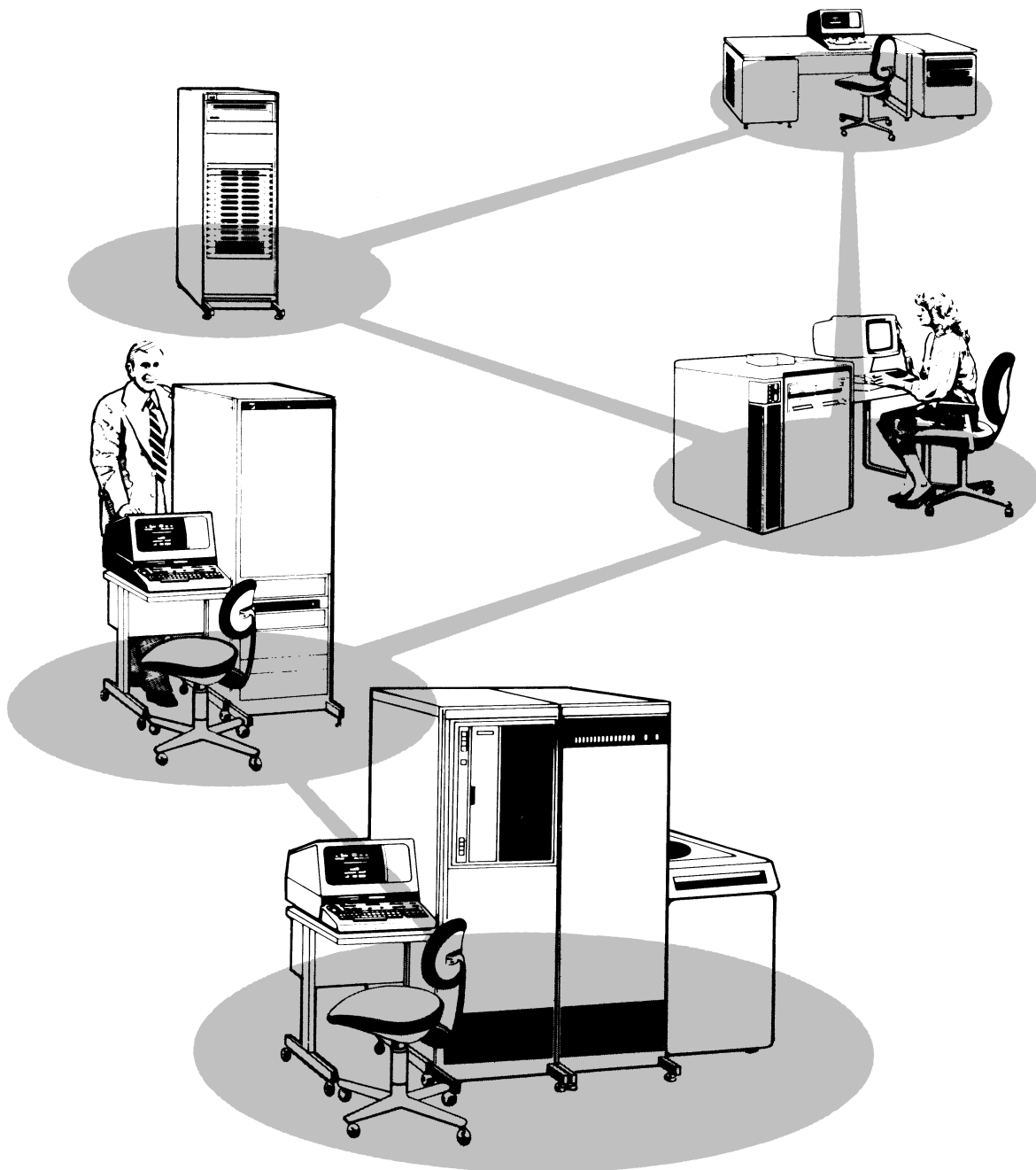# HP 1000 Computer Systems

HEWLETT PACKARD

Communications Products Technical Data Supplement

Introduction

This HP 1000 Communications products technical data supplement contains data sheets on new and significantly enhanced existing software products that have become available since the last revision of the HP 1000 Communications products technical data book.

Contents   Page Number

Data Link

product numbers:
HP 12790A, 91730A, 3074A/M,
92901A, 92902A, 92905A,
Multidrop Communication for HP 1000 Computers 92909A
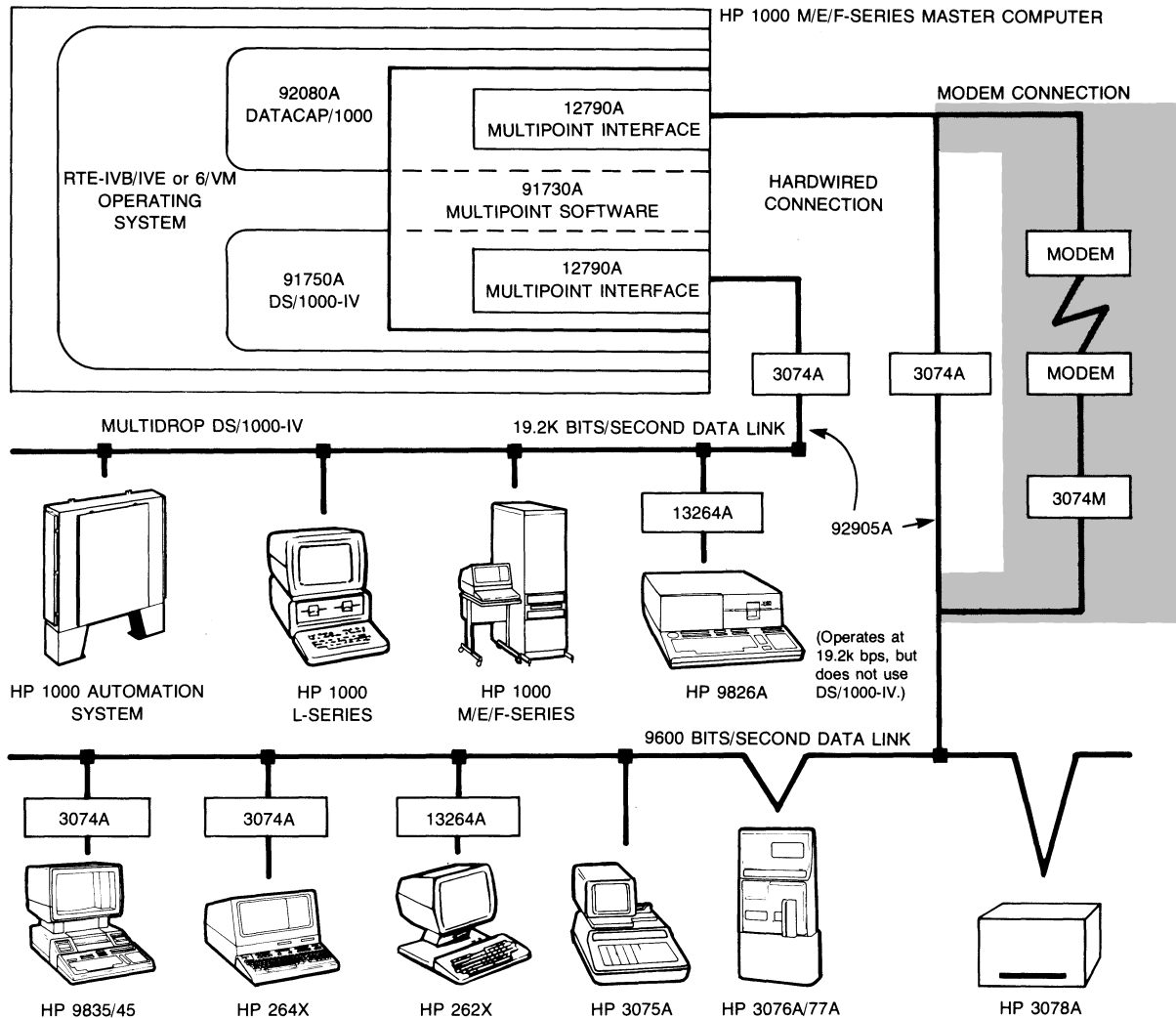

Figure 1. Data Link Overview

The HP 1000 Data Link is a datacommunications capability used to interface a wide variety of devices to an HP 1000 computer system. The Data Link is a low speed, rugged, flexible, and inexpensive multidrop communications link designed for operator data capture, automatic data capture, distributed processing, and distributed control applications. The wide range of devices supported on the Data Link includes M/E/F-Series Computers, L-Series Computers, Desktop Computers, Data Capture Terminals, CRT Terminals, and Data Couplers.

The Data Link communications capability is formed by the combination of 12790A Multipoint Interface, 91730A Multipoint Software, 3074A/M Data Link Adapter, and 92909A Data Link Test Cable, together with a host HP 1000 M/E/F-Series computer system. The host computer is designated Data Link master, and all other devices installed on the Data Link are designated slave devices.

The high reliability due to CRC-16 error checking, optical isolation, and RS-422 differential voltages, combined with multidrop link configuration flexibility, makes the Data Link for HP 1000's an ideal low speed, local communication link for factory and plant automation applications.
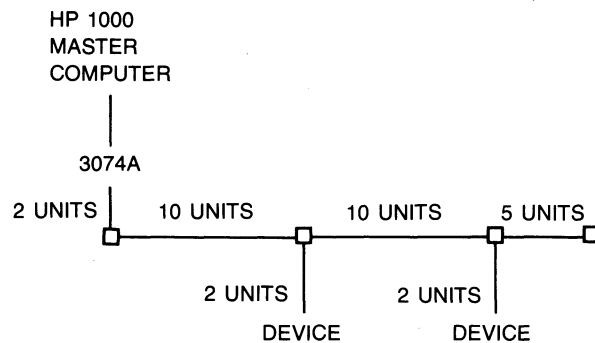
Features

- **Master computer and slave devices can be installed at any location on the Data Link**
- **Up to 128 physical connections per Data Link, subject to system software and performance considerations**
- **Rugged wiring and connectors for harsh industrial environments**
- **Baud rates up to 19.2k**

- **High noise immunity due to double-shielded, twisted-pair cable**
- **CRC-16 error checking**
- **Up to 4 km (2.5 miles) total Data Link length**
- **Device connections are "make before break" — plugging or unplugging a device does not affect other devices on the link**
- **Multidrop topology provides low cost per additional device connection**
- **Wide selection of link compatible devices**
- **Ground isolation provided by opto-isolation of the Data Link from attached devices**
- **System Functional Tests for verification of communication between the master computer and devices connected to the Data Link**
- **Compatible with data communications analyzers**

Functional description

A Data Link network consists of one master computer and one or more slave devices connected to the Data Link. All devices can be installed at any location on the Data Link by plugging into a connection box on the cable or wiring directly into the cable. The maximum Data Link length is 4 km (2.5 miles). This distance includes the length of the main Data Link cable and twice the distance from the Data Link cable to all devices.

```
HP 1000
MASTER
COMPUTER

          |

        3074A
2 UNITS  |   10 UNITS        10 UNITS     5 UNITS
   [=]---------------[=]------------[=]-----------[=]
              2 UNITS |    2 UNITS |
              DEVICE       DEVICE
```

This sample Data Link would
have a total length
(in units) of:
(2×2) + 10 + (2×2) + 10 + (2×2) +5 = 37 units

Communication on the Data Link is controlled by the master computer, using multipoint asynchronous Bisync (BSC) protocol with CRC-16 error checking for data integrity. This is similar, but not identical to, IBM Bisync. See the Multipoint Software Data Sheet (91730A) and the Multipoint Interface Data Sheet (12790A) for more information on the communication software.

Excellent ground loop isolation noise immunity is provided by the optical isolation of the Data Link master from all the devices connected to the Data Link, RS-422 electrical levels, sensitive signal receivers and drivers, and the 100 ohm termination of the twisted pair cable itself.

The Data Link can operate at baud rates up to 19.2k baud. All devices connected to the Data Link must operate at the same baud rate. Maximum speeds for the supported devices are given below:

Computers	Speed
HP 1000 M/E/F and L-Series computers	19.2k baud
9835/45 Desktop Computers	9600 baud
9826A Desktop Computer	19.2k baud

Terminals	
2645A/47A/48A/49B/49C/49G/49I	9600 baud
2624B/26A/29D CRT Terminal	9600 baud
3075A/76A/77A Data Capture Terminal	9600 baud

Data Coupler	
3078A Data Coupler	9600 baud

3074M Compatible Modems	
Bell 202T	300 or 1200 baud*
Bell 212A	300 or 1200 baud*
Vadic VA 3400 series	300 or 1200 baud*
Gandalf LDS 120	9600 baud

Due to performance considerations, the 1200 baud Bell and Vadic modems are recommended over the 300 baud versions.

HP Distributed Systems/1000-IV (91750A) Network Software provides high level network communication between M/E/F-, and L-Series computers connected to the Data Link. For more information concerning this Multidrop DS/1000-IV capability, see the DS/1000-IV Network Software Data Sheet (91750A).
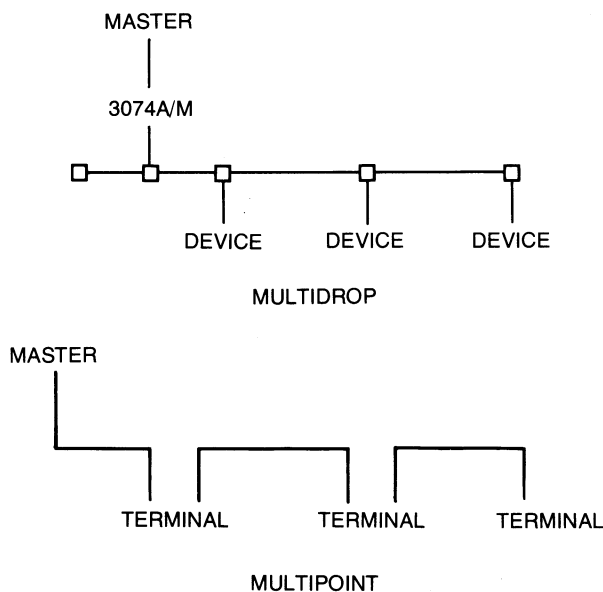
Performance

The aggregate throughput of the Data Link is limited to 19.2k baud maximum. The effective data throughput is approximately 1500 characters per second at 19.2k baud, and 850 characters per second at 9600 baud. As more devices are installed on the Data Link, the proportionate share of the total bandwidth available for each device decreases. With additional devices requiring access to the Data Link communication line, the response and transit time for devices on the Data Link will increase. Maximum CPU overhead in the master computer is 20% at 19.2k bps and 10% at 9600 bps. The maximum overhead is encountered with one slave device connected to the Data Link. As more devices are added, the overhead decreases due to the efficiency of the polling algorithm.

These performance considerations must be taken into account when configuring Data Links with terminals where operator response in critical. It is for this reason that it is recommended that computer devices are not intermixed with terminals requiring fast response times on the Data Link.

The following sections briefly describe the components of a Data Link installed on the master HP 1000 computer. Detailed information concerning these products can be found in their individual data sheets.

Data Link components

NOTE: The terms Multipoint and Multidrop are similar but not identical in meaning. Below are examples of a multidrop and multipoint configuration.

```
            MASTER
              |
              |
           3074A/M
              |
  ┌────┬──────┬──────────┬────────────┐
  □    □      □          □            □
              |          |            |
           DEVICE     DEVICE       DEVICE

              MULTIDROP
```

```
  MASTER
    |
    |
    └──┐   ┌──┐   ┌──┐   ┌──┐
       |   |  |   |  |   |
    TERMINAL  TERMINAL   TERMINAL

          MULTIPOINT
```

The 12790A Multipoint Interface and 91730A Multipoint software are used in both the Multipoint configuration for terminals, and the Multidrop Data Link configuration. In multidrop configurations the 3074A/M converts the RS-232 Multipoint signal levels to Data Link compatible levels, allowing all devices to connect to the same link.

Only 262x, 264x, and 307x terminals operate in a multipoint configuration. See the Multipoint Software data sheet (91730A) for additional information regarding multipoint terminal configurations.

HP 12790A Multipoint Interface. The 12790A Multipoint interface is installed in the master HP 1000 M/E/F-Series computer and provides front end protocol handling and error control for the multipoint communication line. An on-board proprietary microprocessor with 1k byte of on-board RAM buffering off-loads the protocol handling and buffering from the CPU. Interface output is an RS-232-C communications line using a Multipoint Binary Synchronous (BSC) protocol. See the 12790A Multipoint Interface data sheet for additional detailed information.

HP 91730A Multipoint Software. The 91730A Multipoint software package contains a driver and support software for communication between the master computer and slave devices connected to the Data Link. All multipoint software features except Group polling and "who are you" are supported on the Data Link.

This software is utilized by Hewlett-Packard supplied software products such as DS/1000-IV and DATACAP/1000-II, and also allows user written application programs in the master computer to communicate with slave devices connected to the Data Link. For more detailed information, refer to the 91730A Multipoint Software data sheet.

HP 3074A/M Data Link Adapter. The 3074A connects Asynchronous/Bisync-compatible devices with an RS-232-C or CCITT V24 interface to the Data Link. When connecting the master computer to the Data Link, the 3074A acts as a half-duplex modem and requires the Request To Send signal to be set high whenever data is to be transmitted to the Data Link. The 3074A in return provides a non-delayed Clear To Send signal, a Data Set Ready signal, and has Carrier Detect line processing.

The 3074A contains a power on/off detection feature which prevents transients of the slave device from interfering with link operation when the device is turned on or off. Electrical isolation (500V/μS) between devices and the link adapter is ensured by optocouplers.

The 3074A is fitted with a Data Link connector compatible with the 92905A Data Link-to-Device cable, an RS-232-C connector for computer or terminal connection, and a device power connector. The adapter can be easily mounted on any flat surface of at least 250 mm by 110 mm (9.8 inches by 4.3 inches).

The 3074M allows remote installation of the Data Link via full-duplex asynchronous modems (see figure 1). It should be ordered with the 92905A Data Link-to-Device cable and the 30062C Modem extender cable.

HP 13264A Data Link Adapter. The 13264A converts the RS-232-C standard electrical levels for 9826A and 262x datacom-type devices to the Data Link standard levels and vice-versa.

HP 92901A Data Link Connection Box. One connection box (product number 92901A for a pack of 5) is required for each device. The box is constructed of plastic, measuring 6.5 cm (2.6 inches) square and contains a set of six metal contacts with screw terminations. The contacts are designed so that a device can be connected and removed without disturbing link communications. Spare boxes can be installed on the cable where needed, and a security feature enables each device cable to be physically locked into the connection box.

HP 92902A Data Link Cabling. The Data Link Cable (HP 92902A or Beldon 9463) is a twisted-pair, double-shielded cable which can be ordered in lengths of 100 or 300 meters. For longer distances, additional 100 or 300 meter sections may be ordered and added to the link through the use of the Data Link Connection Boxes (92901A).

The Data Link Cable may not be run outside a building. For Data Link communication between buildings, 3074M modem adapters are available.

HP 92905A Data Link-to-Device Cable. This cable extends the Data Link to the device (or adapter). It is two meters (6.5 feet) long and is fitted with a Data Link connector at one end and a connector for a 3074A/M at the other end.

HP 92909A Data Link Test Cable. Pre-configured Data Link cable consisting of a 4 meter length of 92902A cable with five equally spaced 92901A connection boxes installed. This cable is used for initial Data Link installation and verification by the HP Customer Engineer. Subsequent cabling of the Data Link for the final network can be connected to the end of the 92909A cable by plugging into the connection box. In this manner, the 92909A can be used for troubleshooting and initial verification of device operation before the complete Data Link is installed.

Specifications

General

Maximum length: 4 km (2.5 miles)

Maximum data rates: 19.2k baud (maximum rate of the Data Link master computer. Maximum Data Link operational speed must be equal to that of the slowest device connected to the Data Link)

Protocol: Binary Synchronous Communication in an asynchronous environment

Data Link interface circuit electrical characteristics: 5V differential signals

Maximum common mode slew rate: 500V/μS

Common mode noise immunity: 500 mV

Differential noise immunity: 100 mV

Electrical isolation of 3074A: 500V/μS

Maximum capacities: 128 devices per Data Link
— 8 Data Links per HP 1000 E/F-Series Master Computer (9600 baud)
— 4 Data Links per HP 1000 E/F-Series Master Computer (up to 19.2k baud)
— 1 Data Link per HP 1000 M-Series Master Computer (up to 19.2k baud)

Supported Data Link Master Computer Systems and Operating Systems

Computers	Systems	Operating Systems	
		RTE-IVB/IVE	RTE-6/VM
2108M,2112M	No pre-configured M-Series systems available	Up to one Data Link at 19.2k baud	*
2109E,2113E	2176C/D 2178A/B	Up to eight Data Links at 9600 baud	Up to eight Data Links at 9600 baud
2111F,2117F	2177C/D 2179A/B	Up to four Data Links at 19.2k baud	Up to four Data Links at 19.2k baud

Not recommended due to performance limitations of RTE-6/VM operation with M-Series computers.

