard HP 1000 Communications Capabilities

hardware-selectable), for a character size of 5, 6, 7, or 8 bits, for 1, 1½, or 2 stop bits, and for odd, even, or no parity. Modem control for any Bell-type 103 or 202 modem (or equivalent) is implemented in software, with no modifications needed on the interface board. Attachment of local or remote terminals is via EIA RS-232-C or CCITT V.24 interfaces. The board can be used with hard-wired local terminals or with remotely connected terminals via modems. It has a secondary data channel capability (i.e., reverse channel, or the ability to receive, detect, and recognize control signals while transmitting). The 12966A is compatible with E, F, and M Series computer systems.

- **12968A ASYNCHRONOUS COMMUNICATIONS INTERFACE:** This unit is identical to the 12966A in all respects save three: 1) it has a 2-character buffer instead of a 128-character buffer; 2) it does not have the ability to store and recognize special characters; and 3) it can connect 20-milliampere terminals. It is a lower-cost unit that is upward-compatible to the 12966A. The 12968A is hardware-compatible with all E, F, and M Series computer systems.
- **12587B ASYNCHRONOUS COMMUNICATIONS INTERFACE:** This is a less programmable and lower-speed (when internal modem clocking is used) unit compared to the 12966A and 12968A. Like the 12966A, it can attach local or remote terminals via EIA RS-232-C or CCITT V.24 interfaces, but unlike the 12968A, it cannot attach 20 mA terminals. Its maximum rate using internal clocking is 2400 bits per second. The bit rate is jumper-selectable but the data rate is not program-selectable. Program-selectable are character size (1 to 9 bits) and parity (odd, even, or none). The number of stop bits (1 or 2) is hardware-selectable. There is a 2-character buffer. Break detection is via software when a Bell-type 202 modem (or equivalent) is used.

The 12587B is compatible with M-Series processors only.

- **12531C TELEPRINTER INTERFACE:** Normally uses locally connected teleprinters communicating via 20 mA current-loop signals. Data rates are jumper-selectable from among a choice of 110, 220, 440, 880, or 1760 bits per second, or at up to 2400 bits per second using an external clock. The character size is fixed at eight bits, and the number of stop bits is a jumper-selectable one or two. Option -001 is used to locally connect EIA-compatible terminals. Also, as with the 12531D following, the optional type 103 data sets (option -002) can be used in the manual mode (hand-switched from send to receive) only.

The standard 12531D Terminal Interface differs from the standard 12531C Teleprinter Interface in only one major respect: the internal clock, and hence the five jumper-selectable bit rates, are different; in this case, the internally clocked rates are 150, 300, 600, 1200, or 2400 bits per second. An option (-001) is used to locally connect EIA-compatible terminals; another option (-002) is used for connecting 103-type data sets in the manual mode.

The 12531C and 12531D are compatible with all E, F, and M Series processors.

- **12790A MULTIPOINT INTERFACE:** A microprocessor-based interface card that is microprogrammed to manage a hard-wired or modem-based RS-232-C interface, the binary synchronous multipoint line protocol, and an on-board data buffer. In conjunction with the 91730A Multipoint Software Package, the 12790A supports HP multipoint 2624B, 2626A, 2629D, 2645A, 2647A, 2648A, 2649C, 2649D, and 2649G CRT terminals in block mode for program development or program execution. Program execution is under the control of one or more user application programs.

Employing this interface, up to 32 HP terminals can be handled per multipoint line, subject to constraints of distance and operating system. The multipoint protocol implemented is similar to IBM's bisynchronous protocol.

The microprocessor manages the routine communications processing, freeing the computer for other tasks. This processing includes control word decoding, data polling, error detection and up to 16 retransmissions, management of asynchronous or synchronous modem control signals, setting of modem control lines, management of the data buffer, and automatic text editing.

The 12790A incorporates a 1024-byte RAM as a data buffer, which allows up to 998-byte block data transfers to the computer and up to 1000-byte transfers from the computer. All transfers to and from the computer are via the DCPC.

The maximum line length between any two terminals is 2,000 feet; total line length cannot exceed 16,000 feet. Synchronous speed may be up to 9600 bps regardless of the number of terminals or line length. Asynchronous speed may be as high as 19.2K bps when used in data link configuration but normally, asynchronous speed is a function of line length and number of terminals per line, as indicated in the following table:

Terminals per line	Line speed		
	2400 bps	4800 bps	9600 bps
4	2000 ft.	2000 ft.	2000 ft.
8	2000 ft.	2000 ft.	1200 ft.
16	2000 ft.	1200 ft.	480 ft.
32	1200 ft.	480 ft.	120 ft.

Error detection is through the use of CRC (cyclic redundancy checking). Error correction is via program-specified retransmission (up to 16 times).

The 12790A can be used with any E, F, or M Series processors. The user may select from the following Bell-type data sets: 201C, 202T, 208A, 209A or compatible modem.

SOFTWARE

Hewlett-Packard offers a series of real-time executive operating systems for the HP 1000 Series computers. A number of older operating systems are considered "mature," and while no longer available with new systems, they are still supported by Hewlett-Packard in existing systems. They include the Basic Control System (BCS), the Real-Time Executive-B (RTE-B), the Real-Time Executive-C (RTE-C), the RTE-II and the Real-Time Executive-III (RTE-III), RTE-M, and RTE-IVA operating system.

The operating systems which are current for the E, F, and M processors are the RTE-IVE, a memory based system; RTE-IVB, a disk-based system; and RTE-6/VM, a more powerful disk-based system supporting up to 2 megabytes of main memory, virtual memory, and extended code address space. The operating systems for the L-Series are the RTE-L and the more powerful XL. The only operating system available for the A-Series is the RTE-A.1 which supports up to 4 megabytes of main memory.

The RTE-IVE is a memory-based (no disk), execute only operating system. It requires at least 128K of main memory and supports up to 2 megabytes of main memory. RTE-IV can function in a DS/1000-IV network environment or as a standalone program execution system.

Hewlett-Packard HP 1000 Communications Capabilities

► The RTE-IVB is the next step up in the E, F, and M Series processor family. This operating system requires at least 128K bytes of memory and supports as much as 2 megabytes of main memory. This disk-based system has an Extended Memory Area which allows for an additional 1.9 megabytes of memory to be used for programming. It can manage up to 64 users and allows for simultaneous use of Basic, Fortran 77, HP assembler, Pascal, and C programming languages.

The RTE-6/VM is the most powerful of the operating systems designed for the E, F, and M Series family. It requires a minimum of 256K of memory in order to run. It supports as many as 64 multi-users, up to 2 megabytes of main memory, and 1.9 megabytes of disk storage (16 7925 disk drives on two disk interface channels). Although not a true virtual system, it does provide 1.9 megabytes of program address space. Programming languages include HP macro assembly, Fortran 77, Basic, C, and Pascal.

The two M-Series processors may have difficulty using some of the functions of the RTE-6/VM operating system due to insufficient address capacity. So, although compatible, Hewlett-Packard does not recommend using this operating system with them.

Like any good operating system, RTE-6/VM provides for the orderly flow of interface with peripherals and communications lines by managing input/output and allows the user many conveniences when engaging the computer.

RTE-L and XL are the two operating systems used with the L-Series. RTE-L, an execute only operating system, requires 64K and RTE-XL 128K bytes of main memory. Both can support up to 512K bytes of memory. Both may be used as either memory only or disk-based systems. The XL operating system, however, does extend DMA performance on the L-Series and generally provides a few more features.

The newest operating system is the RTE-A.1 for the A-Series of processors. The RTE-A.1 requires a minimum of 128K bytes of memory and supports an HP 1000 high of 4 megabytes of main memory with DMA access to any section. It provides an additional 12.6 megabytes of virtual programming address space. It also supports up to 255 users with each user needing 64K allocated dynamically. Like many of the other RTE family, programming languages include HP macro assembly, Fortran 77, Basic, C, and Pascal.

The current RTE family operating systems support DS/1000 network software including communications to an HDLC, X.25 network or to an HP 3000. The RTE family will still execute programs written under and by its mature predecessors. Table 3 provides comparisons of these six operating systems.

Hewlett-Packard offers several modular software and software/firmware products which afford a variety of communications and networking capabilities to the HP 1000 Series. These include DS/1000-IV, the networking product for all current RTE systems; NCCP, an older communications product for RTE-II systems; RTE/1000, which offers IBM-compatible RJE communications for disk-based HP 1000 systems, the Multipoint Terminal Subsystem Software, and Data Link.

• 91750A DISTRIBUTED SYSTEM/1000-IV (DS/1000-IV): This product consists of software providing an integrated set of high-level network facilities and procedures. These include network resource-sharing, distributed file management, communication between application programs (program-to-program data ex-

change), and coordinated distribution of processor workloads to other HP 1000 computers or systems and/or HP 3000 Series 40, 44, and 64 or the older Series II, III, 30, and 33 systems.

DS/1000-IV features network-wide nodal addressing with store-and-forward communications for maximum configuration flexibility, intelligent microprocessor-controlled interfaces offloading the CPU, remote system generation and remote program development and testing between HP 1000 systems, remote command processing between any two HP 1000 network nodes (even nodes that are not directly connected except through an intervening HP 1000 node), L-Series remote front panel, and HP 1000 virtual terminal capability with respect to HP 3000 Series II, III, 30, 33, 40, 44, and 64 systems.

The DS/1000-IV software in each system, or network node, consists of several layers. The Network Service Intrinsic (NSI/1000) are called by the user's application programs or operator commands to generate the transaction format for master requests to remote nodes, with data as required. DS/1000-IV operates under all HP 1000 processors running current operating systems.

The Network Interface Monitors (NIM/1000) process incoming master requests received from the Communications Management software (CM/1000) and link them as required to the user's slave programs, file management routines, or the RTE exec. The CM/1000 layer routes network transactions, queues them, and manages the local system resources necessary for network communications. CM/1000 also manages the store-and-forward operations.

The CM/1000 layer communicates with the interface hardware, which may be several hard-wired and/or modem interface cards, via the Communications Access Method/1000 (CAM/1000) software and firmware. CAM/1000 provides a line protocol for the control of communications input and output, including error detection and correction by retransmission. The lower layers are managed by software, firmware, and hardware so as to be completely transparent to the user. Changes to these layers of the network can be made with little or no effect on the user's application programs.

For HP 1000 to HP 3000 communications, the CM/1000 layer includes translators for conversion of HP 1000 requests and replies to/from DS/3000 format. The CM/1000 software does not provide for nodal addressing or store-and-forward operation to/from the HP 3000. CAM/1000 for HP 1000 to HP 3000 communication is a software-only synchronous line controller.

- 91780A RJE/1000: This software/hardware package enables an HP 1000 E, F, and M Series computer system to communicate with IBM 360/370 batch-oriented computers in a manner similar to an IBM 2780 Data Transmission Terminal. However, RJE/1000 does not support these IBM 2780 features: terminal identification, multipoint operation, and bell operation. RJE/1000 is implemented under RTE-IVB and RTE-6/VM operating systems. The package can be employed in a multi-programming environment that allows concurrent program development, computation, and data acquisition while communicating with an IBM 360/370 batch system.

Data is transmitted in either half- or full-duplex mode over dial-up or leased lines using Bisync protocol. Magnetic tape drives, disk drives, card readers, or CRT terminals can be used as remote job entry devices via modems at the speeds indicated in the table below. Line printers can serve as output devices: ►

**Hewlett-Packard HP 1000
Communications Capabilities**

TABLE 3. HP 1000 OPERATING SYSTEM COMPARISON*

Operating System	RTE-IVE	RTE-IVB	RTE-6/VM	RTE-L	RTE-XL	RTE-A.1
Minimum Memory (Bytes) Required	128K	128K	256K	64K	128K	128K
Maximum Main Memory (Bytes) Supported	2M	2M	2M	512K	512K	4M
Virtual Extended Program Memory	No	No	1.9M bytes	No	No	12.6M bytes
Processors Supported	E, F, M	E, F, M	E, F	L	L	A
Comments	Execute-only	—	Supports up to 64 users and 1.9 gigabytes of disk	Execute-only	—	Supports up to 255 users

*For comparison only; note that additional main memory may be required for language compilers, assemblers, utilities, device handlers, etc.

Connection and Modem Type	Max. Synchronous Data Rate, half- or full-duplex
Switched telephone network and:	
Bell 201A modem	2000 bps
Bell 201C modem	2400 bps
Bell 208B modem	4800 bps*
Non-Bell modem	4800-9600 bps
Private lines and:	
Bell 201B modem	2400 bps
Bell 201C modem	2400 bps
Bell 208A modem	4800 bps
Bell 209A modem	9600 bps
Non-Bell modem	4800-9600 bps

*Half-duplex only.

Features include EBCDIC transparency, auto turnaround, auto answer, multirecord transmission, end of media, and EBCDIC and ASCII code sets. RJE/1000 operates



HP 1000 computers offer the versatility of board, desktop, box, or cabinet configurations. The L-Series Model 5 is shown above.

directly with HASP in IBM operating systems using the BTAM, TCAM, or RTAM access methods. RJE/1000 also operates with the HASP, RES, and JES/2 scheduler software. Also included is Trace, an off-line data link diagnostic analysis facility. Trace provides for logging on magnetic tape or disk for subsequent printout and analysis.

The RJE/1000 hardware consists of two boards. The software is supplied on HP mini-cartridge tapes and operates on all processors except the 2105A and on all packaged systems except the Model 20 and Model 25.

- **91730A MULTIPOINT TERMINAL SUBSYSTEM SOFTWARE:** This package provides multipoint terminal communications between HP 2624B, 2626A, 2629D, 2645A, 2647A, 2648A, 2649C, 2629D, and 2649G CRT Terminals and an HP 1000 E, F, and M Series computer system. Features of the package include support of single I/O channel communications with multiple CRT terminals on a single communications line, program development and/or application program execution at multipoint terminals on RTE-IVB and RTE-6/VM-based systems, application program execution on RTE-IVE-based systems, computer interface block transfers up to 1000 characters long, support for up to eight 12790A Multipoint Terminal Interfaces, a multipoint master application program capability, a multipoint network status display program, command identification of multipoint terminals, auto-acknowledgement of data entry, group and line message broadcast capabilities, an intelligent polling algorithm, a system-level exerciser program, and a power fail restart subroutine. The 91730A software is also used for Data Link communications.

For further information, see the section on the 12790A Multipoint Terminal Subsystem Interface.

- **91731A ASYNCHRONOUS MULTIPLEXER SUBSYSTEM SOFTWARE:** This package provides multiplexed terminal communications support for the 12920B 16-Channel Multiplexer Interface. Terminals supported are HP 2624B, 2626A, 2629D, 2645A, 2647A, 2648A, 2649C, 2649D, and 2649G. The 91731A may only be used with E, F, or M Series processors and may *not* be used with the RTE-6/VM operating system.
- **91751A X.25 COMMUNICATIONS SOFTWARE:** Provides CCITT X.25 Packet Level three support for 12075A (A and L Series) and 12250A (E, F, and M Series) X.25 Network Interfaces. Inter-vendor user level services such as program-to-program communications or remote file access may be implemented via user developed software.

HP communications software support packages are "backward compatible" in the sense that they may be used

Hewlett-Packard HP 1000 Communications Capabilities

▶ with older or "mature" interfaces. Also, older communications software support packages may be upgraded to current products.

