

Exxon Qwip Series Facsimile Transceivers

Models 1200, 1300, 2000, 2150 & 2310

■ PROFILE

Function • general-purpose analog and digital facsimile transceivers.

Type • tabletop; FM (Model 1200), AM (Model 1300), AM/FM (Models 2000 and 2150) and digital (Model 2310) transceivers.

CCITT Compatibility • Group 2 all models except 1200; Group 1 for 2000, 2150, and 2310; Group 3 for 2310.

Max Scanning Width • 10.1 inches for 2310; 8.5 inches all other models.

Feeder • single-sheet, manual feed for all models except 2150 and 2310; auto-feed, 15-document send and 150-document receive capacities on a Model 2150; 30-document capacity send and roll-fed receive on Model 2310.

Image Resolution • 96x64/96 lpi (Model 1200); 86x78 lpi or 96x96 lpi (Model 1300); 86x78 lpi or 96x64/96 lpi (Models 2000 and 2150); 204x96/196 lpi (Model 2310).

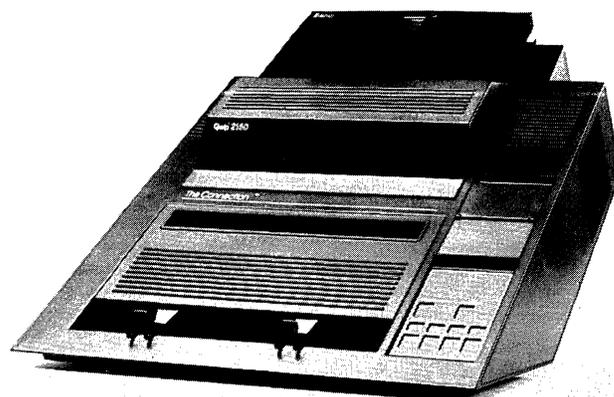
Half-Tone Support • supported on all models.

Communications • dedicated line or DDD for all models; transmit/receive speed 2400/4800 bps standard on Model 2310 with 9600 bps optional • auto-answer and polling supported on Models 2000, 2150 and 2310.

First Delivery • 1975 (Model 1200); 1978 (Model 1300); 1980 (Models 2000 and 2150); 1982 (Model 2310).

Units Installed • not available.

Comparable Systems • competitive with all general-purpose Group 1 and 2 units, especially Burroughs dex 1103/108/580/700/2100/3600/4100/4200/4300/4400/5100, Canon Fax 601, 3M EMT 9136/9140/9160/2346/1000B/VRC II, Muirhead K-442/6400; Nippon System 11/110/System III, Panafax MV 300/1200; Rapicom 3100/3300; Siemens HF 2040, Stewart Warner Datafax 825, Telautograph Omnifax G21, and



Xerox Telecopier 200/400/410/455.

Vendor • Exxon Office Systems Co; 777 Long Ridge Road, Stamford, CT 06904 • 203-329-5000.

Distribution • marketed through Exxon sales offices.

■ ANALYSIS

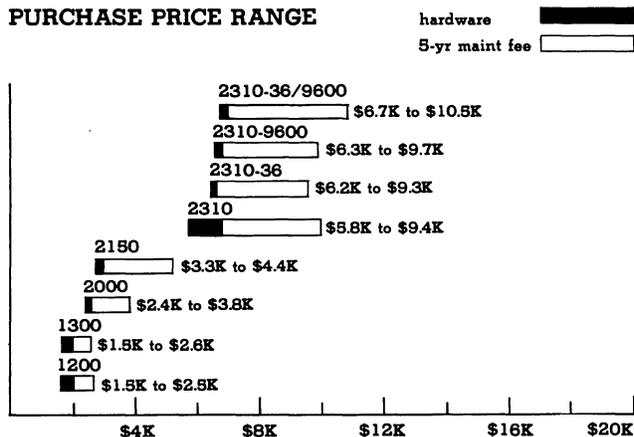
For the second consecutive year, Exxon has made no significant changes to its Qwip family. In fact, there has been no movement at all in either the technical attributes of the product line or the purchase prices. Only monthly rentals have been lowered on the 2310 models (between \$25 and \$30 per month); however, rentals are available only to major accounts.

Given the movement within the Burroughs dex and Rapicom families, Exxon's lack of activity in the new product area is surprising. As far as can be determined, nothing new is on the horizon that would account for the lack of movement in the Qwip line. And there is no indication that Exxon plans to divest itself of this business.

Exxon's Qwip family offers users a variety of low-cost transceivers for general-purpose applications. Four of the 5 models are analog transceivers that satisfy low-to-medium volume requirements. Exxon's new high-performance digital transceiver, Model 2310, serves high-volume and medium-to-high resolution needs and can be used in a polled, unattended environment. The 4 analog models satisfy different transmission requirements, and except for Model 1200 at the low end, provide transmission compatibility with other vendor terminals that comply with CCITT recommendations for transmission compatibility. This is an important consideration that should not be overlooked, especially by users with extensive communication environments. Although Model 2310 is a digital terminal, it provides transmission compatibility with analog terminals that are CCITT compatible. However, this operating mode considerably reduces the 2310's transmission speed and its performance so that it can only satisfy low-to-medium volume applications.

Image resolution is quite good on the analog models by comparison with competitive models, and high on the digital

PURCHASE PRICE RANGE



EXXON QUIP MODELS 1200, 1300, 2000, 2150, 2310, 2310-36, 2310-9600 & 2310-36/9600 PURCHASE PRICING bar graphs cover price range between "small" and "large" transceivers • solid bars show hardware costs, while open bars show associated 5-year maintenance fee • small system consists of Model 1200 FM analog transceiver • large system consists of Model 2310-36/9600 digital transceiver with Group 1 and 9600-bps integral FCC-certified modem. All prices reflect single-quantity purchase.

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Models 1200, 1300, 2000, 2150 & 2310

2310. The resolution for analog models is more than adequate for transmitting typed copy, but is not high enough for fine details.

All models except Model 1200 contain an integral FCC-registered modem for connecting directly to a dedicated or dial-up telephone line. However, Model 1200 does include an integral acoustic coupler for dial-up communication via a conventional telephone. Models 2000, 2150, and 2310 support polling and provide auto-answer/-disconnect for unattended operation.

The new high-performance 2310 digital transceiver exhibits state-of-the-art technology. User benefits include selectable medium and high resolution, multivendor compatibility via conformity to CCITT recommendations, data compression using modified Huffman and modified READ techniques, and an integral FCC-registered modem with automatic fallbacks. The 2310's high-performance multiple user benefits, and surprisingly low price by comparison with competitive products, make it an especially attractive package.

□ Strengths

The principal strengths of the analog models are reasonably good image resolution as compared with competitive models, multivendor compatibility, and an integral FCC-registered modem (except for Model 1200). These models are extremely price competitive in the market and deserve strong user consideration.

Model 2310 offers strong user benefits and performance equivalent to that of many floor-console transceivers at a much lower price. Its selectable high resolution should yield high-quality results for printed copy and acceptable results for photographs. And its extended scanning width accommodates oversize documents, and auto-reduction facilitates ease of handling. Other strong user benefits are communication related. Compatibility with CCITT recommendations supports communication with other CCITT-compatible vendor models. Data compression results in more efficient communication, eliminating redundant characters, blanks, and information from the page to reduce transmission time and the cost of transmission over the DDD network. The integral modem eliminates the need for an extra-cost external modem, and an external Data Access Arrangement (DAA) since the modem is FCC-registered. Polling auto-answer/-disconnect, and terminal ID features support unattended operation (after hours use), and the ID feature guards against unauthorized access.

□ Limitations

Models 1200, 1300, and 2000 require attended operation since they contain manual feed and accommodate single-sheet paper. Alternatively, Model 2150 features auto-feeding for both send and receive modes, but uses single-sheet paper instead of roll feed. Therefore, the 2150 could be used unattended except that single-sheet paper is more likely to jam than roll feed paper, making unattended operation risky.

There are no severe limitations with the 2310; however, while the unit's image resolution is certainly adequate for detailed documents, a higher resolution would improve half-tone reproduction.

■ HARDWARE

□ Terms & Support

Terms • all Exxon terminals are available on a purchase, 1-year, and 2-year lease basis • 2-year lease includes maintenance within 60-mile radius; beyond 60-mile radius, maintenance is billed on time-and-material basis.

Support • on-site, vendor-supplied maintenance is available for terminals installed within a 60-mile radius; beyond 60 miles customers must ship or deliver Models 1200 and 1300 to nearest Exxon Service Center; on-site service is available for Models 2000, 2150, and 2310 • service charges are based on a Zone 1 (30-mile radius) and Zone 2 (60-mile radius); maintenance costs shown for terminals described in this report are for Zone 1.

□ Overview

The Exxon Qwip family consists of 4 analog transceivers and 1 digital transceiver designed for general-purpose applications. The analog products use conventional technology and share many operational characteristics. For example, with the exception of the Model 1200, all support 86x78 and 96x64/96 image resolutions, and all employ single-sheet manual feeding—except the 2150 which has auto-feeding on both send and receive. The key differences among the analog products are the transmission technique, communication interface, and terminal transmit/receive compatibility.

Model 2310, by contrast, is a digital transceiver compatible with CCITT Group 3; Group 1 compatibility is optional. The 2310 provides reasonably high image resolution (204x96/196) for handling fine print, and is equipped with an auto-feed, 30-document input, and roll-fed output. This transceiver also supports both CCITT Group 3 data compression and modified READ. The data communication interface is supported by an FCC registered, integral 4800-/2400-bps modem, a 9600-bps modem is optional. The 2310 also has auto-answer, can be polled, and has provisions for identifying/verifying the polling terminals.