Supported Devices and Data Link Adapters

Device	Product	Adapter
Computers	HP 1000 M/E/F-Series Master CPU HP 1000 M/E/F-Series Slave CPU HP 1000 L-Series (Slave only) 9835A/B and 9845B/C Desktop Computers 9826A Desktop Computer	3074A none required none required 3074A 13264A
Terminals	2645A/47A/48A/49B/49C/49G/49I CRT Display Terminals 2624B/26A/29D CRT Display Terminals 3075A/76A/77A Data Capture Terminals	3074A 13264A none required
Data Coupler	3078A Data Coupler	none required
Modems*	Bell 202T Bell 212A Vadic VA 3400 series Gandalf LDS 120**	3074M 3074M 3074M 3074M

All modems require a 4-wire telephone line.
**The Gandalf LDS 120 is a short-haul modem whose line speed is dependent on the distance to be covered.*

Cable (mechanical)

Cable: HP 92902A

Construction: two conductor, twisted pair shielded cable, per UL style 2464

Conductor: 20 AWG stranded tinned copper

Insulation: PVC per UL style 1007

Outer shield: Braid of 36 AWG tinned copper for 90% (physical) coverage

Inner shield: Aluminum mylar for 100% coverage

Cable lay: Twisted pair of conductors

Jacket: PVC rated for 105°C (220°F) at 300V

Cable (electrical)*

Voltage rating: 300 Vrms

Resistance: 0.032 ohm/m

Capacitance (between conductors): 130 pF/m

Inductance (between conductors): 0.65 μH

Data Link voltage levels are compatible with RS-422 test equipment.

Ordering information

M/E/F-Series master computer

12790A Multipoint Interface (includes interface, 35 foot 5061-1393 cable, and technical manual)
 opt. 001 Substitutes 25 foot 5061-1391 modem cable
 (required)

91730A Multipoint Software (includes software and technical manuals; a media option must be specified)
 opt. 020 264x compatible Mini cartridges
 opt. 022 7908/11/12 compatible cartridge
 opt. 050 9-track 800 bpi magnetic tape
 opt. 051 9-track 1600 bpi magnetic tape

3074A or 3074M Data Link Adapter (30062C Modem Extender Cable must be ordered with the 3074M for modem operation)
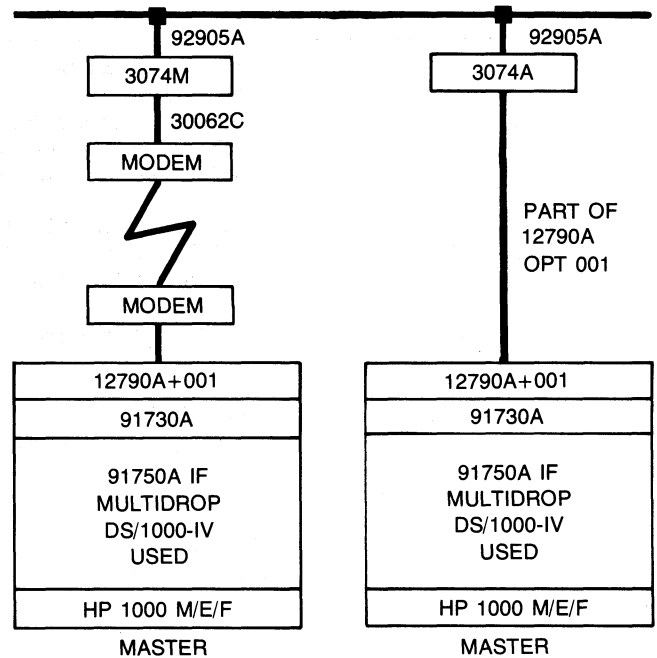
92905A Device-to-Data Link Cable (one required for 3074A/M connection)

92909A Data Link Test Cable

03705-60021 Data Link Tester

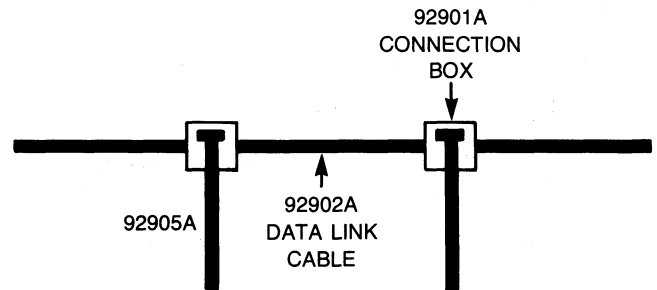91730-90006 Data Link Manager's Manual*

Order separately

Data Link components

92901A Five Data Link Connection Boxes

92902A* Shielded Twisted Pair Data Link Cable
 opt. 001 100 meters
 opt. 002 300 meters

Belden cable, product number 9463, can be used in place of the HP 92902A cable.

To connect a 9835A/B order:

98046B RS-232-C Datacomm Interface
 opt. 001 Male modem connector
98317A Basic Datacom ROM for 9835A/B
98332A I/O ROM for 9835
09835-10240 System 35 Data Link Software
3074A Data Link Adapter
92905A Data Link-to-Device Cable
92901A Five Data Link Connection Boxes, if needed
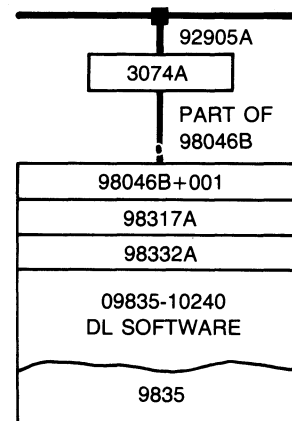
To connect a 9845B/C order:

98046B RS-232-C Datacomm Interface
  opt. 001 Male modem connector
98417A Basic Datacomm ROM for 9845B/C
09845-10240 System 45 Data Link Software
3074A Data Link Adapter
92905A Data Link-to-Device Cable
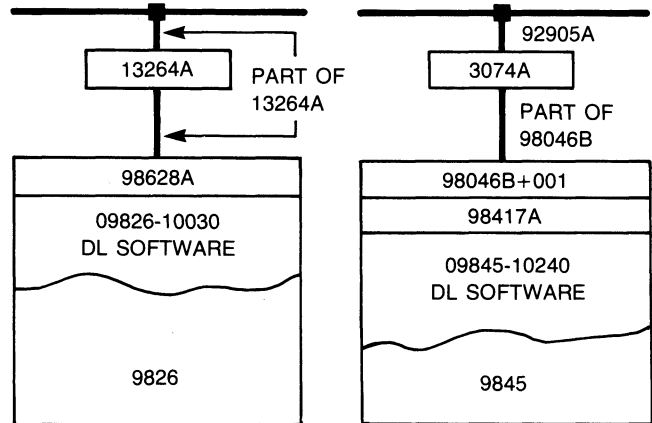92901A Five Data Link Connection Boxes, if needed

## To connect a 9826A order:

98268A Datacomm Interface
09826-10030 Basic Enhancement Binary
13264A Data Link Adapter
92901A Five Data Link Connection Boxes, if needed

To connect an M/E/F-Series or L-Series Slave computer order:

12830A Slave Card Interface for M/E/F-Series
12072A Slave Card Interface for L-Series
91750A/R Distributed Systems 1000-IV Network Software
for master and all slave computers

Connection of M/E/F- and L-Series computers as slave devices on the Data Link is only supported when used in conjunction with DS/1000-IV software for communication between the master and slave computers. See the DS/1000-IV Network Software data sheet for information concerning Multidrop DS/1000-IV.
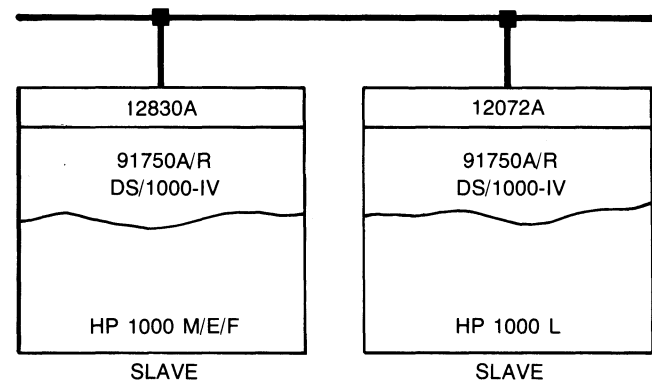
To connect CRT terminals order:

262x Series:

2624B/26A/29D CRT Display Terminal
13264A Data Link Adapter
91901A Five Data Link Connection Boxes, if needed

264x Series:

2645A/47A/48A/49B/49C/49G/49I CRT Display Terminal
  opt. 033 Asynchronous Multipoint communication
          (13260C accessory)
13232A Terminal to Adapter Modem Cable
3074A Data Link Adapter
92905A Data Link-to-Device Cable
91901A Five Data Link Connection Boxes, if needed
At least 4k bytes more memory than standard display
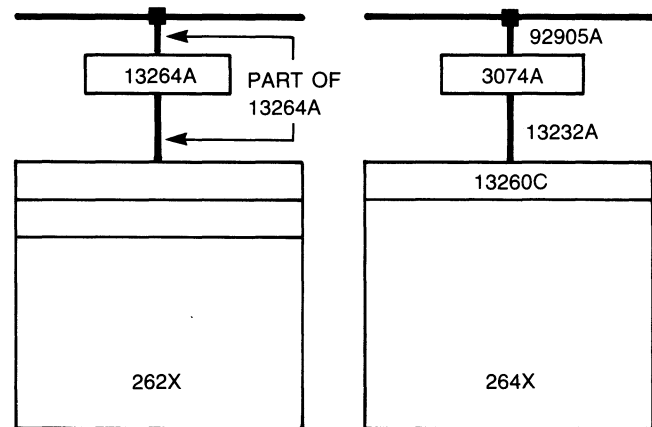
To connect Data Capture Terminals and Couplers order:

3075A Data Capture Terminal — Desktop Mount
opt. 030 Installation kit, including test connectors and
    Data Link tester
92905A Data Link-to-Device Cable

3076A Data Capture Terminal — Wall Mount
opt. 030 Installation kit (see 3075A)

3077A Time Reporting Terminal
opt. 030 Installation kit (see 3075A)

3078A Data Coupler

The 3076A/77A/78A connect directly to the Data Link via
screw terminations.
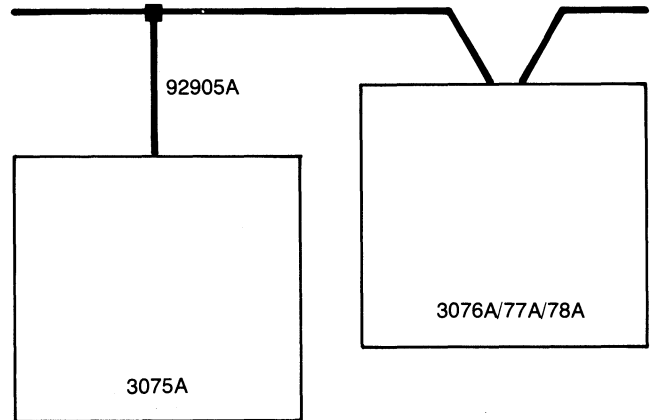
To obtain Software Support Services order:

91730T Customer Support Service for 91730A software
(same media option as 91730A)
91730V Support for an additional copy of 91730A
91730S Software Subscription Service for 91730A software
(same media option as 91730A)
91730Q Manual Update Service for 91730A software
manuals

Multipoint Software

For HP 1000
M/E/F-Series Computers   product number 91730A

The 91730A is a software package for multipoint terminal communication and multidrop Data Link communication. In a multipoint configuration, HP 2624B, 2626A, 2629D, 2645A, 2647A, 2648A, 2649B, 2649C, 2649D, and 2649G display terminals can be connected to a master HP 1000 M/E/F-Series based computer system using the 12790A Multipoint Interface. The 91730A software also supports HP 3075A, 3076A, and 3077A Data Capture terminals on a separate multipoint line or on the same multipoint line as terminals.

The multidrop Data Link communication link utilizes the 91730A software and 12790A interface for communication and protocol handling. This data sheet covers the features of 91730A software common to multipoint terminal and multidrop Data Link as well as those only pertaining the multipoint terminal communications. For detailed information on the Data Link, refer to the Data Link data sheet.

Features

- Supports single I/O channel communication with multiple devices on a single communication line
- Program development and application program execution at terminals in both multipoint terminal and multidrop Data Link configurations on RTE-IVB and RTE-6/VM based systems
- Application program execution on RTE-IVE based systems
- Computer to interface block transfers up to 1000 characters long at DCPC (direct memory access) rates
- Support for up to eight 12790A Multipoint interfaces at 9600 baud and four at 19.2k baud in an E/F-Series computer
- Multipoint master application program capability
- Multipoint network status program
- "Who Are You" command identification of terminals in a multipoint terminal connection (not available with multidrop Data Link connections)
- Automatic acknowledge of data entry on multipoint terminals on both multipoint terminal lines and multidrop Data Link connections
- Group and line message broadcast capability in a multipoint daisy-chain connection (not available with multidrop Data Link connections)
- Intelligent polling algorithm
- Power fail restart subroutine
- System functional tests for multipoint terminal lines and multidrop Data Link connections
- Supports communications with Mini cartridges and auxiliary printers on display terminals and multifunction readers and printers on data capture terminals in both multipoint terminal and multidrop Data Link configurations
- Supports communication with HP 1000 computers, and 9800 series desktop computers in a multidrop Data Link configuration

DATA LINK ADAPTER

DATA LINK

MULTIPOINT TERMINAL LINE
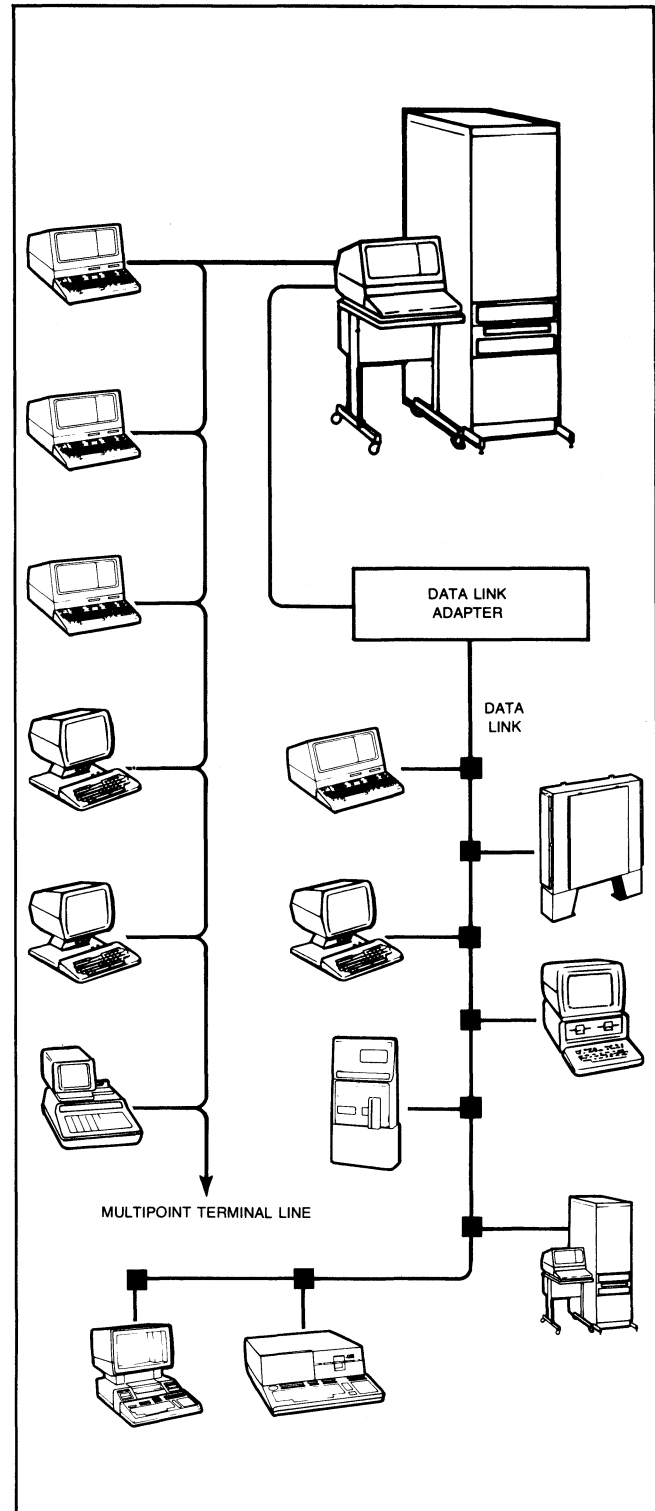
The 91730 Multipoint Software supports connection of multiple devices to HP 1000 Computers, via single hardwired, modem, or Data Link communications lines, and the 12790A Multipoint interface.

Functional description

Multidrop Data Link

The HP 1000 Data Link is a multidrop communications link which utilizes the 91730A software and 12790A interface for communication between the master computer and slave devices connected to the Data Link. HP 1000 M/E/F and L-Series computers, 9800 series desktop computers, 262X terminals, 264X terminals, and 307X data capture terminals and couplers can be connected to the Data Link. For more information about the Data Link, refer to the Data Link data sheet.

Data capture terminals on multipoint

HP 3075A and 3076A Data Capture Terminals and HP 3077A Time Reporting Terminals are application-specific units that operate in the multipoint communications environment under the 92080A DATACAP/1000-II applications software or user-written applications software. For more information about their capabilities, see the 92080A data sheet in the HP 1000 Software Technical Data book and the Data capture peripherals section in the HP 1000 Peripherals Data book.

Multipoint and Data Link usage

User-written application programs access devices connected either in multipoint terminal or multidrop Data Link configuration by their Logical Unit (LU) number. Reading from and writing to devices is supported from both FORTRAN READ/WRITE statements and RTE EXEC calls. Each device can be running under the control of its own unique application program for read and write only. Therefore, a single communications line can be shared and effectively utilized. Multipoint software driver queries the status of all devices in sequence such that: (1) Pending Read, Write, and Control requests to a device can be serviced, and (2) and enabled device can be "routinely polled" and thereby get RTE system attention or can schedule a program in the multipoint master computer. This querying process is TRANSPARENT to the user's application program. Users of multipoint line and multidrop Data Link terminals can utilize programs such as RTE File Manager, EDIT/1000 (screen mode not supported), and FORTRAN.

Data transfer mode

All data transfers between the buffer on the 12790A Multipoint interface and the user's application program are done via direct memory access under the control of the Dual Channel Port Controller (DCPC). All devices operate in block mode.

Support of user-written master application programs

Multipoint software supports user-written master application programs for communication and control of devices in both a multipoint terminal line or a multidrop Data Link configuration.

Auto acknowledgement

Multipoint software optionally provides for an audible auto acknowledgement at any terminal in both a multipoint line and multidrop Data Link configuration. As soon as the 12790A Multipoint interface has unloaded a message to the computer system, an audible response is sounded at the terminal, alerting the operator that data can now be entered.

Multipoint status display

The multipoint software includes a program which displays pertinent information about all currently active multipoint lines and multidrop Data Links and devices. By device LU, it displays parameters such as device ID and availability, EQT number and status, and whether routine polling is enabled. The display device can be a terminal on the multipoint line or multidrop Data Link.

Terminal status querying and initialization

A "Who Are You" command is available to the application programmer. It obtains the device identification and status of every operational (power turned on) terminal within a group of terminals. This is NOT available on a multidrop Data Link configuration, only on a multipoint terminal line. A Group is a logical subset of all terminals connected to the multipoint line. The terminals respond in the sequence of their physical position within the group. If the system is suitably generated, it is possible to programmatically initialize all the terminals within the group.

Alternatively, all devices and terminals in multipoint line and multidrop Data Link configurations can be initialized by FMGR commands from a system terminal.

Message broadcasting

The multipoint software provides the capability to broadcast a message simultaneously to all terminals in a group, or all of the terminals on a multipoint line. This capability is NOT available in multidrop Data Link configurations, only on a multipoint terminal line.

Access to terminal Mini cartridges and auxiliary printers

A multipoint software subroutine provides for the transfer of data between user's programs in the master computer and Mini cartridges on multipoint line and multidrop Data Link terminals. This same subroutine also supports direct output to an auxiliary printer connected to multipoint line and multidrop Data Link terminals. Direct communication between RTE File Manager and Mini cartridges or auxiliary printers on terminals is not supported.

Transparent transmission

Multipoint software and interface card firmware support the transparent transmission of binary files as well as ASCII characters.