PRICING

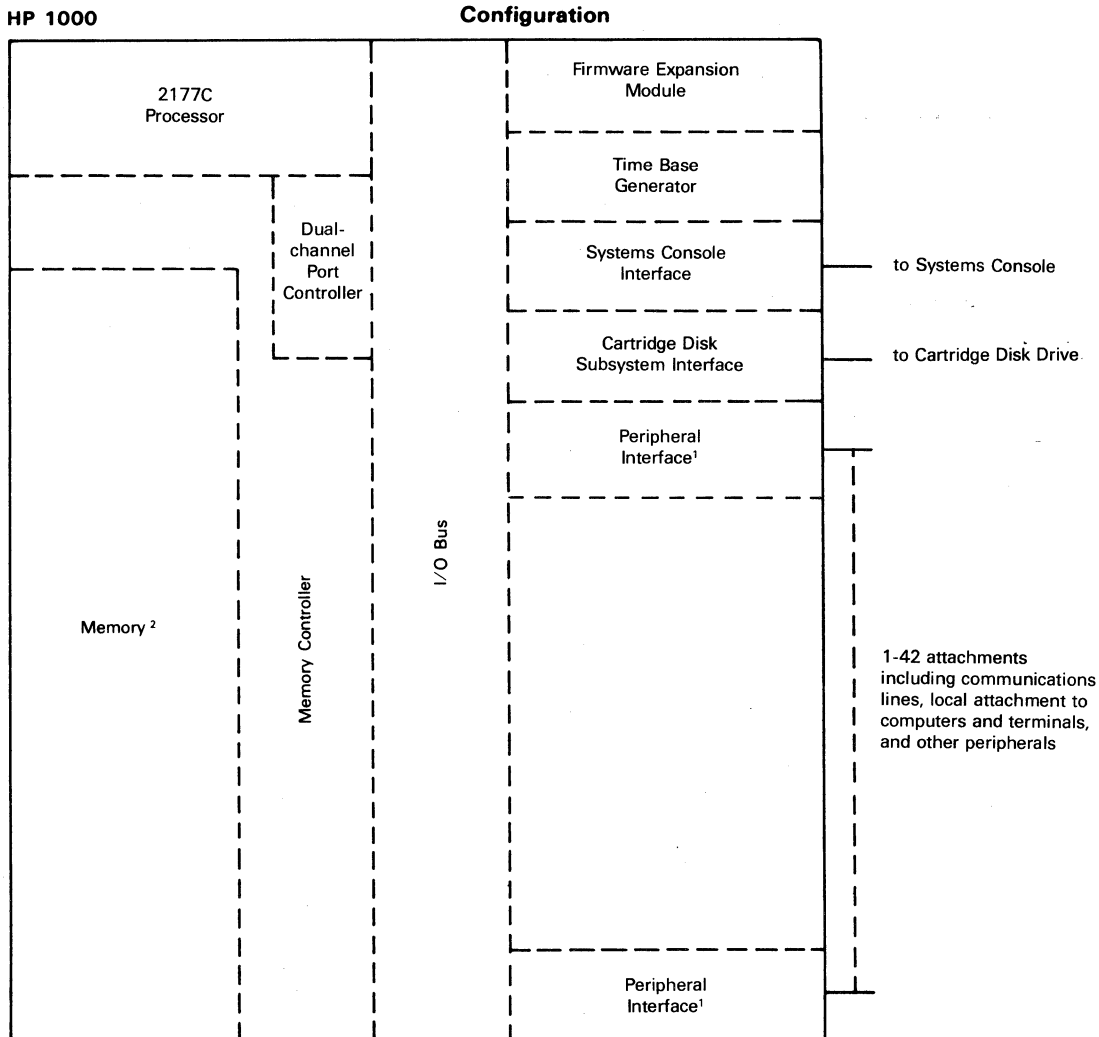
The HP 1000 is available for purchase only. Maintenance contracts are available, and the monthly maintenance charges are included in the following price list.

Maintenance is offered through over 200 offices worldwide. The standard Basic Monthly Maintenance Charge (BMMC) contract calls for 4-hour response time within a 25-mile radius of a Hewlett-Packard office. Coverage is provided Monday through Friday, 8 a.m. to 5 p.m. Extended coverage is available in most locations. The contract also covers

automatic software and reference manual updates and service on non-reproducible system failures.

On-site installation assistance from HP is included with certain software products. Installation in the U.S. includes travel up to 100 miles from the nearest HP service facility. Assistance for other software products is provided at prevailing service rates or through phone-in consulting of comprehensive software support. Assistance is provided for RTE family operating systems, programming languages, RJE/1000, and DS/1000-IV network software.

Several software and system support contracts are available to the user, and vary depending on whether the software is active or inactive (mature). The Software Subscription Service is a monthly fee paid for software and manual updates. The Comprehensive Software Support fee (also monthly) includes the subscription service and HP's phone-in consulting service. ▶



(1) Basic system includes 10 I/O Bus Slots. Up to two 16 Slot I/O Expanders can be attached.

(2) Basic system includes 128K bytes of memory. Nine additional memory module slots permit main memory to be expanded to 2048K bytes.

**Hewlett-Packard HP 1000
Communications Capabilities**

EQUIPMENT PRICES

Purchase Price **Monthly Maint.**

PROCESSORS

A-Series

2186A	HP 1000 Model 6 with 128K bytes of main memory, two 5¼-inch diskette drives, three I/O slots, and RTE-A.1 operating system	\$12,000	\$57
2186B	HP 1000 Model 6 with 128K bytes of main memory, four I/O slots, and RTE-A.1 operating system	8,700	37
2136A	HP 1000 Model 6 with 128K bytes of main memory, two 5¼-inch diskette drives, and four I/O slots	10,000	57
2136B	HP 1000 Model 6 with 128K bytes of main memory, and five I/O slots	6,800	31
2196A	HP 1000 Model 16 with 128K bytes of main memory, RTE-A.1 operating system, and 20 I/O slots	13,800	46
2196B	HP 1000 Model 16 with 128K bytes of main memory, RTE-A.1 operating system, and 20 I/O slots in 28.3-inch cabinet	13,200	46
2197A	HP 1000 Model 17 with 256K bytes of memory, and 13 I/O slots in 56-inch cabinet	21,600	60
2197B	HP 1000 Model 17 with 256K bytes of memory, and 13 I/O slots in 23-inch cabinet	2,000	60

L-Series

2142A	HP 1000 Model 5 with 128K bytes of main memory, two 5¼-inch diskette drives, three I/O slots, and RTE-XL operating system	10,600	57
2142B	HP 1000 Model 5 with 128K bytes of main memory, four I/O slots, and RTE-XL operating system	8,250	38
2103L	L-Series microcomputer with 64K bytes of main memory, and eight I/O slots	4,675	26
2122A	L-Series microcomputer with 64K bytes, two 5-¼ inch diskette drives, three I/O slots, and RTE-L operating system	8,100	48
2122B	L-Series microcomputer with 64K bytes of main memory, and five I/O channels	4,750	24

E-Series

2178A	HP 1000 Model 60 with 256K bytes of main memory, and 11 I/O slots in 56-inch cabinet	23,500	172
2178B	HP 1000 Model 60 with 256K bytes of memory, and 11 I/O slots in desk cabinet	23,500	173
2176C	HP 1000 Model 40 with 128K bytes of memory, and 11 I/O slots in 56-inch cabinet	42,420	276
2176D	HP 1000 Model 40 with 128K bytes of memory, and 11 I/O slots in desk cabinet	42,420	278
2109E	E-Series processor with 64K bytes of main memory, and nine I/O slots	10,000	79
2113E	E-Series processor with 128K bytes of main memory, and 14 I/O slots	12,000	112

F-Series

2179A	HP 1000 Model 65 with 256K bytes of main memory, and 10 I/O slots in 56-inch cabinet	32,500	189
2179B	HP 1000 Model 65 with 256K bytes of main memory, and 10 I/O slots in desk cabinet	32,500	188
2177C	HP 1000 Model 45 with 128K bytes of main memory, and 10 I/O slots in 56-inch cabinet	53,570	301
2177D	HP 1000 Model 45 with 128K bytes of memory, and 10 I/O slots in desk cabinet	53,570	303
2111F	F-Series processor with 64K bytes of main memory, and nine I/O slots	16,000	123
2117F	F-Series processor with 128K bytes of main memory, and 14 I/O slots	20,000	126

M-Series

2108M	M-Series processor with 64K bytes of main memory, and nine I/O slots	8,900	74
2112M	M-Series processor with 128K bytes of main memory, and 14 I/O slots	12,000	111

PROCESSOR OPTIONS

A-Series

12103A	128K-byte memory add-on	1,700	4
12103B	256K-byte memory add-on (2137A and 2197 processors only)	2,500	9
12103C	512K-byte memory add-on	4,000	16
12103D	1M-byte memory add-on	7,000	33
12104A	512K-byte memory add-on (2137A and 2197 processors only)	6,000	25
-012	512K-byte memory substitution instead of 128K	2,500	22

L-Series

12002A	128K-byte memory add-on	2,800	17
12002B	512K-byte memory add-on	5,000	32
-012	512K-byte memory substitution instead of 128K	2,500	15
-011	128K-byte memory substitution instead of 64K	800	9
-011	512K-byte memory substitution instead of 64K	3,000	24

E-Series

12786A	128K-byte memory add-on	3,500	49
12786B	256K-byte memory add-on	4,900	74
12786C	512K-byte memory add-on	7,700	124
12786D	1M-byte memory add-on	13,300	224

Hewlett-Packard HP 1000
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EQUIPMENT PRICES

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
E and F Series			
12788E	512K-byte memory add-on (64K RAM chips)	\$ 7,300	\$40
12788F	1M-byte memory add-on (64K RAM chips)	12,300	58
12788G	1.5M-byte memory add-on (64K RAM chips)	17,300	76
12788H	2M-byte memory add-on (64K RAM chips)	22,300	94

E, F, and M Series

12979B	16 slot I/O extenders	6,300	12
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COMMUNICATIONS EQUIPMENT

A and L Series

12040A	8-Channel Asynchronous Multiplexer	2,100	12
12044A	HDLC Direct Connect Interface	2,520	10
12007A	HDLC Modem Interface	2,205	14
12005B	Asynchronous Interface	1,400	7
12072A	Data Link Slave Interface	630	6
12828A	RS-232-C Connection Panel	630	4
12075A	X.25 Network Interface	2,200	9
12042B	Programmable Serial Interface	2,000	not offered
12082A	BSC Interface	2,200	9
12073A	BSC Modem Interface	2,200	9

E, F, and M Series

12889A	HP 1000-3000 Hard-Wired Serial Interface	790	11
30220A	HP 1000-HP 3000 Cable	185	n/c
12792A	8-Channel Asynchronous Multiplexer	2,100	11
12920B	16-Channel Asynchronous Multiplexer	2,730	7
12825A	HDLC Direct Connect Interface	2,100	9
12794B	HDLC Modem Interface	1,785	9
12834A	BSC Interface	1,890	8
12793B	BSC Modem Interface	1,890	9
12830A	Data Link Slave Interface	1,200	5
12967A	Synchronous Communications Interface (half-duplex)	840	4
12618A	Synchronous Communications Interface (full-duplex)	895	8
12589A	Automatic Dialer Interface (M-Series only)	790	11
12771A	DS/1000 Serial Interface	1,260	16
12773A	DS/1000 Modem Interface	630	8
12826B	Programmable Serial Interface	1,600	not offered
12250A	X.25 Network Interface	1,720	9

TERMINAL INTERFACES*

E, F, and M Series

12966A	Asynchronous Interface	735	3
12968A	Asynchronous Interface	790	4
12587B	Asynchronous Modem Interface (M-Series only)	735	6
12531C	Teleprinter Interface	370	3
12531D	Teleprinter Interface	370	3
12790A	Multipoint Interface	1,575	8

All Series

12828A	RS-232-C Connection Panel	630	4
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*Contact vendor for A and L Series terminal interface pricing.

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SOFTWARE PRICES

		<u>One-time Charge</u>	<u>*SSS</u>	<u>**CSS</u>
▶ 92077A	RTE-A.1 operating system: for 2136 or 2156A for 2137A	\$2,500 5,000	\$100 100	\$390 390
	RTE-A.1 execute-only: for 2136 or 2156A for 2137A	500 800	15 15	65 65
92084A	RTE-6/VM operating system	9,000	110	400
92068A	RTE-IVB operating system	5,250	100	300
92068E	RTE-IVE operating system	1,575	30	65
92071A	RTE-XL operating system	1,500	55	240
92070B	RTE-L operating system	1,000	55	240
91750A	DS/1000-IV	4,200	30	65
91780A	RJE/1000 and two board synchronous modem interfaces	3,150	20	65
91730A	Multipoint Terminal Subsystem software	265	15	45
91731A	Asynchronous Multiplexer Subsystem software	265	15	40
91751A	X.25 Communications Support software	4,000	30	90

*SSS is the Software Subscription Service which includes manual and software updates. **CSS is the Comprehensive Software Service which includes manual and software updates as well as telephone consulting.■

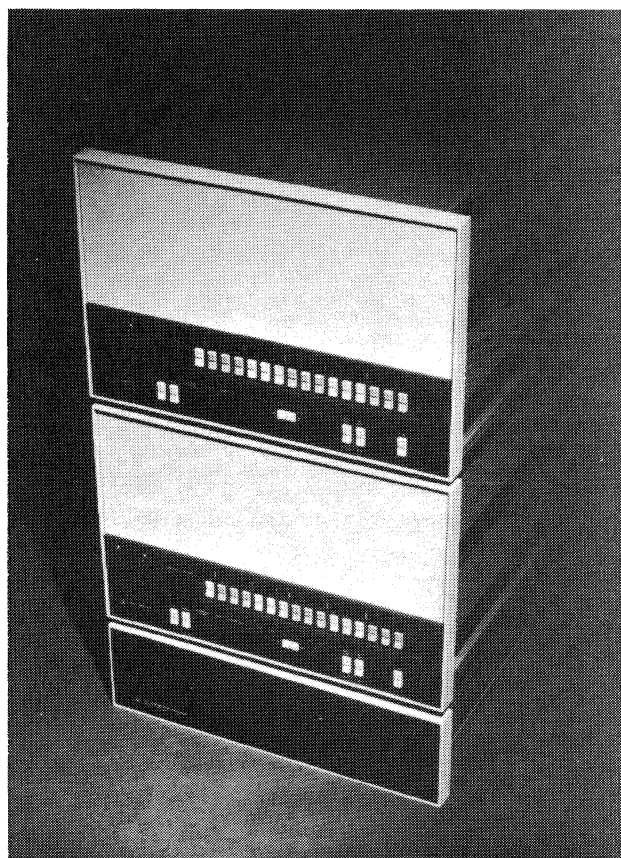
Hewlett-Packard HP 1000 Communications Capabilities

MANAGEMENT SUMMARY

According to information provided by Hewlett-Packard, almost ten percent of the estimated 12,000 HP 1000 processors now in operation are employed as distributed or nodal processors in multiprocessor networks with other HP 1000 and HP 3000 systems. This has been brought about as a result of the Hewlett-Packard Distributed System Network (DSN); the architecture first announced by HP years ago, but implemented only recently as a result of enhanced operating and networking software releases.

Since its introduction in May 1974, the HP 1000 processor (then called the HP 21MX) has been progressively enhanced with expanded peripheral offerings and new firmware/hardware features. The 1000 F-Series processor is not only Hewlett-Packard's latest introduction, but also its most sophisticated. It brings the HP 1000 processor family up to 14 products built around the 1000 M-Series, 1000 E-Series, and 1000 F-Series processors.

HP originally introduced two 21MX models, the 2105A and the 2108M; these are now part of the 1000 M-Series. ➤



The 2111F (top) and the 2117F are the most advanced HP 1000 processors yet to be offered, and the only current members of the HP 1000 F-Series. The 2117F is also the basic processor in the Models 25 and 45 packaged systems.