Model 2310 is also offered in 3 variants. Model 2310-36 is the basic transceiver with CCITT Group 1 compatibility; Model 2310-9600 is the basic unit with an integral 9600-bps modem; and Model 2310-36/9600 is the basic unit with CCITT Group 1 compatibility and a 9600-bps modem.

□ Qwip Model 1200 FM Transceiver

Tabletop unit measuring 22.1(W) x 8(D) x 6.5(H) inches; 16 pounds • accommodates input document up to 8.5x11 inches; single-sheet; manual feed • single-sheet, 8.5x11-inch output document • rotating cylinder; fiber optics; moving scan head • switch-selectable resolution at 96x64/96 lpi; contrast control • transmission speed per 8.5x11-inch document: 4 minutes at 96x64 lpi; 6 minutes at 96x96 lpi • 8.5-inch maximum scanning width • restricted to type size no less than 8 points • electrosensitive recorder/printer • compatible with most 4- and 6-minute FM units • half-tone support • integral acoustic coupler:

NA/NA mo \$1,495 prch \$16 maint

□ Qwip Model 1300 AM Transceiver

Tabletop unit measuring 11(W) x 8(D) x 8.5(H) inches; 17 pounds • accommodates single-sheet input document up to 8.5x11 inches; manual feed • single-sheet, 8.5x11-inch output document • rotating cylinder; fiber optics; moving scan head • switch-selectable resolution at 86x78 lpi or 96x96 lpi • transmission speed per 8.5x11-inch document: 2 minutes at 86x78 lpi; 3 minutes at 96x96 lpi • 8.5-inch maximum scan width • restricted to type size no less than 8 points • electrosensitive recorder/paper • CCITT Group 2 compatibility • half-tone support • integral FCC-registered modem; requires USOC RJ13C telephone jack:

NA/NA mo \$1,495 prch \$18 maint

□ Qwip Model 2000 AM/FM Transceiver

Tabletop unit measuring 19.25(W) x 24.63(D) x 14.38(H) inches; 31 pounds • accommodates single-sheet input document 5 to 8.5x3.5 to 11 inches; manual feed • 8.5x11-inch single-sheet output document; manual feed • rotating cylinder; fiber optics; moving scan head • switch-selectable resolution at 86x78 lpi or 96x64/96 lpi; contrast control • transmission speed per 8.5x11-inch document: 2 minutes at 86x78 lpi; 3 or 6 minutes at 96x96 lpi; 4 minutes at 96x64 lpi • 8.5-inch maximum scanning width • electrosensitive recorder/printer • CCITT Group 1 and 2 (3 minutes) compatibility • half-tone support • integral FCC-registered modem; requires USOC RJ13C telephone jack •

MO: 1-year/2-year monthly lease charge; 2-year lease includes maintenance. PRCH: purchase price. MAINT: monthly maintenance charge for purchased units. NA: not available for lease. Prices effective as of July 1984. All prices are single quantity.

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auto-answer/-disconnect; polling supported:

\$119/\$107 mo \$2,375 prch \$24 maint

Qwip Model 2150 AM/FM Transceiver

Tabletop unit measuring 19.25(W) x 24.63(D) x 14.38(H) inches; 42 pounds • accommodates single-sheet input document 5 to 8.5x3.5 to 11 inches; auto-feed; 15-document capacity • single-sheet, 8.5x11-inch output document; auto-feed; 150-document capacity • rotating cylinder; fiber optics; moving scan head • switch-selectable resolution at 86x78 lpi, 96x96 lpi, or 96x64 lpi; contrast control • transmission speed per 8.5x11-inch document: 2 minutes at 86x78 lpi; 3 or 6 minutes at 96x96 lpi; 4 minutes at 96x64 lpi • 8.5-inch maximum scanning width • electrosensitive recorder/printer • CCITT Group 1 and 2 (3 minutes) compatibility • half-tone support • integral FCC-registered modem; requires USOC RJ13C telephone jack • auto-answer/-disconnect; polling supported:

\$161/\$145 mo \$3,375 prch \$35 maint

Qwip Model 2310 Digital Transceiver

Tabletop unit measuring 17.7(W) x 18.4(D) x 8.35(H) inches; 50.6 pounds • input document size up to 10.1 x length of original; auto-feed; 30 documents • output document size 10.1 x length of original; roll-fed; 328 foot roll • flat-bed, CCD array scanning • switch-selectable resolution at 204x96 (normal) or 204x196 lpi (fine) for digital; 96x96 lpi Group 1 (optional) and Group 2 • transmission speed per 8.5x11-inch document at 4800/9600 bps, respectively: 40/20 seconds at 204x96 lpi; 60/35 at 204/196 lpi; 6 minutes for Group 1 and 3 minutes for Group 2 • 10.1-inch maximum scanning width • thermal recorder/paper • CCITT Groups 1 (optional), 2 and 3 compatibility • data compression uses standard Group 3 and modified READ • half-tone support • integral 4800-/2400-bps auto-fallback, FCC-registered modem; 9600/7200/4800/2400-bps, FCC-registered modem optional • auto-answer • polling with remote terminal ID:

NA/\$200 mo \$5,845 prch \$45 maint

Qwip Model 2310-36

Same as Model 2310, but includes CCITT Group 1 compatibility:
NA/\$210 mo \$6,245 prch \$51 maint

Qwip Model 2310-9600

Same as Model 2310, but includes FCC-registered 9600/7200/4800/2400-bps modem:
NA/\$250 mo \$6,345 prch \$57 maint

Qwip Model 2310-36/9600

Same as Model 2310, but includes the 36 and 9600 options:
NA/\$260 mo \$6,745 prch \$63 maint

36 Option • CCITT Group 1 6-minute transmission feature:
NA/NA 400 NA

9600 Option • FCC-registered 9600/7200/4800/2400-bps auto-fallback modem:
NA/NA 500 NA

Communications

All terminals communicate over dedicated voice-grade lines. Model 1200 contains an acoustic coupler for connection with the DDD via a telephone handset. The other terminals contain integral FCC-registered modems.

The digital Model 2310 transmits data at speeds up to 9600 bps. Standard modem operates at 4800 bps with a 2400-bps fallback speed. As an option, the vendor offers a 9600-bps modem with 7200-, 4800-, and 2400-bps fallback rates.

Polling is supported on the 2000, 2150, and 2310. These terminals also include auto-answer.

• END

Forte Communication Emulators

PJ 3278/3279/3279-S3G, ForteLink SNA, ForteCall & FortePrint

■ PROFILE

Function • emulates IBM 3278/3279/3279-S3G terminals • ForteLink SNA and ForteCall also emulate remote IBM 3274/3276 controllers with 3278/3279/3287 terminals/printers attached; ForteCall allows ASCII terminals to emulate 3278 • PJ 3278/3279/3279-S3G rely on IBM 3274/3276 local/remote controllers for communications service • file-transfer utilities provided.

Packaging • printed circuit card fits into single long slot on IBM PC, PC/XT, PC/AT, or compatible; PJ 3279 and 3279-S3G sister-board attach to PJ 3278 motherboard.

Communications/Networks • PJ 3278/3279/3279-S3G attach via the personal computer to an IBM 3274/3276 local and/or remote cluster controller and relies on them for communication services and network control (see report 950-I048-3270 for details on the 3274/3276) • emulates 3278-2, -3, or -4 monochrome displays; 3279-2A, -2B, -3A, or -3B base-color displays; or 3279-S3G color graphics terminals • supported as an LU2-type device • ForteLink SNA emulates the IBM 3274/3276 and attaches to the IBM System/370, 30XX, 4300, and 8100 over point-to-point, full-duplex lines at speeds to 9600 bps • RS-232C interface.

First Delivery • 1984 and 1985.

Systems Delivered • undisclosed.

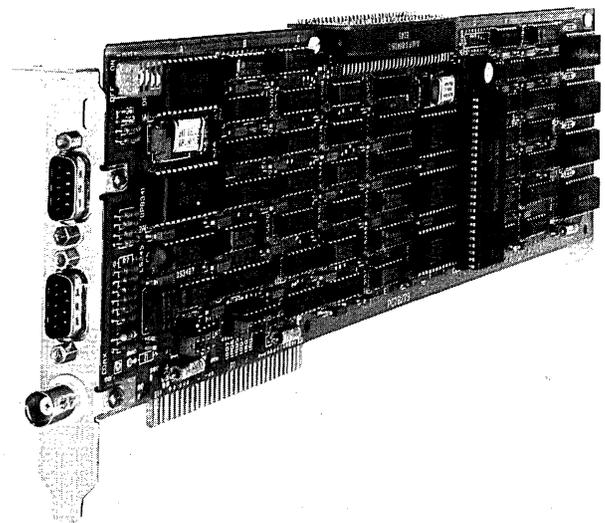
Comparable Systems • ABM Computer Systems SC-Series, AST Research AST-PCOX/SNA/BSC/3780/5251, Avatar PA100 and PA100 Turbo, CXI Inc CXI 3278/3279, DCA Irma, Micro-Integration Coax/Micro/BIS Family, Pathway Design PC Path, Persyst Products Coax/3278 and PC/3270/3780/HASP, Techland Systems Bluelynx Series, and Winterhalter Datatalker/Coax, 3270/3780/2780.

Vendor • Forte Communications, Inc; 2205 Fortune Drive, San Jose, CA 95131 • 408-945-9111 or 800-233-3278 (toll free).