Intelligent terminal servicing

Multipoint software driver DVR07 implements an intelligent device servicing algorithm which prevents line monopolization by a single device while prioritizing activity on the multipoint line or multidrop Data Link. DVR07 queries the status of each device sequentially and directs the 12790A to generate Bisync Poll Messages (for Reads and Routine Polls) or Bisync Select Messages (for Write or Control requests), as determined by the algorithm. In a status inquiry at a given device, DVR07 checks for active Write, Read, or Control requests from a system or user program.

A Control request or a Write to a terminal, if pending, is serviced immediately. A Read from a given device is done after the status of all other devices on the multipoint line has been queried once. No more than 1000 characters of text can be written to or read from a given device before a status inquiry is performed on all devices in sequence. Likewise, if a status inquiry for a device shows no active Write, Read, or Control requests, then that device will, if enabled, be "routinely polled" for operator intervention to get RTE system attention or schedule the multipoint master application program **after** a status inquiry of all other devices on the multipoint line has been performed once. In this way, the intelligent device servicing algorithm gives Writes and Control requests priority over Reads and Routine Polls. It also prevents one device from monopolizing the line by doing a status inquiry at all other devices (and potentially servicing them) before more than 1000 characters in a long message are transmitted to or from that one device. Each device thus has equal access to the resources of the system.

System level exerciser

A system-level exerciser program is supplied with the multipoint software. The exerciser sends a specified terminal one or more lines of data, and causes the same lines of data to be transmitted back to the exerciser program for verification.

System functional tests

The system functional tests supplied with the multipoint software are designed for verification of communication between the master computer and devices connected to either the multidrop Data Link or multipoint terminal line.

Functional specifications

Operating system and computer compatibility matrix

Computers	Multipoint line (up to 9600 baud)		Multidrop Data Link (up to 19.2k baud)	
	RTE-IVB/IVE	RTE-6/VM	RTE-IVB/IVE	RTE-6/VM
2108M, 2112M	up to 8 I/F	*	up to 1 I/F at 19.2k baud	*
2109E, 2113E 2111F, 2117F	up to 8 I/F	up to 8 I/F	up to 8 I/F at 9600 baud up to 4 I/F at 19.2k baud	up to 8 I/F at 9600 baud up to 4 I/F at 19.2k baud

Not recommended due to performance limitations of RTE-6/VM operation with M-Series computers.

Compatible multipoint line terminals

2624B, 2626A, 2629D, 2645A, 2647A, 2648A, 2649B, 2649C, 2649D, and 2649G display terminals and 3075A, 3076A, and 3077A data capture terminals (2647A and 2649G operation subject to available card slots).

For compatible multidrop Data Link devices, see the Data Link data sheet.

Number of terminals per multipoint line

Normally, up to 32 terminals can be connected to the 12790A interface via a single multipoint line. The following three factors determine the number of terminals which can be connected:

1. The number of terminals that can be *physically* connected depends upon the transmission mode. Asynchronously, up to 32 terminals can be *physically* connected; the distance between any two terminals can be 609 metres (2000 ft), provided that the total line length does not exceed 4876 metres (16000 ft), regardless of transmission speed up to a maximum distance between any two terminals is also 609 metres (2000 ft) and maximum total line length is also 4876 metres (16000 ft), but the number of terminals per line depends upon the average distance between terminals and line speed, as summarized in Table 1.
2. The maximum number of *logically connectable* terminals may be constrained by the logical unit number capacity of the RTE operating system in which the 12790A and its supporting 91730A software are operated.
3. Finally, the number of terminals that can be *realistically* supported depends upon the amount of text character I/O generated by each terminal on the line, the length of those text blocks, the speed of the line itself, and other user-dependent requirements, such as response time.

Table 1. Average line lengths between multipoint terminals on a synchronous line

Terminals per line	Average line length versus line speeds of:		
	2400 bps	4800 bps	9600 bps
4	609m (2000 ft)	609m (2000 ft)	609m (2000 ft)
8	609m (2000 ft)	609m (2000 ft)	365m (1200 ft)
16	609m (2000 ft)	365m (1200 ft)	146m (480 ft)
32	365m (1200 ft)	146m (480 ft)	36.5m (120 ft)

Maximum system usage per 12790A interface

The maximum requirement for time that would otherwise be available to a compute-bound user program in the RTE system occurs during Routine Polling while there is no Read, Write, or Control communication with any of the multipoint terminals. This is true for the no communica-tion condition since this results in the highest rate of HP 1000 computer interrupts and therefore imposes a maximum demand on system processing time. System usage is essentially independent of the number of devices on the multipoint line or multidrop Data Link, but is a direct function of the number of 12790A interfaces and is also dependent upon the transmission mode and line speed. The following usage figures apply to operation of the 91730A Multipoint software in an HP 1000 E-Series Computer with standard performance memory operating under RTE-IVB;

Multipoint Line	Asynchronous	Synchronous
Line speed	9600 bps	9600 bps
Approximate requirement for otherwise user-available processing time	10%	6%

Multidrop Data Link	Asynchronous	Asynchronous
Line speed	9600 bps	19.2k bps
Approximate requirement for otherwise user-available processing time	10%	20%

RTE system capabilities accessible from multipoint line and multidrop Data Link terminals

The multipoint software gives multipoint line and multidrop Data Link terminals the same access to system capabilities as non-multipoint terminals, except that:
1. Intra-line character edits (CTRL/R,I,C,T to Replace, Insert, Cancel, or Truncate characters) are not effective in the multipoint environment wherein whole lines are transmitted to EDIT/1000 at a time. However, the multipoint terminals have the intelligence, buffering, and predefined keys to support selective forward tab spacing and backspacing, and the replacement, insertion, or deletion of characters within a line without interrupting the 12790A interface. The screen mode of EDIT/1000 is not available on multipoint line and multidrop Data Link terminals.
2. Terminal peripherals, such as Mini cartridges, are addressed as subchannels to the Terminal Logical Unit. Therefore, while multipoint subroutines can access the terminal peripherals, there is no direct interface between the RTE File Manager and those peripherals.

Power fail restart

Working in conjunction with the RTE power fail/auto restart routines, a power fail restart subroutine furnished with the multipoint software resets each 12790A interface in the system so that I/O may resume after a power failure. This subroutine also runs the 12790A firmware-controlled self test. If the power failure occurred during a phase of the I/O operation from which recovery is not possible, an I/O error message is sent to the system console. A power failure message is broadcast to all multipoint terminals on the system.

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Approximate memory requirements

Multipoint driver DVR07: 4k bytes
Terminal peripheral subroutine: 964 bytes
Power fail restart subroutine: 512 bytes*
System-level exerciser program: 3446 bytes*
System status program: 1732 bytes*

These subroutines and programs can be placed in the resident library or appended to a user's application program.

Ordering information

91730A Multipoint software

The 91730A Multipoint Software includes:
1. One of software media options 020, 022, 050, or 051 which must be ordered.
2. Multipoint software numbering catalog (91730-90001).
3. Multipoint user's guide (91730-90002).
4. Data Link Manager's Manual (91730-90006).*

Order as a separate part number for Data Link configurations.

91730A Options

020: Provides Multipoint Software on Mini cartridges.
022: Provides Multipoint Software on 7908/11/12 compatible cartridges.
050: Provides Multipoint Software on 800 bpi, 9-track magnetic tape.
051: Provides Multipoint Software on 1600 bpi, 9-track magnetic tape.
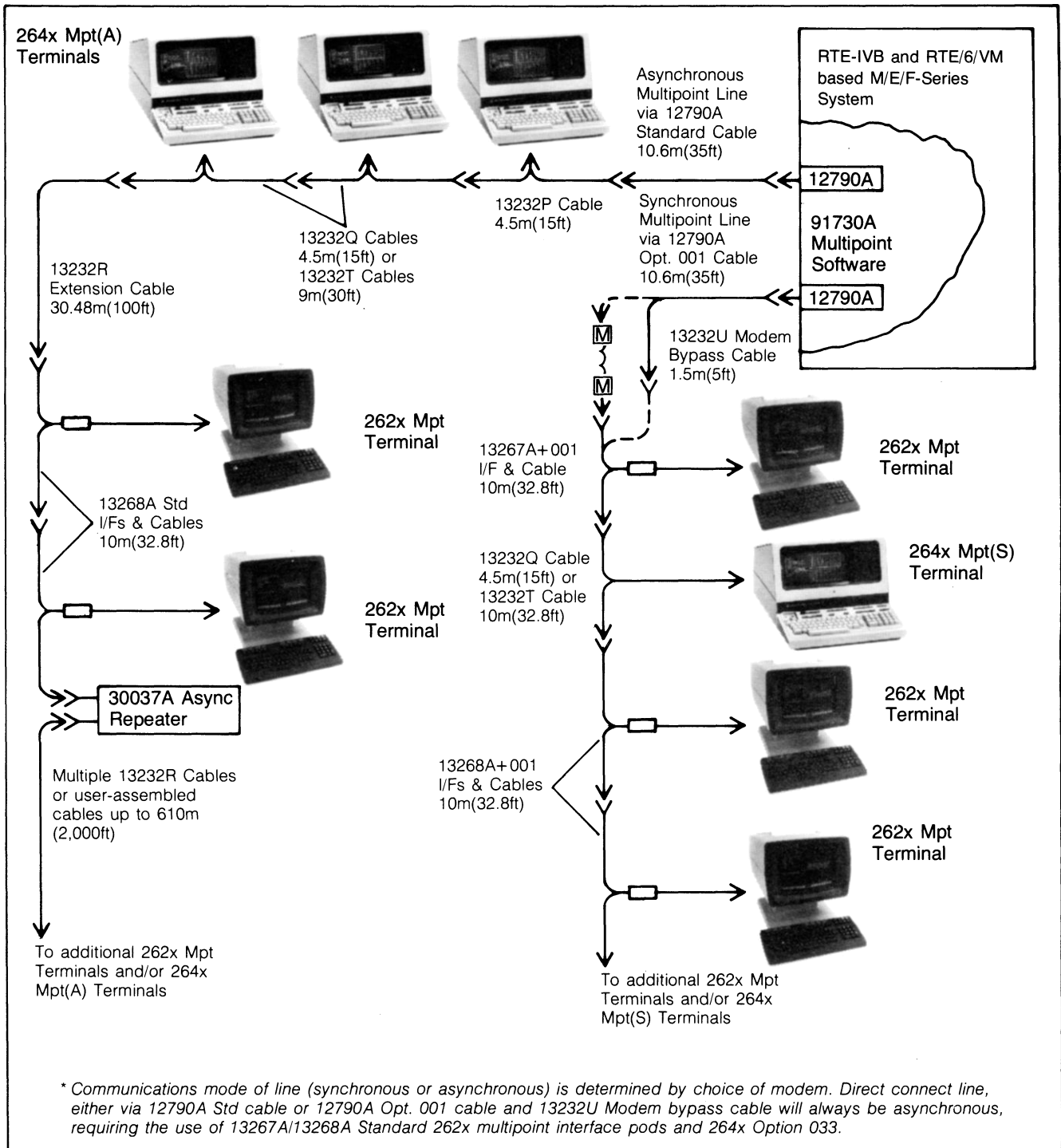
Software support products available

92730T Customer Support Service for 91730A software (same media option as 91730A)

91730V Central support for additional copy of 91730A

91730S Software Subscription Service for 91730A software (same media option as 91730A)

91730Q Manual Update Service for 91730A software manuals

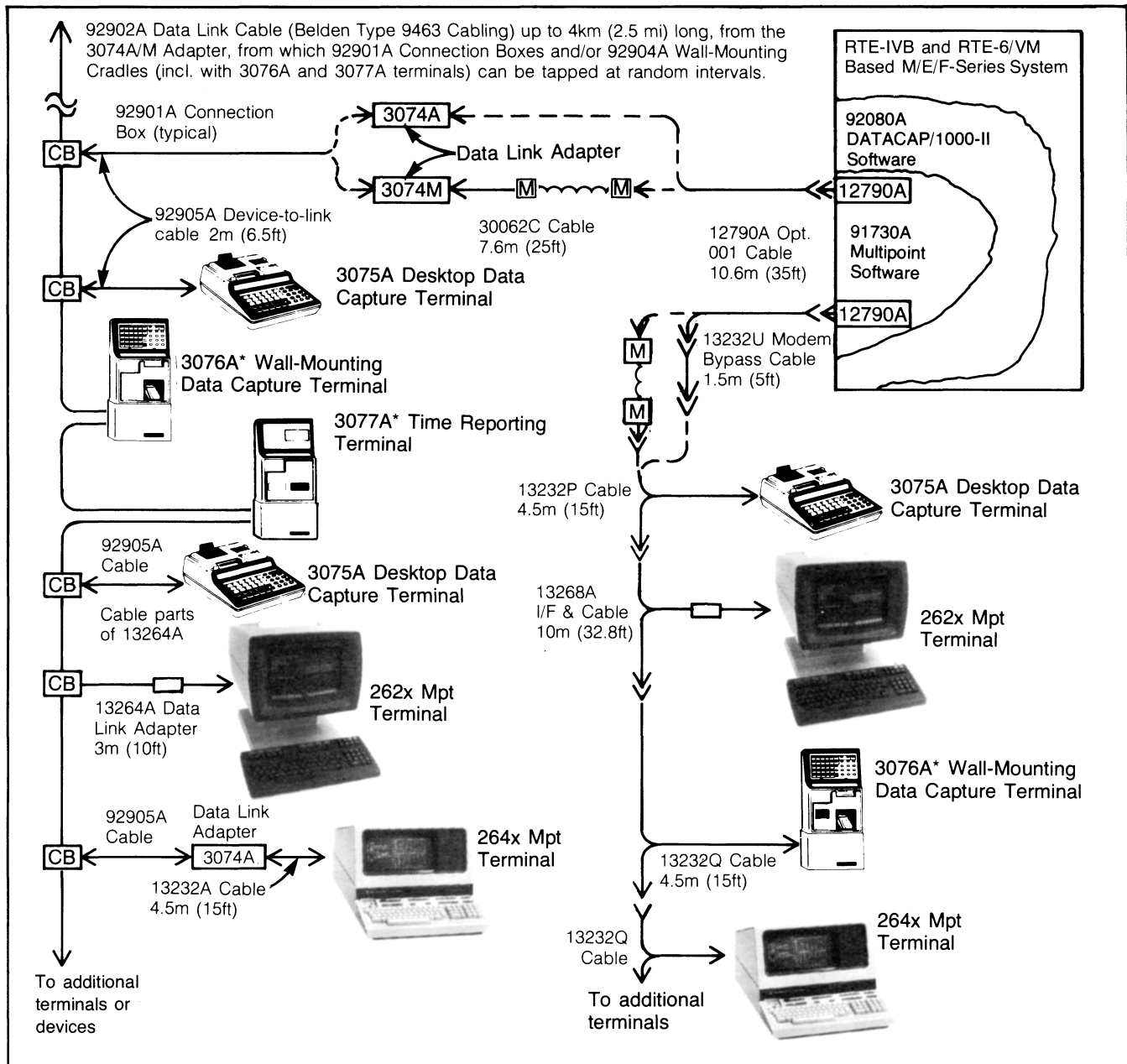# HP 1000 M/E/F-Series Sample Multipoint Line Connection Configurations

264x Mpt(A)
Terminals

Asynchronous
Multipoint Line
via 12790A
Standard Cable
10.6m(35ft)

RTE-IVB and RTE/6/VM
based M/E/F-Series
System

12790A

91730A
Multipoint
Software

12790A

13232P Cable
4.5m(15ft)

Synchronous
Multipoint Line
via 12790A
Opt. 001 Cable
10.6m(35ft)

13232Q Cables
4.5m(15ft) or
13232T Cables
9m(30ft)

13232R
Extension Cable
30.48m(100ft)

13232U Modem
Bypass Cable
1.5m(5ft)

262x Mpt
Terminal

13267A+001
I/F & Cable
10m(32.8ft)

262x Mpt
Terminal

13268A Std
I/Fs & Cables
10m(32.8ft)

13232Q Cable
4.5m(15ft) or
13232T Cable
10m(32.8ft)

264x Mpt(S)
Terminal

262x Mpt
Terminal

262x Mpt
Terminal

30037A Async
Repeater

13268A+001
I/Fs & Cables
10m(32.8ft)

Multiple 13232R Cables
or user-assembled
cables up to 610m
(2,000ft)

262x Mpt
Terminal

To additional 262x Mpt
Terminals and/or 264x
Mpt(A) Terminals

To additional 262x Mpt
Terminals and/or 264x
Mpt(S) Terminals

Communications mode of line (synchronous or asynchronous) is determined by choice of modem. Direct connect line, either via 12790A Std cable or 12790A Opt. 001 cable and 13232U Modem bypass cable will always be asynchronous, requiring the use of 13267A/13268A Standard 262x multipoint interface pods and 264x Option 033.

LEGEND:

264x Mpt(A) = 2645A/48A/49B/49C terminal with Async multipoint option 033 (or 13260C accessory) and at least 4kb more than standard display memory.

264x Mpt(S) = 2645A/48A/49B/49C terminal with Sync multipoint option 034 (or 13260D accessory) and at least 4kb more than standard display memory.

262x Mpt = 2626A/29D terminal with 13267A Async multipoint interface pod or 13267A+001 Sync multipoint interface pod for first terminal on the line, 13268A Async multipoint interface pod or 13268A+001 Sync multipoint interface pod for each additional terminal on the line.

13232P = Modem multipoint cable to first 264x Mpt(A/S) terminal on the line.

13232Q = Multipoint continuation cable to 264x Mpt(A/S) terminal that is not the first terminal on the line.

13232T = Power protect multipoint continuation cable to 264x Mpt(A/S) terminal that is not the first terminal on the line.

Data capture terminal multidrop Data Link and multipoint line connections
(See the Data Link data sheet for additional data link device connections)

92902A Data Link Cable (Belden Type 9463 Cabling) up to 4km (2.5 mi) long, from the 3074A/M Adapter, from which 92901A Connection Boxes and/or 92904A Wall-Mounting Cradles (incl. with 3076A and 3077A terminals) can be tapped at random intervals.

RTE-IVB and RTE-6/VM Based M/E/F-Series System

92080A DATACAP/1000-II Software

91730A Multipoint Software

92901A Connection Box (typical)

3074A

Data Link Adapter

3074M

12790A

92905A Device-to-link cable 2m (6.5ft)

30062C Cable 7.6m (25ft)

12790A Opt. 001 Cable 10.6m (35ft)

3075A Desktop Data Capture Terminal

13232U Modem Bypass Cable 1.5m (5ft)

3076A* Wall-Mounting Data Capture Terminal

3077A* Time Reporting Terminal

13232P Cable 4.5m (15ft)

3075A Desktop Data Capture Terminal

92905A Cable

3075A Desktop Data Capture Terminal

Cable parts of 13264A

13268A I/F & Cable 10m (32.8ft)

262x Mpt Terminal

13264A Data Link Adapter 3m (10ft)

262x Mpt Terminal

3076A* Wall-Mounting Data Capture Terminal

92905A Cable

Data Link Adapter

3074A

264x Mpt Terminal

13232A Cable 4.5m (15ft)

13232Q Cable 4.5m (15ft)

13232Q Cable

264x Mpt Terminal

To additional terminals or devices

To additional terminals

NOTE: DATACAP/1000-II supports only the 3075A, 3076A, and 3077A terminals. The 262x Mpt (Multipoint) and 264x Mpt terminals shown in this diagram can share the Data Link and/or async multipoint line and its supporting 91730A Multipoint software with the 307x terminals, but have no interaction with the DATACAP/1000-II software.

* 3076A & 3074A Wall-mounting terminals with 92904A Wall-Mounting Cradle are connected to the Data Link or the Multipoint line at screw terminals within the 92904A cradle and thus do not require a connection box or a 92905A Device-to-Link Cable.

LEGEND: M = Asynchronous Modem   CB = data link Connection Box

262x Mpt   = 2626A/29D Terminal, which can support connection to the Data Link via a 13264A Data Link Adapter and 92901A Connection Box, or to the multipoint line via a 13267A/13268A Multipoint Adapter (for more on multipoint connection, see page COT-12)

264x Mpt   = 2645A/48A/49B/49C Terminal with Asynchronous Multipoint Option 033 and at least 4kb more than standard display memory

13232P   = Modem multipoint cable to first 307x or 264x Mpt Terminal on the multipoint line

13232Q   = Multipoint continuation cable to additional 307x and 264x Mpt Terminals on the multipoint line

# DSN/Distributed Systems DS/1000-IV Network Software

HEWLETT PACKARD

For HP 1000 Computers

product number
91750A

Distributed Systems/1000-IV (DS/1000-IV) software provides an integrated set of high-level network facilities and procedures for HP 1000 L/M/E/F-Series Computer Systems. These facilities and procedures support network resource sharing, remote data base access, distributed data file management, communication between application programs, and the coordinated distribution of processor workloads to other HP 1000 Computer Systems in the network and/or to HP 3000 Series II/III/30/33/44 Systems.