A family of minicomputers which, when configured with the appropriate hardware and software components, serve as the building blocks for HP's Distributed Systems Network (DSN). An HP 1000 may control its own terminal network, may be configured in a network with multiple other HP 1000's, or may be employed as a distributed processor to a remote IBM 360/370.

Available networking software supports resource sharing, program-to-program communications, remote file access/transfer, and even store-and-forward message switching in a network of HP 1000 nodes. Asynchronous and synchronous transmission (including BSC) is supported on switched or leased lines to 19.2K bps.

A typical HP 1000, Model E, with 128K bytes of memory, 19.6-megabyte disk subsystem, operator terminal, RT-IV operating system, DS/1000 software, and interfaces for 16 asynchronous and two interprocessor communications lines can be purchased for \$45,700. Monthly maintenance is available for \$278.

CHARACTERISTICS

VENDOR: Hewlett-Packard Company, Data Systems Division, 11000 Wolfe Road, Cupertino, California 95014. Telephone (408) 257-7000.

DATE OF FIRST ANNOUNCEMENT: M-Series Models 2105 and 2108, May 1974; Model 2112, May 1975; E-Series Models 2109 and 2113, December 1975; F-Series Models 2111 and 2117, May 1978; Model 30 Packaged System, October 1976; Model 20, March 1977; Models 25, 40 and 45, May 1978.

DATE OF FIRST DELIVERY: M-Series Models 2105 and 2108, August 1974; Model 2112, October 1975; E-Series Models 2109 and 2113, September 1976; F-Series Models 2111 and 2117, August 1978; Model 30 Packaged System, December 1976; Models 25, 40 and 45, September 1978.

NUMBER DELIVERED TO DATE: 12,000; Over 1,260 DSN nodes.

SERVICED BY: Hewlett-Packard Company.

CONFIGURATION

All the HP 1000 Series processors are mounted in standard 19-inch racks along with the operator panel and memory chassis. The packaged system models offer both an upright cabinet and a desk-mounted configuration.

Depending on the HP 1000 model, each offers a different number of I/O channel slots as standard. A maximum of ➤

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TABLE 1. HP 1000 PROCESSOR MODEL COMPARISON

HP 1000 Model	Processor Type	Basic System Main Memory (bytes)	Maximum System* Memory (bytes)	Standard I/O Channel Slots	Operating System Support
2105	M-Series	32K	64K	4	RTE-MI, MII
2108	M-Series	64K	640K/1792K	9	All RTE
2109	E-Series	64K	640K/1792K	9	All RTE
2111	F-Series	64K	640K/1792K	9	All RTE
2112	M-Series	128K	1280K/2048K	14	All RTE
2113	E-Series	128K	1280K/2048K	14	All RTE
2117	F-Series	128K	1280K/2048K	14	All RTE
HP 1000 Packaged Systems**					
Model 20 (2174A, B)	E-Series	64K	1280K/2048K	12	RTE-MI, MII, MIII
Model 25 (2175A, B)	F-Series	64K	1280K	12	RTE-MI, MII, MIII
Model 30 (2170, 2171, 2172)	E-Series	64K	64K	14	RTE-II
Model 40 (2176A, B)	E-Series	128K	1280K/2048K	11	RTE-IV
Model 45 (2177A, B)	F-Series	128K	1280K	11	RTE-IV

*When two figures are given, smaller amount is maximum capacity within computer; larger amount is total system with 12990B Memory Extender.

**Models A are upright cabinet configurations; Models B are desk cabinet configurations and are limited to smaller amount of maximum memory, when two figures are given.

➤ Both models use the same CPU and differ only in configuration. The 2112M, the third and last member of the 1000 M-Series, was announced in May 1975 and features a 12¼-inch chassis that contains space for up to 10 memory modules (1280K bytes maximum). With the memory extender chassis, the memory capacity can go to 2048K bytes. The 2112M has slots for 14 I/O modules in the basic system and can accommodate a total of up to 46 I/O channels through two I/O extender chassis.

The 2109E, announced in December 1976, is the smallest member of the 1000 E-Series and employs the same housing and expansion capacities as the 2108M. The 2113E is the 1000 E-Series equivalent of the 2112M, with the same expansion possibilities; it was announced at the same time as the 2109E. The major difference in the memory expansion capabilities of the E Series over the M Series is the availability of both standard and ➤

➤ two 16-slot I/O extenders are allowed per processor. This yields a maximum I/O capacity of 36 slots for the 2105; 41 for the 2108, 2109 and 2111; and 46 for the 2112, 2113 and 2117. Generally speaking, each peripheral device or communications line adapter requires an I/O slot. Several of the communications interfaces require more than one, and these are specifically mentioned in the following text, and in Table 3.

These are two I/O mechanisms common to the HP 1000 Series processors; programmed I/O, and Direct Memory Access (DMA). DMA channels, such as those used for communications links to remote processors, access the host through an optional Dual-Channel Port Controller (DCPC). The DCPC contains all necessary logic to control DMA transfer for multiple devices. This arrangement avoids the need for redundant DMA control logic in each individual I/O controller. DMA data transfers, once the DCPC has been initialized by the program, proceed automatically. Programmed I/O, on the other hand, permits the computer to manipulate the data as it is transferred, and to do other work between interrupts. ➤

TABLE 2. COMPARISON OF HP 1000 PACKAGED SYSTEMS

	Model 20	Model 25	Model 30	Model 40	Model 45
Processor Type (Model)	E-Series (2113)	F-Series (2117)	E-Series (2113)	E-Series (2113)	F-Series (2117)
Operating System	Memory-based RTE-M	Memory-based RTE-M	Disk-based RTE-II	Disk-based RTE-IV	Disk-based RTE-IV
Memory Range (K bytes)	64-2048	64-1280	64	128-2048	128-1280
Mass Storage Maximum Capacity (bytes)	Diskette 1028K	Diskette 1028K	Disk 370M	Disk 400M	Disk 400M
DBMS Support (IMAGE/1000)	No	No	Yes	Yes	Yes
RJE/1000 Support	No	No	Yes	Yes	Yes
DS/1000 Support	Yes	Yes	No	Yes	Yes
Basic I/O Channel Slots	12	12	11	11	11
Max. Expandable	28	28	27	27	27
Multipoint Terminal Package Support	Yes	Yes	No	Yes	Yes

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The Model 45, at right, represents the top of the line among the HP 1000 packaged systems. This configuration includes the 2117F processor, with up to 1280K bytes of high-performance RAM memory, an HP 2648A Graphics Terminal, an HP 7906 Disk Subsystem, and the RTE-IV Operating System.



- ▷ high-performance MOS memory modules, currently available in 32K-byte and 128K-byte increments.

The 2111F, announced along with the 2117F in May 1978, utilizes the same expansion capacities as the 2108M and 2109E and features a 12¼-inch chassis. The 2117F features two chassis that use 17½ inches of vertical space and is the 1000 F-Series equivalent of the 2112M and the 2113E with the same expansion capacities.

Hewlett-Packard currently offers five packaged systems based on the HP 1000 E- and F-Series processors. Models 20, 30, and 40 are based on the 1000 E-Series Model 2113E processor; and the Models 25 and 45 on the 1000 F-Series Model 2117F processor. Models 20 and 30 are packaged with 64K bytes of standard-performance memory; Model 25 with 64K bytes of high-performance memory; Model 40 with 128K bytes of standard-performance memory; and Model 45 with 128K bytes of high-performance memory. Models 20 and 25 are memory-based systems, while Models 30, 40, and 45 are cartridge disc-based. Models 20 and 25 employ the RTE-M Operating System; Model 30, the RTE-II Operating System; and Models 40 and 45, the RTE-IV Operating System.

Significant differences also prevail with regards to processor performance. The M-Series processors offer 325-nanosecond instruction execution time and a 650-nanosecond memory cycle time. In comparison, the E- and F-Series feature an instruction execution time of from 175 to 280 nanoseconds, and a memory cycle time of 595 nanoseconds (reducible to 350 nanoseconds with the optional high performance memory). Table 1 may be useful in comparing the basic characteristics of the currently-marketed versions of the HP 1000.

From a networking point of view, Hewlett-Packard offers several comprehensive communications packages, ▷

- ▶ The HP 1000 Series uses a vectored priority interrupt system which has over 54 distinct interrupt (priority) levels. The top four levels are devoted to power failure, parity checking, memory protection, and then DMA transfers via the DCPC. The remaining 50 levels are assigned to all other I/O devices and communications interfaces. With M-Series processors, the maximum programmed I/O transfer rate is 91K bytes per second. The DMA transfer rate is 1.23 megabytes per second. In comparison, the E- and F-Series feature a programmed I/O transfer rate of 384K bytes per second, and over 2 megabytes per second via DMA.

Table 1 compares the various HP 1000 Series models including memory range, number of I/O slots, and operating system compatibility.

COMMUNICATIONS INTERFACES

Hewlett-Packard offers a choice of three asynchronous communications interfaces, an asynchronous multiplexer, a pair of synchronous communications interfaces, three asynchronous terminal interfaces, a multipoint terminal interface, an automatic dialing interface that can be used with the synchronous and/or asynchronous interfaces, and a hard-wired serial interprocessor high-speed interface. Table 3 presents a comparison of these interfaces.

12889A HARD-WIRED SERIAL INTERFACE: This is a special-purpose high-speed serial asynchronous interface for direct (point-to-point) data communications between two HP 1000 Series computers. At a distance of 1,000 feet the maximum data rate can be 2.5 million *bits* per second; at 2,000 feet this data rate is halved. The feature is a single card, with data transmission taking place in one of four modes: program to program, program to DCPC, DCPC to program, or DCPC to DCPC. Included are automatic data acknowledgement (handshaking hardware), cyclic redundancy check (CRC) hardware for generation, transmission, and processing, and a 6-bit hardware address recognition circuit. The CRC uses a 15th degree polynomial. A pair of 75-ohm coaxial cables functions as a unidirectional pair of transmission lines for fast turnaround. The cable is optically isolated at the receiving end, enabling long-distance transmission with a low probability of errors due to common-mode noise or ground-level shifting. ▶

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TABLE 3. COMMUNICATIONS LINE INTERFACES

Communications supported	Timing	Mode	No. Lines Supported	Maximum Line Speed (bps)	Model Number	Number I/O Slots Required	Bell-type Modems Supported	O/S Compatibility or Software Required	Remarks
Local Interprocessor Connections: To other HP 1000 To HP 3000	—	—	1	62.5K at 600 ft.	12771A	1	NA	DS/1000	—
	—	—	1	250K at 1,000 ft.	12889A	1	NA	DS/1000	—
Remote HP 1000	Async. or Sync.	Half or full Duplex	1	Up to 1200 (Async.) (Up to 19.2K (Sync.))	12773A	1	103, 201, 202, 208, 209	DS/1000	—
Remote Synchronous, including IBM BSC	Sync.	Half or Full Duplex	1	Up to 9600	12618A	2	201, 203, 208, 209	RJE/1000	Emulates IBM 2780 BSC to IBM host
	Sync.	Half-Duplex	1	Up to 19.2K	12967A	1	201, 203, 208, 209	RJE/1000	Emulates IBM 2780 BSC to IBM host
Local Terminal Connections	—	—	1	Up to 9600	12880A	1	NA	RTE-M, II, III, IV	—
Remote Multipoint terminals	Async. or Sync.	Half or full Duplex	1	Up to 9600	12790A	1	103, 201, 202, 208, 209	RTE-M III, IV	Supports up to 32 Terminals/Line
Single Remote terminals	Async.	Full-Duplex	1	Up to 300	12966A	1	103	RTE-M II, III	Buffered Interface
	Async.	Half or Full Duplex	1	Up to 9600	12968A	1	103, 202	All RTE	Non-Buffered
	Async.	Half or Full Duplex	1	Up to 9600	12587B	1	103, 202	M-Series Only	—
	Async.	Half-Duplex	1	Up to 2400	12531C	1	103	RTE-M, II, III, IV	20 mA or EIA/CCITT Interface
	Async.	Half-Duplex	1	Up to 9600	12531D	1	103	RTE-M, II, III, IV	20 mA or EIA/CCITT Interface
Multi-Line Terminal Multiplexer	Async.	Half or Full Duplex	16	Up to 300 or 2400	12920B	3 or 4	103, 202	RTE-M III, IV	300 bps/Line, if at Full Capacity
Auto-Call Unit Interface	—	—	1	—	12589A	—	801 Series	M-Series Only	—

➤ but all are not supported by all of the HP 1000 models; hence the subject of this report.

➤ The 12889A is hardware-compatible with all HP 1000 Series computers and packaged systems except the Model 30. Software support is provided by DS/1000.

Distributed Systems/1000 (DS/1000) is one such package. It is a software/firmware combination that affords the HP 1000 user impressive networking capabilities with other HP 1000 systems (both local or remote), and with local HP 3000 processors. DS/1000 is an upgraded replacement for the Network Communications Packages which offered limited networking capabilities for the early HP 1000 operating system. DS/1000 is the software basis for the Hewlett-Packard Distributed Systems Network (DSN) architecture. It offers store-and-forward message routing, program-to-program communications, and many other features which support general resource sharing of hardware, software and communications facilities.

DS/1000 and the DSN architecture of Hewlett-Packard is strikingly similar to the DECnet software and the DNA architecture of the Digital Equipment Corporation. This should come as no great surprise as both are leading minicomputer manufacturers, and have sought to achieve general interaccessibility between their respective machines. The net result for both vendors has been the development of networking software modules which are loaded into each of the interconnected processors, making them network nodes. This is in sharp contrast to the centralized network control ➤

12920B ASYNCHRONOUS MULTIPLEXER: This unit provides EIA or CCITT interfacing for up to 16 communications devices at programmable data rates up to 2400 bits per second, in any mix of hard-wired terminals, 103-type data sets, or 202C-type data sets. For hard-wired devices, the multiplexer simulates a data set and can be hard-wired. For use with 202C-type data sets, an option (-001) is required, and this adds one card and requires a fourth slot.

Programmable are: 1) data rates from 57 to 2400 bits per second, 2) speed detection for six speeds plus the IBM 2741, 3) character lengths from 5 to 12 bits, 4) split speed operation, 5) parity generation and/or checking, and 6) full-duplex, half-duplex, or echoplex transmission mode. Hardware automatically detects breaks and assembles characters. The unit has a data-in and data-out line for each of the 16 channels, plus 5 receive-only diagnostic channels. Up to eight Bell 801-type automatic dialers can be attached.

Using the 12920B, a minor modification must be made when the operating system is BCS, since that operating system only configures the equipment table for up to eight devices on a controller.

The 12920B is hardware-compatible with 2108M, 2109E, 2112M, and 2113E processors.

12966A BUFFERED ASYNCHRONOUS COMMUNICATIONS INTERFACE: The 12966A is the most capable of HP's single-line asynchronous interfaces. It has a 128-character buffer and also a 256-character special character ➤

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- approach taken by many of the mainframe vendors, which involves the placement of networking logic in a single host/front-end site.

Although not technically an entity of DSN, Hewlett-Packard also offers an RJE/1000 package which provides the HP 1000 with networking access to remote IBM 360/370 systems. This software package essentially causes the HP 1000 to emulate an IBM 2780 batch terminal, but is supported only on disk-based systems (those running the RTE-II and RTE-IV operating systems). By contrast, DS/1000 may run on memory-based HP 1000's (RTE-M operating systems) as well as disk-based RTE-IV systems. DS/1000 is not supported, however, on RTE-II systems.