Canadian Headquarters • Louis Albert Associates; 5411 Canotech Road, Ottawa, ON K1J 8Y5 • 613-748-9751.

Distribution • through direct sales staff and computer retail stores.

GSA Schedule • unlisted.



The Forte PJ family provides IBM 3278/3279/3279-S3G emulation for IBM PC users. ForteCall option allows ASCII terminals to dial-in and be emulated as a 3278-2. The Forte products have limited communication capabilities and most require the IBM 3274/3276 to interface with the host.

■ ANALYSIS

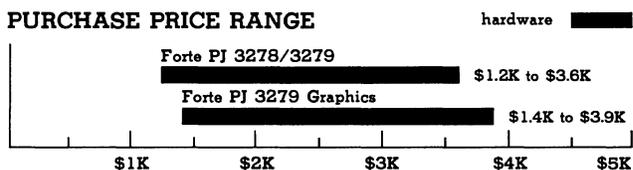
The Forte family of products fall into the general category of "protocol" converters designed to allow normally incompatible personal computers (PC) to communicate with IBM mainframes. Like so many products in this growing marketplace, the Forte units emulate the facilities and features of the IBM 3270.

The Forte line, however, is different because it offers more than emulation. While many of the so-called protocol converters are designed to link asynchronous devices such as ASCII terminals/printers and personal computers to IBM mainframes, Forte goes much further by supporting file transfers. That's the **real strength** of the product line. It also offers an interface for user-written applications.

File-transfer operations involve uploading and downloading of data between the PC and host processor, and are under control of IBM's Conversational Monitor System (CMS) or Time Sharing Option (TSO). While those schemes for transferring files are easiest to use (for nonprogrammers) and require few host processing resources, they tend to be slow and somewhat limited. To alleviate these shortcomings, Forte offers faster file transfer options called ForteNet TSO and CMS. Both increase file transfer more than **100 fold** over the standard transfer utility (see Strengths).

A major limitation of most of the Forte product line is the inability to handle communication directly with the host. Rather, the IBM 3274/3276 controllers are required to interface the personal

PURCHASE PRICE RANGE



FORTE PJ LINE PURCHASE PRICING bar graphs cover price ranges between "small" and "large" configuration for hardware products (solid bar) • small PJ 3278/3279 is the basic IBM 3278/3279 emulator with standard file transfer facilities; large system consists of basic emulators plus TSO File Transfer packages, ForteCall, FortePrint, and 3270 PC emulation • small PJ 3279 Graphics consists of PJ 3278/3279 emulator with IBM 3279-S3G emulation; large system consists of basic emulator, 3279-S3G emulation, TSO File Transfer package, and 3270 PC emulation • all prices single-quantity purchase • maintenance is negotiated with selling agency.

Forte Communication Emulators

PJ 3278/3279/3279-S3G, ForteLink SNA, ForteCall & FortePrint

computer with the IBM mainframe. The only exception occurs when the ForteLink SNA option is added to a standard PJ 3278/3279 configuration. With this combination, the PJ emulates a remote IBM 3274/3276 controller with 3278/3279 terminals attached.

The cornerstone of the Forte product line is the PJ 3278. This product consists of a long-slot printed circuit board and emulation software that allows the PC to emulate an IBM 3278 Model 2, 3, or 4 terminal and an IBM 3278 keyboard, as well as a personal computer. The PJ 3279 and 3279-S3G are "sister" and "daughter" boards, respectively, to the PJ 3278, and work in conjunction with it. PJ 3279 emulates the IBM 3279 Models 2A, 2B, 3A, or 3B; PJ 3279-S3G emulates its IBM counterpart. The Forte product can use the same graphics library available to IBM terminals.

One of the more common applications of protocol converters and emulators is the substitution of low-cost ASCII terminals/printers for IBM products. While Forte is not particularly strong in this area, it does support such with its ForteCall and FortePrint software packages. ForteCall resides in a PC equipped with PJ 3278/3279 boards, and allows a remote ASCII terminal such as a DEC VT 100/200, IBM 3101, etc to dial into the PC to be connected to an IBM host. ForteCall provides the necessary remote terminal interface and emulation, making the ASCII terminal appear to be an IBM 3278-2. The link to the host is provided by the PC connected to the IBM 3274/3276.

FortePrint also resides in a PC and allows low-cost ASCII printers to be used in place of the 80-cps IBM 3287-1. FortePrint also provides a 4K-byte print buffer, sufficient to hold 2 full screens of data.

The remaining products are the Forte 3270 PC emulator and EComNet, a virtual disk emulator. The 3270 PC allows a PJ 3278/3279 equipped PC to emulate the multiwindowing and multission facilities offered by IBM's popular 3270 PC. Like IBM, the Forte unit supports up to 7 application windows. It also supports 4 concurrent host sessions with a local DOS session and 2 window notepads.

The EComNet allows PC users to employ host-processor storage facilities to build virtual disks and share large files, and/or retrieve host files under MIS control. Users interface with host facilities via familiar PC-DOS commands instead of more complex MIS verbs.

In summary, the Forte product line is really nothing special if you only need emulation services. In fact, products from Black Box, Datastream, ICOT, Infotron, Local Data, Micom, and Innovative Electronics, to name a few, can do the same job and support multiple terminals/printers (see Survey report 737 for details). Most of those products are standalone boxes, however, which require space on an already crowded desk. In addition, none of them support the file transfer facilities of Forte.

In overall breadth of products, Forte is rivaled only by DCA's Irma Family (see report 930-D665-0041). The PJ 3278/3279 is almost the same as the Irma PC Interface, except the latter provides the 7-color support of the IBM 3279-S3G. Forte requires a separate 3279-S3G graphics board to move from 4-to 7-color displays. Until recently, Forte had a clear advantage over Irma with its support of full S3G graphics (Forte even offered Irma users a plug-in to upgrade Irma PC to graphics) and IBM 3270 PC support. DCA neutralized this situation on May 7, 1985, with its IRMAX upgrade that not only provides graphics for the PC, but also allows it to function as an **IBM 3270 PC with graphics**. In short, DCA eliminated 2 Forte advantages with a single product. IRMAX lists for \$1,195.

Another Forte advantage eliminated on May 7 is the windowing facility of the 3270 PC product. Irmalink/Windows provides users with simultaneous PC, mainframe, and notepad windows for an IBM PC, PC/XT, PC/AT, or IBM-compatible products. Up to 10 active window profiles, each containing a mainframe window and 2 notepad windows, can be maintained. Irmalink/Windows sells for \$149 and supports transfer of CMS or TSO files using Irmalink FT/TSO or FT/CMS.

The ForteCall and FortePrint are comparable to the Irmaline and Irmalink, except Irmaline provides 7-color support and Irmalink

emulates the IBM 3287 Models 1 and 2, while Forte emulates only the Model 1. Irmacom/3270 and ForteLink SNA are comparable products.

DCA, however, has nothing to compare with EComNet. The ability to establish large files and/or extract MIS-controller files at the host is a real product **Strength**.

□ Strengths

The strength of the Forte family varies with the product. The Forte boards provide a standalone, card-level emulation of the IBM 3278/3279 terminal, and VM/CMS or MVS/TSO file transfer operations for \$1,195. The key here is the file transfer. Being able to upload and download files between the host mainframe and personal computer adds a degree of processing power and flexibility well-suited to distributed processing. In addition, using a file transfer utility is substantially faster than having an operator enter data from the terminal. This is especially true where a volume of data must be transmitted. The TSO employed by the Forte product is fairly simple for non-data processing professionals to learn and puts few burdens on the host mainframe resources. TSO is slow, however, and does not work directly with IMS or CICS (see Limitations).

The ForteNet TSO and CMS file transfer applications are substantially faster and more efficient. Under the standard file transfer routines provided with the PJ 3278/3279, only 255 cps are uploaded and 349 are downloaded between the PC and mainframe. With the enhanced file transfer, applications between 4,500 and 6,000 cps are transferred. Part of the reason for the increase in speed is that the editing routines associated with TSO and CMS are bypassed. Under normal (nonbypassed) operation, the PC must wait for a mainframe response after every screen of data.

EComNet (Extended Communications Network) is a mainframe and PC program that allows the personal computer user to set up virtual disks in the mainframe memory and use host printers as though they were locally attached devices. EComNet allows users to establish exclusive and/or sharable files on the virtual disks using standard PC-DOS commands. EComNet consists of a virtual peripheral facility that is used to establish files in mainframe memory, and control the accessing and updating of them. Up to 32M bytes per virtual disk can be managed by virtual peripheral and MIS facilities.

Also part of EComNet is the Cross-System Link that allows host files to be called up from the PC as though they were locally stored. Cross-System allows accessing of any mainframe file—not just those established by the PC users as is the case with virtual peripheral. Cross-Link runs under MIS, but file transfers are accomplished via the standard PC-DOS COPY command.

□ Limitations

The limitations of Forte products, like their strengths, vary with the product. For example, the standard TSO file transfer shipped with the PJ 3278 board interfaces with the TSO editor. That utility reads data a line at a time and responds back to the personal computer regarding the acceptability of data. For interactive applications, this isn't a real problem, but for the file transfers it's too slow. The ForteNet TSO and CMS bypasses the editor and substantially increases the overall transfer speed between uploaded/downloaded files.