Features

- Complete backward compatibility with 91740A/B DS/1000 nodes so applications software which runs on them may be transported and run in 91750A DS/1000-IV nodes and so that existing DS/1000 nodes can communicate with new DS/1000-IV nodes

- Transparent dynamic message rerouting between HP 1000 systems to bypass a "down" node or communications link

- Transparent Message Accounting which guarantees that each message is definitely received and that it is received only once by the user level task to which it is directed (between HP 1000 systems only)

- Transaction logging to facilitate network traffic analysis and fault isolation

- Generalized DS/1000-IV network architecture

- Network support of all HP 1000 Computer Series (L, M, E, and F) operating under RTE-L, RTE-XL, RTE-IVE, RTE-IVB, and RTE-6/VM

- Full network communication with HP 3000 Series II/III/30/33/44 Systems equipped with DS/3000 software, via hardwired and modem links (from HP 1000 M/E/F-Series only)

- Support for new, higher-efficiency microprocessor-based, fully-buffered HDLC and Bisync network interfaces

- Network-wide nodal addressing with store-and-forward between HP 1000 systems for maximum configuration flexibility

- Remote HP 1000 system generation and remote program development

- Remote command processing between any DS/1000-IV network nodes and between DS/1000-IV nodes and an HP 3000 System

- Remote access to IMAGE/1000 data bases at HP 1000 Systems

- HP 1000 virtual terminal capability to HP 3000 Series II/III/30/33/44 Systems

- Remote I/O mapping enables unit-record I/O to be directed to/from any unit-record device at any HP 1000 System in the network, thereby offering substantial savings in overall network hardware costs

- Support for Multidrop connections using Data Link
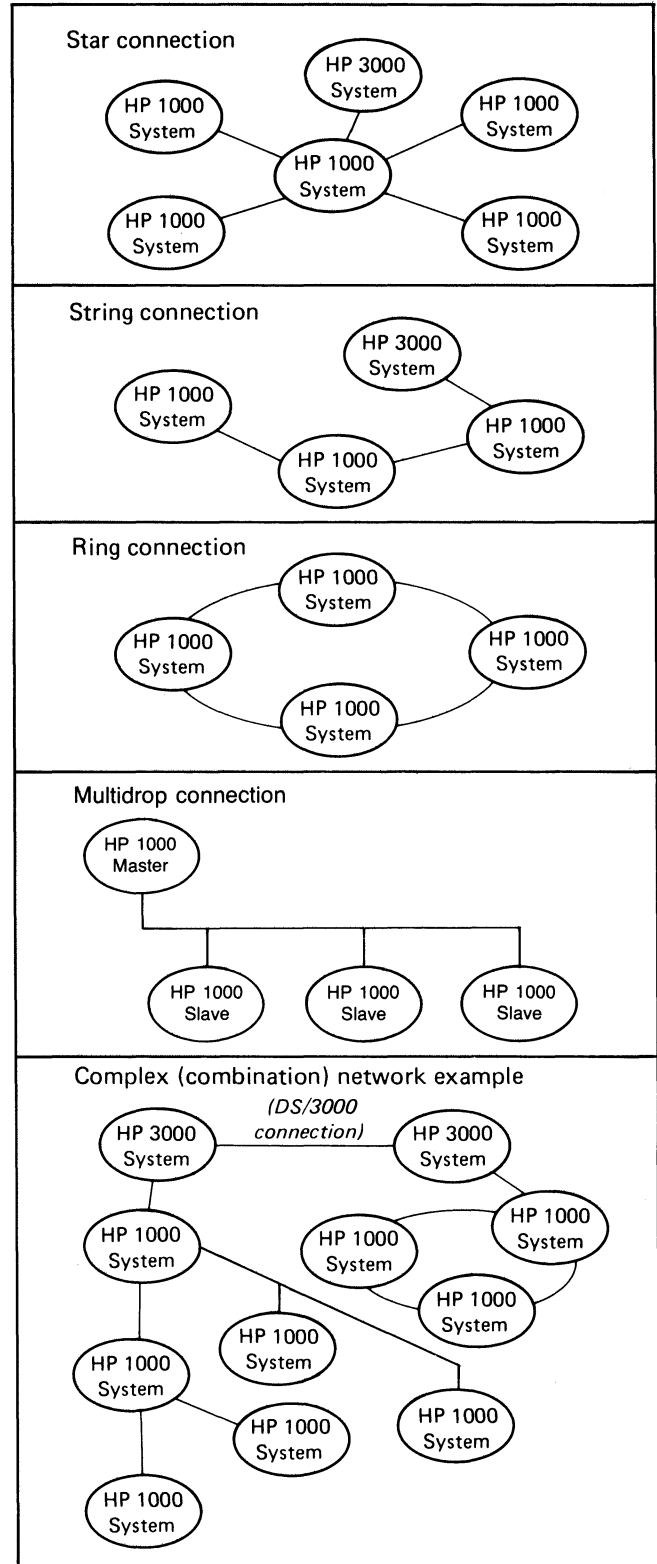
DS/1000 Network Configuration Choices

Topologically-independent network architecture

Nodal addressing (Between HP 1000 computers only)

Within a network of interconnected HP 1000 Computer Systems, each system is assigned a unique node identification number by the user. Remote operator commands and user program requests reference the number(s) of the node(s) to which they are directed.

Node numbers for DS/1000 network connections are specified after an RTE operating system has been generated and loaded. A Nodal Routing Vector (NRV), which specifies the Logical Unit (LU) number through which a DS/1000 transaction goes from the local node to the target node, can be specified interactively or read from a file at each DS/1000 node. In each node, this file specifies the logical unit connections required to get to any accessible node, as shown in Figure 1.
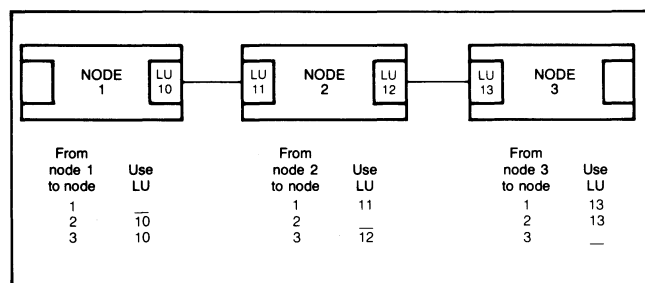

From node 1 to node	Use LU		From node 2 to node	Use LU		From node 3 to node	Use LU
1	—		1	11		1	13
2	10		2	—		2	13
3	10		3	12		3	—

Figure 1. Nodal Addressing in DS/1000-IV Network

Store and forward operations (Between HP 1000 Computers only)

Using the example of Figure 1, a transaction goes from node 1 to node 2 or 3 via LU10. At node 2, the DS/1000 communications management modules examine the destination node address in the message and either route the message to the local network interface monitors for processing if addressed to node 2, or forward the message to node 3 via LU12. In this way a single communications path is established between any two DS/1000 nodes, regardless of whether there is a direct, neighbor connection between them. Store-and-forward communications are not limited to a specified number of levels. However, store and forward to or through an HP 3000 system is not supported.

Nodal addressing with store-and-forward offers important advantages. Hardwired or modem links can be shared in a string or ring configuration, reducing initial costs for hardwired connections or operating costs for data communications. A program can be written, debugged, and tested in one node and then transported to any other DS/1000 node in the network while accessing the same local or remote peripheral logical units, or slave application programs. No user application programs are required to perform store-and-forward functions in any node.

DS/1000-IV Network Features

Dynamic message rerouting (DS/1000-IV to DS/1000-IV only)

In a network set up with alternate communication paths, DS/1000-IV supports dynamic rerouting of messages that are blocked by failure of a node or communications link. When a node or link failure is detected, the dynamic message rerouting software attempts to locate and set up an alternate communications path. If more than one alternate path exists, the best available route will be selected, using a relative "cost" table prepared by the network manager. As part of this operation, the originating node sends updated routing information to other network nodes. If no alternate path exists, an error message is sent to the user. When the "down" communications path is brought back up, the original message routing is automatically restored. (At "down" nodes using the 12771A and 12773A interfaces for the link, operator intervention will be required to re-enable the link.) Dynamic message rerouting can be omitted from network nodes that cannot take advantage of it, to minimize memory requirements.

Message accounting (DS/1000-IV to DS/1000-IV only)

In process control, order processing, stock re-ordering, and many other applications, it is critically important to assure that each message is received once and only once by the user level task to which it is directed. Optionally-usable DS/1000-IV subroutines provide this assurance by setting up an end-to-end protocol that both prevents duplication of messages and retransmits messages lost due to severe line failure. In addition, the message accounting function makes channel status information available to the user. Because it is optional, the message accounting function can be used selectively for only those channels that require maximum reliability, without incurring the additional memory requirements and CPU overhead for all nodes in the network.

Transaction logging and reporting

Transaction logging and reporting gives the user a powerful tool for analyzing and optimizing network traffic as well as isolation of communications link faults. With this facility enabled, all message request and reply buffers are logged on disc or magnetic tape. This includes transactions between the local DS/1000-IV node and remote nodes and/or a remote HP 3000 System. On request, the user can have the recorded information translated, edited, and reported in a format that facilitates analysis.

Remote I/O mapping and unattended network nodes (DS/1000-IV to DS/1000-IV only)

Remote I/O mapping can be used in DS/1000-IV networks to transparently map any local unit record device to another unit record device anywhere in the network. In this way, messages that would normally be exchanged with a local CRT terminal, printer, or mag tape unit can

instead be exchanged with a similar device at another node. This can significantly reduce overall network hardware and programming costs and, along with the forced cold load capability of HP 1000 L, E, and F-Series Computers, enables unattended operation.

Remote Virtual Control Panel access to HP 1000 L-Series network nodes*

DS/1000-IV includes two programs that work through the 12007A or 12044A L-Series HDLC interface in a neighboring L-Series network node to give an operator remote access to the Virtual Control Panel (VCP) program in that node. These programs in the accessing node provide control access to the VCP program and also monitor and display messages from the VCP program. With this capability, the remote operator can examine and change the contents of registers and memory locations, control the execution of diagnostics and other programs, and select a bootstrap loader and initiate the boot-up of the neighboring L-Series System. By making possible a considerable degree of remote fault diagnosis and maintenance, this remote VCP capability greatly enhances the supportability of completely unattended DS/1000-IV L-Series network nodes. It is important to understand, however, that remote VCP access cannot take advantage of the store-and-forward capability of the DS/1000-IV network. For that reason, remote VCP access can only be from neighboring DS/1000-IV network nodes.

*Because the 12007A or 12044A L-Series HDLC interfaces are required for remote VCP operation, this feature is not available on Multidrop DS/1000-IV connections using the 12072A L-Series interface.

Multidrop configuration using Data Link (DS/1000-IV to DS/1000-IV only)

DS/1000-IV capabilities are now available in multidrop configurations using the Data Link. The Data Link provides a flexible, low speed communication facility, allowing DS/1000-IV communication between an HP 1000 E/F-Series master computer and L-Series or M/E/F-Series slave computers attached to the link. The Data Link supports the full set of DS/1000-IV features (except Remote Virtual Control Panel to an L-Series computer) at a lower cost per network node than point-to-point connections.

DS/1000-IV capabilities

DS/1000-IV capabilities with respect to communication with other HP 1000 Systems and with HP 3000 Systems are summarized in Table 1, and discussed in the following paragraphs.

Table 1. 91750A Network Communications Capabilities

LEGEND:			
Y = Yes, is supported by DS/1000-IV for this communications link.			
N = Not supported by DS/1000-IV for this communications link.			
n/a = Not applicable to this communications link.			
R = REMAT (DS/1000 Remote Command Processor) capability.			
* = Node 1 and/or Node 2 can be either local or remote.			

DS/1000-IV to DS/1000-IV	DS/1000-IV to DS/3000	DS/3000 to DS/1000-IV	Categories and descriptions of capabilities
			REMOTE COMMANDS (Local operator's requests to local or remote DS/1000 nodes or HP 3000 System)
Y	n/a	Y	Local operator can issue any RTE system command to remote HP 1000 system. LU mapping now makes it possible to include running the file manager in this overall capability.
n/a	Y	n/a	Local HP 1000 operator can issue MPE commands to remote HP 3000 system, including access to HP 3000 subsystems, such as Cobol and QUERY/3000.
R	Y	Y	Attach or log on to remote account.
R	N	N	Send a message to all other nodes.
R	N	N	List mounted cartridges at node 1* on LU at node 2*.
R	N	N	Create, close, purge, or rename file at node 1*.
R	N	N	List file directory at node 1* on LU at node 2*.
R	N	N	Dump a file or LU input from node 1* to LU at node 2*.
R	N	Y	Terminate remote command processor.
R	N	N	Display local node number and both local and remote session identification numbers.
R	N	N	List file at node 1* on LU at node 2*.
R	Y	N	Change local list or log device.
R	N	N	Load absolute program from node 1* file or LU into node 2 RTE-L/XL system.
R	N	N	List all programs resident in RTE-L/XL system at node 1*.
R	N	N	List all program-to-program "slave" programs at node 1*.
R	N	N	Terminate a "slave" program at node 1*.
R	Y	N	Store all records from a file or LU at node 1* to a file at node 2*.
R	N	N	Transfer execution of subsequent commands to/from specified nodes.
R	Y	N	Send message to operator at node 1*.
R	Y	N	Transfer control of remote command processing to file or LU at a DS/1000 node.
			REMOTE QUERY ACCESS TO IMAGE/1000 DATA BASE (Local operator's requests to QUERY at remote HP 1000 System)
Y	N	N	Give remote data base access name and select file name to remote QUERY.
Y	N	N	Create procedure file at remote node for repetitive data base access operations.
Y	N	N	Display previously-created QUERY procedure file.
Y	N	N	Run interactive editor at remote node for editing procedure files, or run any other specified program.
Y	N	N	Delete previously-created QUERY procedure at remote node.
Y	N	N	Locate one or a group of data item names and/or data item.
Y	N	N	Add, change, or delete a data item(s) that have been located in the remote data base by the QUERY find command.
Y	N	N	Display or print out data item(s) that have been located in the QUERY data base by the find command.
Y	N	N	List remote data base structure.
Y	N	N	Explain form and purpose of specified types of QUERY commands or all QUERY commands.
Y	N	N	Terminate remote QUERY execution.
Y	N	N	Transfer command input to a file.
Y	N	N	Change list device.

Table 1. 91750A Network Communications Capabilities (Continued)

DS/1000-IV to DS/1000-IV	DS/1000-IV to DS/3000	DS/3000 to DS/1000-IV	Categories and descriptions of capabilities
			PROGRAM-TO-PROGRAM (PTOP) INTRINSICS (Program requests for communication between programs at local and remote HP 1000 and/or HP 3000 systems)
Y	Y	Y	From master program, initiate PTOP communications and schedule a slave program in the remote node, if necessary.
Y	Y	Y	Read data block from remote program and exchange tags.
Y	Y	Y	Send data block to remote program and exchange tags.
Y	Y	Y	Exchange user-defined tag field with remote slave program for user-defined control functions.
Y	Y	Y	Disconnect remote slave program from the master and initiate its termination.
Y	Y	Y	Get next request from the remote master program.
Y	Y	Y	Accept and complete master program's request.
Y	Y	Y	Reject master program's request.
Y	N	Y	From slave program, terminates communication with all master programs. Communication can be re-established by the master program by re-initiating PTOP.
			REMOTE DATA BASE ACCESS (RDBA) INTRINSICS (Program requests for access to data base in a remote HP 1000 system)
Y	N	N	Initiate access to data base.
Y	N	N	Get information on the organization and components of the data base.
Y	N	N	Locate master data set entry containing a specified key item value.
Y	N	N	Read data item values.
Y	N	N	Modify values of data in existing records.
Y	N	N	Add new records.
Y	N	N	Delete existing data records.
Y	N	N	Lock data base temporarily to provide exclusive access.
Y	N	N	Unlock previously locked data base.
Y	N	N	Close the data base files.
			REMOTE FILE ACCESS (RFA) INTRINSICS (Program requests for access to files in a remote HP 1000 or HP 3000 system)
Y	Y	Y	Create a file.
Y	Y	Y	Remove a file and directory entry.
Y	Y	Y	Open, close, or rename specified file.
Y	Y	Y	Transfer one record from a file (either sequential or direct access file on HP 3000).
n/a	Y	n/a	Read or write user's file label.
Y	Y	Y	Transfer one record to a file (sequential or direct access file on HP 3000).
Y	Y	N	Change file access mode.
Y	Y	N	Dynamically lock or unlock a file.
Y	Y	Y	Update record in a file.
Y	Y	Y	Position a file.
Y	Y	Y	Position file to a specified record.
Y	Y	N	Reset pointer for sequential file.
N	Y	N	Prepare for reading direct access file.

Table 1. 91750A Network Communications Capabilities (Continued)

DS/1000-IV to DS/1000-IV	DS/1000-IV to DS/3000	DS/3000 to DS/1000-IV	Categories and descriptions of capabilities
			REMOTE FILE ACCESS (RFA) INTRINSICS (Program requests for access to files in a remote HP 1000 or HP 3000 system) (Continued)
Y	n/a	Y	Send control request to peripheral device identified as type 0 file.
Y	Y	N	Control file or terminal device.
Y	Y	Y	Reset file to first record.
Y	Y	Y	Return file status.
N	Y	N	Request details on file I/O status.
Y	n/a	Y	Return status of mounted discs.
N	Y	N	Determine if file pair is interactive or duplicative.
			REMOTE EXEC CALLS (DEXEC) (Program requests for action by executive in remote HP 1000 or HP 3000 system)
Y	n/a	Y	Read from or write to I/O device at remote system.
Y	n/a	Y	Control I/O device at remote system.
Y	n/a	N	Terminate remote program.
Y	n/a	N	Schedule remote program with or without wait.
Y	n/a	Y	Request time from system clock in remote system.
Y	n/a	Y	Set execution interval or start time of remote program.
Y	n/a	Y	Request status of remote system I/O device.
Y	n/a	N	Queue schedule remote program with wait.
Y	n/a	N	Queue schedule remote program without wait.
Y	n/a	N	Request partition status from remote system.
Y	n/a	N	Request remote program status.
			DS/1000 UTILITY CALLS (Network utility program requests)
Y	N	N	Send message to remote operator's console or to remote system's message processor.
Y	N	N	Obtain node number of local system.
Y	N	N	Down-load absolute program into remote RTE-L/XL or RTE-IVE node.
Y	Y	N	Copy file from one node to another.
Y	N	N	Provide interactive access to RTE editor at remote disc-based node.
Y	N	N	Establish destination node for formatted FORTRAN I/O statements.
Y	N	N	Send command from program to remote command processor.
Y	N	N	Return information on DS/1000-IV errors.

Remote command processing

DS/1000-IV to DS/1000-IV. DS/1000-IV remote command processing makes it possible for a user at a local terminal to interactively access any HP 1000 system in the DS/1000-IV network, via the nodal addressing and store-and-forward capabilities of DS/1000-IV. The local operator can use the entire RTE command set of the remote node as well as special network-oriented commands provided by the DS/1000 remote command processor, REMAT, which provide the capabilities tagged by R's in the DS/1000-IV to DS/1000-IV column of Table 1. A Network Security Code (NSC) is required to direct commands to a remote system, which protects the network from unauthorized access. Remote command processing is initiated as easily as:

```
RU,REMAT
$SW,N1,N2,NSC
```

This two-command sequence runs REMAT and directs subsequent RTE and/or REMAT commands to Node 1 (N1) or from Node 1 (N1) to Node 2 (N2). The accompanying Network Security Code (NSC) is always required to run REMAT, but not thereafter. By providing for Node 1 to Node 1 actions, DS/1000-IV remote command processing supports the direction of activities at unattended DS/1000-IV nodes.

HP 1000 virtual terminal to HP 3000. The operator at an HP 1000 system communicating with an HP 3000 system can execute local HP 3000 MPE commands. The HP 1000 system thereby becomes a virtual HP 3000 terminal, gaining access to facilities not available on the HP 1000, such as the COBOL compiler and QUERY/3000. Security is controlled by the requirement for an account (and, optionally, a password) in the HELLO sign-on command addressed to the HP 3000. Access to the HP 3000 from the HP 1000 is obtained by these three simple commands:

```
RU,RMOTE
$SW
HELLO (account)
```

HP 3000-to-DS/1000-IV. An operator at an HP 3000 system using DS/3000 can execute any RTE system command, which supports control of an unattended HP 1000 satellite system.

Remote data base access between HP 1000 Systems

Remote QUERY access now makes it possible for an operator at a memory-based or disc-based system to interactively access data in a 92069A IMAGE/1000 data base in a remote HP 1000 System operating under RTE-IVB or RTE-6/VM. Remote access is essentially as easy as local access, since all command mnemonics and parameters are the same. The one exception is that the RU, QUERY request is issued from REMAT in the local system to the remote system and must include the node number of the local system.