A characteristic of HP 1000 communications is modularity, and inherent flexibility. Even though the communications software is loaded into the same machine running applications software, the communications software remains functionally segregated, permitting the user to readily alter his communications configuration while keeping his applications software intact. This is true not only for software which drives the HP 1000 in communications with other processors, but also for terminal communications within a single HP 1000 system. A single software support package is available, for example, that facilitates the handling of multipoint terminals.

Early HP communications software required that nodes be operating in either a master or a slave role. DS/1000, however, establishes more of a peer relationship between network nodes, with each node capable of initiating or responding to a remote processor's request for a file transfer, request for use of a peripheral, etc. All DS/1000 nodes, even the memory-based systems, are capable of store-and-forward message routing. This feature permits the HP 1000 family to be implemented in virtually any topological configuration (rings, stars, trees, or a hybrid mixture).

Many HP 1000 configurations will still utilize a central, disk-based processor and, from an applications point of view, will be maintaining a traditional master/slave relationship with remote, memory-based nodes. Communications control, however, remains equally distributed among each network processor.

So far, DS/1000 and DSN networking is peculiar to the Hewlett-Packard product line, and is architecturally incompatible with most other major vendors. For example, the DSN network interprocessor links utilize an unusual protocol called WASP (for Word-oriented Asynchronous Protocol), while most other major vendors now offer a high-level bit-oriented protocol for network communications which operates in a full-duplex, synchronous mode.

Hewlett-Packard acknowledges this schism, but has stated that industry-compatible communications features, such as X.25 protocol support (and the HDLC bit-

- memory that can be used to set an interrupt flag whenever one of the 256 characters is received. The interface also has flags to indicate buffer status. The 12966A is programmed in HP's assembly language for one of 15 baud rates ranging from 50 to 9600 bits per second (these are also hardware-selectable), for a character size of 5, 6, 7, or 8 bits, for 1, 1½, or 2 stop bits, and for odd, even, or no parity. Modem control for any Bell type 103 or 202 modem (or equivalent) is implemented in software, with no modifications needed on the interface board. Attachment of local or remote terminals is via EIA or CCITT interfaces. The board can be used with hard-wired local terminals or with remotely connected terminals via modems. It has a secondary data channel capability (i.e., reverse channel, or the ability to receive, detect, and recognize control signals while transmitting).

The 12966A is compatible with all HP 1000 Series computer systems.

12968A ASYNCHRONOUS COMMUNICATIONS INTERFACE: This unit is identical to the 12966A in all respects save three: 1) it has a 2-character buffer instead of a 128-character buffer; 2) it does not have the ability to store and recognize special characters; and 3) it can connect 20-milliampere terminals. It is a lower-cost unit that is upward-compatible to the 12966A.

The 12968A is hardware-compatible with all HP 1000 Series computer systems.

12587B ASYNCHRONOUS COMMUNICATIONS INTERFACE: This is a less programmable and lower-speed (when internal modem clocking is used) unit than the 12966A and 12968A. Like the 12966A, it can attach local or remote terminals via EIA or CCITT interfaces, but unlike the 12968A, it cannot attach 20-milliampere terminals. Its maximum rate using internal clocking is 3110 bits per second. The bit rate is jumper-selectable. Program-selectable are character size (1 to 9 bits) and parity (odd, even, or none). The number of stop bits (1 or 2) is hardware-selectable. There is a 2-character buffer. Break detection is via software when a Bell type 202 modem (or equivalent) is used.

The 12587B is hardware-compatible with all HP 1000 computer systems.

12967A SYNCHRONOUS COMMUNICATIONS INTERFACE: This is a half-duplex synchronous interface with reverse channel capability that is programmable in HP assembly language and operates with Bell type 201, 203, 208 or equivalent data sets. Under program control are parity generation/checking (odd, even, or none) and data set status monitoring for interrupt (for any character with one masking instruction). The choice of a synchronization character is switch-selectable, and the character length is fixed at 8 bits. The unit's maximum data rate is 20,000 bits per second. The 12967A has a 2-character buffer. No LRCC or CRCC checking or special character recognition is provided.

The 12967A is hardware-compatible with all HP 1000 computer systems. A user-written driver, programmed in assembly language, is required to run this interface in a real-time computer system.

12618A SYNCHRONOUS COMMUNICATIONS INTERFACE: This is a full-duplex synchronous interface that operates with Bell 201, 203, or 208-type modems. The interface is programmable in HP assembly language and offers program-selectable character length (1 to 8 bits), choice of synchronization character, parity generation and checking (odd, even, or none), and special character recognition of any character provided by the program. The interface operates in either full- or half-duplex mode at a maximum data rate of 9600 bits per second. The 12618A has

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oriented protocol) are currently under development, and should be appearing in the near future. It should also be noted that Hewlett-Packard has recently begun marketing its own modem line. Both 4800 bps and 9600 bps synchronous modems are now available.

USER REACTION

From the Datapro User Survey of Computer Systems conducted in the fall of 1978, five HP 1000 users were identified. Their ratings represented a total of 13 systems.

All but one of the systems had been purchased, and all had been in operation over 24 months. From the information provided, it could not be determined which, if any, of the users were using their processors in a DSN network configuration. The responses indicated, however, that most were operating in a stand-alone environment, especially since most of the reported operating systems do not support the DS/1000 software required to perform as a node in a DSN network.

With this in mind, it should be noted that the following ratings probably do not represent HP 1000's functioning as DSN network nodes, but should nevertheless provide some indication of hardware/software reliability and vendor support. The ratings are as follows:

	Excellent	Good	Fair	Poor	WA*
Overall satisfaction	1	2	2	0	2.8
Ease of operation	2	1	1	0	3.3
Mainframe reliability	4	1	0	0	3.8
Peripheral reliability	2	3	0	0	3.4
Maintenance responsiveness	2	3	0	0	3.4
Maintenance effectiveness	0	3	1	0	2.8
Technical support	0	3	0	1	2.5
Operating system	0	1	3	1	2.0

*Weighted Average based on 4.0 for Excellent.

The users were apparently pleased with the HP 1000 hardware performance and reliability, but less satisfied with the vendor's maintenance effectiveness, technical support and operating software. Specific comments by the users supported this conclusion. It should be noted, however, that one of the users specifically praised his RTE-IV operating system, which does support DS/1000 and networking, and rated it as good. □

► a 2-character buffer, and can attach modems via EIA or CCITT interfaces.

The 12618A is hardware-compatible with all HP 1000 Series computer systems. Software support is provided by the RJE/1000 software.

12589A AUTOMATIC DIALER INTERFACE: This EIA or CCITT interface can be used with any HP computer that is equipped for asynchronous or synchronous data communications, plus a Bell 801 A or C or equivalent automatic dialing unit. The 12589A is hardware-compatible with the 2105A, 2108M, 2109E, 2112M, and 2113E processors.

TERMINAL INTERFACES: HP offers three low-to-medium-speed terminal interfaces: 1) the *12531C Teleprinter Interface* for use with EIA-compatible devices using Bell type 103 data sets or equivalent; 2) the *12531D Terminal Interface* for use with various terminal devices with optional local EIA and Bell 103 connections; and 3) the *12880A Console Terminal Interface* for use with an HP 2645A Interactive Display Station console, with an HP 2648A Graphics Display Terminal, or with the HP 2640B. These interfaces use programmed I/O only.

The 12531C normally uses locally connected teleprinters communicating via 20-milliampere current-loop signals. Data rates are jumper-selectable from among a choice of 110, 220, 440, 880, or 1760 bits per second, or at up to 2400 bits per second using an external clock. As with all of the HP terminal interfaces, the character size is fixed at eight bits, and the number of stop bits is a jumper-selectable one or two. Option -001 is used to locally connect EIA-compatible terminals. Also, as with the 12531D following, the optional type 103 data sets (option -002) can be used in the manual mode (hand-switched from send to receive) only.

The standard 12531D Terminal Interface differs from the standard 12531C Teleprinter Interface in only one major respect: the internal clock, and hence the five jumper-selectable bit rates, are different; in this case, the internally clocked rates are 150, 300, 600, 1200, or 2400 bits per second. An option (-001) is used to locally connect EIA-compatible terminals; another option (-002) is used for connecting 103-type data sets in the manual mode.

The 12880A Console Terminal Interface uses an external clock only, at a rate of up to 9600 bits per second. Its standard cable connects an EIA-type interface.

The 12531C, 12531D, and 12880A are hardware-compatible with all HP 1000 Series processors.

12790A MULTIPOINT TERMINAL SUBSYSTEM INTERFACE: A microprocessor-based interface card that is microprogrammed to manage a hard-wired or modem-based RS-232C interface, the binary synchronous 2645A multipoint line protocol, and an on-board data buffer. In conjunction with the 91730A Multipoint Terminal Subsystem Software Package, the 12790A supports HP 2645A or 2648A CRT terminals in block mode for program development or program execution. Program execution is under the control of one or more user application programs.

Employing this interface, up to 32 HP 2645A or 2648A terminals can be handled per multipoint line, subject to constraints of distance and operating system. The multipoint protocol implemented on the interface is 2645A multipoint protocol, which is similar to IBM bisynchronous protocol.

The microprocessor manages the routine communications processing, freeing the computer for other tasks. This processing includes control word decoding, data polling, error detection and up to 16 retransmissions, management of asynchronous or synchronous modem control signals, setting of modem control lines, management of the data buffer, and automatic text editing.

The 12790A incorporates a 1024-byte RAM as a data buffer, which allows up to 998-byte block data transfers to the computer and up to 1000-byte transfers from the computer. All transfers to and from the computer are via the DCPC.

The maximum line length between any two terminals is 2000 feet; total line length cannot exceed 16,000 feet. Synchronous speed may be up to 9600 bps regardless of the number of terminals or line length. Asynchronous speed is a function of line length and number of terminals per line, as indicated in the following table. ►

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TABLE 4. HP 1000 OPERATING SYSTEM COMPARISON*

	RTE-M			RTE-II			RTE-IV		
	Product	Memory Required (bytes)		Product	Memory Required (bytes)		Product	Memory Required (bytes)	
		Main	Disk		Main	Disk		Main	Disk
Operating System	RTE-MI	12K	—	RTE-II	27K	—	RTE-IV	50K	—
	RTE-MII	13.5K	—						
	RTE-MIII	15K	—						
System Generator	RTE-M	30K	—	RTE-II	—	20K	RTE-IV	—	26-40
Interprocessor Networking	DS/1000; to HP 1000	13-52K	—	NCCP	6K	20K	DS/1000; to HP 1000	15-52K	—
	to HP 3000	32-36K	—				to HP 3000	36K	—
	to Both	38-77K	—				to Both	40-77K	—
IBM/RJE	None	NA	NA	RJE/1000	4K	10K	RJE/1000	1K	15K
Multipoint Terminal	MTSP	2.5K	—	None	NA	NA	MTSP	2.5K	—
DBMS	None	NA	NA	IMAGE/1000	.5K	24K	IMAGE/1000	.5K	26K

*For comparison only; note that additional main and disk memory will be required for language compilers/assemblers, utilities, device handlers, etc.

Terminals per line	Line speed		
	2400 bps	4800 bps	9600 bps
4	2000 ft.	2000 ft.	2000 ft.
8	2000 ft.	2000 ft.	1200 ft.
16	2000 ft.	1200 ft.	480 ft.
32	1200 ft.	480 ft.	120 ft.

Error detection is through the use of CRC (cyclic redundancy checking). Error correction is via program-specified retransmission (up to 16 times).

The 12790A can be used with any HP 1000 Series processor except the 2105A. The user may select from the following Bell-type data sets: 201A3, 201C, 202T, 208A, 208B, or 209A. As an alternative, the Vadic VA 3400 modem is also acceptable.

12771A COMPUTER SERIAL INTERFACE: This is a two-card interface that forms a complete, hard-wired hardware communications link between two HP 1000 computer systems equipped with the 91740A/B DS/1000 Network Software-Firmware Package and managed by the RTE-M or RTE-IV operating system.

Errors detected in the hardware word parity check on the 12771A board and in the longitudinal or diagonal parity checks on the blocks received are corrected by retransmission. Transmission speeds are user-selected by jumper on each interface card to correspond with the cable length used, as tabulated below. Software overhead will slow down network throughput rates.

Cable Length, feet	Max. Transmission Speed, bytes per second
0-600	60,606
600-1200	38,460
1200-2000	22,222
2000-3000	12,048
3000-4000	22,222
4000-5400	12,048
5400-7300	6,288
7300-10000	3,214

The 12771A is compatible with all HP 1000 Series computers, and systems except the 2105 processor and the Model 30 packaged system.

12773A COMPUTER MODEM INTERFACE: Provides for interconnection of HP 1000 Series computer systems in a DS/1000 network using full-duplex modems. The interface is supported by the 91740A/B Network Software-Firmware Package and is compatible with the EIA RS-232B and CCITT V.24 interfaces with full-duplex operation. The transmission link is full-duplex over switched (direct distance dial) or private (leased) common-carrier telephone lines. Modems may have automatic answering capability. Transmission is in bit-serial, synchronous, or asynchronous mode, depending on the modem used. Asynchronous data transfer rates of 75, 150, 300, 600, or 1200 bps are possible. Synchronous rates depend on the modem selected.

The user may select from several modems, including the Bell type 103A2, 103A3, 201A3, 201C, 202T, 208A, and 209A data sets and the Vadic VA 3400 modem.

Errors detected in the hardware word parity check on the 12773A board and in the longitudinal or diagonal parity checks on the blocks received are corrected by retransmission.

SOFTWARE

Hewlett-Packard offers a series of real-time executive operating systems for the HP 1000 Series computers. A number of older operating systems are considered "mature", and while no longer available with new systems, they are still supported by Hewlett-Packard in existing systems. They include the Basic Control System (BCS), the Real-Time Executive-B (RTE-B), the Real-Time Executive-C (RTE-C), and the Real-Time Executive-III (RTE-III).

The operating systems which are considered current are RTE-M, a memory-based system available in three versions (MI, MII and MIII); the Real-Time Executive-II, a disk-based system which supports up to 64K bytes of main memory; and the Real-Time Executive-IV, the latest and most powerful disk-based system which supports up to 2048K bytes of memory.

RTE-M offers flexible configurability and is functionally divided into RTE-MI, RTE-MII, and RTE-MIII. RTE-MI provides a single-terminal, single-program, execution-only environment with optional program development. RTE-MII presents to the user a multiprogramming, multi-user environment with multi-terminal support, concurrent single-user program processing, and buffered output. RTE-MIII contains all the capabilities of RTE-MII plus management of up to 64 individually mapped and protected partitions in up to 2.048 megabytes of memory.

Hewlett-Packard HP 1000 Communications Capabilities

▶ RTE-MI will run in 16K bytes of memory, with the same minimum peripheral complement as BCS, but does not support system protection. To the extent that memory space is available, optional modules can be added to provide I/O buffering, program-to-program scheduling, real-time clock and I/O timeout, time scheduling of programs, additional on-line commands, auto restart after power failure, file direct access, and on-line installation of programs.

RTE-MII supports memory protection and includes I/O buffering and program-to-program scheduling as standard. All other options of RTE-MI are supported, as well as resource management, mailbox data exchange for more effective control of multiprogramming operations, a multi-terminal monitor, and single-user program development.

RTE-MIII supports all the features of RTE-MII and requires an absolute loader for on-line program installation.

Real-Time Executive II (RTE-II) is a disk-based operating system that provides real-time and background disk swapping partitions and operates in a maximum of 64K bytes of main memory. Program swapping to and from disk memory extends its multi-user capability. Typically, over 37,000 bytes of memory are available for users' programs under RTE-II in a 64K-byte system.