For those opting not to use the ForteNet products, applications can be created using PC-DOS piping to redirect output from the screen to a file, and the converse. Thus, the CMS TYPE command could be used to list a file on the screen after having redirected it to a file. The converse would be to establish a CMS file using the CMS editor, prepare it for input, and then use the PC-DOS TYPE command to load the data into it. This type of file handling, however, is not especially user-friendly and probably will require more familiarity with system operations than the average PC user has.

If your application requires the transfer of ASCII/EBCDIC/binary files, Forte will provide (at a small charge) a host-resident application program that provides ASCII/EBCDIC code conversion plus translation of binary data. Unfortunately, this

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program does not address the problems associated with mixed data (EBCDIC/ASCII and binary), which means binary data could be translated when it should not be. For example, the binary value 00110001 is an ASCII "1," decimal 49, and hex 31, and in an ASCII/EBCDIC conversion would be translated to an EBCDIC "1" and hex F1. A second problem occurs when binary data less than hex 30 is transmitted, since these codes could be generated on an IBM 3278/3279. The 3274/3276 controller **do not** expect to see them and consequently reserve these codes for control purposes. Therefore, users can only transfer data characters (i.e., all data must be expanded to external format before the transfer occurs).

Minor limitations of the Forte line are their dependence on the IBM 3274/3276 for communication services; the inability to interface local ASCII terminals; and the lack of a 3278/3279 keyboard.

The lack of 3274/3276 emulation, except with ForteLink SNA, excludes the use of the products in any environment other than an IBM 3270 shop. Apparently, Forte's marketing strategy is based on the assumption that remote users having a more pressing need for such emulation—therefore, the ForteLink SNA—and that local users have a 3274/3276 port available to them. Maybe so. However, since 3270 shops tend to load up the controllers in order to justify their existence, ports might not be available. Therefore, the use of Forte-equipped personal computers might require the purchase of additional cluster controllers to handle them, and the 3274/3276 aren't exactly cheap.

One of the most popular applications for protocol converters is the substitution of low-cost ASCII terminals for expensive IBM offerings. While companies such as Datastream, PCI, ICOT, etc have targeted—and virtually dominate—that market segment with products comparable to Forte's, they are now supporting multiple ASCII terminals along with the 3278/3279 emulation services provided for the personal computer. AST Research offers a product that allows a personal computer to attach up to 3 ASCII terminals and provides 3278 emulation for them. Forte's **only** ASCII terminal support is via ForteCall.

The lack of a 3278/3279 keyboard is more an inconvenience than a limitation. Like all protocol converters, the Forte products map the 3278/3279 keys (especially the program attention and program function keys) to the PC layout. Thus, the operator must learn new keying sequences if he/she is an experienced IBM operator. A minor matter, but one worth considering.

■ SOFTWARE

□ Terms & Support

Terms • software utilities offered on a license-basis only • firmware bundled into price of component.

Support • telephone consulting provided by vendor or end-seller personnel.

□ Utilities

Forte offers several utilities supporting component emulation and file transfer. The emulation utilities are a combination of hardware/software designed to work directly on the IBM PC, PC/XT, PC/AT, and compatible personal computers, and emulate the facilities of IBM 3278, 3279, or 3279-S3G terminals (see Converters/Emulators for a description), as well as the IBM 3287-1 printer.

The file transfer utilities consist of a standard rudimentary "screen-at-a-time" data transfer routine, plus optional utilities that transfer relatively large blocks of records. The standard file transfer utility delivered as part of the PJ 3278/3279 requires the user to display the data to be transferred and transfer it to a new disk file or append it to an existing disk file. The utility works with the PC-DOS piping facility to redirect output from the screen to a file and the converse. This permits the CMS utilities to list a file on the screen after having redirected it to a disk file. The converse of this establishes a CMS file by using the CMS editor to prepare the file for input, and then employ the PC-DOS TYPE command to load the data into it. As mentioned under Limitations, this is a **slow** way to build a file.

A much more efficient scheme is offered with the ForteNet and EComNet packages. ForteNet permits complete mainframe files to be downloaded to the PC and output in PC-DOS formats. Conversely, data can be uploaded to the host. ForteNet is offered in TSO and CMS versions, and both support transfer rates from 4,500 to 6,000 cps.

The EComNet utility is loaded into the host and allows PC users to build files on virtual disks established in mainframe memory, and transfer print data to the host for remote printouts. EComNet consists of 2 elements: EComNet VP and Cross-System Link. Both are controlled at the host site via MIS, and run under VTAM.

The VP (Virtual Peripheral) permits users to establish exclusive and/or sharable files in the host's memory. To do so, the user employs familiar PC-DOS commands—not the more complex file definition language normally employed by MIS. Up to 32M bytes per virtual disk can be managed by the VP and MIS facilities. To invoke host-printer facilities, the user employs DOS print commands and the data is spooled to the host.

The Cross-System Link allows mainframe files to be called up from the PC, just as if they were locally stored PC files. Cross-System differs from Virtual Peripheral in that the former allows accessing any standard operating system file on the host, which the latter files are specifically defined and controlled by VP. Cross-System Link runs under MIS. Mainframe file access or transfer is via DOS COPY command.

For those requiring only the most basic file-transfer capability, Forte offers a data transfer program that resides on the host and performs ASCII/EBCDIC code conversion and the transmission of binary data. This facility has its problems, however, as discussed under Limitations.

In addition to file transfer, Forte offers another utility to enhance the power of the 3278/3279 boards. Called 3270 PC Emulator/Adapter, it permits the PC to emulate the multiwindowing and multisessions facilities offered by IBM's 3270 PC. Like its IBM counterpart, the Forte product will display 7 windows and support concurrent sessions on up to 4 different hosts along with a DOS session and window notepads. Data can also be transferred between windows—just like IBM. Unlike IBM, however, a Forte-equipped personal computer can transfer entire files via the file-transfer utilities previously described.

The final emulators supported are the ForteCall and FortePrint. The ForteCall utility runs in conjunction with the PJ 3278/3279 and allows a remotely located asynchronous ASCII terminal to dial into the PC as an emulated 3278-2. FortePrint also works in conjunction with the PJ 3278/3279 and allows an ASCII terminal to emulate an IBM 3287-1.

Forte Standard File Transfer • diskette and host-resident software application running on IBM PC, PC/XT, and compatible products with Forte PJ 3278/3279 board and PC-DOS 1.1 or greater • interfaces with IBM mainframe via 3274/3276 cluster controllers • requires VM/CMS at host site; needs 30K bytes for CMS program storage and 29K bytes for CMS help files:

NC prch NC mo

ForteNet TSO File Transfer • host-resident application running on IBM PC, PC/XT, PC/AT, and compatible products with Forte PJ 3278/3279 board and PC-DOS 1.1 or greater • interfaces with IBM mainframe via 3274/3276 cluster controllers • supports PC-DOS-compatible fixed and partitioned data sets with either fixed or variable record formats; transfers text and binary files at speeds ranging from 4.5K to 6K cps • requires MVS/TSO at host site:

1,000 NA

ForteNet CMS File Transfer • same as ForteNet TSO except requires VM/CMS at host site:

1,000 NA

EComNet Mainframe Communications • host-resident

PRCH: single-quantity purchase price. MO: monthly rental price. NA: not applicable. NC: no charge item. Prices current as of June, 1985.

Forte Communication Emulators

PJ 3278/3279/3279-S3G, ForteLink SNA, ForteCall & FortePrint

application running on IBM 30XX or 43XX host under MVS and VTAM • links to IBM PC, PC/XT, PC/AT, or compatible machine running DOS 1.1 or greater; requires PJ 3278/3279 board • interfaces with mainframes via IBM 3274/3276 controllers • under MIS control, builds fixed and partitioned data sets with fixed or variable record formats in mainframe storage established as virtual disks • Cross-System Link utility permits direct retrieval of MIS-controlled files:

30,000	800
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Forte 3270 PC Emulator/Adapter • diskette- and host-resident application running on IBM PC, PC/XT, PC/AT, and compatible products with Forte PJ 3278/3279 board and PC-DOS 2.0 or greater • interface with IBM mainframe via 3274 cluster controllers • displays up to 7 application windows concurrently; allows 4 concurrent host sessions along with a DOS session and window notepads • permits data transfer between windows:

1,495	NA
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ForteCall Terminal Emulator • diskette-resident application running on IBM PC, PC/XT, and compatible products with Forte PJ 3278/3279 boards and DOS 1.1 or greater • interfaces single ASCII terminal and emulates 3278-2 display and keyboard characteristics • supports file-transfer facilities available with PJ 3278/3279; prevents unauthorized access via user ID and passwords:

295	NA
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FortePrint Printer Emulator • diskette-resident application running on IBM PC, PC/XT, and compatible products with Forte PJ 3278/3279 boards and DOS 1.1 or greater • interfaces single ASCII printer via RS-232C port on PC; emulates IBM 3287-1 printer and provides 4K-byte print buffer:

495	NA
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■ HARDWARE

□ Terms & Support

Terms • offered for purchase or monthly rental • discounts available.

Support • provided primarily by end-seller personnel • telephone consulting offered by Forte.

□ Overview

The Forte family of emulators allow the IBM PC, PC/XT, and PC/AT and compatible products to communicate with IBM mainframes. In addition, ForteCall allows any **ASCII** terminal such as a DEC VT 100/200, Lear Siegler, Televideo, etc to interface with mainframes by emulating IBM 3270 cluster controllers/terminals.

Principal products are the PJ 3278/3279/3279-S3G boards, which form the basis for most Forte services. As their numerical designators imply, they emulate the display characteristics/attributes and keyboard facility of the IBM 3278, 3279, or 3279-S3G terminals employed with 3274/3276 cluster controllers. The Forte boards, like the terminals they emulate, require the aforementioned cluster controllers to support communication with IBM host mainframes.