Remote access from programs is accomplished with similar ease and can access both 92069A and 92073A data bases. All data base access calls, both local and remote, include an IBASE array parameter. The only difference between a local data base call and a remote one is that one of the words in the IBASE array in the DBOPN call for remote access contains the node number of the system whose data base is to be accessed. This provides total program transportability among systems in the DS/1000 network and supports network-wide data base data entry and retrieval with respect to one or several data bases.

Program-to-Program data exchange (PTOP)

Using high-level distributed system calls (Table 1), a Pascal, FORTRAN, or Assembly language program in a DS/1000-IV node can initiate a data exchange with a named Pascal, FORTRAN, or Assembly language program in a remote DS/1000-IV node or a FORTRAN or SPL program in a remote HP 3000 System. A program in the HP 3000 can also initiate the PTOP exchange.

Multiple PTOP exchanges can be active on the same network connection concurrently, and in DS/1000-IV nodes one program can communicate with more than one remote node concurrently. PTOP between DS/1000-IV nodes and to HP 3000 Systems supports data buffers up to 8k bytes long.

In addition to its use for exchanging data to be processed, the PTOP capability can be used to implement access by remote programs to IMAGE/3000 data bases. The records can be transferred to/from the remote requesting program, using PTOP intrinsics.

Remote file access

High-level DS/1000-IV calls analagous to standard RTE-FMP or FS/3000 calls can be used by Pascal/FORTRAN/Assembly language programs in HP 1000 Systems and FORTRAN/SPL programs in HP 3000 Systems to define, access, control, and query the status of named files in a remote DS/1000 node or HP 3000 System. This capability facilitates the establishment, maintenance, and use of distributed data files using the intrinsics described in Table 1. Remote file access between DS/1000-IV nodes supports transfers of very large files, with up to 2^{63} logical records.

Remote calls to the RTE system executive

Pascal/FORTRAN/Assembly language programs in an DS/1000-IV node or FORTRAN/SPL programs in an HP 3000 System can make calls to the system executive in a remote DS/1000-IV node to write to, read from, control, or get status of I/O devices. Other calls can be used to request partition and/or program status, schedule programs with or without wait, request system clock time, and to set execution interval or start time of a program. A single DS/1000-IV node can concurrently service multiple system executive request calls which are listed in Table 1.

Remote FORTRAN read/write (DS/1000-IV to DS/1000-IV only)

The FORTRAN IV formatter for RTE systems, working with DS/1000-IV subroutine RMTIO, supports locally programmed FORTRAN read/write statements to read from or write to any logical unit (LU) specified peripheral device at any specified remote node with programming as simple as:

```
C WRITE A MESSAGE ON LU6 AT NODE 21
      CALL DNODE(21)
      WRITE(6,10)
   10 FORMAT('DS/1000 SUPPORTS REMOTE
               FORTRAN I/O')
```

With LU mapping set up, remote FORTRAN read/write is even simpler, since the DNODE call is not necessary.

Remote DS/1000-IV node system generation

Operating systems for RTE-L, RTE-XL, RTE-IVB, RTE-IVE, or RTE-6/VM based DS/1000-IV nodes can be generated at a single RTE-XL, RTE-IVB, or RTE-6/VM based DS/1000-IV node and copies distributed using REMAT and loaded locally. RTE-L/XL and RTE-IVE systems can also be generated elsewhere and loaded directly into neighboring RTE-L/XL or RTE-IVE based nodes from RTE-XL, RTE-IVB or RTE-6/VM based DS/1000-IV nodes using the built-in DS loader on the L-Series processor in the RTE-L/XL based system or the Communications Bootstrap Loader in the RTE-IVE based system.

It is most convenient to generate all systems at one RTE-IVB or RTE-6/VM based node and send system files through the network to the node in which they will reside. The same gen file can be sent to several RTE-IVB or RTE-6/VM nodes at which each would be switched and, if necessary, slow booted for the appropriate memory and I/O configuration. With disc-based RTE-L/XL nodes, the gen file can be sent to the system disc using REMAT and later loaded from the local file. For RTE-IVE nodes and memory based RTE-L/XL nodes, the gen file can be sent to a neighboring disc-based node and stored in a file on the disc there for later loading into the memory-based node. Optionally, the gen file can be downloaded from a non-adjacent node by utilizing store and forward.

Remote DS/1000-IV node program development

Program development for an entire DS/1000-IV network of HP 1000 systems can be accomplished at a single DS/1000-IV node. At an RTE-IVB, RTE-6/VM, or RTE-XL node, programs for other DS/1000-IV nodes can be developed on-line, relocated off-line, and loaded on-line into other RTE-L/XL or RTE-IVE nodes by operator command or program call. If necessary, these programs can be relocated into RTE-IVB or RTE-6/VM nodes by operator command. At an RTE-IVB or RTE-6/VM node, programs can be developed and relocated on-line and loaded into any target RTE-L/XL or RTE-IVE node using an operator command or program call. Programs can also be relocated into any target RTE-IVB or RTE-6/VM node by operator command.

Network utilities (DS/1000-IV to DS/1000-IV)

Network utilities provide single-call programming for such network tasks as sending messages to remote DS/1000-IV nodes, retrieving local node numbers, copying files from any DS/1000-IV node to any other DS/1000-IV node, and retrieving any DS execution errors. The interactive RTE Editor can be run at remote RTE-IVB or RTE-6/VM nodes. These capabilities make the network manager's and application programmer's jobs easier.

Remote sessions under RTE-IVB and RTE-6/VM

Remote access to a DS/1000-IV node operating under RTE-IVB or RTE-6/VM with Session Monitor is possible with the same control as a local session at that node. Session Monitor access control requires all users, including remote users, to log on under a pre-defined user name that has been given specific capabilities by the system manager. All RFA, DEXEC, PTOP, and operator command access to a remote RTE-IVB or RTE-6/VM Session Monitor node thus requires a prior log-on. This is accomplished in one of the following ways:
1. Utility program DLGON that creates a specific remote, non-interactive session, or
2. REMAT "ATTACH" command, or
3. REMAT "SWITCH" command, with a user-name qualifier appended to the requested node number, or
4. HP 3000 REMOTE HELLO command, or
5. No specific assignment request; if no specific session log-on has been issued, the system will set up a session for the default user name that was specified during network initialization.

Once logged on, each user is assigned a unique session ID, which is that user's key to access the remote node. A user can have a session at any of up to 16 different HP 1000 nodes. Sessions are non-interactive in the sense that remote session (FMGR) commands to the remote node are not supported. However, REMAT commands are supported and can be used to remotely perform various program development and program testing tasks, or to remotely run applications. Because remote session commands are not supported, and because there is no REMAT-type support in the HP 3000 environment, HP 3000 virtual terminal access to a remote HP 1000 session is not supported.

All accessed files must reside on an existing and mounted private, group, or system disc cartridge. "System discs" also include session monitor global discs, which can be read/written by any user in the system.

A default account can be set up for use by all requesting nodes that do not explicitly log on. "Old" nodes (those using 91740A/B DS/1000 Network software-firmware) will be assigned to a single shared default session, which, once created, will be permanently active. Old node shared access to this session will appear to the user as a non-session monitor system.

DS/1000-IV to DS/1000-IV network description

Layered architecture

The DS/1000-IV software and hardware for DS/1000-IV to DS/1000-IV connections in each system, or network node, consists of several layers, as shown in Figure 2. The Network Service Intrinsics 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 master requests generated are those for PTOP, RFA, DEXEC, Remote operator command, and utility program capabilities described in Table 1.

The Network Interface Monitors process incoming master requests received from Communications Management software (CM/1000) and link them as required to user's slave PTOP 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, and dynamic message re-routing and message accounting if these optional capabilities are used.
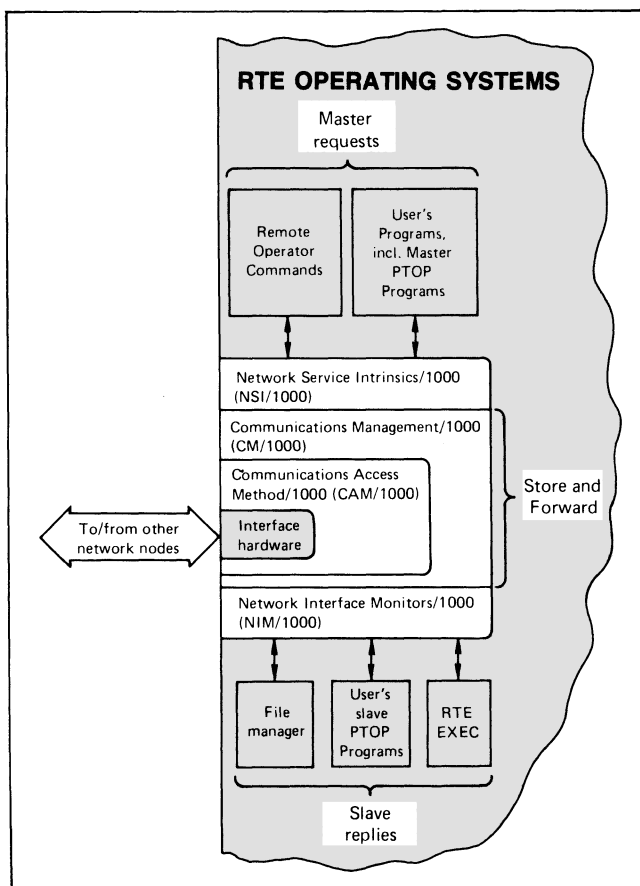
Figure 2. DS/1000 Layered Network Communications Architecture

The CM/1000 layer communicates with the link-level software drivers, which in turn communicate with the interface hardware, which may be several hardwired and/or modem interface cards, via the Communications Access Method (CAM) firmware. The CAM firmware is located in the computer's control store for use with the older 12771A/12773A interfaces, and in the interface control store on the new 12007A, 12044A, 12794A, and 12825A HDLC interfaces and the 12072A and 12830A Data Link Slave interfaces. The CAM firmware provides a line protocol for the control of communications input and output, including error detection and correction by retransmission. The lower layers are managed such as to be completely transparent to the user. Changes to these layers of the network can be made with little or no effect on user's application programs.

Modular software supports many levels of DS/1000-IV node capability

Another advantage of Hewlett-Packard's layered approach to network communications software and firmware is its modularity. Modularity allows network node capability to be tailored to meet a wide range of application requirements, using the RTE operating system most appropriate.

RTE-L nodes are low-cost, unmapped, memory or disc-based systems intended for use in dedicated, target node network applications. These nodes support full DS/1000-IV to DS/1000-IV communication, including remote access to data bases in RTE-6/VM, RTE-IVB, or RTE-XL based network nodes. DS/1000-IV to HP 3000 systems is not currently supported from RTE-L based nodes.

RTE-XL nodes are memory or disc-based systems whose increased memory capability (128k to 512k bytes) allows increased flexibility and networking power on low cost, L-Series systems. Full DS/1000-IV to DS/1000-IV features are supported, including automatic message rerouting and message accounting. DS/1000-IV to HP 3000 systems is not currently supported on RTE-XL based nodes.

RTE-IVE nodes are memory based systems with a memory capacity of 256k to 2.048 million bytes. Being an execute-only subset of the powerful RTE-IVB disc-based operating system, RTE-IVE supports full DS/1000-IV capabilities between HP 1000 systems, as well as between an HP 1000 and HP 3000 system. Using the features of Remote Forced Cold Load and Remote I/O Mapping, an RTE-IVE node can also operate unattended to provide an economical solution in environments where a disc-based node would be inappropriate.

RTE-IVB nodes are powerful disc-based systems requiring 128k bytes of memory, expandable to 2.048 million bytes, and supporting 19.6 million to 960 million bytes of disc memory storage. RTE-IVB nodes can support all DS/1000-IV capabilities, including system generation and down load to other DS/1000-IV nodes, and DS/1000-IV to HP 3000 communication.

RTE-6/VM nodes are the most capable of all. These disc-based nodes require at least 256k bytes of memory, and are expandable to 2.048 million bytes. Disc memory support of 19.6 million bytes to 960 million bytes is provided. Virtual Memory Areas and a Multi-Level Segmentation/Load-On-Call loader provide large program and data capabilities which make RTE-6/VM nodes the most powerful in the DS/1000-IV network environment. RTE-6/VM nodes can provide network-wide support for HP 1000 system generation and program development, and high speed computation and data file facilities to other DS/1000-IV nodes in the network. Full DS/1000-IV capabilities, including DS/1000-IV to HP 3000 communication, are supported.

NOTE: See the "Memory Requirements" section of this data sheet for specific memory size recommendations using DS/1000-IV with a particular RTE Operating System.

Transaction request buffering

The Network Interface Monitors in DS/1000-IV (for PTOP, RFA, RDBA, remote operator command, remote I/O, and remote program scheduling functions) interface to CM/1000 communications management processors via complete requests and replies with data buffers as required. Therefore, the Network Interface Monitors can service multiple requests or replies concurrently, though working on only one request at a time. The monitors themselves can be swapped in RTE-IVB or RTE-6/VM while the system performs the data transfer, thereby freeing up memory for other programs or tasks.

DS/1000-IV architecture for DS/1000-IV to HP 3000 communication

DS/1000-IV software for DS/1000-IV to HP 3000 communications is layered similarly to Figure 2. The important differences appear in the bottom two layers. The CM/1000 layer includes translators for conversion of DS/1000-IV requests and replies to/from DS/3000 format. 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. Communications Access Method functions are performed by a software-only synchronous line controller with the 12889A Hardwired Serial Interface or by CAM firmware on the microprocessor-controlled 12793A Bisync Modem Interface or 12834A Bisync Direct Connect Interface.

Hardware interfaces available*

Point-to-point communication:

The 12825A, 12007A, 12044A, and 12794A interfaces utilize HDLC protocol to provide maximum throughput with a minimum of CPU overhead, between HP 1000s. The 12044A and 12825A are direct connect interfaces, whereas the 12007A and 12794A are provided for modem connections.

* *See the HP 1000 Communications products technical data book (literature number 5953-4259) for further information.*

The 12793A (modem) or 12834A (direct connect) interfaces utilize binary synchronous protocol to provide connection between HP 1000s and an HP 3000, with minimum CPU overhead.

The 12771A or 12773A interfaces provide high throughput for communication between HP 1000s, using hardwired direct connection or modem connection. Available for backward compatibility to older 91740A nodes, the 12771A and 12773A incur higher CPU overhead then the newer HDLC interfaces.

The 12889A interface provides the highest throughput between HP 1000s and an HP 3000 (Series II and III only), where higher CPU overhead is acceptable.

Multidrop communication:

The 12830A, 12072A and 12790A provide multidropped master-slave computer connection over the Data Link for lower cost, lower speed network configurations than point-to-point connections.

Efficient error control

HP 1000-to-HP 1000 communication via HDLC interfaces

On both the direct connect and modem HDLC interfaces, CRC-16 cyclic redundancy checking detects errors, and the interface retransmits all frames sent or received in error. This maximizes transmission accuracy while only rarely requiring intervention by the CPUs at the respective DS/1000-IV network nodes.

HP 1000-to-HP 1000 communication via 12771A/12773A interfaces

The 12771A and 12773A interfaces use LRC/VRC/DRC (longitudinal, vertical, and diagonal redundancy checking) for error detection. Longitudinal parity is checked by the interface card at the receiving node. Vertical and diagonal parity words are generated by the microcoded CAM/1000 drivers (91740A DS/1000 firmware), which must be installed in the control store of the computers in the transmitting and receiving nodes. The receiving node returns its parity words to the transmitter for comparison. A parity word mismatch causes retransmission of the block. Because error control is accomplished mostly by HP 1000 microcode in the control store of the computer, system overhead is kept low, though not as low as with the HDLC interfaces.

HP 1000-to-HP 1000 via Data Link

In communications via Data Link using the 12830A or the 12072A, errors are detected using CRC-16 cyclical redundancy error checking on blocks received or sent. The interface retransmits or requests retransmission of the block containing the error, to attain error free data transfer.

HP 1000-to-HP 3000 communication

Both direct-connect and modem communications between HP 1000 and HP 3000 systems are monitored for errors by CRC-16 cyclic redundancy checking on all blocks sent or received. Error detection is implemented in hardware on the 12889A, 12793A and 12834A interfaces. Detection of an error results in a request for retransmission. The 12793A and 12834A interfaces automatically respond to retransmission requests from the HP 3000, thereby minimizing error control overhead at the HP 1000 system.

Functional specifications

Network capacity and performance

Usable transfer rates and the maximum number of star-connected nodes that can be serviced by a central node are complex functions of the following factors:

- The type and speed of communications links in use.

- The way in which a user's application program uses a particular type of DS/1000-IV Network Service Intrinsic, such as PTOP or RFA.

- The processing time required by the DS/1000-IV software and the user's application in a particular HP 1000 Computer.

- The resources, such as System Available Memory, available in the computer at each node.

- The impact on system resources of local activity that must also be supported at the nodes.

Because of the complexity of the interrelationships of these factors, Network capacity and performance are discussed in a separate DS/1000-IV Performance Brief, which is available from your Hewlett-Packard representative.

Configuration information

DS/1000-IV network nodes can be connected using a variety of interfaces, enabling one to tailor the network for particular application needs. Point-to-point direct connect or modem connection, as well as multidrop configurations using the HP 1000 Data Link, are supported in the DS/1000-IV network environment. Interconnection of point-to-point nodes with multidrop nodes in the same DS/1000-IV network is also supported, providing maximum configuration flexibility to the network designer.

Point-to-Point DS/1000-IV connections

Point-to-point DS/1000-IV interfaces are designed for providing high throughput communication between network nodes. HDLC interfaces provide efficient, full duplex communication particularly suited for applications requiring high volume data transfers with low computer overhead. Interfaces are available for HP 1000 to HP 1000 connection, as well as HP 3000 to HP 1000 (M/E/F-Series only) in both direct connect and modem versions. Any type of topological configuration such as a star, string, ring, or combination, is supported via DS/1000-IV Point-to-Point interfaces.

For specific configuration information using point-to-point interfaces, see Figure 3. For hardware data rates and specifications of each DS/1000-IV interface, see individual interface product data sheets.

Multidrop DS/1000-IV connections

HP 91750A Network Software also supports multidrop configurations over the HP 1000 Data Link. This provides a low cost network solution (for applications where lower communication speed is acceptable) and greater connection flexibility than point-to-point, using the 12790A Multipoint interface as a master in an E-Series or F-Series computer. HP 12072A and 12830A Data Link Slave interfaces allow L-Series and M/E/F-Series computers, respectively, to communicate to the master computer over the Data Link. In this configuration, slave computers can be multidropped anywhere along the Data Link, creating a logical star network. Multidrop DS/1000-IV nodes can be added or deleted from the Data Link without affecting network operation.

The master computer controls the Data Link, using a half-duplex Bisync protocol to poll the slave computers. Since DS/1000-IV is a layered architecture, all networking features (except Remote Virtual Control Panel to an L-Series computer) are fully supported in multidrop configurations. Using the low cost, twisted pair Data Link cabling and only one interface per incremental slave node (versus two for point-to-point), Multidrop DS/1000-IV provides a lower cost alternate to point-to-point connection where lower performance is appropriate. For specific multidrop configuration information using Data Link interfaces, see Figure 4. For hardware data rates and specifications of the respective Data Link interfaces, see their specific data sheets in this data book.