Real-Time Executive IV (RTE-IV) is the head of a compatible family of RTE systems that also includes *Real-Time BASIC (RTE-B)*, a main memory-based system for up to 16-user task scheduling and conversational BASIC programming; *RTE-RTE-C*, a main memory-based, time- and event-scheduled real-time multiprogramming system; *RTE-M*, a main memory-based, modular operating system that can vary from a single-terminal, single-program environment to a multiprogramming, multi-user environment; and *RTE-II*, a disk-based, real-time, multi-user operating system that differs from RTE-IV largely with respect to capacity, responsiveness, and throughput.

RTE-IV, a step up from RTE-II, offers the Dynamic Mapping System (DMS) for control of a maximum of 2048K bytes of memory, memory management of up to 64 disk-resident program partitions, addressing of an extended area for data (EMA) limited only by available memory (nearly 2 megabytes in a 2048K-byte system), and minimization of disk swapping. Up to two million bytes are available for user programs and data in a maximum-memory RTE-IV system.

Both RTE-II and RTE-IV offer a batch spool monitor, file management, on-line system generator, and drivers for all standard peripherals. Both can be configured to support HP's IMAGE data base management system, automatic test or measurement using multiple instrument clusters connected via the HP-1B interface bus, and on-line development by the user of new microcoded instructions for the system through the use of the RTE Microprogramming Package.

Furthermore, both RTE-II and RTE-IV support concurrent processing and program development in FORTRAN II, FORTRAN IV, Conversational Multi-User Real-Time BASIC, ALGOL, and HP Assembly language. An interactive text editor is supplied for program development. Time, event, and program-to-program scheduling is available for real-time measurement, control and/or automatic test applications. Table 4 compares the basic characteristics of these three operating systems.

Hewlett-Packard offers several modular software and software/firmware products which afford a variety of communications and networking capabilities to the HP 1000 Series. These include DS/1000, the networking product for RTE-M and RTE-IV systems; NCCP, an older communications product for RTE-II systems; RTE/1000, which offers IBM-compatible RJE communica-

tions for disk-based HP 1000 systems; and the Multipoint Terminal Subsystem Software.

9174X DISTRIBUTED SYSTEM/1000 (DS/1000): This product consists of both software and firmware, providing an integrated set of high-level network facilities and procedures. These include network resource-sharing, distributed file management, communication between application programs (program-to-program data exchange), and coordinated distribution of processor workloads to other HP 1000 computers or systems and/or HP 3000 Series II and Series III systems.

DS/1000 features network-wide nodal addressing with store-and-forward communications for maximum configuration flexibility, a firmware driver optimized for concurrent servicing of multiple hard-wired or modem lines with error correction, remote system generation and remote program development and testing between HP 1000 systems, remote command processing between any two HP 1000 network nodes (even nodes that are not directly connected except through an intervening HP 1000 node), and HP 1000 virtual terminal capability with respect to HP 3000 Series II and Series III systems.

The DS/1000 software in each system, or network node, consists of several layers. The Network Service Intrinsic (NSI/1000) are called by the user's application programs or operator commands to generate the transaction format for master requests to remote nodes, with data as required.

The Network Interface Monitors (NIM/1000) process incoming master requests received from the Communications Management software (CM/1000) and link them as required to the user's slave programs, file management routines, or the RTE exec. The CM/1000 layer routes network transactions, queues them, and manages the local system resources necessary for network communications. CM/1000 also manages the store-and-forward operations.

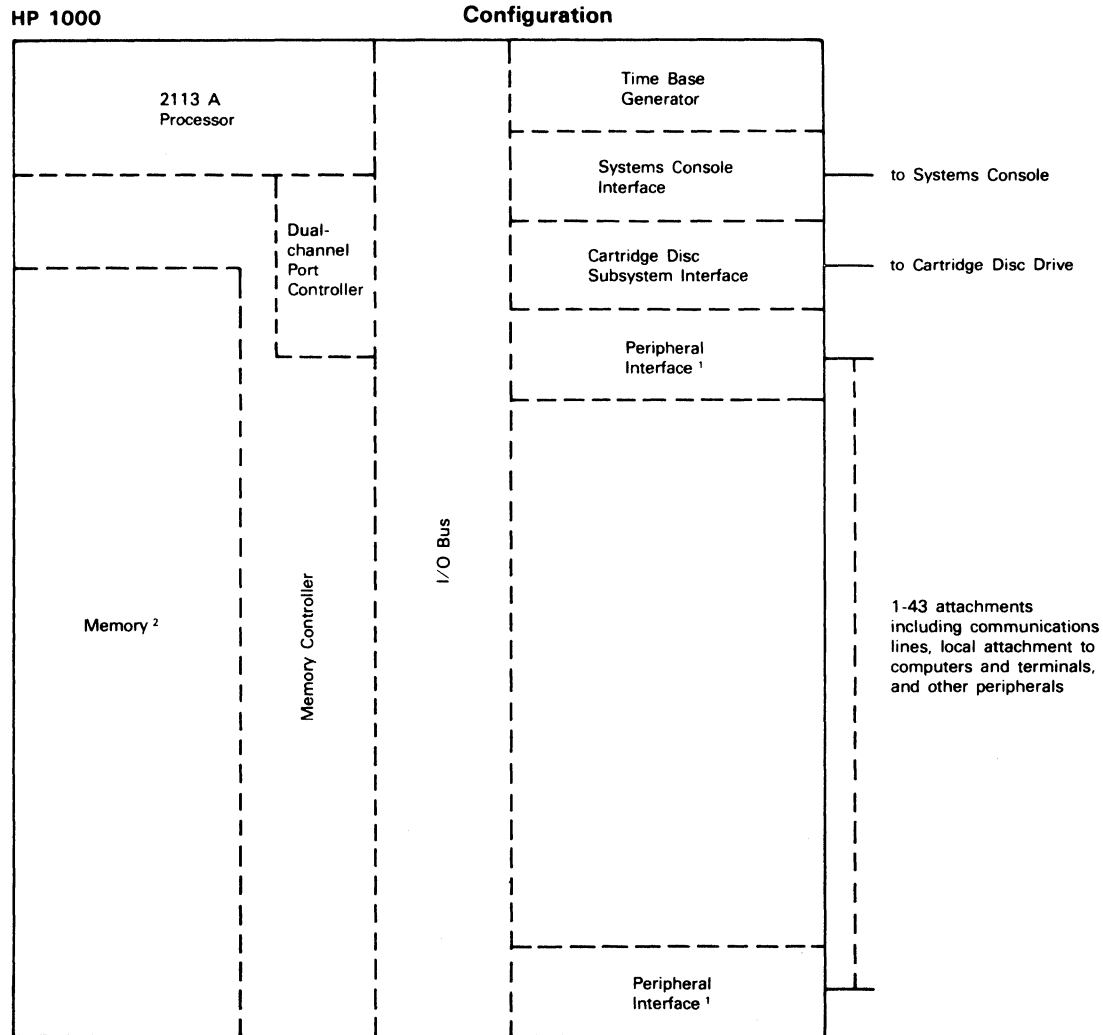
The CM/1000 layer communicates with the interface hardware, which may be several hard-wired and/or modem interface cards, via the Communications Access Method/1000 (CAM/1000) software and firmware. CAM/1000 provides a line protocol for the control of communications input and output, including error detection and correction by retransmission. The lower layers are managed by software, firmware, and hardware so as to be completely transparent to the user. Changes to these layers of the network can be made with little or no effect on the user's application programs.

For HP 1000 to HP 3000 communications, the CM/1000 layer includes translators for conversion of HP 1000 requests and replies to/from DS/3000 format. The CM/1000 software is designed to work with only one remote HP 3000 system and does not provide for nodal addressing or store-and-forward operation to/from the HP 3000. CAM/1000 for HP 1000 to HP 3000 communication is a software-only synchronous line controller.

HP 1000 Series computer systems can communicate via either hard-wired or modem links. The 12771A hard-wired interface operates at rates to 60.6K bytes per second (subject to software overhead) at distances to 600 feet and at lower rates over longer distances up to 10,000 feet. The 12771A can operate with or without the 12620A interface for privileged interrupt control. In lightly-loaded HP 1000 systems, non-privileged operation results in higher throughput.

The 12773A modem interface operates with full-duplex modems asynchronously at rates to 1200 bits per second or synchronously at rates to 19,200 bits per second. The 12773A must be used with the 12620A interface for privileged

Hewlett-Packard HP 1000 Communications Capabilities



(1) Basic system includes 11 I/O Bus Slots. Up to two 16 Slot I/O Expanders can be attached.

(2) Basic system includes 128K bytes of standard performance memory. Nine additional memory module slots permit main memory to be expanded to 1280K bytes. With 12990B Memory Expander, capacity can be increased to 2048K bytes.

► interrupt control and is compatible with Bell type 103, 201, 208, and 209 data sets and with Vadic VA3400 or equivalent modems.

An HP 1000 Series computer system connects to an HP 3000 Series II system via a 12889A hard-wired serial interface and a counterpart hard-wired interface in the HP 3000 system. The 12889A operates at rates to 250K bytes per second (subject to software overhead) at distances to 1000 feet or at 125K bytes per second (subject to software overhead) over distances to 2000 feet.

The accuracy of both hard-wired and modem communications between HP 1000 systems is supported by LRC/VRC/DRC (longitudinal, vertical, and diagonal) redundancy checking. HP 1000 to HP 3000 communications are error-checked by the CRC-16 error detection method, which is implemented in hardware on the 12889A interface card. Detection of an error results in a request for retransmission.

The 91740A/B and 91741A DS/1000 software-firmware products are compatible with the 32190A DS/3000 software in HP 3000 Series II systems and the 91780A RJE/1000

IBM 360/370 remote job entry package. The DS/1000 software is not compatible with the 91700A, 91703A, 91704A,

or 91705A distributed systems communications packages. However, RTE-C and RTE-II programs using those packages are upward-compatible with DS/1000 with only minor modifications.

DS/1000 operates under RTE-M or RTE-IV on all HP 1000 Series processors except the 2105A.

91700A NETWORK CENTRAL COMMUNICATIONS PACKAGE (NCCP): The 91700A is an interface and software communications package that operates under RTE-II. It allows an HP 1000 Series computer system to function either as a network central system, capable of supporting a distributed network of memory-based HP satellite computer systems, or as a communications agent to another RTE (Real-Time Executive) based HP 1000 system on a program-to-program basis. NCCP also allows remote task assignment, remote file access data transfers, and use of remote peripherals. NCCP has compatibility with the 91703A BCS, the 91704A RTE-B, and the 91705A RTE-C memory-based satellite Communications Packages.

Transmission line speed is determined by cable length, as summarized below. ►

Hewlett-Packard HP 1000 Communications Capabilities

Cable Length, Feet	Line Speed, Bits/Second
0 to 600	1,000,000
600 to 1200	500,000
1200 to 2000	250,000
2000 to 3000	125,000
3000 to 4000	250,000*
4000 to 5400	125,000
5400 to 7300	62,500
7300 to 10000	31,250

*For distances of 3000 feet, current-limiting resistors are in series with the receivers in both data interface cards; these resistors are shorted for lengths greater than 3000 feet, giving the increase in line speed shown for the 3000 to 4000 foot cable length.

Requirements for NCCP include 6100 bytes of resident memory under either RTE-II or RTE-IV (including a 1400-byte user-defined buffer area).

NCCP is an older offering, considerably less capable and flexible than other DS/1000 software products; HP does not recommend that this product be purchased for new applications.

91789A RJE/1000: This software/hardware package enables an HP 1000 Series computer system to communicate with IBM 360/370 batch-oriented computers in a manner similar to an IBM 2780 Data Transmission Terminal. However, RJE/1000 does not support these IBM 2780 features: terminal identification, multipoint operation, and bell operation. RJE/1000 is implemented under RTE-C, RTE-II, and RTE-IV operating systems. The package can be employed in a multiprogramming environment that allows concurrent program development, computation, and data acquisition while communicating with an IBM 360/370 batch system.

Data is transmitted in either half- or full-duplex mode over dial-up or leased lines using Bisync protocol. Magnetic tape drives, disc drives, card readers, or CRT terminals can be used as remote job entry devices via modems at the speeds indicated in the table below. Line printers can serve as output devices.

Connection and Modem Type	Max. Synchronous Data Rate, half or full duplex
Switched telephone network and:	
Bell 201A modem	2000 bps
Bell 201C modem	2400 bps
Bell 208B modem	4800 bps*
Non-Bell modem	4800-9600 bps
Private lines and:	
Bell 201B modem	2400 bps
Bell 201C modem	2400 bps
Bell 208A modem	4800 bps
Bell 209A modem	9600 bps
Non-Bell modem	4800-9600 bps

*Half duplex only.

Features include EBCDIC transparency, auto turnaround, auto answer, multirecord transmission, end of media, and EBCDIC and ASCII code sets. RJE/1000 operates directly with HASP in IBM operating systems using the BTAM, TCAM, or RTAM access methods. RJE/1000 also operates with the HASP, RES, and JES/2 scheduler software. Also

included is Trace, an off-line data link diagnostic analysis facility. Trace provides for logging communications on an RJE/1000 link. Logging is on magnetic tape or disc for subsequent printout and analysis.

The RJE/1000 hardware consists of two boards. The software is supplied on HP mini-cartridge tapes and operates on all processors except the 2105A and on all packaged systems except the Model 20 and Model 25.

91730A MULTIPOINT TERMINAL SUBSYSTEM SOFTWARE: This package provides multipoint terminal communications between HP 2645A and/or 2648A CRT Terminals and an HP 1000 Series computer system. Features of the package include support of single I/O channel communications with multiple CRT terminals on a single communications line, program development and/or application program execution at multipoint terminals on RTE-IV-based systems, application program execution on RTE-III-based systems, computer interface block transfers up to 1000 characters long, support for up to eight 12790A Multipoint Terminal Interfaces, a multipoint master application program capability, a multipoint network status display program, command identification of multipoint terminals, auto-acknowledgement of data entry, group and line message broadcast capabilities, an intelligent polling algorithm, a system-level exerciser program, and a power fail restart subroutine.

For further information, see the section on the 12790A Multipoint Terminal Subsystem Interface.

PRICING

The HP 1000 is available for purchase only. Maintenance contracts are available, and the monthly maintenance charges are included in the following price list.

Maintenance is offered through 53 U.S. offices, 9 Canadian offices, and 121 international offices. The standard Basic Monthly Maintenance Charge (BMMC) contract includes six preventive maintenance calls a year. The basic monthly contract calls for four-hour response time within a 100-mile radius of a major metropolitan area. Coverage is provided Monday through Friday, 8 a.m. to 5 p.m. Extended coverage is available in most locations (see below). The contract also covers automatic software and reference manual updates and service on non-reproducible system failures.

On-site installation assistance from HP is included with certain software products. Installation in the U.S. includes travel up to 100 miles from the nearest HP service facility. Assistance for other software products is provided at prevailing service rates or through phone-in consulting of comprehensive software support. Assistance is provided for RTE-M, RTE-II, RTE-IV, BCS, RTE-B, RTE-C, programming languages, 91700A NCCP, RJE/1000, and DS/1000 Network Software.

Several software and system support contracts are available to the user, and vary depending on whether the software is active or inactive (mature). The Software Subscription Service is a monthly fee paid for software and manual updates. The Comprehensive Software Support fee (also monthly) includes the subscription service and phone-in consulting service.