Other hardware/software products are ForteLink SNA, ForteCall, and FortePrint. ForteLink SNA emulates the remote 3274/3276 controllers and 3278-2 terminals, and allows remote PC's direct access to IBM hosts. ForteCall and FortePrint are primarily software emulators that work in conjunction with local PC's equipped with PC 3278/3279 boards. ForteCall permits remote asynchronous ASCII terminals to dial into the PC and emulate an IBM 3278-2. FortePrint also requires a PJ 3278/3279, and permits locally attached ASCII printers to emulate an IBM 3287-1. For a description of ForteCall and FortePrint, see Software section.

The mainstay of the line is the PJ 3278 board that requires a long channel board slot in the PC. The PJ 3279 is a "sister" board and 3279-S3G is a "daughter" board that piggybacks onto the PJ 3278/3279. The PJ 3278 emulates the display-format characteristics of an IBM 3278 Models 2, 3, or 4, while PJ 3279 emulates the 3279 Models 2A, 2B, 3A, or 3B. The PJ 3279-S3B

emulates the 7-color display and format facilities of the 3279-S3G and allows use of mainframe graphics employing IBM's Graphic Data Display Management system.

Forte supports these products with some first-rate software that allows building of large files in host-processor main storage and offers efficient file-transfer utilities to move data quickly between the host and PC (see Software for details). For those requiring more sophisticated display capabilities, the Forte 3270 PC Emulator/Adapter provides the windowing and multihost sessioning found with IBM's 3270 PC offered with the 3274 controller. The Forte product, like IBM, supports 7 concurrent windows and simultaneous sessions on 4 hosts. Data can also be transferred between windows.

□ Converters/Emulators

PJ 3278/3279 Emulators • printed circuit cards plug into long slots of IBM PC, PC/XT, or compatible products with DOS 1.1 and 64K bytes of RAM; requires at least 1 single-sided diskette although 2 are recommended. PJ 3279 function card attaches to PJ 3278 and uses adjacent slot • emulates IBM 3278-2, -3, -4, and 3279-2A, -2B, -3A, or -3B terminals; typewriter-style keyboard with 24 function keys emulated • coaxial (direct) connects to IBM 3274/3276 controllers • file transfer under VM/CMS or MVS/TSO:

\$1,195	prch	NA	mo
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PJ 3279 Graphics Emulator • printed circuit daughter board plugs into and includes PJ 3278/3279 • requires 64K or 128K bytes of RAM for DOS 1.1 or 2.0, respectively, plus at least 1 diskette • emulates IBM 3279-S3G; simulates 3279 graphics on all-points-addressable (APA) color/graphics display; 720x396 dot-pixel resolution • typewriter-style keyboard with 24 function keys emulated • file transfer under VM/CMS or MVS/TSO:

1,395	NA
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ForteLink SNA • half-size printed circuit card plugs into short slot of IBM PC/XT or AT with DOS 3.0 or higher; requires 128K bytes of RAM plus 1 diskette • runs in conjunction with PJ 3278/3279 • emulates communication facilities of remote IBM 3274/3276 controllers; supports SNA/SDLC communication at speeds up to 9600 bps:

695	NA
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□ Terminals/Printers

The Forte PJ 3278/3279 interface with an IBM PC, PC/XT, or compatible products; PJ 3279 Graphics Emulator also can be used with the IBM PC/AT. These products, as noted earlier, emulate the display characteristics of the IBM 3278, 3279, or 3279-S3G terminals.

ForteCall interfaces remotely located asynchronous ASCII terminals such as those offered by Lear Siegler, Televideo, DEC, and IBM. ForteCall emulates the display characteristics for IBM 3278-2 as well as 3278 keyboard functions.

FortePrint attaches any ASCII printer with an RS-232C interface, and emulates an IBM 3287-1 printer. FortePrint includes a soft-loaded formatting control and a 4K-byte print buffer.

□ Communications

All products, except ForteLink SNA, require the IBM 3274/3276 controllers for communication services. Those controllers attach to the IBM System/370, 30XX, 43XX, 8100, and 3790 processors over point-to-point and multipoint lines at speeds up to 9600 bps, half-/full-duplex. Locally attached controllers transfer data to the host at 56K bps.

ForteLink SNA emulates the 3274C (remote) controllers, as well as the 3276, and communicate with the host over point-to-point

PRCH: single-quantity purchase price. MO: monthly rental price. NA: not applicable. Prices current as of June 1985.

Forte Communication Emulators

PJ 3278/3279/3279-S3G, ForteLink SNA, ForteCall & FortePrint

and multipoint lines at speeds up to 9600 bps, full-duplex, SNA/SDLC. Terminal emulator for this product is the IBM 3278-2.

ForteCall allows a remote asynchronous ASCII terminal to emulate an IBM 3278-2 and to interface with an IBM PC

equipped with PJ 3278/3279 boards and attached to a 3274/3276 controller. Communication interface is RS-232C.

• END



Gandalf Multiplexers

Model GLM 504, PIN Series & Switchmux 2000

■ **PROFILE**

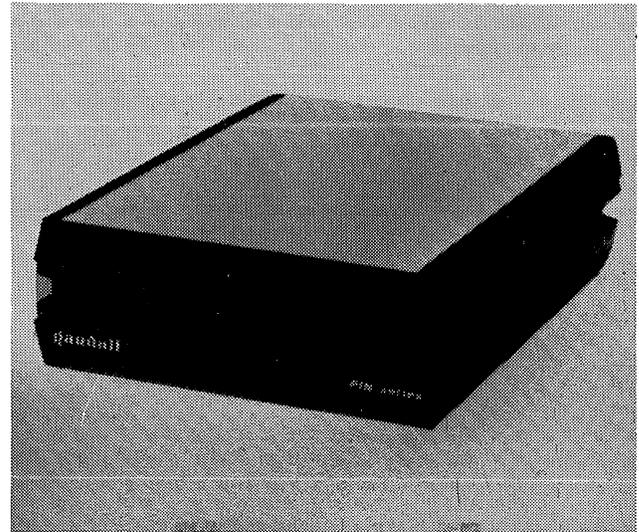
Function • bit-interleaved time-division multiplexer (GLM 504) • statistical multiplexers (PIN 9103/PIN 9106) • statistical multiplexer for X.25/public packet-switched networks; Datapac, Telenet, Tymnet, Uninet certified (PIN 9101E) • switching statistical multiplexer (Switchmux 2000).

Communications/Networks • GLM 504 supports 4 synchronous channels; PIN 9101E supports 4, 8, or 16 asynchronous channels; PIN 9103 supports 4, 8, 16, 24, or 32 asynchronous channels; PIN 9106 supports 2 or 4 asynchronous channels; Switchmux 2000 supports 4, 8, 12, or 16 asynchronous and up to 4 synchronous channels • maximum aggregate input rate of 56K bps (GLM 504); 19.2K bps (PIN 9106); 57.6K bps (PIN 9101E); 76.8K bps (PIN 9103); 153.6K bps (Switchmux 2000) • supports single composite link in point-to-point dedicated networks (GLM 504, PIN 9103/9106, and Switchmux 2000); supports dual composite links for automatic fallback and load balancing and multinode communication in a 3-node network • supports access to public or private X.25 packet-switched networks (PIN 9101E) • HDLC Level II link protocol (PIN 9103/9106, Switchmux 2000); X.25 Level III link access protocol (PIN 9101E).

First Delivery • 1980 (PIN 9103) • 1981 (GLM 504) • June 1982 (PIN 9101, Canada only) • August 1983 (PIN 9106) • November 1983 (PIN 9101E) • scheduled for December 1984 (Switchmux 2000).

Systems Delivered • 3,160 (PIN Series, all models); 135 (GLM 504).

Comparable Systems • principal competition for GLM 504 from Infotron Timeline 290 and Micom Micro700 • for PIN 9101E from Dynapac Multi-PAD X.25; Memotec Statpack; Micom Micro800/X.25; Rixon X.25 PAD; Timeplex Microplexer X.25 • for PIN 9103/9106 from Codex 6005/6005; DCA System 120;



DCC 9100; Infotron 380/480; Micom Micro800/2; Paradyne/Rixon DCX815/DCX825; Racal-Milgo Omnimum • for Switchmux 2000 from Infotron 600 Series; Micom Micro800/2; CASE Rixon DCX825.

Vendor • Gandalf Data, Inc, a subsidiary of Gandalf Technologies, Inc; 1019 South Noel Avenue, Wheeling, IL 60090 • 312-541-6060.

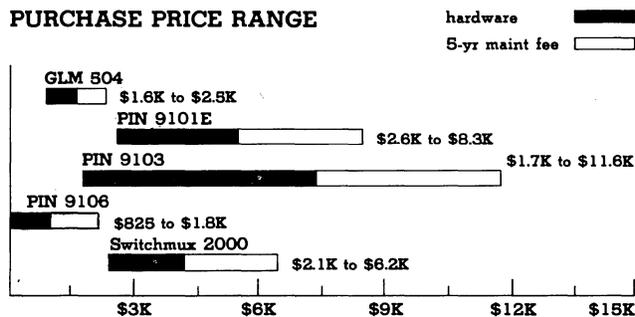
Distribution • nationwide through regional sales offices and authorized sales representatives • in Canada through Gandalf Data Communications Ltd; Gandalf Plaza, 9 Slack Road, Ottawa, Ontario K2G 0B7 • 613-225-0565 • in the U.K. through Gandalf Digital Communications, Ltd, Cheshire, U.K.; in continental Europe through Gandalf Services S.A., Geneva, Switzerland.