Point-to-Point DS/1000-IV Network Connections
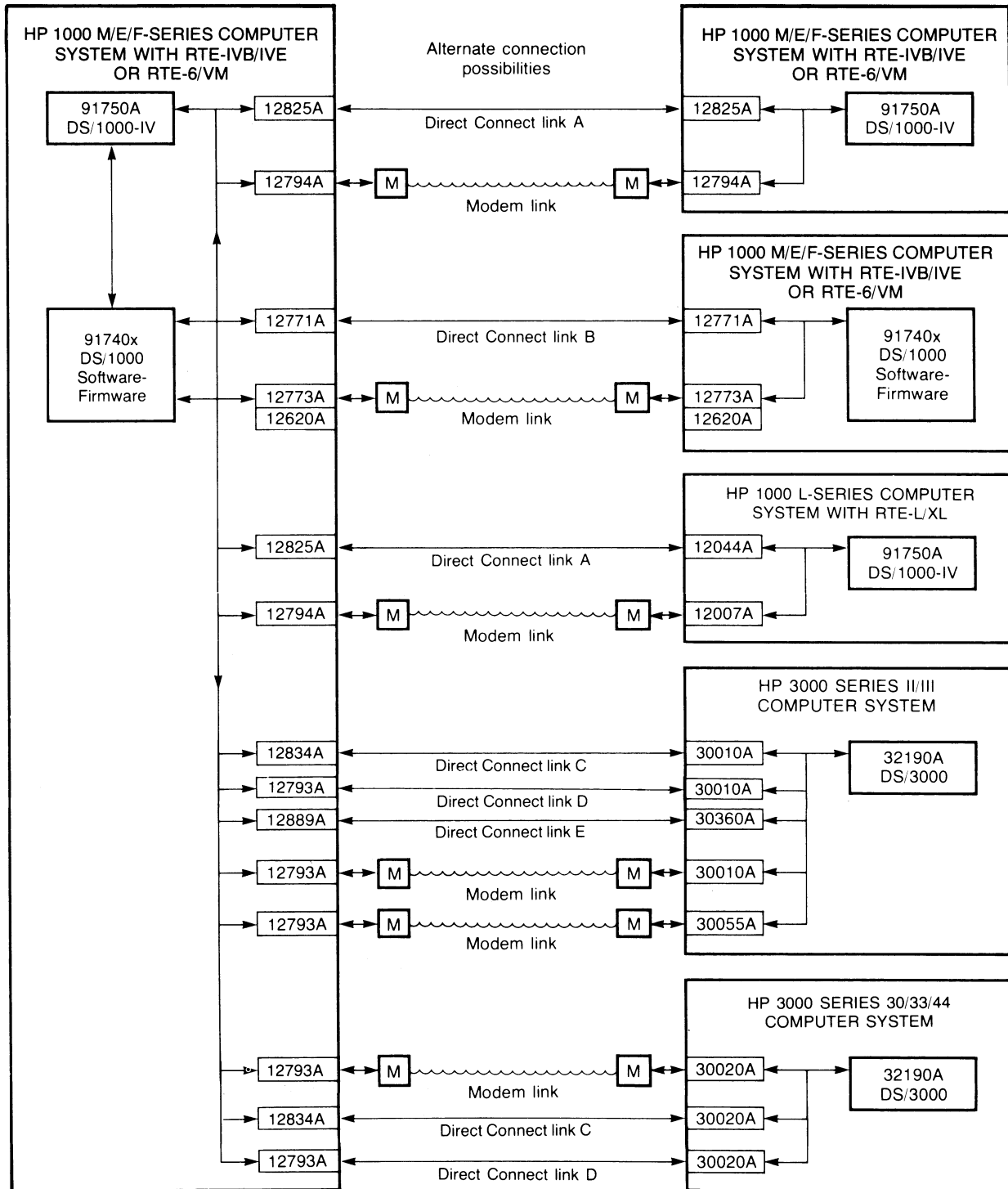
Direct Connect link A: Maximum cable length 2.2 km/7218ft; interface options may be ordered to obtain 75M/255ft extension cable and 300M/984ft user-assembled cable kit.

Direct Connect link B: Maximum cable length 3 km/10000ft; communications cable extension may be ordered as a 91720A cable kit with unassembled connectors or as 91721A cable with assembled connectors with 76M/250ft std length, 152M/500ft option 001 length, or 297M/975ft option 002 length. (Link A, using the 12825A is preferred for direct connect configurations.)

Direct Connect link C: Maximum cable length 1 km/3280ft; must be provided by 30225F cable to 30010A or 30221F cable to 30020A Interface options may be ordered to obtain 75M/246ft extension cable and 300M/984ft user-assembled cable kit.

Direct Connect link D: Maximum cable length 15.2M/50ft; must be provided by 30225A Modem eliminator cable to 30010A or 30225B Model eliminator cable to 30020A. (Link C, using the 12834A is preferred for direct connect configurations.)

Direct Connect link E: Maximum cable length 609M/2000ft; must be provided by 30220A Coaxial cable kit, available in lengths from 7.6M/25ft to 609M/2000ft.

Figure 3. Point-to-Point DS/1000-IV Network Connections
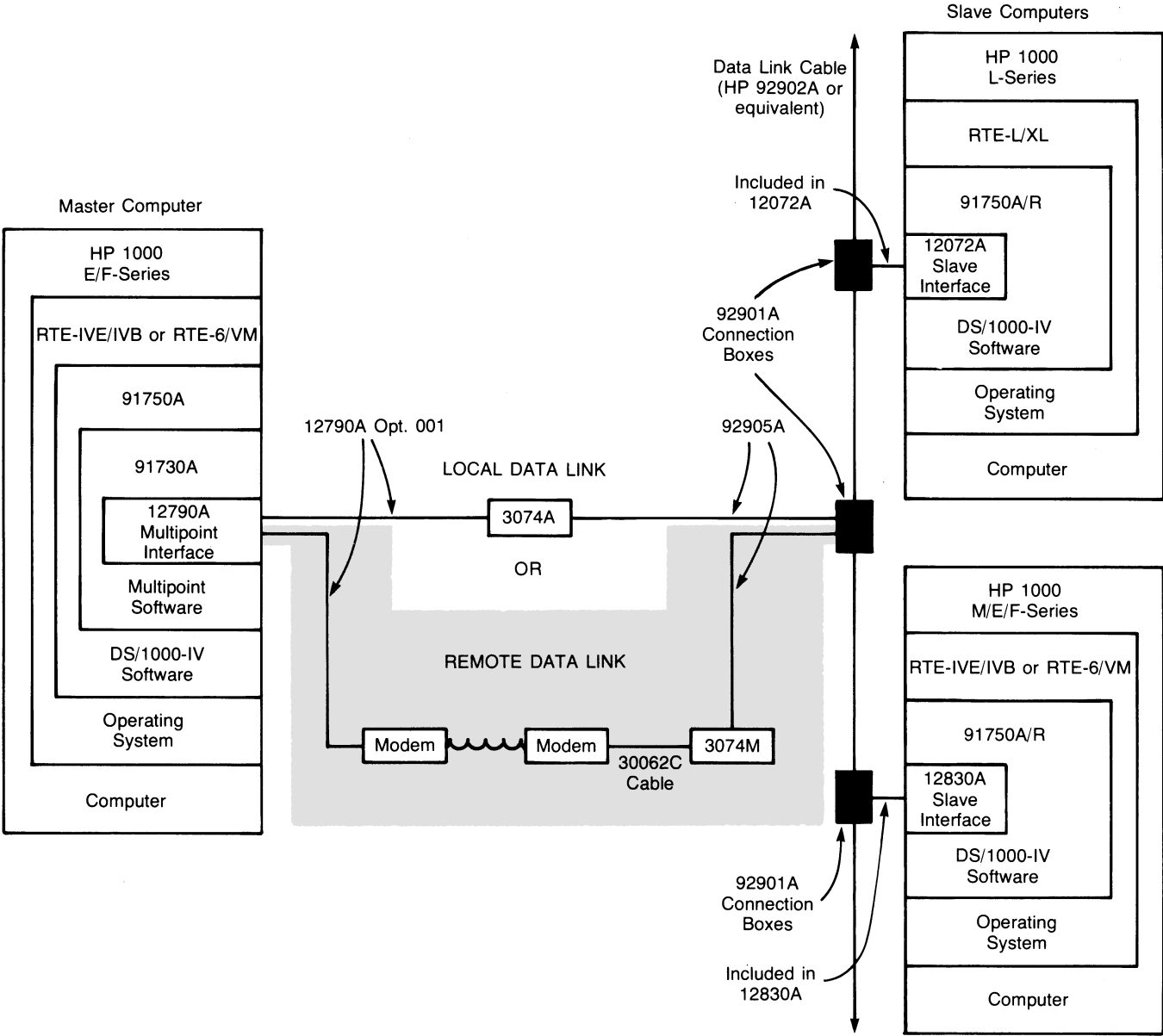
Multidrop DS/1000-IV Connections

Figure 4. Multidrop DS/1000-IV Network Connections

System Compatibility

For complete compatibility information regarding DS/1000-IV interfaces with various HP 1000 computers and RTE operating systems, see Table 2. Information on compatibility with inactive operating systems is available from your Hewlett-Packard representative.

Table 2. 91750A DS/1000-IV System Compatibility

INTERFACE PRODUCT NUMBERS	COMPATIBLE COMPUTERS	COMPATIBLE COMPUTER SYSTEMS	COMPATIBLE OPERATING SYSTEMS	REMOTE SYSTEM
Point-to-Point DS/1000-IV Connections:				
12007A L-Series Modem I/F 12044A L-Series Direct Connect I/F	2103L, 2122A/B Note B	2142A/B, 2145A/B 2146A/B Note B	RTE-L (92070B/E) RTE-XL (92071A/E)	HP 1000 L/M/E/F-Series Systems using 91750A software and appropriate interface.*
12794A M/E/F-Series Modem I/F 12825A M/E/F-Series Direct Connect I/F	2108M, 2109E, 2111F, 2112M, 2113E, 2117F	2176C/D, 2177C/D 2178A/B, 2179A/B	RTE-6/VM (92084A) RTE-IVB (92068A) RTE-IVE (92068E)	HP 1000 L/M/E/F-Series Systems using 91750A software and appropriate interface.*
12793A M/E/F-Series Modem I/F 12834A M/E/F-Series Direct Connect I/F	2108M, 2109E, 2111F, 2112M, 2113E, 2117F	2176C/D, 2177C/D 2178A/B, 2179A/B	RTE-6/VM (92084A) RTE-IVB (92068A) RTE-IVE (92068E)	HP 3000 Series II/III/30/33/44 System and appropriate interface.*
12773A M/E/F-Series Modem I/F 12771A M/E/F-Series Direct Connect I/F Note A	2108M, 2109E, 2111F, 2112M, 2113E, 2117F	2176C/D, 2177C/D 2178A/B, 2179A/B	RTE-6/VM (92084A) RTE-IVB (92068A) RTE-IVE (92068E)	HP 1000 M/E/F-Series Systems using 91740A/B or 91750A software, 91740A/B firmware, and appropriate interface.*
12889A M/E/F-Series Direct Connect I/F	2108M, 2109E, 2111F, 2112M, 2113E, 2117F	2176C/D, 2177C/D 2178A/B, 2179A/B	RTE-6/VM (92084A) RTE-IVB (92068A) RTE-IVE (92068E)	HP 3000 Series II/III System and appropriate interface.*
Multidrop DS/1000-IV Connections:				
12790A M/E/F-Series Data Link Master I/F	2108M,** 2109E, 2111F, 2112M,** 2113E, 2117F	2176C/D, 2177C/D, 2178A/B, 2179A/B	RTE-6/VM (92084A) RTE-IVB (92068A) RTE-IVE (92068E)	Any HP 1000 L/M/F/F-Series System using 91750A software and 12830A or 12072A Data Link Slave Interface.
12830A M/E/F-Series Data Link Slave I/F	2108M,** 2109E, 2111F, 2112M,** 2113E, 2117F	2176C/D, 2177C/D 2178A/B, 2179A/B	RTE-6/VM (92084A) RTE-IVB (92068A) RTE-IVE (92068E)	Any HP 1000 M/E/F-Series System using 91750A and 91730A Software and the 12790A Interface.
12072A L-Series Data Link Slave I/F	2103L, 2122A/B Note B	2142A/B, 2145A/B, 2146A/B Note B	RTE-L (92070B/E) RTE-XL (92071A/E)	Any HP 1000 M/E/F-Series System using 91750A and 91730A Software and the 12790A Interface

* *Appropriate interface means that interface in remote system must match communication mode and protocol (direct connect or modem and WASP, Bisync or HDLC) of interface in local system. For appropriate counterpart interfaces, see Figure 3.*

** *Although software compatible, the M-Series Computer is not recommended as a Data Link master computer due to lower performance.*

NOTE A: *The 12771A and 12773A are provided for backward compatibility only and are not recommended for new applications. 91740A/B/P/R DS/1000 firmware is required with 12771A and/or 12773A interfaces used in a DS/1000-IV node. With the 12773A Modem interface, a 12620A Breadboard interface used as a privileged interrupt control card is also required.*

NOTE B: *Floppy disc based applications should take into consideration the reduced disc access time, storage capacity, and media lifetime inherent in a flexible disc environment.*

Compatibility with other active HP network products

91750A DS/1000-IV Network software is compatible with 32190A DS/3000 software in HP 3000 Series II/III/30/33/44 Systems and the 91780A RJE/1000 IBM 360/370 Remote Job Entry package.

Backward compatibility with "old" DS/1000 network nodes

The 91750A DS/1000-IV Network software is backward compatible with 91740A/B (inactive) Network software-firmware at "old" DS/1000 network nodes. All DS/1000 features supported between 91740A/B nodes are supported between a 91750A node and a 91740A/B node, but some new DS/1000-IV features, such as Dynamic Message Rerouting and direct communication between HP 1000 L-Series and M/E/F-Series computers, are not supported. In addition, communication between a 91750A node and a 91740A/B node must use 12771A direct connect interfaces or 12773A modem interfaces in both nodes. In the 91750A node, 91740A/B DS/1000 firmware must be provided to support communication via the 12771A/12773A interface. When the 12773A interface is used, a 12620A Breadboard interface must be provided in each node as a privileged interrupt control card.

Operating system and DS/1000-IV software for DS/1000-IV network nodes

The operating system (92084A RTE-6/VM, 92068A RTE-IVB, 92071A RTE-XL, or 92070A RTE-L) software and 91750A DS/1000-IV network software must be purchased for the first network node. Systems generated from this software may then be copied to additional network nodes provided that the customer has purchased an appropriate right to copy product (92084R, 92068R, 92071R/E, 92070R/E, and 91750R) for each additional node supported. Purchase of an operating system included in a 214x or 217x system product does not qualify the customer to purchase a right to copy that operating system.

Requirements for remote data base access

The remote data base to be accessed must be managed by the 92069A or 92073A Image/1000 Data Base Management System operating under the 92084A RTE-6/VM, 92068A RTE-IVB, or 92071A RTE-XL real-time executive system. The 92073A Image/1000 Data Base Management System does not support remote Query access.

Memory requirements

For RTE-L based node: The RTE-L operating system and minimum required DS/1000-IV programs use about 44k bytes of memory, leaving about 18k bytes for addition of PTOP, DEXEC, or remote session access capabilities and user's application programs. Because maximum memory supported under RTE-L is 64k bytes, the remote response capabilities supportable at an RTE-L based node are relatively limited. However, the level of capability that is available is generally adequate for a dedicated node that functions mainly as a satellite to one or more RTE-IVB or RTE-6/VM based DS/1000-IV network nodes.

For RTE-XL memory based node: The RTE-XL memory based operating system and minimum required DS/1000-IV programs use about 110k bytes of memory (120k bytes with rerouting and message accounting). For a DS/1000-IV system with complete capabilities, an additional 100k bytes of memory would be required. Since this is a memory based system, any desired capabilities must reside in memory. It is therefore recommended that for a DS/1000-IV system with full capabilities, 256k bytes should be the minimum memory size. A larger system of 384k bytes or 512k bytes would provide additional storage for application programs. Any other software systems and user application may require additional memory.

For RTE-XL disc based node: The RTE-XL disc based operating system and minimum required DS/1000-IV programs use about 80k bytes of memory (90k bytes with rerouting and message accounting). For a DS/1000-IV system with full capabilities, an additional 100k bytes of memory would be required so that a reasonable number of DS/1000-IV capabilities can reside in partitions at the same time. This minimizes swapping and assures fastest possible network response. For such a system, at least 256k bytes of memory should be provided, and 384k bytes or 512k bytes would be preferred. Of course, addition of other capabilities not associated with DS/1000-IV, such as applications programs or other software, may require additional memory.

For RTE-IVE based node: The RTE-IVE operating system and minimum required DS/1000-IV programs use about 90k bytes of memory (100k bytes with rerouting and message accounting). Because RTE-IVE is a memory based system, all the capabilities required must reside in memory. For a DS/1000-IV system with full capabilities, an additional 100k bytes of memory would be required. It is therefore recommended that at least 256k bytes of memory should be provided for a fully capable DS/1000-IV system. A system of 384k bytes or 512k bytes is preferred. Other software and user applications may require additional memory.

For RTE-IVB based node: The RTE-IVB operating system and minimum required DS/1000-IV programs use about 90k bytes of memory (100k bytes with rerouting and message accounting). Because an RTE-IVB based node will usually support most, if not all, of the optional capabilities of DS/1000-IV, at least 256k bytes of memory, and preferably 384k bytes or 512k bytes, should be provided so that a reasonable number of DS/1000-IV capabilities can reside in their partitions at the same time. This minimizes swapping and assures fastest possible network response. Of course, addition of other capabilities with large memory requirements, such as Pascal/1000 or DATACAP/1000, would necessarily require more memory.

For RTE-6/VM based node: RTE-6/VM operating system and minimum required DS/1000-IV programs use about 110k bytes of memory (120k bytes with re-routing and message accounting). Because an RTE-6/VM based node will usually support most, if not all, of the optional capabilities of DS/1000-IV, at least 256k bytes of memory, and preferably 384k or 512k bytes, should be provided so that a reasonable number of DS/1000-IV capabilities can reside in their partitions at the same time. This minimizes swapping and assures fastest possible network response. Of course, addition of non-DS capabilities with large memory requirements, such as Pascal/1000 or DATACAP/1000, would necessarily require even more memory.

Sample System Configurations

NOTE: *Refer to latest HP 1000 Ordering Information (August 1, 1981 or later) for details on terminal interface cable options and other configuration details.*

Attended RTE-6/VM based HP 1000 E/F-Series DS/1000-IV Network node:

1. One of the following computer systems:
   a. 2178A/B Computer System (includes 256k bytes of standard performance memory and the RTE-6/VM operating System), or
   b. 2179A/B Computer System (includes 256k bytes of high performance memory and the RTE-6/VM Operating System).
2. 264x System Console with minicartridge capability.
3. Any 79xxM/MR MAC Master disc and 13175B MAC disc interface to computer, or 7908, 7911, 7912, or 7935 CS/80 disc and 12821A ICD disc interface.
4. 91750A DS/1000-IV Network software.
5. Choose appropriate network interfaces for point-to-point connection:
   a. 12794A (modem) or 12825A (direct connect) HDLC interface with appropriate modems and phone lines or direct connect cables for each connection to a DS/1000-IV network node.*
   b. 12793A (modem) or 12834A (direct connect) Bisync interface with appropriate modems and phone line or direct connect cables for connection to HP 3000 systems (only one interface per HP 3000 is supported).**

   or Multidrop Connection:

   c. 12790A Multipoint interface with appropriate Data Link cables for use as a DS/1000-IV master network node (also requires 91730A Multipoint software).

* *12773A (modem) or 12771A (direct connect) interface with appropriate modems and phone line or direct connect cable for each connection to an "old" DS/1000 network node. 91740B DS/1000 firmware is required for use of 12773A and/or 12771A interfaces and a 12620A Breadboard interface is required for privileged interrupt control if a 12773A interface is used. Refer to the section on "Backward compatibility with "old" DS/1000 network nodes."*

** *12889A direct connect Bisync interface with appropriate direct connect cables for connection to HP 3000 Series II/III systems using the Hardwired Serial Interface.*

   d. 12830A Data Link Slave interface with appropriate Data Link cables for use as a DS/1000-IV slave network node.
6. Application-related items required at the attended node.

Unattended RTE-XL Based HP 1000 L-Series DS/1000-IV Network node:

1. One of the following Microcomputers:
   a. 2103L Microcomputer with option 011 (128k byte memory) and one 12003A 128k byte Memory Array Card, or option 012 (512k byte memory).
   b. 2103LK Board Microcomputer with option 011 (128k byte memory) and one 12003A 128k byte Memory Array Card, or option 012 (512k byte memory) and 12030A, 12031A, or 12032A Card Cage and 12035A Power Module or user-furnished power supply.
2. 12013A Battery Backup Module (or user-fabricated memory backup provision).
3. 92071A RTE-XL real-time executive system (or 92071E Right-to-Execute RTE-XL or 92071R Right-to-Copy RTE-XL after first-time purchase of 92071A).
4. 91750R Right-to-Copy DS/1000-IV network software (assumes first-time purchase of 91750A for host system).
5. Appropriate network interface selected from the following:
   a. Point-to-point connections: 12007A (modem) or 12044A (direct connect) HDLC interface with appropriate modems and phone lines, or direct connect cables for each connection to a DS/1000-IV network node.
   b. Multidrop connections: 12072A Data Link Slave interface with appropriate Data Link cables for use as a DS/1000-IV slave network node.

Responsibilities of the customer

The DS/1000-IV user must assume the following responsibilities with the purchase of 91750A DS/1000-IV Network software:

1. Installation of communication facilities (cables and/or modems) and their connection to the HP 1000 Computer Systems equipped with DS/1000-IV. The establishment of successful communication between HP 1000 Computer Systems equipped with DS/1000-IV is the customer's responsibility.
2. One person in the customer's organization must be designated as the Network Manager. This person will assume responsibility for configuration and generation of the customer's systems and will function as the focal point for Hewlett-Packard's support of the network. This person must be knowledgeable in HP's RTE operating system and must have taken the DS/1000-IV User's and Theory of Operation Courses.