Hewlett-Packard HP 1000 Communications Capabilities

EQUIPMENT PRICES

	Purchase Price	Monthly Maintenance
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► PROCESSORS

All HP 1000 Series processors feature 128 (162 for the 1000 F-Series) standard instructions, including floating-point and extended arithmetic unit instructions, 211 user-accessible control processor instructions, power-fail interrupts, semiconductor memory, memory parity check, multi-level vectored interrupt structure, and up to four separate internal bootstrap loaders, selectable from the front panel, are available on most models. Additionally, the processors and all peripheral units except the punched tape punch, plotters, and teletypewriter are available for 115-VAC, 60-Hertz or 230-VAC, 50-Hertz operation at the same prices.

All HP 1000 M-Series processors are supplied with a paper tape loader ROM and sockets for three additional loader ROM's.

2105A	HP 1000 M-Series; supports two memory modules in the mainframe, four powered I/O channels; front panel is 5.25 inches high	\$ 4,750	\$ 66
2108M	HP 1000 M-Series; supports five memory modules in the mainframe, nine powered I/O channels, front panel is 8.75 inches high, includes two 32K-byte standard performance memory modules	7,425	71
2112M	HP 1000 M-Series; supports 10 memory modules in the mainframe, 14 powered I/O channels; front panel is 12.25 inches high; includes dynamic mapping system and one 128K-byte standard performance memory module	10,450	103

All HP 1000 E-Series processors are supplied with paper tape and disk loader (7900/7905/7906/7920) ROM's along with sockets for two additional loader ROM's and firmware accessory board.

2109E	HP 1000 E-Series; supports five memory modules in the mainframe, nine powered I/O channels; front panel is 8.75 inches high, includes two 32K-byte standard-performance memory modules	9,250	74
2113E	HP 1000 E-Series; supports 10 memory modules in the mainframe, 14 powered I/O channels; front panel is 12.25 inches high; includes one 128K-byte standard-performance memory module and dynamic mapping system	11,750	103

All HP 1000 F-Series processors include a hardware-based floating-point processor, fast FORTRAN processor, and FORTRAN accelerator instructions, scientific instruction set with transcendental function instructions, firmware accessory board, and disk loader (7900/7905/7906/7920) ROM's along with sockets for three additional loader ROM's.

2111F	HP 1000 F-Series; supports five memory modules in the mainframe, nine powered I/O channels; front panel is 12.25 inches high; includes two 32K-byte high-performance memory modules	12,250	102
2117F	HP 1000 F-Series; supports 10 memory modules in the mainframe, 14 powered I/O channels; front panel is 17.50 inches high; includes one 128K-byte high-performance memory module and dynamic mapping system	16,000	130

PACKAGED SYSTEMS

All packaged systems include, as standard equipment: 12897B Dual-Channel Port Controller (except 2174A/B and 2175A/B); 12991B Power Fail Recovery System; 12992C CRT Console Loader ROM (mini-cartridge); 12539C Time Base Generator; 13304A Firmware Accessory Board; auto boot-up capability (except 2174A/B and 2175A/B); 2645A Display Station Console with 128-character set, dual mini-cartridge tape I/O, and extended asynchronous communications (except 2648A or 2177A/B); and diagnostics on mini-cartridges.

2174A	HP 1000 Model 20 Computer System; includes a 2113 E-Series processor with 2102B memory controller, two 13187B 32K-byte standard-performance memory modules, and 12892B Memory Protect; 29402B Single-Bay Upright Cabinet; and RTE-M operating system with file managers and RTE drivers on mini-cartridges	22,000	124
2174B	In desk configuration instead of upright cabinet	22,000	126
2175A	HP 1000 Model 25 Computer System; includes a 2117 F-Series processor with 2102E memory controller; two 12741A 32K-byte high-performance memory modules and 12892B Memory Protect; 29402B Single-Bay Upright Cabinet; and RTE-M operating system with file managers and RTE drivers on mini-cartridges	27,500	157
2175B	In desk configuration instead of upright cabinet	27,500	159
2170A	HP 1000 Model 30 Computer System; includes a 2113 E-Series processor with 2102B memory controller, two 13187B 32K-byte standard-performance memory modules and 12892B Memory Protect; 29402B Single-Bay Upright Cabinet; 4.9-megabyte 12960A Cartridge Disk Subsystem (system disk); and RTE-II operating system with batch spool monitor and RTE drivers	31,500	237
2171A	As described under 2170A, but system disk is 19.6-megabyte 7906MR Cartridge Disk Subsystem	36,500	217
2172A	As described under 2170A, but system disk is 19.6-megabyte 7906M Cartridge Disk Subsystem in a mini-rack cabinet and system is mounted on a desk cabinet	36,500	218
2176A	HP Model 40 Computer System; includes a 2113 E-Series processor with 128K-byte 12786A Standard-Performance Memory Package, 19.6-megabyte 7906MR Cartridge Disk Subsystem, 29402B Single-Bay Upright Cabinet, and RTE-IV operating system	40,000	244
2176B	As described under 2176A, but in desk configuration with 7906M disk drive	40,000	245
2177A	HP Model 45 Computer System; includes a 2117 F-Series processor with 128K-byte 12788A High-Performance Memory Package, 19.6-megabyte 7906M Cartridge Disk Subsystem, 2648A Graphics Terminal, 29402B Single-Bay Upright Cabinet, and RTE-IV operating system	46,500	273
2177B	As described under 2177A, but in desk configuration	46,500	274

PROCESSOR OPTIONS

For all HP 1000 Series systems:

12897B	Dual-Channel Port Controller; included in packaged systems except for 2174A/B or 2175A/B without option 032	750	8
12979B	I/O Extender; adds 16 slots to processor's capacity; panel height 8.75 inches	4,500	12
12898A	Dual-Channel Port Controller for I/O extender	350	11
13197A	Writable Control Store with 1024-instruction-word capacity	2,000	12
13047A	User control store for up to 2048 PROM instruction words	550	5
12991B	Power Fail Recovery System for 2112M, 2113E, 2111F, and 12990B Memory Extender	600	5

COMMUNICATIONS EQUIPMENT

12531C	Current Loop Teleprinter Interface; EIA-compatible	350	4
12531C-001	Local Terminal Interface; EIA-compatible; 110, 220, 440, 880, or 1760 bps	405	4
12531C-002	Remote Terminal Interface; same as -001 via data modem	405	4
12531D	Current Loop Terminal Interface; EIA-compatible	350	4
12531D-001	Local Terminal Interface; EIA-compatible; 150, 300, 600, 1200, or 2400 bps	405	4
12531D-002	Remote Terminal Interface; same as 12531D-001 via data modem	405	4
12880A	Interface for local CRT terminal	350	—
12790A	Multipoint Terminal Interface	1,500	8

Hewlett-Packard HP 1000 Communications Capabilities

EQUIPMENT PRICES

COMMUNICATIONS EQUIPMENT (Continued)

Purchase Price Monthly Maintenance

12587B	Asynchronous Data Set Interface	550	6
12589A	Automatic Calling Unit Interface for use with Bell System 801 Automatic Calling Unit	450	3
12618A	Transmit-Receive Synchronous Data Set Interface	700	10
12889A	Hard-wired Serial Interface	750	4
12920B	Asynchronous 16-Channel Multiplexer for 103A-Type Modems or Terminals	2,000	16
12920B-001	Asynchronous 16-Channel Multiplexer for 202-Type Modems	800	4
12966A	Buffered Asynchronous Communications Interface	600	4
12967A	Synchronous Communications Interface	650	5
12968A	Asynchronous Communications Interface	750	5
12771A	DS/1000 Computer Serial Interface	1,200	16
12773A	DS/1000 Computer Modem Interface	600	8
12889A	HP 1000 to HP 3000 Hard-Wired Serial Interface	750	10
91200B	Video Display Monitor Interface; requires option 10, 11, or 15	1,700	15
91200B-010	U.S. Scan Mode Crystal	—	—
91200B-011	Industrial Monitor Scan Mode Crystal	—	—
91200B-015	European Scan Mode Crystal	—	—
91700A	Central Communications Package with Central Communications Executive and Hard-Wire Interface for Central RTE-II software on paper tape	3,500	8
91700A-001	Modem interface instead of hard-wire interface	3,500	8
91703A	Satellite Communications Package with Satellite Communications Executive and two Hard-Wire Interfaces for BCS; software on paper tape	4,000	16
91703A-001	Two modem interfaces instead of hard-wire interfaces	4,000	16
91705-A	Satellite Communications Package with Satellite Communications Executive and two hard-wire interfaces for RTE-C; software on paper tape	4,000	16
91705A-001	Two modem interfaces instead of hard-wire interfaces	4,000	16

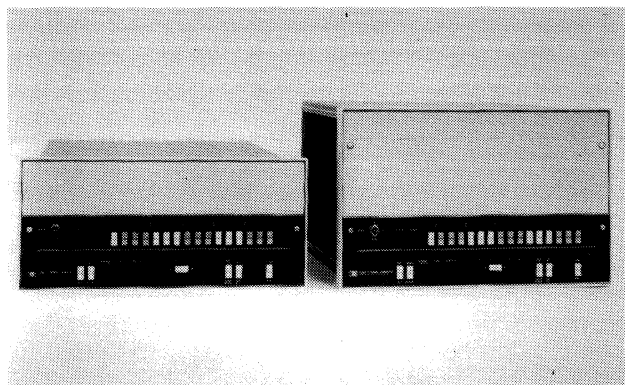
SOFTWARE PRICES*

		<u>License</u>	<u>Monthly Maint.</u>	<u>Software Subscrip.</u>	<u>Comprehensive Software Support</u>
92001B	RTE-II Disk-Based Real-Time Operating System	5,000	—	—	—
92001 S/T	Software support for RTE-II	—	—	85	175
92064A	RTE-M Memory-Based Real-Time Operating System	1,750	—	—	—
92064 S/T	Software support for RTE-M	—	—	65	175
92067A	RTE-IV Disk-Based Real-Time Operating System; includes EMA firmware for E- and F-Series Computers and EMA software for M-Series Computers	5,000	5	—	—
92067 S/T	Software support for RJE-IV	—	—	85	175
91740A	DS/1000 Network software-firmware for M-Series	2,500	6	—	—
91740P	DS/1000 Network firmware for M-Series and the right to duplicate software and updates once	1,000	6	—	—
91740B	DS/1000 Network software-firmware for E- and F-Series	2,500	6	—	—
91740R	DS/1000 Network firmware for E- and F-Series and the right to duplicate software and updates once	1,000	6	—	—
91740 S/T	Software support for DS/1000	—	—	35	125
91741A	DS/1000 Software Enhancement for HP 1000 to HP 3000 Communication	500	—	—	—
91780A	RJE/1000 IBM 2780 Emulator and two card synchronous interface	4,500	10	—	—
91780 S/T	Software support for RJE/1000	—	—	130	85
91730A+020	Multipoint software on mini-cartridge tapes	250	—	—	—
91730 S/T+020	Software updates on mini-cartridge tapes	—	—	10	50
91730 T-200	Comprehensive Software Support coverage for additional copy	—	—	—	30
92063A	IMAGE/1000 DBMS	2,500	—	—	—
92063 S/T	Software support for IMAGE/1000	—	—	30	125

*S following the model number indicates Software Subscription Service; T indicates Comprehensive Software Support. ■

Hewlett-Packard Distributed Systems Network

(HP 1000/21MX Central and 2100/21MX Satellite Systems)



Two models of the 21MX E-Series computers are shown above. The model on the right is used as the basis of the HP 1000 computer system.

MANAGEMENT SUMMARY

Hardware and software standardization is most noteworthy in the Hewlett-Packard Distributed Systems Network. The optional features are straightforward and devoid of restrictive clauses. The network's name, however, does not tell the whole story behind its architecture. While distributed data processing is a capability unquestionably provided by the system, the network architecture is based on clusters of master/slaves (Central/Satellites). Within a cluster there is one master and one or more slave computer systems. Only the master within the cluster supports maintenance of files and data bases. When the network has only one cluster, the network is truly a master/slave network with centralized data base. When the network is comprised of two or more clusters, each of the masters can be either masters or slaves to one another and can change their status dynamically, depending upon the user's systems requirements.

User programs in each master are given the capability to transfer data directly among themselves. In this manner, data from one cluster can be transferred to another cluster. This mechanism must be used for a computer in one cluster to access the data base management system in another cluster. Access to conventional data files does not require user program support in each master to perform the routing function, and therefore, is transparent to the user. Since it is Hewlett-Packard's intent that the communications function be entirely transparent to the user, future releases will most likely remove the user involvement in routing data base accesses among master computers on the network. Should this be the case, the distinction between master and slave will be sufficiently blurred to the point that calling the network a Distributed Systems Network will be truly descriptive of the system's architecture.

Currently, typical users of the network system are using Satellite (slave) systems as real-time data collectors for Central (master) systems, which store and analyze the recorded real-time events.

The 21MX and the 2100 A/S families of minicomputers with Hewlett-Packard's Distributed System Communication software are used to configure a Distributed Systems Network.

The 21MX E is incorporated in the HP 1000 series computer systems that are offered as either a stand-alone system or as a Central Computer System (master), on the network. Each model of the HP 1000 supports up to 43 I/O slots for attachment of computers, communications lines, and other peripherals.

Asynchronous lines up to 9600 bps and synchronous lines up to 20,000 bps are supported.

A typical HP 1000/80 acting as a Central Computer System in a distributed network with 64K words, 14.7M byte disc drive, 800-bpi magnetic tape drive, 200 line-per-minute printer, and the Distributed System Central hardware/software can be purchased for \$65,175. It can be leased on a 5-year, third party arrangement for \$1,361 per month, not including maintenance; a hardware/software maintenance contract costs \$530 per month.

CHARACTERISTICS

VENDOR: Hewlett-Packard Company, Data Systems Division, 11000 Wolfe Road, Cupertino, California 95014. Telephone (408) 257-7000.

DATE OF FIRST ANNOUNCEMENT: 2100A—April 1971; 2100S—March 1973; 21MX—May 1974; 1000—October 1976.

DATE OF FIRST DELIVERY: 2100A—June 1971; 2100S—August 1973; 21MX—August 1974; 1000—December 1976; Distributed Systems Network—August 1973.

NUMBER DELIVERED TO DATE: 2100A—Over 5500; 2100S—Over 2200; 21MX—Over 4000; 1000—Over 350; Distributed Systems Network—Over 150.

SERVICED BY: Hewlett-Packard Company.