■ **ANALYSIS**

Gandalf has recently expanded its multiplexer product line with the addition of the Switchmux 2000 switching statistical multiplexer. As the first model in an emerging line of products that integrate data switching and multiplexing functions, the Switchmux 2000 is designed for office automation environments with small-scale switching needs. Available in both standalone and rackmount versions, the Switchmux 2000 supports centralized switching and multinode networking. Since this report was last published, Gandalf has halted all special-request shipments of the discontinued MX Series and PIN 9102 multiplexers. Furthermore, existing 9101 users can now upgrade their systems to the enhanced 9101E on a board swap basis for an end-user fee of \$500.

Other members of the Gandalf line up include the GLM 504, a nonexpandable bandsplitter that combines as many as 4 synchronous channels on a single link. Composite link rates can be clocked to 56K bps, which means the GLM 504 can be used on a high-speed communication facility such as AT&T's DDS. Channel rates are switch-selectable at fixed fractions of the composite link rate. The unit passes 4 control signals per channel which means it can accommodate tail circuits; however, the propagation delay ranges from 48 to 488 bit times at the

PURCHASE PRICE RANGE



GANDALF MULTIPLEXER PURCHASE PRICING bar graphs cover price ranges between "small" and "large" configurations of multiplexers packaged with central control, composite link, and channels (solid bars), and for associated 1-year period of on-call maintenance fees within 50 miles of a Gandalf service center (open bars) • **GLM 504** configuration packaged with 4 synchronous channels only • **PIN 9101E** small configuration consists of 4-channel asynchronous mux; large of 16-channel asynchronous mux • **PIN 9103** small configuration consists of 4-channel asynchronous mux; large of 32-channel asynchronous mux with integral 9600-bps modem, including 4-channel TDM bandsplitter • **PIN 9106** small configuration consists of 2-channel asynchronous mux; large of 4-channel asynchronous mux with integral synchronous short-haul modem • **Switchmux 2000** small configuration consists of 4-channel asynchronous mux; large of 16-channel asynchronous/synchronous mux (maximum of 4 sync).

Gandalf Multiplexers

Model GLM 504, PIN Series & Switchmux 2000

composite link rate, depending on configuration. The GLM 504 eliminates the high cost of 2 or more dedicated lines and high-performance modems by combining synchronous traffic on one line.

The PIN (Private Intelligent Network) Series are statistical multiplexers for use on an X.25 packet-switched network or a point-to-point dedicated line. The PIN 9101E can be used at both ends of a packet network to support communication between remote asynchronous terminals and a host computer. The PIN 9101E complies with CCITT Recommendation X.3, X.29, and X.28. In addition to the parameters defined by X.3, PIN 9101E provides control over parity treatment, flow control type, choice of EIA connection procedures, and control of reverse charging. Auto-baud software (on single character input at up to 9600 bps) automatically sets the X.3 speed parameter when a new terminal is connected. X.28 allows individual terminal users to control their own channel parameters, either automatically, or at the request of the user. The PIN 9101E replaces a NIM (Network Interface Machine) or PAD (Packet Assembler/Disassembler) and provides protection from errors on the link between it and the network.

It supports both switched (SVC) or permanent (PVC) virtual circuits. An SVC is a virtual circuit maintained only for the duration of a call; a PVC is effectively a point-to-point, nonswitched virtual circuit that is maintained for a user-defined period. Any channel can be configured as a PVC or SVC through an operator console connected to the unit's operator interface.

The PIN 9101E Service ID Feature is important to users served by multiple host computers running different applications. This feature allows users to group channels according to specific services through an assigned service ID number. This applies only to SVC channels since a PVC is dedicated to a specific channel. Any number of channels assigned the same ID can access a specific service, and any one channel that requires more than one service can be assigned the required number of IDs. The user establishes Service ID numbers through an operator console connected to the unit's operator interface.

The PIN Series employ dense packaging techniques to reduce circuit board requirements, and common parts to reduce components among models for ease of maintenance and to limit spare parts requirements.

The PIN 9103 is designed to satisfy small-to-medium-scale network requirements for asynchronous terminals, eliminating the cost of a separate line and modems for each terminal. Designed for simple point-to-point communication over a dedicated facility, the PIN 9103 is available in 4- or 8-channel, nonexpandable standalone versions for small-scale applications as well as rackmount versions expandable from 8 to 24 or 32 channels to accommodate growth. Channel adapters are available in 8-channel increments, which may be more channels than needed for any particular upgrade; however, it does leave room for future growth.

Full performance at 19.2K bps can be achieved over a long distance via a wide-band carrier service or by using 2 dedicated lines with a bplexer (such as the Codex 296 Bplexer) at each end. The bplexer splits the 19.2K-bps transmission into 2 9600-bps streams and provides clocking at each end. High-speed communication over limited distances can be achieved through private lines and limited distance modems.

Gandalf offers an integral link modem (its Super Modem) for rackmount versions of the PIN 9103; however, the modem reduces the rate to 9600 bps, which may not satisfy some applications. The modem is available with a 4-channel multiplexer which combines up to 4 synchronous channels on a single line. Users with synchronous terminals should consider this option to eliminate the cost of extra lines and modems. However, precautions should be taken to insure load balancing among the synchronous terminals and the multiplexer composite link so as not to limit multiplexer throughput.

The PIN 9106 is a low-end statistical multiplexer designed to combine communication to/from 2 to 4 asynchronous data terminals. It is a more sophisticated unit than the old MX Series it essentially replaces, with enhanced features such as bidirectional flow control, an SDLC-like link protocol, and auto-baud for dial-in tail circuits. Although similar to the higher-capacity PIN 9103, the

PIN 9106 does not include some of the more advanced features found in its higher-priced sibling. The PIN 9106 is also designed differently than the PIN 9103, and the 2 units are incompatible.

The Switchmux 2000 addresses small-scale switching and multiplexing requirements. Switchmux 2000 supports a 64K-bps aggregate data rate over 1 or 2 synchronous composite links. This device can be used as a switching node in Gandalf's PACX 1000 and PACX IV switching systems or in a PACXNET network. Its dual links support both centralized switching and multinode networking. This dual link feature also supports initial link path redundancy with loadsharing and auto-switchover. Other standard features include selectable local or remote console control, multilevel security, comprehensive diagnostics, statistical usage data, FOX message generators, and BSC support.

Gandalf Technologies is a highly successful Canadian manufacturer of data communications equipment, with primary product lines in the limited-distance modem and digital switch markets. All Gandalf equipment currently on the market, including the multiplexers in this report, were designed at Gandalf Headquarters in Ontario, Canada. However, design and manufacturing facilities are expanding at the U.S. subsidiary in Wheeling, IL, spurred by the amount of sales in this country totaling over 50 percent of Gandalf's business.

Recently, Gandalf enhanced its comprehensive product line with the introduction of the Line Miser Series, and the PACX 1000 and the PACX 2000 line of switching systems. The Line Miser Series of local multiplexing products are designed for use with Gandalf's PACX line of data PBXs. Members of the Line Miser Series include: the GLM 528 T1 multiplexer, the GLM 510 local multiplexer, and the data-over-voice (DOV) local modem. PACX 1000 has been added to the existing PACX line up as a centralized switching system. The latest member of the PACX family is the PACX 2000, a distributed switching system designed to interconnect all electronic devices throughout an organization. Gandalf has already revealed intentions to expand its PACX 2000 family with a series of plug-in gateway links and interface modules.

□ Strengths

The GLM 504 accommodates synchronous traffic with a wide range of speeds. Its 56K-bps maximum link rate makes it useful for combining high-speed traffic for long-distance communication via a wide-band facility, such as AT&T's DDS. It is also useful for combining high-speed traffic in short-haul applications or to combine 2 or more multiplexers. The GLM 504's 15 selectable rate combinations makes it highly flexible for a wide range of traffic conditions.

The PIN 9101E supports both switched and permanent virtual circuits to satisfy applications that require sending data between source and a number of destinations, or between source and a single destination over a sustained path. Channels are easily assigned to switched or permanent virtual circuit communication, and operating parameters are easily established through the convenience of a user-supplied ASCII terminal connected to the unit's supervisory port.

The Service Selection feature is a key advantage to users who communicate with more than one host computer to support different applications. The user can assign any one or a group of channels to one or more host-supported services, which makes for extremely flexible operation. The feature also prevents security breaks among unauthorized users. Channel assignments are easily established through a user-supplied ASCII terminal connected to the unit's supervisory port.

In addition, PIN 9101E can function as a terminal concentrator connected directly to a CPU instead of a network (the CPU must support X.25). This approach eliminates the need for a pair of statistical multiplexers, reduces CPU port requirements, and results in line cost savings.

The PIN 9103's principal attribute is application flexibility. Its packaged systems meet user needs for combining a small number of asynchronous terminals on a single line, while its component systems accommodate small-to-medium-scale needs with expansion capacity to allow for future growth. Another key factor is the unit's high aggregate input rate and high link rate,

Gandalf Multiplexers

Model GLM 504, PIN Series & Switchmux 2000

which supports high-speed traffic. The HP option increases throughput and is useful to Hewlett-Packard users. The integral modem feature benefits users who want to eliminate separate modems and extra cables, and puts service under one umbrella. The modem also accommodates requirements for combining synchronous terminals with the multiplexer link to eliminate extra cost lines and modems. Ease-of-use is still another asset. Operating parameters are easily established via a user-supplied ASCII terminal connected to the unit's supervisory port, with an English language interface. Parameters are downloaded to the remote multiplexer.