3. DS/1000-IV software is a customer-installed product unless it is ordered with an HP 1000 System.
4. Hewlett-Packard strongly recommends that the customer purchase Customer Support Service or Software Subscription Service for DS/1000-IV and related hardware and software support products.

Ordering information

91750A DS/1000-IV Network Software

The 91750A DS/1000-IV Network Software includes:

1. One of software media options 020, 022, 041, 050, or 051, which must be ordered.
2. 91750-80007 Communications Bootstrap Loader (CBL) ROM.
3. 91750-90001 DS/1000-IV Software Numbering Catalog.
4. 91750-90002 DS/1000-IV User's Manual.
5. 91750-90004 Getting Started with DS/1000-IV.
6. 91750-90005 DS/1000-IV Quick Reference Guide.
7. 91750-90006 DS/1000-IV Communications Bootstrap Loader ROM Installation Manual.
8. 91750-90010 DS/1000-IV Network Managers Manual Volume I.
9. 91750-90011 DS/1000-IV Network Managers Manual Volume II.

91750A Options

001: Provides discount for upgrade from 91740A/B or previous revision of 91750A to latest revision for customers without 91740T/S or 91750T/S.
002: Provides discount for upgrade from 91740A/B to 91750A for customers with 91740T/S support service.
020: Provides DS/1000-IV software on Mini cartridges.
022: Provides DS/1000-IV software on 7908/11/12 compatible cartridge tapes
041: Provides DS/1000-IV software on double-density, double-sided flexible disc for L-Series.
050: Provides DS/1000-IV software on 800 bpi, 9-track magnetic tape.
051: Provides DS/1000-IV software on 1600 bpi, 9-track magnetic tape.

91750R Right to Copy DS/1000-IV software for use on an additional Computer System

The 91750R Right to copy product is available only to customers who have purchased a license to use 91750A. 91750R consists of:

1. The right to make one copy of software purchased with the 91750A DS/1000-IV Network software product for use on an additional system.
2-9. Same as items 2 through 9 of 91750A, above.

91750R Options

001: Discount for right to copy 91750A+001 product or 91750T/S updates for customer who has previously purchased 91750R product.
002: Discount for right to copy 91750A+002 product for customer on 91740T/S software support service who has previously purchased 91740P/R product.

Software support products available

91750T Customer Support Service for 91750A Software (same media option as 91750A)

91750V Central Support for additional copy of 91750A

91750S Software Subscription Service for 91750A Software (same media option as 91750A)

91750W Right to copy 91750S updates once

91750Q Manual update service for 91750A software manuals.

91750T/V/S/W Interface firmware update options

101: Firmware update support for one HDLC interface.
102: Firmware update support for two HDLC interfaces.
104: Firmware update support for four HDLC interfaces.
108: Firmware update support for eight HDLC interfaces.
201: Firmware update support for one Bisync interface.
202: Firmware update support for two Bisync interfaces.
204: Firmware update support for four Bisync interfaces.
208: Firmware update support for eight Bisync interfaces.

Multipoint Interface

(hp) HEWLETT PACKARD

For HP 1000
M/E/F-Series Computers

product number 12790A

The 12790A Multipoint interface is a microprocessor-based interface card that is microprogrammed to manage a hardwired or modem based RS-232-C interface, the Binary Synchronous Multipoint Link protocol, and an on-board data buffer. In conjunction with the 91730A Multipoint software, the Multipoint interface supports 2624B, 2626A, 2629D, 2645A, 2647A, 2648A, 2649C, 2649D, and 2649G multipoint display terminals on a multipoint terminal line. When combined with the 3074A/M Data Link Adapter, the Multipoint interface and Multipoint software support communication between the master HP 1000 computer and L/M/E/F-Series computers, 9800 Series Desktop computers, 264X terminals, 262X terminals and 307X Data Capture terminals connected to the multidrop Data Link. For more information regarding the Data Link, see the Data Link data sheet. 92080A DATACAP/1000-II software combined with the Multipoint interface and Multipoint software supports 3075A, 3076A, and 3077A Data Capture terminals in multipoint line and multidrop Data Link configurations.

Features

- **Microprocessor management of Multipoint Protocol, line/modem control signals, and on-board data buffer**
- **Up to 32 262X, 264X, and 307X terminals per multipoint terminal line**
- **Hardwired or modem-linked communications**
- **Full-duplex or half-duplex communications in multipoint terminal configurations, half-duplex only in multidrop Data Link configurations**
- **Synchronous or asynchronous communication at rates up to 9600 baud in multipoint terminal configurations. Asynchronous communications only at rates to 19.2k baud when used in multidrop Data Link configurations**
- **CRC-16 error checking**
- **1024 byte RAM memory for I/O operations**
- **Firmware controlled self tests**
- **Support for up to eight 12790A Multipoint interfaces at 9600 baud and four at 19.2k baud in an E/F-Series computer**
- **Sharing of communication resources**
- **Computer to interface block transfers up to 1000 characters long at DCPC (direct memory access) rates**

Functional description

Sharing of communication resources

With a multipoint terminal line or multidrop Data Link, a number of devices can share valuable communications resources, including the communications line, the HP 1000 master computer I/O channel, the interface card, and modems.
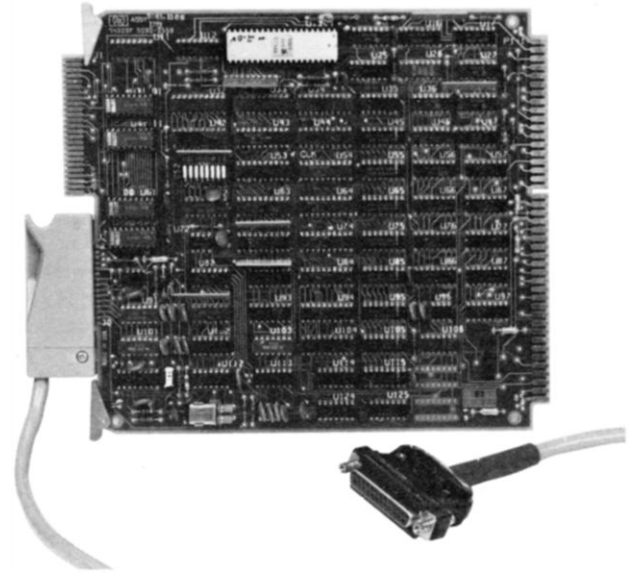
Built-in microprocessor off-loads the computer

A powerful, control-oriented microprocessor on the 12790A interface manages routine communications processing, freeing the computer itself for applications-oriented tasks. The multipoint protocol implemented on the interface is HP Multipoint Protocol, which is similar to IBM Bisync.

Under the control of firmware, the microprocessor converts a control word into actions, such as polling a device for data, selecting a device for a write, or loading/unloading text. CRC-16 Cyclical Redundancy Error Checking is performed on the interface for all text blocks received or sent. The microprocessor automatically requests up to 8 retransmissions upon detection of an error, unless directed to request any other number of retransmissions from zero to 16 by the user's program.

The microprocessor also manages synchronous or asynchronous modem control signals and is capable of setting additional modem control lines, such as rate Select, upon receiving the appropriate command word from the user's program. A controllable watchdog timer is used to generate communications line timeouts.

The microprocessor manages the data buffer used to store blocks of data being sent to or received from the computer. This buffer management includes packing bytes into words for direct memory transfers to the computer via DCPC and unpacking words into bytes for transmission to terminals.

Finally, under programmatic initiation, the interface can perform several optional text editing functions automatically. On writes to a terminal, these include "homing"

the terminal's cursor, clearing the display screen, and/or appending a carriage return/line feed after the last character of text. On reads from a terminal, the interface strips group separators and optionally can strip carriage returns, line feeds, and/or the record separators which define protected fields on the 2624B/2645A/2626A/2648A/2649B/2649C.

Bisync multipoint protocol

The 12790A interface supports a character-oriented Bisync Multipoint Protocol that manages the communications activity on a multipoint line. Message sequences, for example, define which device is to be selected for a write from the master computer or which device is to be polled for text to be read into the master computer. The message sequences also report whether an addressed device is ready for I/O and transfer user's text to and from the device. Protocol characters frame each message and also provide error control on any text blocks transferred in a given message. The activity on a multipoint line thus consists of protocol-related characters and device information.

Built-in text buffering for efficient operation

For any given line speed, large block mode character transfers make the most efficient use of protocol characters, communications line capacity, and computer processing time. For that reason, the 12790A interface incorporates a 1024-byte random access memory which allows up to 998-byte block data transfers to the computer and up to 1000-byte block transfers from the computer to the interface. All transfers are directly to or from the computer memory via the Dual Channel Port Controller (DCPC) in the computer, which promotes extremely efficient utilization of each interrupt to the computer and of every request sent over the communications line. One block mode data transfer can fill over half of a terminal's display screen. Messages longer than 1000 bytes can be transmitted by multiple block mode data transfers of approximately 1000 bytes each. DCPC access to the computer is thus consistent with, and supports, the high performance block mode capabilities of the 12790A interface plus 91730A Multipoint Software.

Firmware-controlled self tests

On-board firmware-controlled self tests help assure reliable operation of the interface. These check out the data buffer, the baud rate generator used for asynchronous communications, and certain logic functions. The self tests are invoked by the PRESET button on the computer and the results are checked by driver DVR07 in the 91730A Multipoint Software upon initializing a communications line.

Functional specifications

Interface level: EIA RS-232-C and CCITT V.24

Transmission mode: Bit serial, asynchronous or synchronous via hardwired cables or half or full duplex modems and telephone lines for multipoint terminal line connections. When used in multidrop Data Link connections, the transmission mode is bit serial asynchronous only via hardwired cables or full duplex modems.

Number of Devices per multipoint line and multidrop Data Link: Up to 32 terminals can be connected to the 12790A interface via a single multipoint line. In a multidrop configuration, up to 128 devices can be connected to the multidrop Data Link subject to system software considerations and performance requirements. The following three factors determine the number of terminals which can be connected to a multipoint line. For additional information on Data Link configurations, refer to the Data Link data sheet.

1. The number of terminals that can be *physically* connected depends upon the transmission mode. Asynchronously, up to 32 terminals can be *physically connected*; the distance between any two terminals can be 609 metres (2000 ft), provided that the total line length does not exceed 4876 metres (16000 ft), regardless of transmission speed up to a maximum of 9600 bps. For synchronous operation, the maximum distance between any two terminals is also 609 metres (2000 ft) and maximum total line length is also 4876 metres (16000 ft), but the number of terminals per line depends upon the average distance between terminals and line speed, as summarized in Table 1.

2. The maximum number of *logically connectable* terminals may be constrained by the logical unit number capacity of the RTE operating system in which the 12790A and its supporting 91730A software are operated.

3. Finally, the number of terminals that can be *realistically supported* depends upon the amount of text character I/O generated by each terminal on the line, the length of those text blocks, the speed of the line itself, and other user-dependent requirements, such as response time.

Line lengths for multipoint line connections

Interface to nearest terminal or modem: 15.2 meters (50 ft), maximum.

Maximum total length between any two terminals on a multipoint line: 609 meters (2000 ft).

Maximum total line length: 4876 meters (16000 ft), not including distance between modems.

Table 1. Average line lengths between multipoint terminals on a synchronous line

Terminals per line	Average line length versus line speeds of:		
	2400 bps	4800 bps	9600 bps
4	609m (2000 ft)	609m (2000 ft)	609m (2000 ft)
8	609m (2000 ft)	609m (2000 ft)	365m (1200 ft)
16	609m (2000 ft)	365m (1200 ft)	146m (480 ft)
32	365m (1200 ft)	146m (480 ft)	36.5m (120 ft)

Line lengths for multidrop Data Link connections

Interface to Data Link adapter: 15.2 meters (50 ft), maximum.

See the Data Link data sheet for additional information regarding Data Link connections and specifications.

Character buffering

Maximum of 998 characters from interface buffer to computer, 1000 characters from computer to interface buffer.

Error detection and correction

Errors are detected using CRC-16 cyclical redundancy error checking on blocks received or sent. Interface retransmits, or requests retransmission of block with error to attain error-free data transfer. User can program-specify any number of retransmissions up to 16; if not user-specified, the number of retransmissions is defaulted to eight.

Line continuity past a "down" terminal

Optional 13232T Power Protect Multipoint Cables can be used for terminal-to-terminal connection after the first terminal in a cluster to ensure line continuity through a terminal that is down. If the 30037A Asynchronous Repeater is used, the first terminal can also be protected with a 13232T Power Protect Cable.

Multipoint line protocol

The 12790A interface implements HP Multipoint Protocol, which is similar to IBM Bisync.

Configuration information

Computer I/O channels required: One per interface.

Compatible CRT terminals for multipoint lines: 2624B, 2626A, and 2629D Terminals. HP 2645A, 2648A, 2649B, and 2649C Terminals are also compatible, and require a 13234A 4k byte terminal memory module and 264X option 033 (asynchronous) or 264X option 034 (synchronous) Multipoint communications with monitor mode capability.

Compatible Data Capture terminals for multipoint line: 3075A, 3076A, and 3077A Terminal using asynchronous polled block mode only.

Compatible modems for multipoint lines: See Table 2.

Table 2. Connections, Modems, and Data Rates

Connection via	Modem Type	Maximum Date Rate
Switched Telephone (Direct Distance Dialing) Network	Bell 201A3	To 2000 bits/sec
	Bell 202T	To 1200 bits/sec
	Bell 208B	To 4800 bits/sec
	Bell 212A	To 1200 bits/sec
	HP 37210T	To 4800 bits/sec
	Vadic VA3400	To 1200 bits/sec
Private lines	Bell 201A3	To 2000 bits/sec
	Bell 202T	To 1800 bits/sec
	Bell 208A	To 4800 bits/sec
	Bell 209A	To 9600 bits/sec
	HP 37210T	To 4800 bits/sec
	HP 37220T	To 9600 bits/sec
	HP 37230A	To 9600 bits/sec*

* Limited by maximum speed of 2645A Multipoint lines.

Operating system and computer compatibility matrix

Computers	Multipoint line (up to 9600 baud)		Multidrop Data Link (up to 19.2k baud)	
	RTE-IVB/IVE	RTE-6/VM	RTE-IVB/IVE	RTE-6/VM
2108M, 2112M	up to 8 I/F	*	up to 1 I/F at 19.2k baud	*
2109E, 2113E 2111F, 2117F	up to 8 I/F	up to 8 I/F	up to 8 I/F at 9600 baud up to 4 I/F at 19.2k baud	up to 8 I/F at 9600 baud up to 4 I/F at 19.2k baud

*Not recommended due to performance limitations of RTE-6/VM operation with M-Series computers.

See the Data Link data sheet for modems compatible with the multidrop Data Link.

Current required from computer power supply:
2.5A(+5V), 0.1A(+12V), 0.05A(−12V), 0.06A(−2V).

Multipoint configuration recommendations: The two points below are for multipoint terminal configurations only. For multidrop Data Link configuration information, refer to the Data Link data sheet.

1. At least one terminal in each local cluster, preferably the one closest to the computer or modem, should be equipped with Monitor mode (13260C/D option 001, which is included with 264X options 033 and 034) to aid in troubleshooting a data communications environment.
2. The 13232T Power Protect Multipoint Cable should be used where terminals are located remotely from each other such that easy audible or visual communication is not possible. However, this capability is supported only on multipoint lines in which the 264X Terminals with power protect are closer to the computer than any 3075A, 3076A, or 3077A Terminals that may share use of the line.

Installation: To install, set the 12790A configuration switches for Baud rate, synchronous or asynchronous operation, and modem control; plug the interface into the computer I/O backplane; connect the standard hardwire interface cable to the first terminal or the option 001 cable to a customer-furnished synchronous or asynchronous modem or Data Link adapter; integrate the interface and 91730A software into the RTE-IVB, or RTE-6/VM operating system, and complete remaining connections to terminals or devices. See the 91730A data sheet for sample multipoint terminal connections, and the Data Link data sheet for Data Link (multidrop) connections.

Ordering information

12790A Multipoint Interface

The 12790A interface consists of:
1. 5061-1389 Multipoint interface card.
2. 12790-80006 through 80009 Control ROMs.
3. 5061-1393 10.6 metre (35 ft) interface cable for hardwire connection to first 13232P cable on multipoint terminal.
4. 12790-90001 Multipoint Interface Reference Manual.

12790A Options

001: Substitutes a 7.6 metre (25 ft) interface-to-modem cable (5061-1391) for the 5061-1393 hardwire cable, item 3, above.

Additional equipment required for multipoint terminal operation

Multipoint line display terminals: One or more 2645A, 2648A, 2649B, or 2649C display terminals each equipped with option 033 or 034 and 13234A 4k byte terminal memory module, or 2624B, 2626A, or 2629D display terminals.

Cable for connection to first terminal:
13232P 4.5 metre (15 ft) modem or multipoint cable for connection to first terminal, with provision for connection to multipoint cable for next terminal.

Modem bypass cable: 13232U 1.5m (5 ft) cable for connection between 12790A option 001 modem cable and 13232P cable.

Cables for connection to succeeding terminals:
1. 13232Q 4.5 metre (15 ft) multipoint cable for continuation of multipoint line.
2. 13232R 30.4 metre (100 ft) multipoint extension cble.
3. 13232T 9 metre (30 ft) Power protect multipoint cable providing continuity around "down" terminal.

DS/1000-IV Data Link Slave Interfaces

For HP 1000 L-Series and
M/E/F-Series Multidrop
DS/1000-IV Communication

product numbers
12072A, 12830A

The 12072A and 12830A are slave interfaces to connect HP 1000 L-Series and M/E/F-Series computers, respectively, to the Data Link. These microprocessor based interfaces, together with 91750A DS/1000-IV software allow high-level user access between slave computers and an HP 1000 M/E/F-Series master computer (controlled by a 12790A interface) on the Data Link. The full set of DS/1000-IV features, except remote front panel access to an L-Series computer, are supported by these interfaces. The 12072A interface is compatible with L-Series computers running RTE-L or RTE-XL. The 12830A interface is supported on M/E/F-Series computers operating with the RTE-IVB, RTE-IVE, or RTE-6/VM operating systems.

Features

- Allows multiple computer access to low cost Data Link.
- Supports full DS/1000-IV software features except for remote front panel access to the HP 1000 L-Series.
- Z-80 based intelligent interface.
- Microprocessor management of Bisync protocol and on board data buffer, leaving more CPU capacity for processing user applications.
- 1k byte of data memory and 4k bytes of program memory.
- Firmware-controlled automatic power-up self test to help assure interface integrity.
- Asynchronous communication at rates up to 19,200 bits/second.
- Optically isolated interface for noise immunity.
- Two, 8 bit banks of switches to program device address, baud rate and datacomm operating mode.

Functional description

### Multiple computer access to factory Data Link

A number of HP 1000 computers can now be connected to the Data Link, allowing multidropped computer connection in the DS/1000-IV network environment. Data Link is an extremely cost effective, local area network for industrial automation, control, and data collection. The link provides flexible configurability and growth potential for distributed networking needs over distances up to 4 km (2.5 miles).

On-board Microprocessor off-loads host computer

A powerful microprocessor on the Data Link slave interfaces manages routine communications processing, freeing the host computer for application-oriented tasks. The protocol used throughout the link is Multipoint Bisync, which is similar to IBM Bisync. Under the control of on-board
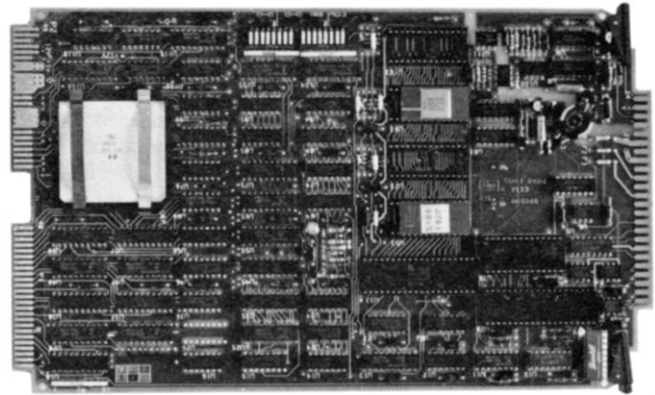
12072A L-Series Data Link Slave Interface
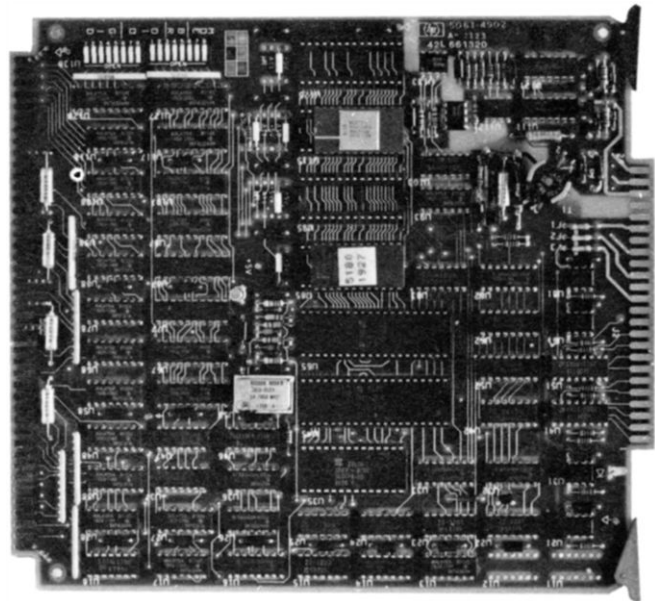
12830A M/E/F-Series Data Link Slave Interface

firmware, the microprocessor converts command words into actions, such as loading/unloading data from the on-board buffers to the host CPU. The microprocessor also performs the protocol generations and interpretation, error checking, and error recovery by retransmission, all without the attention of the host computer.