CONFIGURATION

Configuring a data processing network utilizing Hewlett-Packard's family of minicomputers is facilitated by Hewlett-Packard's Distributed Systems Communications software package. With the package resident in each computer on the network, along with the appropriate operating system, the communications function is transparent to the user application programs. Distributed Systems Communications provides for a network composed of one or more master computer systems, slave computer systems, connections to

Hewlett-Packard Distributed Systems Network (HP 1000/21MX Central and 2100/21MX Satellite Systems)

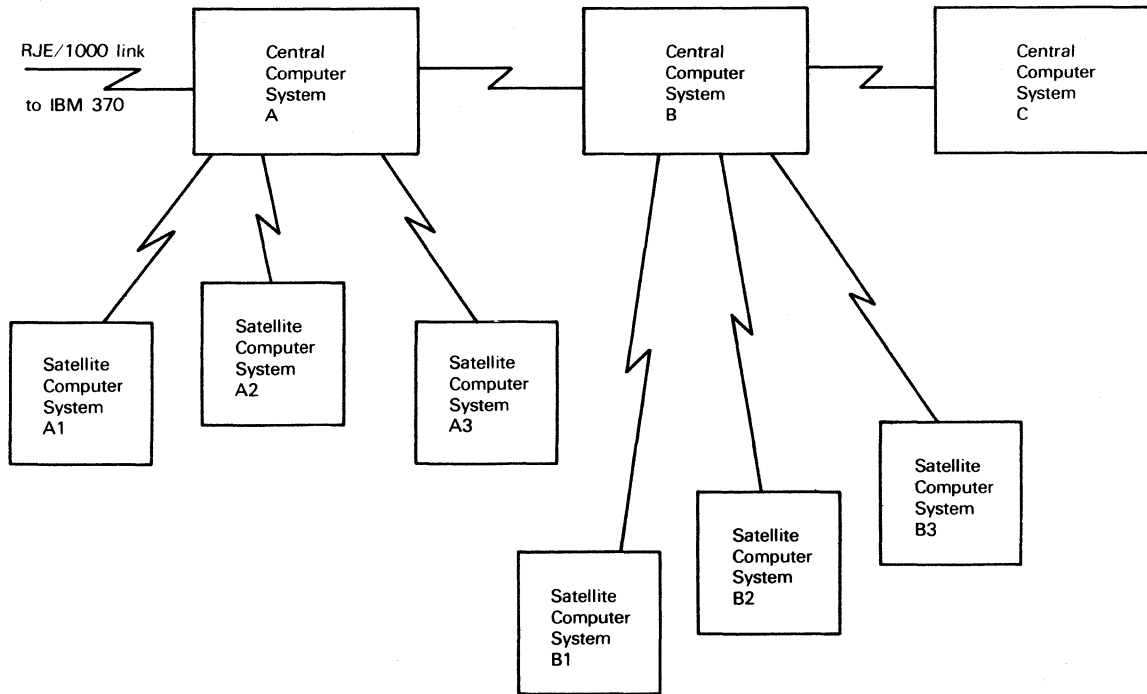


Figure 1. Hewlett-Packard Distributed Systems Communications Network Approach.

▷ With the appropriate operating systems, all program development for Satellite computers can be accomplished at the Central site. The network software will support program testing of a Satellite program on the Central Computer System without having to make any coding changes. A debugged program can be cross-loaded to the Satellite from the Central computer. Satellite operating systems can be centrally generated and remotely loaded.

While any model in the 21MX line can be used in the network, the 21MX E used as a Central system offers the best price performance selection. The prices quoted for the HP 1000 (packaged 21 MX E systems) include the software as well as the hardware.

The 2100 A minicomputer series and the packaged version, the 2100 S series, is a core memory based, smaller-scale computer family than the 21MX family. The 2100 offers an inexpensive Satellite Computer System for specific function processing.

USER REACTION

In June 1977, Datapro talked with five users who have been operating networks with Hewlett-Packard computers for an average of three years. All but one user is using the Distributed System Communication package. Typically each installation has four satellites and one master; only one installation has two masters on the network. The network approach varied at each installation from distributed to pure master/slave. The users' ratings are summarized below. ▷

▶ other disk-based systems, and RJE links to IBM System/360 and 370's.

Central Computer Systems on the network are essentially master computers to a cluster of slaves. Any model 21MX computer can be used as a Central Computer System. The fastest 21MX, the 21MX E, has been packaged in several models to form the HP 1000 systems.

Four of the six HP 1000 models are suited to serve as a Central Computer System in the Hewlett-Packard network. They are the HP 1000/30, 31, 80, and 81.

Slave computers on the network are called Satellite Computer Systems and can be configured from either the 21MX or the 2100 A/S product line of minicomputers.

A Central Computer System can serve as a master to one or more slave Satellite Computer Systems. When there are two or more Central Computer Systems on the network, a given Central Computer System can function as a slave or as a master to another Central Computer System, depending on the functions each system is performing.

With the Distributed Systems Communications package and the related hardware interface, each Satellite System can communicate with its Central Computer System, can use the peripheral resources of its Central Computer, and can be program loaded from its Central Computer System.

Along with the Distributed Systems Communications package, each Satellite requires one of the three operating systems that support the communications package. The BCS operating system is an event-scheduled, single-task operating system. RTE-B is a memory-based, multi-task, time- and event-scheduled operating system that includes a BASIC language interpreter. RTE-C is a multiprogramming, time-operator's, program-, and event-scheduled operating system.

▶ A Central Computer System can be interfaced with another Central Computer System, either locally or remotely. From ▶

Hewlett-Packard Distributed Systems Network
(HP 1000/21MX Central and 2100/21MX Satellite Systems)

TABLE 1. COMMUNICATIONS LINE INTERFACES

Interface Type	Timing Mode	Speed, bps	No. of Lines Supported	No. of I/O Slots Rqd.	Model No.	Remarks
RS232C, V.24, Bell 103, 202, 20 mA Current Loop	Async. Half-duplex	Up to 9600	1	1	12966A	128 char. buffer; special character interrupt
RS232C, V.24, 20 mA Current Loop	Async. Half-duplex	Up to 2400	1	1	12968A	
RS232C, V.24, 20 mA Current Loop	Async. Half-duplex	100, 200, 440, 880, 1760	1	1	12531C	Terminal interface; 5 jumper-selectable line rates
RS232C, V.24, Bell 103	Async. Full- or half-duplex	Up to 2400	16	3	12920B	IBM 2741 and other; speed detection programmable
RS232C, V.24, Bell 202C	Async. Full- or half-duplex	Up to 2400	16	4	12920B-001	IBM 2741 and other; speed detection programmable
RS232C, V.24, Bell 201, 203, 208	Sync. Half-duplex	Up to 20,000	1	1	12967A	DMA transfer; BSC compatible
Bell 201, 203, 208	Sync. Full- or half-duplex	Up to 9600	1	2	12618A	DMA transfer; BSC compatible
Local Connection between 2100 computers	—	2.5 million at 1,000 feet	1	1	12889A	Hard wired
Auto calling Unit Interface, Bell 801	—	—	1	1	12589A	

Excellent Good Fair Poor WA*

Overall satisfaction	2	3	0	0	3.4
Ease of installation	3	2	0	0	3.6
Throughput	3	1	1	0	3.4
Hardware reliability	4	1	0	0	3.8
Promptness of mfr's. maint.	1	4	0	0	3.2
Quality of mfr's. maint.	3	1	1	0	3.4
Mfr's software	0	5	0	0	3.0
Mfr's technical support	1	3	0	1	2.8

*Weighted Average based on 4.0 for Excellent.

As the ratings showed, each user was more than satisfied with the reliability of the hardware and the quality of the software. The technical support was the only area that elicited any statement of dissatisfaction. The dissatisfaction was with the level of detail supplied about the software. (The quality of the documentation supplied was considered very good.) There also were some problems with diagnosing the cause of operating problems (software, hardware, user program), especially when certain features were attached to the system. These problems, the users said, were resolved. □

► a network standpoint, one of the CPU's will serve as master to the other CPU. The master may itself be a slave to a third Central Computer System. User programs in each Central System can transfer data between each other but cannot share peripheral resources. The operating system in a Central System can be either RTE-II or RTE-III.

An example of Hewlett-Packard's Distributed Systems Communications Network is shown in Figure 1. Central Computer System A is master to three Satellite Computer Systems: A1, A2, and A3. The master also has an RJE link to an IBM 370. Central Computer A, itself, is a (dynamic) slave to Central Computer System B. Central Computer B is also a master that has three Satellite Computer Systems: B1, B2, and B3. But, Central Computer Systems B is a (dynamic) slave to Central Computer System C, the ultimate master on the network. The fact that Central C rather than Central A is the ultimate master is an arbitrary, user, decision.

HP 1000 Model Computers

The HP 1000 model computers include, as standard, a 21MX E processor, 64K bytes of memory, the RTE-II or -III operating system, a systems console with a Minicartridge I/O drives, and either a 4.9M byte or a 14.7M byte disc. The four HP 1000 models that support attachment to a Hewlett-Packard network differ in cabinetry and standard peripherals and software; see Pricing for details. Until recently the basic system of each HP 1000 model could support up to 10 Memory Modules of 16K bytes each. With the Memory Extender option, an additional 9 Memory Modules could have been added for a total system memory capacity of 304K bytes. A recent introduction permits use of 8 memory modules of 128K bytes at the same per word price of the 16K byte modules. With the Memory Extend option, a total of 2 megabytes of semi-conductor memory is now available. Since the instruction set of this 16-bit word computer can handle memory addresses up to 32K bytes, the Dynamic Mapping System option is required to handle access to specific memory addresses beyond 32K bytes. The memory cycle time is 595 nanoseconds for the standard 21MX E memory. A High Performance Memory with a cycle time of 350 nanoseconds is optionally available. A different Memory Controller (memory bus) is required for the Standard Memory and for the High Performance Memory.

The basic I/O Bus for the HP 1000 computer systems accommodates 14 attachments. One slot is used for the Time Base Generator (a real time clock); another slot is used for the Systems Console Interface; and a third slot is used for the Cartridge Disc Subsystem. The remaining 11 slots are available for attachment of network interfaces and other peripheral attachments. Optionally, up to two 16 slot I/O Extenders can be added to the system accommodating a system total of 43 attachments beyond the basic configuration.

The Dual-Channel Port Controller feature, a standard feature with the four HP 1000 computer systems that accommodate network interfaces, provides direct memory access for high performance peripherals. Transfers of over one million words per second are possible via the Dual-Channel Port Controller. The interrupt priority for each I/O Bus slot is determined by the physical address of the slot. ►

Hewlett-Packard Distributed Systems Network (HP 1000/21MX Central and 2100/21MX Satellite Systems)

At the user's discretion, time critical and frequently used functions can be microprogrammed into either of two optional micromemories. (The PC load to contain the micromemories is supplied with the HP 1000 as a standard feature.) A Hewlett-Packard PROM micromemory of 3.5K, 24-bit words or a Writable Control Storage micromemory of 1K, 24-bit words can be attached. Microassembled code requires the PROM Writer feature to permanently load PROM memory. Microassembled code for the Writable Control Storage must be reloaded each time the system is initialized.

Application instructions, in memory, are executed under a technique called Dynamic Micro-Cycle Timing. Under this technique, each instruction that requires more than the 175-nanoseconds basic microcycle is assigned, by micro-logic, a micro-cycle of up to 280 nanoseconds.

21MX M Series Computer

The 21MX M series computers is predecessor to the E series. The M series uses a memory with a cycle time of 650 nanoseconds, as compared to the 595-nanosecond memory of the standard E series systems. But because the E series has the Dynamic Micro-Cycle Timing technique, its performance can be up to three times faster than the M series, a capability not apparent when comparing cycle times.

2100 A/S Computer System

The 2100 family of computers preceeded the 21MX family. The 2100A is a system with a 980-nanosecond memory, a 16-bit word, and up to 32K words of memory. A 196-nanosecond control storage option is available in RAM or PROM. The standard I/O Bus accommodates 12 attachments and can be expanded to accommodate 43 attachments.

CONNECTION TO HOST COMPUTER

A hardware interface, along with Distributed System Communication software support, is provided for Satellite Computers to interface, via cable or modem, with a local or remote Central Computer System. The software requires either the BCS, RTE-B, or RTE-C operating system to be resident in the Satellite.

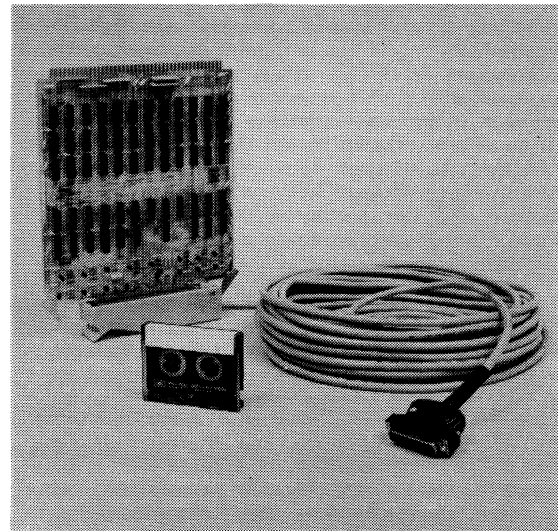
The companion hardware and software used in the Satellite System is required at the Central Computer System to interface with either a Satellite System or another Central Computer System. The RTE-II or RTE-III operating system must be resident in the Central System.

The physical number of computer systems that can be connected as slaves and as masters is sufficiently large enough that throughput considerations will most probably prove the limiting factor in every case.

TRANSMISSION SPECIFICATIONS

Asynchronous, half-duplex lines up to 9600 bps; asynchronous, full-duplex lines up to 2400 bps; synchronous, half-duplex lines up to 20,000 bps, synchronous, full-duplex lines up to 9600 bps, and local computer connections up to 1.0 million bps are supported for attachment to Satellite or Central Computer Systems. Local connections can be at distances up to 10,000 feet, with the supported speed reduced at increasing distances. Table 1, Communications Line Interfaces, lists the types of interfaces provided. Primarily, each interface supports one communications line; however, a 16-line Multiplexor for local or remote interfaces is offered to support Bell 103 and Bell 202C modems or equivalents.

Connection between a Central system and Satellite system or between two Central systems is supported for asynchronous full-duplex operation at up to 1800 bps; for synchronous half-duplex operation at up to 20,000 bps, or for local at up to 1.0 million bps.



The above hardware and software (recorded on the cartridge) comprises the RJE/1000 feature that enables a HP 1000 to communicate with an IBM System/360 or 370 as a remote job entry terminal.

One asynchronous interface is offered with a 128 character buffer, permitting block mode transfer to and from memory. The same device can be programmed to recognize special characters that will trigger interrupts.

The Satellite connection to the host consists of a standard hardware interface and the Distributed System Communication software. A companion interface and the Distributed software is used to connect a Central Computer System with either a Satellite or another Central Computer System.

The RJE/100 option permits attachment to an IBM System/360, 370 by either a Central Computer System or a RTE-C Satellite Computer System. With this option, the Hewlett-Packard computer can emulate an IBM 2780 and function in a batch communications mode with the IBM computer. The IBM host software can be BTAM, TCAM, or HASP. The line speed can be up to 9600 bps; bisync protocol is used.