The PIN 9106's major attraction is its low price. Users with a need to multiplex only a few channels can obtain a PIN 9106 for a thousand dollars or less, and gain the advantages of statistical multiplexing. The PIN 9106 can also accommodate an integral Gandalf short-haul or medium-range modem, eliminating the extra cost, additional cables, and service problems of an external modem.

The Switchmux 2000 saves line and cable costs and provides error correction and data networking flexibility. A major benefit to geographically dispersed users of Switchmux 2000 is its multinode networking support that allows data to be exchanged between devices located at any 3 nodes of a multinode network. In addition, it provides redundant paths to reroute data in case of a link outage. Channel priority control handles critical traffic. Ease of operation is facilitated by the menu-oriented English language commands employed for data call set-up. A variety of connection/disconnection protocols besides auto-baud are supported.

Security, utilization statistics, and diagnostic testing are controlled through a password protected console that can be accessed locally or from any network location. Multiple users can contend for available computer ports with Switchmux's beneficial Queueing facility that accommodates more users on the system than there are available resources. Another Switchmux advantage is its modular design that allows for expansion in 4-channel increments to meet users' growth requirements. Networking applications can be accommodated with Switchmux functioning as a switching node in PACX IV, PACX 1000, and PACX 2000 switching systems or in a PACXNET data network. Gandalf plans to offer a Switchmux Routing Feature by mid 1985 that will enable a Switchmux unit to perform as an active member of the network with full networking and routing capabilities.

□ Limitations

The GLM 504 limits its support to 4 or fewer synchronous terminals. It is a simple no-frills, bit-interleaved TDM. Operating parameters cannot be downloaded, which requires attended operation at remote sites. Overhead can range to 12.5 percent for full loading.

The PIN 9101E does not support CCITT Recommendation X.121 address coding, which allows a 14-character address sequence used mainly for calls to international packet-switched networks. Users without a need for international public data communication, however, would not be affected by this limitation.

The PIN 9106 is restricted to a 4-channel maximum port capacity, and does not support synchronous channels. To combine synchronous channels for transmission with this low-capacity stat mux, users would require a TDM bandsplitter positioned in tandem with the PIN 9106; Gandalf can provide this capability with its 4-channel Supermodem II, a 9600-bps modem with integral bandsplitter. The PIN 9106 is not as flexible as the PIN 9103 in support of various connect protocols and flow control techniques. For example, the 9106 does not support the Hewlett-Packard ENQ/ACK protocol support option for HP 3000 minicomputers.

The PIN 9103 4- and 8-channel standalone versions are fixed, nonexpandable units, and satisfy the needs of small-scale applications only. Data compression for increased communication efficiency is not provided. Although designed for asynchronous use, synchronous channels can be combined with the composite link as with the PIN 9106. However, the user is advised to insure proper load balancing between synchronous channels and asynchronous composite so that synchronous

transmission does not severely reduce throughput or choke off asynchronous channels.

The unveiling of the Switchmux 2000 establishes Gandalf as a contender in the switching multiplexer market. The 16-channel capacity per Switchmux unit positions the Gandalf entry at the low-end of the market and restricts the Switchmux 2000 to small-scale applications that do not exceed its 3-node limit. In addition, the Switchmux 2000 **does not** support link compatibility with other members of the Gandalf multiplexer product line. Synchronous channels are limited to 4 at 4000 bps maximum.

■ HARDWARE

□ Terms & Support

Terms • Gandalf multiplexers are available for purchase only; lease terms available from third-party leasing companies • separate maintenance contract available • one-year warranty on parts and service • quantity discounts available.

Support • installed by Gandalf or by user • \$75 installation charge, all models, within 50 miles of a Gandalf Service Center; installations beyond the 50-mile radius incur a 4-hour minimum labor charge plus travel expenses; installation free of charge with maintenance contract • maintenance available under service contract, on-call service, or factory repair • fixed-price maintenance within the 50-mile service radius performed during the hours 8:00 AM to 5:00 PM, Monday through Friday; includes 4-hour response time, guaranteed spares, and 24-hour telephone consulting • weekend/holiday service under maintenance contract incurs a 0.25 percent surcharge on list price of contracted equipment • contract maintenance performed outside the 50-mile service radius incurs a 0.25 percent equipment surcharge up to 100 miles; 1.5 percent up to 200 miles; 1.75 percent over 200 miles plus travel expenses; 7-day, 24-hour maintenance contracts and other custom plans available on quotation basis • factory repair available at a \$90 flat rate for all multiplexers, plus cost of any major components; units under warranty repaired free of charge, with customer paying shipping expenses (one-way) to the Wheeling, IL facility • maximum factory repair time is 7 days, not including shipping time • contract maintenance performed by Gandalf personnel from 8 U.S. Service Centers located in Los Angeles and San Francisco, CA; Denver, CO; Wheeling, IL; Silver Spring, MD; Englewood, NJ; Boston, MA; Dallas, TX; and Atlanta, GA; service locations in Canada at Edmonton, Alberta; Ottawa and Toronto, Ontario; Montreal and Quebec City, Quebec; Halifax, Nova Scotia; Calgary, Alberta; and Vancouver and Victoria, B.C. • end-user sales (U.S.) provided from 4 Gandalf regional sales offices and 16 area sales representatives.

□ Overview

Gandalf multiplexers satisfy a range of applications in small-to-medium scale, point-to-point network configurations and in public or private packet-switched networks. The family consists of a conventional four-channel time division multiplexer (TDM) for synchronous devices, the GLM 504, and several statistical multiplexers with different composite link protocols and varying levels of support for CCITT Recommendation X.25. All of the statistical multiplexers are designed to concentrate several asynchronous channels onto a single composite link; Model PIN 9103 can be packaged with Gandalf's 9600-bps SuperModem II which contains an integral 4-channel TDM bandsplitter, allowing synchronous devices to share the composite output with the asynchronous aggregate; Model PIN 9106 can also include an optional integral limited-distance or medium-distance modem.

The PIN 9106 is comprised of 2- and 4-channel statistical multiplexer modules for low-volume point-to-point applications. It includes features to support most types of ASCII asynchronous channel communication; synchronous channels are not supported. The PIN 9106 employs an SDLC-like link protocol with CRC 16 and ARQ error detection and correction, bidirectional flow control, and auto-baud support for dial-in tail circuit channels.

For more advanced capabilities (at a higher price), the PIN 9103 offers point-to-point statistical multiplexing of up to 32 channels. It provides bidirectional flow control as well as an HDLC protocol

Gandalf Multiplexers

Model GLM 504, PIN Series & Switchmux 2000

with CRC 16 and ARQ error detection and correction. System management and statistics reporting can also be accomplished with the 9103 through a user-provided supervisory terminal attached to an assigned data channel.

The PIN 9101E is a statistical multiplexer of a different bent. Functioning as PAD (packet assembly/disassembly) devices for public packet-switched networks, this model allows asynchronous devices to access services intended primarily for high-speed synchronous communication. And unlike other statistical multiplexers, PIN 9101E channels are not necessarily dedicated to ports at the opposite end of transmission: users select and contend for channels or channel groups, taking advantage of inherent packet-switching functions. The 9101E is currently certified for the Canadian Datapac network; for Telenet, Tymnet, and Uninet in the U.S.; and for public data networks in Belgium, Britain, Holland, Germany, and Switzerland. It supports CCITT X.29 allowing for downline loading of PAD and other parameters. One or more remote PIN 9101Es can contend for channels at a single host-site 9101E. Like the PIN 9103, the PIN 9101E user can access a supervisory terminal (a user-supplied ASCII terminal) to establish PAD parameters and display statistical report data on system performance. PIN 9101E and PIN 9103 models can be rackmounted in a slotless, adjustable card nest that can accommodate more than one PIN multiplexer and/or Gandalf SuperModem II modem; all PIN rackmount models can be field upgraded with the same 8-channel adapter module(s).

The Switchmux 2000 is a switching statistical multiplexer that performs local and remote switching for up to 16 channels per network node or up to 48 channels in a 3-node network. Each Switchmux handles synchronous data at up to 4800 bps from as many as 4 users and asynchronous data at up to 19.2K bps from as many as 16 users. Users can select networked resources by alphanumeric service name and then contend for access to that service. When users are waiting for a particular service, a queuing facility automatically connects users to the next available port. Autobaud and split-speed operation are supported. Switchmux 2000 employs both service password protection and console password protection.

GLM 504 Configuration • 4-channel fixed-configuration standalone unit • supports synchronous channels at multiples of the composite rate of 56K bps • single composite link at synchronous rates to 56K bps; synchronization and control signals occupy from 0.39 to 12.5 percent of bandwidth in overhead.

PIN 9101E Configuration • 4- and 8-channel fixed-configuration standalone units; packaged/expandable rackmount units with 4/8/16 channels • supports asynchronous channels at rates to 9600 bps; 57.6K-bps maximum aggregate channel rate • single composite link with X.25 Level III framing; Datapac, Telenet, Tymnet, and Uninet certified; synchronous rates to 19.2K bps.

PIN 9103 Configuration • 4- and 8-channel fixed-configuration standalone units; packaged rackmount unit with or without integral 9600-bps modem, expandable to 32 channels in 8-channel increments • supports asynchronous channels at rates to 9600 bps; supports up to 3 synchronous channels in a bandsplit arrangement with integral modem; 76.8K-bps maximum aggregate channel rate • single composite link with HDLC (Level II) framing; synchronous rates to 19.2K bps.