Interface buffer tasks, also microprocessor managed, include packing bytes into words for direct memory access transfers to the host CPU, and unpacking words into bytes for transmission. The basic Data Link slave interface uses 4k bytes of program space and 1k byte of buffer memory, of which two 192k byte buffers are for data transmission and two 250k byte buffers are for data reception.

Firmware controlled self-tests

On board, firmware controlled self-tests, performed at power-up, help to assure reliable operation of the Data Link slave interface and minimize troubleshooting time. These tests check out RAM and ROM memories and baud rate generators.

Error detection correction

Errors are detected using CRC-16 cyclical redundancy error checking on blocks received or sent. The interface retransmits, or requests retransmission of the block with error to attain error free data transfer.

DS/1000-IV compatibility

Operation of the 12072A and 12830A slave interfaces is supported by 91750A DS/1000-IV software as described in the 91750A data sheet. All DS/1000-IV networking features are supported by the Data Link slave interfaces except remote Virtual Control Panel access to an L-Series computer.

Interface level

Data Link Driver specifications:

Output Voltage High: 4.0 Volt minimum
Output Voltage Low: 0.4 Volt maximum
Differential Voltage: 7.2 Volt Peak-to-Peak minimum
Drive Current: 100 mA minimum

Internally clocked, programmable data rates: 300, 600, 1200, 2400, 4800, 9600, 19200 bits/second

Externally clocked data rates: Up to 2400 bits/second

NOTE: Since the speed of Data Link is limited by the speed of the slowest device on the link, 12072A and 12830A speeds must be set in conjunction with those of all other devices on the Data Link.

Transmission mode: Bit serial, asynchronous, half-duplex

Performance: See DS/1000-IV Performance Brief.

Configuration information

Computer and System Compatibility (See table below):

Interface Product Numbers	Compatible Computers	Compatible Computer Systems	Compatible Operating Systems
12790A M/E/F-Series Data Link Master I/F	2108M,* 2109E, 2111F, 2112M,* 2113E, 2117F.	2176C/D, 2177C/D, 2178A/B, 2179A/B.	RTE-6/VM (92084A) RTE-IVB (92068A) RTE-IVE (92068E)
12830A M/E/F-Series Data Link Slave I/F	Same as for 12790A above.	Same as for 12790A above.	Same as for 12790A above.
12072A L-Series Data Link Slave I/F	2103L, 2122A/B	2142A/B 2145A/B 2146A/B	RTE-L (92070A/E) RTE-XL (92071A/E)

Although the M-Series is software compatible for master computer operation, it is not recommended due to performance considerations.

Computer I/O channels required: One per interface

Interface current required from computer power supply:

	+5V	+12V	−12V
12072A	1.5A	.16A	.07A
12830A	1.3A	.16A	.07A

Software support: Operation of each 12072A or 12830A is supported by slave driver software located in the 91750A DS/1000-IV software product.

Installation: To install, set the interface configuration switches for baud rate, internal or external clock and device ID. Turn slave computer power off, plug the interface into the computer I/O backplane, and connect the supplied cable. Configure the master and the slave. Plug the slave computer cable into the link connector box and power-up the slave computer.

Ordering information

12072A Data Link Slave Interface

The 12072A interface includes:
5061-4904   L-Series Data Link Slave Interface
5061-4903   Data Link to computer cable, consisting of five meters, twin version, of HP Data Link cable attaching a six-contact male connector to an HP 1000 hood connector.
12072-90001   Data Link Slave Interface Reference Manual
1818-1114   Data Link RAM
5180-1927   Data Link ROM
1AF5-6001   I/O Processing Chip

12072A Options

001: Provides one set of updated firmware ROMs.

12830A Data Link Slave Interface

The 12830A interface includes:

5061-4902	M/E/F Data Link Slave Interface
5061-4903	Data Link to computer cable five meters long; a twin version of the HP Data Link cable attaching a six-contact male connector to an HP 1000 hood connector.
12830-90001	Data Link Slave Interface Reference Manual
12830-13301	Diagnostics Software
5061-4909	Data Link Diagnostic Hood
5180-1927	Data Link ROM
1818-1114	Data Link RAM

12830A Options:

001: Provides one set of updated firmware ROMs.

Additional equipment required for operation:

Data Link slave computer with 91750A DS/1000-IV software package.

Data Link master computer, 3074A, Data Link cable, connector boxes, 12790A Multipoint master, 91730A Multipoint software package.

Diagnostic software is provided on the 12830A as part of the product. The 12072A Diagnostic software is obtained from the 24600A Datacomm Diagnostic Package.

DS/1000-IV Binary Synchronous Direct Connect Interface

HEWLETT PACKARD

For Communication Between HP 1000 M/E/F-Series and HP 3000 Systems

product number 12834A

The 12834A is a microprocessor-based interface that is programmed to manage a hardwire communications link from an HP 1000 M/E/F-Series Computer System to a counterpart interface in an HP 3000 Computer System, when both systems are operating in an HP-DSN environment. The 12834A interface handles all Binary Synchronous protocol generation, CRC-16 error checking, and on-board buffer management functions. In conjunction with 91750A DS/1000-IV Network software, the 12834A interface supports high level user access between HP 1000 and HP 3000 Systems.

NOTE: The 12834A interface is for use only in the 91750A DS/1000-IV environment for HP 1000-to-HP 3000 communication links. It is not a general purpose Binary Synchronous Interface.

Features

- Support for synchronous hardwire links up to 1km (0.62 mi)
- 16k bytes of RAM memory for extensive on-board message buffering
- Firmware-controlled automatic power-up self test to help assure interface integrity
- Long term communication line statistics are available through user request via DS/1000-IV software to facilitate checks of line quality and assist link troubleshooting
- Binary synchronous interface for DS/1000-IV to DS/3000 communication links with microprocessor management of Bisync protocol, CRC-16 error checking, buffer management, and DMA transfers
- Data rates up to 57.6k bits/sec
- 12834A optically isolated input breaks ground loops, maximizing noise immunity for direct connect links
- On-board microprocessor off-loads the computer

Functional description

On-board microprocessor off-loads host computer

A powerful microprocessor on the 12834A interface manages routine communications processing, freeing the host computer for application oriented tasks. Under control of on-board firmware, the microprocessor converts command words into actions, such as establishing the communications link and loading/unloading data from the on-board buffers to the host CPU. The microprocessor also performs protocol generation and interpretation, error checking, and error recovery by retransmission, all without the attention of the host computer.

Numerous user programmable parameters are available to tailor the interface to specific applications and configurations, which are also managed by the microprocessor. For example, from 0 to 255 retransmissions of blocks in error can be selected by the user, or a default of 7 may be used. The transmission block size can also be specified.
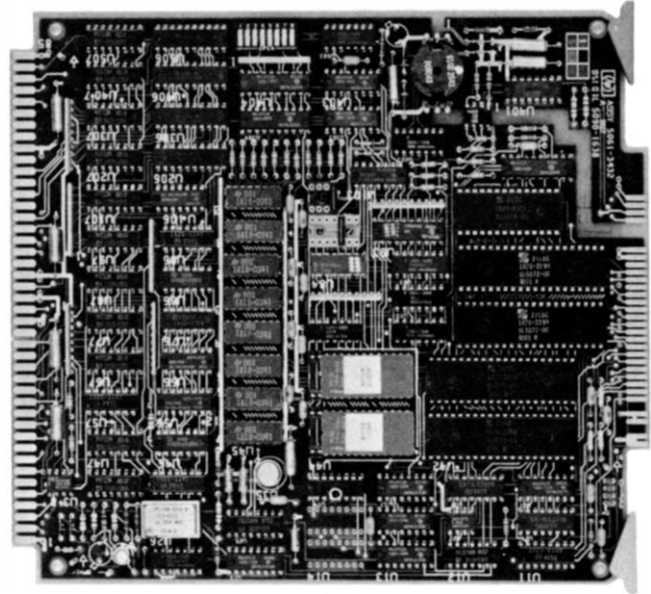
Interface buffer tasks, also microprocessor managed, include packing bytes into words for Direct Memory Access transfers to the host CPU and unpacking words into bytes for transmission.

Firmware controlled self tests

On-board, firmware-controlled self tests, performed at power-up, help to assure reliable operation of the 12834A interface and minimize troubleshooting time. These tests check out the RAM and ROM memories, the Direct Memory Access operations, baud rate generators, and the I/O channel control.

Communications line statistics

Eleven long-term statistics are accumulated automatically and buffered on the interface. These statistics can be easily read by the user to help determine the quality of the communication line and to aid link troubleshooting. They are:

1. Good blocks sent.
2. Good blocks received.
3. Bad blocks received.
4. NAKs received.
5. WACKs sent.
6. WACKs received.
7. TTDs sent.
8. TTDs received.
9. Response errors.
10. Three-second timeouts.
11. Line errors.

Functional specifications

Communications

Interface level: EIA RS-422.

Internally-clocked, programmable data rates: 300, 1200, 2400, 4800, 9600, 19200, and 57600 bits/second.

Transmission mode: Bit-serial, synchronous half-duplex.

Message buffering: A maximum of 6432 bytes in each direction (12864 bytes total) may be buffered using the 16k byte on-board RAM memory.

Error detection and correction: Errors are detected using CRC-16 cyclic redundancy checking on all blocks sent or received. The interface retransmits, or requests retransmission of all blocks with errors to attain error-free data transfer. User can specify 0 to 255 retransmissions. If number is not user specified, the maximum number of retransmissions initiated by the interface defaults to 7.

Line protocol: The 12834A interface implements an extended subset of the IBM Binary Synchronous Communications Line protocol and is NOT a general-purpose Binary Synchronous Interface. It should be used only for HP 1000-to-HP 3000 communications links in the HP-DSN environment.

Maximum cable length: 1km (0.62 mi).

Configuration information

System compatibility: The 12834A interface is compatible with 2108M, 2109E, 2111F, 2112M, 2113E, and 2117F Computers and 217x Computer Systems operating under the 92068A RTE-IVB or 92064A RTE-M (MIII configuration) real-time executive system.

Computer I/O channels required: One per 12834A interface.

Interface Current required from M/E/F-Series Computer Power Supply: 1.81A(+5V), 0.27A(+12V), and 0.04A (−12V).

Counterpart interfaces and cables in HP 3000 Systems: HP 30010A interface and 30222F cable for HP 3000 Series II/III, HP 30020A interface and 30221F cable for HP 3000 Series 30/33/44.

Software support: Operation of one HP 1000-to-HP 3000 communications link (which can use the 12834A interface) is supported by 91750A DS/1000-IV software as described in the 91750A data sheet.

12834A Installation: Set the interface configuration switch for baud rate and forced cold load disable. With power off, plug the interface into the computer I/O backplane, fabricate any necessary direct connect extension cables, connect cables and integrate the interface card and 91750A software into the RTE-IVB/RTE-M operating system.

12834A Limitations: The 12834A interface has optical and transformer isolation for voltages up to 1000V, maximum. This isolation is usable only for intra-building communication. Because 12834A isolation is not intended to survive a lightning strike, these interfaces are not recommended or warranted for connections between buildings.

Ordering information

12834A Bisync Direct Connect Interface (for M/E/F-Series)

The 12834A interface includes:

1. 5061-3432 M/E/F-Series Programmable Serial Direct Connect Interface.
2. 91750-80005 and 80006 Bisync Firmware ROMs.
3. 5061-3422 one 5m/16ft direct connect interface cable to a male connector. Extension cables (available through options 002 through 004) may be required.
4. One 5061-3460 Programmable Serial Interface Diagnostic Test Hood.
5. 12834-90001 Bisync Direct Connect Interface Hardware Reference Manual.

12834A Options

001: Provides one set of updated firmware ROMs.

002: Adds one 5061-3437 75m/245ft direct connect extension cable with assembled connectors.

003: Adds male and female connectors for customer-assembly of direct connect extension cable, using cabling purchased from the cable manufacturer.

004: Adds male and female connectors and 300m/980ft of cable for customer assembled direct connect extension cable.

HP 1000 L-Series 8-Channel Asynchronous Multiplexer Interface

product number 12040A

The 12040A is an asynchronous multiplexer interface that can connect up to eight asynchronous teleprinter-like terminal devices to an HP 1000 L-Series Computer System using a single I/O slot. It is important to note, however, that none of the multiplexer-connected terminals can function as the system console.

Features

- **Inexpensive multiport interface for up to 8 devices increases terminal I/O capacity of system at low per-terminal interfacing costs**
- **EIA RS-423-A and RS-232-C/CCITT V.24 compatibility**
- **On-board microprocessor off-loads computer**
- **On-board buffering with DMA capability**
- **Programmable data rates using two baud rate generators to eliminate hardware speed strapping**
- **Programmable character size, parity checking, and number of stop bits for flexible control of transmission format**
- **Parity, overrun, and framing error detection minimizes the possiblity of undetected transmission errors**
- **Full duplex or Echoplex transmission**
- **Downloadable firmware diagnostic for assuring the integrity of the multiplexer**
- **Backspace and line delete capabilities support intelligent editing of data before it is passed from the card to computer memory**

Functional description

The 12040A Asynchronous Multiplexer Interface provides multiplexed terminal support for up to eight asynchronous RS-232-C compatible devices connected directly, or through full-duplex asynchronous modems*, to the multiplexer. The multiplexer interface can operate at programmable data rates up to 19,200 bits/second on a given channel with an aggregate throughput capability of 7,680 char/sec (8 channels x 960 char/sec). A separate, eight-port Multiplexer panel, product number 12828A, is offered to provide for convenient connection to to the 12040A interface via EIA 25-pin connectors. For more information, see the 12828A data sheet.

* The 12040A does not actively control modems. The modem control lines are strapped on the multiplexer panel to allow passive full-duplex modem support.

In a single interface card slot, the 12040A Multiplexer Interface replaces the interfacing capabilities of eight point-to-point interfaces. It thereby frees up to seven valuable CPU I/O channels for other uses and significantly reduces interface power requirements.
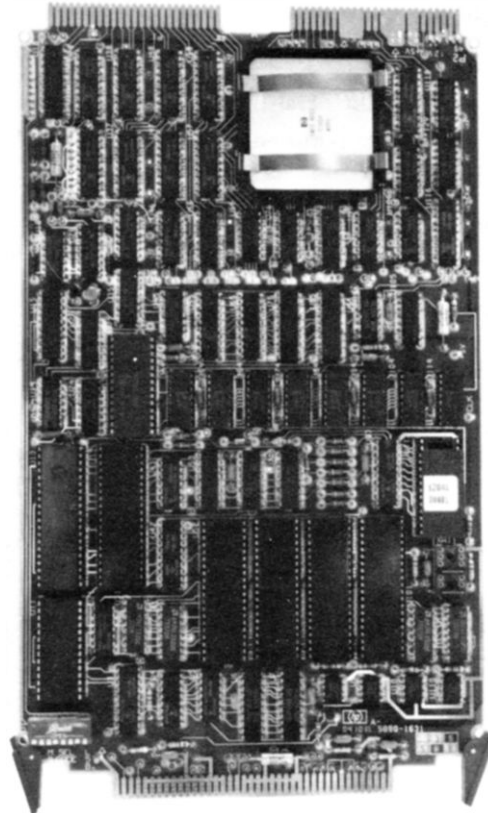
Down-loadable firmware-controlled self tests exercise the RAM, ROM, and control circuits of the multiplexer, assuring its integrity. Test status is returned to the CPU upon completion of self test.

Functional specifications

Capacity

Channels: Eight full-duplex (transmit and receive) communications channels.

Buffering: Two 254 byte transmit buffers and two 254 byte receive buffers for each channel.

Communications

Interface level: RS-423-A/RS-232-C or CCITT V.24.

Program-selectable data rates: 50, 75, 110, 134.5, 150, 300, 1200, 1800, 2400, 3600, 4800, 9600, and 19200 bits/second.

Aggregate throughput capacity: 7,680 characters per second per interface (8 channels at 960 characters/second) which may be restricted by the RTE-L/XL limitation of 79 I/O requests per second.

Communication mode: Asynchronous, bit serial.

Other programmable communications parameters: Character length from 5 to 8 bits; 1, 1-1/2, or 2 stop bits; and odd, even, or no parity.

Configuration information

System compatibility: The 12040A Interface is compatible with HP 1000 L-Series Computer Systems operating under the RTE-L or RTE-XL real-time executive system.

Computer I/O slots required: The 12040A Multiplexer re-. quires a single I/O slot.

System capacity: Up to 63 devices are supported by the RTE-L/XL real-time executive operating system and may be connected via an appropriate number of 12040A multiplexer interface cards. However, L-Series card cage capacity may limit the total number of devices in the L-Series system to a number less than 63. The number of terminals that can be concurrently active will depend upon the application.

Software support: Software support for the 12040A Asynchronous Multiplexer Interface is included with the 92070A RTE-L and 92071A RTE-XL Real-Time Executive operating system.

Currently supported Hewlett-Packard terminals without Mini cartridge I/O: 2621A/P Interactive Terminals, 2631A/B Printers, 2635A/B Printing Terminals, 2640B Display Terminal, 2645A (std) Display Station, 2648A (std) Graphics Terminal, 2649B (std) OEM Block or Character Mode Terminal, 2649C (std) OEM Graphics Terminal, 2675A+070 120 cps Thermal Printing Terminal, and 7310A Graphics Printer.

Currently-supported Hewlett-Packard terminals with Mini cartridge I/O: 2645A+007 Display Station, 2647A Intelligent Graphics Terminal, 2648A+007 Graphics Terminal, 2649B+007 OEM Block or Character Mode Terminal, 2649C+007 OEM Graphics Terminal, and 2649G OEM Intelligent Graphics Terminal.

Current required from computer power supply: 2.5A(+5V), 0.07A(+12V), 0.05A(−12V).

Approximate memory requirements: See Table 1.

Table 1. 12040A Memory Requirements

FILE NAME	DESCRIPTION	MEMORY REQUIRED
IDM00	Basic interface driver, including device driver for basic CRT display terminals.	2,100 bytes
	Additional per 12040A interface.	48 bytes
	Additional per device.	68 bytes
DD.00	Device driver for 26xx terminal or RS232-C compatible printing devices (IDM00 is also required).	1500 bytes
	Additional per terminal or printer.	44 bytes
DD.20	Mini cartridge driver for 264x terminal (IDM00 and DD.00 are also required).	1100 bytes
	Additional per Mini cartridge tape unit.	44 bytes

Installation: Set the interface's I/O address on its select code switches; turn off power to the computer; plug the multiplexer card into the computer backplane; and connect to terminals using the furnished connector kit and a customer-fabricated cable or through the cable supplied with the 12828A Multiplexer Panel and additional multiplexer panel-to-terminal cables. Then generate IDM00 and necessary device drivers with other appropriate supporting software into the RTE-L/RTE-XL operating system.

Physical characteristics

Dimensions

289mm(11.38in) long by 172mm(6.75in) wide by 1.6mm(0.063in) board thickness, with 10.2mm(0.4in) top-of-board parts clearance and 5.1mm(0.2in) beneath-board clearance.

Weight

481grams (17oz) with mating connector.

Ordering information

12040A 8-Channel Asynchronous Multiplexer Interface

The 12040A Interface includes:
1. 12040-60001 8-channel Multiplexer Interface.
2. 5061-3467 80-pin connector kit.
3. 12040-90001 Interface Reference Manual.
4. 12040-90003 Diagnostic-Operating Manual.

12040A Options

041: Multiplexer software on 1.2M byte flexible disc.

050: Multiplexer software on 800 bpi, 9-tr mag tape.

051: Multiplexer software on 1600 bpi, 9-tr mag tape.

120: Diagnostic software on 264x Mini cartridge.

141: Diagnostic software on 1.2M byte flexible disc.

Accessory connection panel

The 12828A RS-232-C Multiplexer Panel is recommended for convenient connection of devices to the 12040A subsystem. For more information on the 12828A and device-to-panel connection cables used with it, see the 12828A data sheet in the HP 1000 Communications Technical Data book.