SOFTWARE

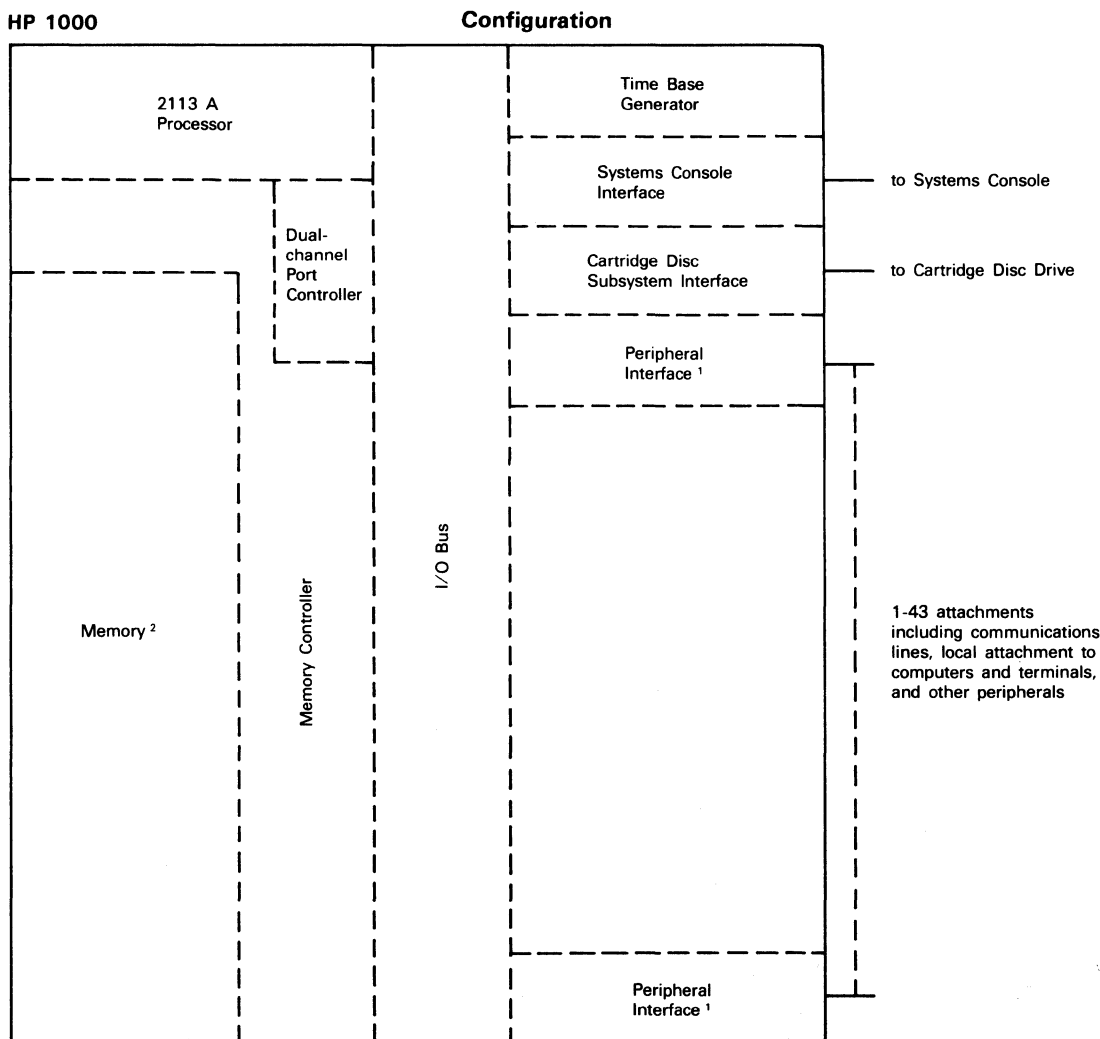
The *Distributed System Communications* software is substantially, a communications line handler, a network message handler, and a user application program interface, all under the control of the operating system. The Communication Driver performs the line handling function, and the Communication Executive, a software module, interfaces the Driver and a specific application program. The Executive also handles message control and queuing functions.

Operating Systems for Satellite Computers

The *Basic Control System* (BCS) is an event-scheduled, single-task operating system. Linked to a Central Computer System via the Distributed System Communications software, BCS can accept programs, a systems generation, and program testing tasks from the Central Computer; share Central peripherals; retrieve data from Central files; and trigger a task in the Central Computer. The programming languages supported are FORTRAN IV/II, ALGOL, and HP Assembly. Up to 4590 words of memory is required for the operating system, including the communications software.

The *Real-Time Basic System* (RTE-B) is a time- and event-scheduled, multi-task, memory-based system. It can accept a

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(1) Basic system includes 11 I/O Bus Slots. Up to two 16 Slot I/O Extenders can be attached.

(2) Basic system can support up to 10 16K-byte Memory Modules. Memory Extender can support 9 additional Memory Modules for a total system memory of 304K words. Beyond 32K bytes, Dynamic Mapping System feature is required. *Recent enhancement permits attachment of 8 Memory Modules, each containing 128K bytes. Memory Extender can support 8 additional Memory Module for a total system memory of 2 megabytes.*

► systems generation and programs from the Central Computer, but cannot support program testing initiated by the Central Computer. The Satellite has access to the Central files and can share peripherals. The Central or the Satellite Computers can initiate a task in the other CPU. RTE-B, including the communications software, requires up to 14,890 words of Satellite memory. Programs are written in Real-Time BASIC.

The *Real-Time CPU Memory-Based System (RTE-C)* is a time-, operator-, program- and event-scheduled, multiprogramming operating system. RTE-C can accept programs from Central System as well as systems generation and program testing. Peripherals can be shared and each system can trigger a task in the other system. The Satellite can also retrieve data from the Central files. Programs are written in FORTRAN IV/II, ALGOL, or HP Assembly. The operating system requires up to 10,000 words of memory, including the communications software.

Operating System for Central Computer Systems

The Real-Time Executive operating system (RTE-II) is a disc-based operating system providing priority, time, event, and job stream scheduling; multi-programming; and roll-

out/roll-in capabilities. RTE-III provides the capabilities of RTE-II plus the ability to support up to 64 interactive user programs in up to 2 megabytes memory. Both RTE-II or RTE-III support the Distributed System Communication package.

Data Base Management

IMAGE/1000, a data base management system, is offered for the Central Computer System. In addition to data base maintenance and access support, an inquiry language, QUERY, is included.

PERIPHERALS

A *Cartridge Disc Subsystem* is offered with up to four dual-drives; each dual-drive stores 4.9 or 14.7 megabytes of data. A dual-drive consists of one fixed and one removeable disc cartridge.

A *Flexible Disc Subsystem* can be attached with up to four drives. Each drive stores 514K bytes.

Magnetic Tape Subsystems are provided in 9-track and 7-track. Each subsystem supports up to 4 drives.

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► **Character printers with keyboards are available with prints speeds of up to 120 characters per second. Line printers are offered with speeds from 200 to 1250 lines per minute.**

Up to 56 Data Entry terminals on a multipoint line can be attached as well as point-to-point keyboard/CRT terminals supporting English, Cyrillic, Danish/Norwegian, and Swedish/Finnish character sets.

Digital and graphic plotters, card readers/punches, and paper tape readers/punches are also offered.

PRICING

Hewlett-Packard systems are available on either a purchase or third-party lease basis. Lease arrangements can be obtained for terms of three to five years. The monthly charge is a percentage of the purchase price, ranging from 3.192 percent for a three-year lease down to 2.088 percent for a five-year lease. Maintenance contracts are available for a monthly charge that is based on the equipment utilized within the system. While the individual software packages are available separately, software is usually included in the system price.

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
	HP 1000; all models include a 21MX E CPU, 64K bytes memory, RTE-II or III operating system, and systems console with mini Cartridge I/O drive—		
2172 A	HP 1000/Model 30; includes 14.7M byte disc in minirack, and desk style cabinet	\$36,500	346
2171 A	HP 1000/Model 31; includes 4.9M byte disc and CPU, and upright cabinet	31,500	352
—	HP 1000/Model 80; includes #2172 A plus RTE-III, additional 64K bytes memory, 14.7M byte disc in upright cabinet, 200 lpm printer, and IMAGE data base management system	61,700	620
—	HP 1000/Model 81; includes #2171 A plus RTE-III, an additional 64K bytes of memory, additional upright cabinet, 14.7M byte disc, 200 lpm printer, 800 bpi magnetic tape, and IMAGE data base management system	62,700	630
21MX Computers			
2109A	E-Series; includes 5 memory modules, and 9 I/O channels	5,850	72
2113A	E-Series; includes 10 memory modules, and 14 I/O channels	6,850	72
2105A	M-Series; includes 2 memory modules, and 4 I/O channels	4,150	66
2108A	M-Series; includes 5 memory modules, and 9 I/O channels	5,300	66
2112A	M-Series; includes 10 memory modules, and 14 I/O channels	6,200	66
12892A	M-Series Memory Protect	500	9
12892B	E-Series Memory Protect	500	9
12897B	Dual Channel Port Controller	750	8
12992A	Disc Loader ROM for M-series	100	—
12992C	Terminal Loader ROM	100	—
12992D	Mag Tape Loader ROM	100	—
12979A	16 Slot I/O Extenders (2 max. per system)	4,500	19
12898A	DCP (DMA) for I/O Extender	350	11
2102A	Semiconductor Memory Controller for M-Series; 650 nsec.	600	8
2102B	Standard Semiconductor Memory Controller for E-Series; 560 nsec.	600	8
2102E	High Performance Semiconductor Memory Controller for E-Series; 350 nsec.	600	8
12998A	8K-byte Memory Module for M-Series	750	10
13187A	16K-byte Memory Module for M- and E-Series	1,600	10
12741A	16K-byte Memory Module for E-Series (High Performance)	2,100	10
Memory Expansion Module with standard 13187A Memory Modules and Dynamic Mapping Instruction Group—			
For M-Series			
12763A	2 modules (32K bytes)	3,500	31
12763B	4 modules (64K bytes)	6,400	51
12763C	6 modules (96K bytes)	9,300	71
For E-Series:			
12766A	2 modules (32K bytes)	3,500	28
12766B	4 modules (64K bytes)	6,400	48
12766C	6 modules (96K bytes)	9,300	71
Memory Expansion Module with high performance 12741A Memory Modules and Dynamic Mapping Instruction Group—			
For E-Series:			
12767A	2 modules (32K bytes)	4,500	28
12767B	4 modules (64K bytes)	8,400	48
12767C	6 modules (96K bytes)	12,300	68
12990A	Memory Extender for M- and E-Series (accommodates 9 memory modules)	3,500	16
13304A	E-Series Firmware Accessory Board	300	3
13305A	E-Series Dynamic Mapping System and Memory Expansion Module, Memory Protect, Dynamic Mapping Instruction Group	1,600	—

Hewlett-Packard Distributed Systems Network

(HP 1000/21MX Central and 2100/21MX Satellite Systems)

21MX Computers (Cont'd.)		Purchase Price	Monthly Maint.
13306A	E-Series Fast FORTRAN Processor	650	5
13307A	E-Series Dynamic Mapping Instruction Group	500	2
12731A	Memory Expansion Module for M & E-Series	1,000	6
12976A	M-Series Dynamic Mapping System and Memory Expansion Module, Memory Protect and Dynamic Mapping Instruction Group, and Fast FORTRAN Processor	1,950	25
12977A	M-Series Fast FORTRAN Processor	950	10
12909B	PROM Writer	700	9
12945A	512 Words User PROM	100	5
13047A	2K words User PROM	550	5
12978A	256 words Writable Control Store	1,000	9
13197A	1K words Writable Control Store	2,000	12
2100 Series Computers			
2100A-	Computer	11,000	85
-008	With 8K-word memory	2,500	16
-012	With 12K-word memory	4,500	24
-016	With 16K-word memory	5,000	32
-024	With 24K-word memory	7,500	49
-032	With 32K-word memory	10,000	65
2100S-	Computer; 2100A with 64K-word memory, floatingpoint, DMA, Time Base Generator, TTY Interface	16,300	12
-024	With 24K-word memory	2,500	-
-032	With 32K-word memory	5,000	--
12894A	Multiplexed I/O	350	7
12895A	DMA	750	5
12907A	Fast FORTRAN Processor	1,290	9
12908B	Writable Control Store	1,545	11
12909B	PROM Writer	700	9
2155A	I/O Extender (provides 31 additional I/O channels)	7,250	15
12896A	DMA for I/O Extender	515	5
Communications Interfaces			
12966A	Single-Line; buffered asynchronous	750	1
12968A	Single-Line; asynchronous current loop	700	5
12531D	Single-Line; terminal current loop	405	4
12920B	16-Line; terminal asynchronous	2,000	16
12920B-001	16-Line; modem asynchronous	3,300	20
12967A	Single-Line; synchronous to 20,000 bps	500	5
12618A	Single-Line; synchronous to 9600 bps	700	10
12889A	2100 Local Connection (cable connection to Central system)	750	4
Distributed System Interface kits (hardware and software)			
91700A	Central Communication Executive and Interface Card for Central RTE-II or RTE-III	3,500	43
91703A	Satellite Communication Executive for BCS Satellite and 2 Interface Cards	4,000	18
91704A	Satellite Communication Executive for RTE-B Satellite and 2 Interface Cards	4,000	18
91705A	Satellite Communication Executive for RTE-C Satellite and 2 Interface Cards	4,000	18
91780A	RJE/1000 IBM 2780 Emulator for RTE-C, RTE-II and RTE-III	4,500	20
Cartridge Disc Subsystems			
12960A-	7900A 5 Megabyte Cartridge Disc Subsystem Drive and Controller; one fixed and one removable disc drive	9,000	117
-010	Additional Disc Drive (up to 3 per subsystem)	8,300	89
7900A	Disc Drive, one fixed and one removable disc drive, front loading	7,975	81
13215A	Power Supply for 7900A	1,400	8
12869A	Disc Cartridge for 7900A	125	--
13210A	Interface Controller for 7900A on 2100 Computer	1,000	28
13211A	Rack Mounting Kit for 7900A and 13215A	210	--
13212A	Multi-Unit Cable for 7900A	285	--
Flexible Disc Subsystem			
12732A	514K byte Flexible Disc Subsystem	4,200	36
12733A	Additional Flexible Disc Drive (3 per Subsystem)	2,600	18
Magnetic Tape Subsystems			
12970A-	Magnetic Tape Subsystem, Drive and Controller; 9-track, NRZI (45, 37.5, or 25 ips)	9,500	72
12971A	Magnetic Tape Subsystem, Drive and Controller; 7-track NRZI (45, 37.5, or 25 ips)	15,950	105
12972A-	Magnetic Tape Subsystem, Drive and Controller; 9-track, phase encoded	10,900	90
-010	Additional Magnetic Tape Drive (3 per subsystem)	7,530	61

Hewlett-Packard Distributed Systems Network
(HP 1000/21MX Central and 2100/21MX Satellite Systems)

		<u>Purchase Price</u>	<u>Monthly Maint.</u>
Printers and Plotters			
12987A	200 lpm Printer	8,325	75
12975A	300 lpm Printer	11,475	136
13053A	600 lpm Printer	16,350	150
12983A	1250 lpm Printer	36,050	153
12935A	Digital Plotter Subsystem	4,610	33
7210A	Digital Plotter; 11x17-inch paper	3,750	30
7202A	Graphic Plotter; 11x17-inch paper; 10, 15, 30 cps ASCII input	4,100	40
Terminals			
2762A	Printer with Keyboard; 30 cps, 75 positions	4,950	29
2762B	Printer with Keyboard; 120 cps, 120 positions	6,575	58
2752A	Teleprinter; modified ASR-33	2,500	54
92900A	Data Entry Terminal Subsystem	2,650	9
3070A	Additional terminal with link cable	1,470	4
40280A	Entry terminal interface Kit	1,200	4
3071A	Modem Connected Data Entry Terminal	1,285	4
2640B-020	Keyboard-CRT Terminal; 128 character set, English; includes extended asynchronous communication	2,750	20
2640C-001	Keyboard-CRT Terminal; 128 character set, cyrillic	4,350	20
2640N-001	Keyboard-CRT Terminal; 128 character set, Danish/Norwegian	2,850	20
2640S-001	Keyboard-CRT Terminal; 128 character set, Swedish/Finnish	2,850	20
-020	Extended asynchronous communication for Keyboard-CRT Terminal	150	—
13260C	Asynchronous Multipoint Communication	435	—
13260D	Bisynchronous Multipoint Communication	450	—
Punched Card and Paper Tape			
12985A	Card Reader Subsystem; 600 cpm Reader and Interface	6,375	54
7261A	Optical Mark Reader and Interface; 300 cpm	530	33
12989A	Card Reader/Punch Subsystem	16,500	132
12925A	Paper Tape Reader and Interface; 500 cps	2,870	26
2895B	Paper Tape Punch; 75 cps	5,000	51
Software			
20855A	Basic Control System Software	1,500	25
2300B	RTE-B Real Time Basic	3,000	35
2300C	RTE-C Memory Based Real Time Operating System	3,000	35
92001B	RTE-II Disc Based Real Time Operating System	5,000	85
92060B	RTE-II Disc Based Real Time Operating System	6,000	85
92061A	Microprogramming Package for RTE-II and RTE-III	1,000	20
92063A	IMAGE/1000 Data Base Management System for RTE-II and RTE-III	2,500	■