PIN 9106 Configuration • 2- and 4-channel standalone units, expandable to 4 channels maximum • supports asynchronous channels at rates up to 9600 bps; 19.2K-bps maximum aggregate channel rate • single composite link with modified SDLC (Level II) framing; synchronous rates to 9600 bps.

Switchmux 2000 Configuration • 4- and 8-channel standalone or rackmount units, expandable to 16 channels in 4-channel increments • supports asynchronous channels at rates to 19,200 bps; 153.6K maximum aggregate channel rate • 1 or 2 composite links; synchronous rates to 4800 bps.

□ GLM 504 Synchronous Time Division Multiplexer

GLM 504 Central Control

Central control module contains central logic for bit-interleaved

time division multiplexing, power supply, integral channel adapters, and composite link module • standard 4-channel unit:
\$1,550 prch \$16.00 maint

GLM 504 Diagnostic Tests

Standard tests include local loopback and remote test; switch-selectable from front panel • composite link local loopback suspends normal data transmission • end-to-end remote test generates a short bit-pattern test message for verification at remote end; suspends transmission of interface control signals for 15-frame test duration; noninterfering with normal data transmission • standard feature:

NC prch NC maint

GLM 504 Status Reporting

LED status display panel indicates transmit or receive data activity on the composite link; presence of transmit or receive clock signal from the modem; Data Carrier Detect (DCD) from modem on; and loss of synchronization with remote multiplexer • standard feature:

NC prch NC maint

GLM 504 Channels

Central control module packaged with 4 channels • synchronous channel rates selectable at 0.125/0.25/0.50/0.75/1.0 times composite rate; 15 rate combinations via front panel thumbwheel switch • overhead bits for synchronization claimed from channel 0; overhead ranges from 0.39 to 12.5 percent depending on configuration, includes 4 EIA full-duplex interface control signals (DIP switch selectable for each channel) requiring a minimum of 3.125 percent overhead per channel • channels configurable as DTE or DCE • channel price included in cost of central control unit:

NC prch NC maint

GLM 504 Composite Link

Central control module packaged with link • up to 56K-bps synchronous full-duplex • external clock • RS-232C/CCITT V.24/V.28 electrical interface • composite link included in cost of central control module:

NC prch NC maint

□ PIN 9101E X.25 Multiplexer

The PIN 9101E is available in 2 packaged versions, as a standalone or rackmount unit; single 9101s can be located at the central site; one or more remote 9101Es can communicate with a central site 9101E • standalone version packaged with 4 or 8 channels, nonexpandable; rackmount version packaged with 4, 8, or 16 channels, expandable to 16 channels maximum • maximum of 2 16-channel PIN 9101Es accommodated by same card nest • modem not required for public packet-switched networks; provided as part of the basic service • card nest fits standard 19-inch equipment cabinet.

PIN 9101E Packaged Systems

Packaged systems contain either 4, 8, or 16 channels plus power supply, central logic, 12K-byte RAM buffer, and composite link module.

PIN 9101E-04S • multiplexer configuration packaged with link module and 4 channels, nonexpandable; standalone:

\$2,650 prch \$26.50 maint

PIN 9101E-04R • multiplexer configuration packaged with card nest, link module, and 4 channels, expandable to 16 channels; rackmount:

2,550 25.50

PRCH: single-unit purchase price. MAINT: monthly maintenance charge for 5-day service (Monday through Friday) within 50 miles of a Gandalf service center. NA: not available. NC: no charge item. Prices are current as of September 1984.

Gandalf Multiplexers

Model GLM 504, PIN Series & Switchmux 2000

PIN 9101E-08S • multiplexer configuration packaged with link module and 8 channels, nonexpandable; standalone:

3,750 37.50

PIN 9101E-08R • multiplexer configuration packaged with card nest, link module, and 8 channels, expandable to 16 channels; rackmount:

3,650 36.50

PIN 9101E-16R • multiplexer configuration packaged with card nest, link module, and 16 channels, nonexpandable:

8,150 51.50

PIN 9101E Flow Control

Supports flow control according to CCITT X.3, parameter #12; guards against multiplexer system overflow and against buffer overflow at terminals, resulting in loss of data; selectable on or off • controls data flow at channel inputs by generating XON/XOFF or CTS on EIA RS-232C interface • detects and responds to XON/XOFF flow control characters from terminals by suspending/resuming data flow to channel inputs • system flow suspension threshold set at 75 percent total buffer utilization; flow resumption at 50 percent total buffer utilization • standard feature included in package price:

NC prch NC maint

PIN 9101E Diagnostic Tests

Automatic self-test verifies internal multiplexer operation upon power-up and after system restart • loopback test plug, not supplied by vendor, can be attached to 9101 to perform digital loopback testing at multiplexer interface • standard feature included in package price:

NC prch NC maint

PIN 9101E Status Reporting

LED status display panel indicates results of performance monitoring; LEDs indicate Data Carrier Detect (DCD) active from synchronous modem, composite link active, and receive/transmit data activity; error indicator flashes for one second for every composite link error • more comprehensive status reporting available through supervisory channel on user-supplied ASCII terminal • standard feature included in package price:

NC prch NC maint

PIN 9101E Channels

Packaged systems available with 4, 8, or 16 channels; card nest supports 4/8/16 channels, or up to 2 16-channel or 4 8-channel PIN 9101s • operating parameters are keyed into the supervisory port (channel 0) via user-supplied ASCII terminal; otherwise defaults to factory-set parameters • asynchronous channel rates at 50/75/110/134.5/150/200/300/600/1200/1800/2000/2400/3600/4800/9600 bps; maximum aggregate input rate of 57.6K bps • 8 data bits, no parity; 7 data bits, odd or even parity; does not support parity checking on reception of data • 1 or 2 stop bits • RS-232C/CCITT V.24/V.28 electrical interface • channels included in package price:

NC prch NC maint

8-Channel Expansion Module • expands 8-channel PIN 9101E-08R to 16-channel PIN 9101E-16R • fits 9000A card nest:

1,500 15.00

Echoplex Feature • echos terminal data from remote multiplexer (local echo) instead of from CPU, improving response time • standard feature:

NC NC

Autobaud Feature (Autospeed) • regulates asynchronous channel rate to rate of dial-up line from 100 to 9600 bps; automatically adjusts speed differential by detecting a single character determined by user • allows user-defined auto-baud "speed limit," on a per-channel basis, to avoid inadvertently exceeding the aggregate input rate • standard feature:

NC NC

Supervisory Port • channel 0 can be shared (front-panel switched) by user-supplied ASCII terminal, called the Operator

Interface, required for setting channel, link, and PAD parameters • menu-driven • password protected • can display statistics including link failures, call statistics, and asynchronous channel characteristics • call statistics include time-of-day, calling address, number of packets received and transmitted, "call clear cause," and number of resets displayed at conclusion of each call • standard feature included in package price:

NC NC

Switched Virtual Circuits • allows user-transparent communication from remote terminal (and remote PAD) to host CPU • terminal operators originate calls according to normal network procedures; calls connected to appropriate host ports on first-come, first-serve basis by the PIN 9101 • allows user to access any network address; not restricted to specific ports at host computer; users select and contend for host ports • PIN 9101 will not accept calls if all channels (8 or 16) are busy, or if host port is busy or will not respond • sends appropriate message to remote terminal verifying successful or unsuccessful connection; clears noncompleted calls • sends Data Lost message to terminal upon loss of data in network transit, or from host or multiplexer interruption • standard feature included in package price:

NC NC

Service Selection • assigns user groups for any or all available channels; established from supervisory port upon system initialization • terminal users enter appropriate 3-character code for access to a given service group; can be used to restrict unauthorized access to secure network facilities • service groups can contain any number of channels; provides any number of service groups up to 16 (PIN 9101 channel maximum) for configuration flexibility • requires user-supplied ASCII terminal to function as Operator Interface • standard feature included in package price:

NC NC

Permanent Virtual Circuits • permanent virtual circuits can be established between remote terminals and host ports, allowing connections to appear as leased lines to user • established from supervisory port for any or all PIN 9101 channels • does not allow port selection; does not require users to contend for ports • requires user-supplied ASCII terminal to function as Operator Interface • standard feature included in package price:

NC NC

PIN 9101E Composite Link

Central control module packaged link • data rates up to 19.2K bps full-duplex synchronous • external clock • X.25 Level III link access balanced (LAPB) protocol • conforms to Datapac 3000 HDLC framing • RS-232C/CCITT V.24/V.28 electrical interface • composite link included in package price:

NC prch NC maint

Link Parameters • X.25 link parameters established from Operator Interface terminal over supervisory channel; includes N2, window, and packet size • N2 is 1-255 value defining number of retries in case of error, adjustable online or off-line • window size is 1-7 value defining number of frames transmitted before acknowledgement is required; adjustable off-line only • network packet size can be set at 128 characters only (except for Datapac versions) • standard feature included in package price:

NC NC

PIN 9101E Packet Assembly/Disassembly (PAD)

Conforms to all 18 CCITT X.3 PAD parameters • supports CCITT X.28 Recommendation for physical connectivity between PAD and DTE equipment; includes full BREAK handling, parameters 0, 1, 2, 8, and 21 • supports CCITT Recommendation X.29 specifying transport procedures for PAD parameters; allows downline loading of channel/PAD parameters • standard feature included in package price:

NC prch NC maint

PIN 9103 Statistical Multiplexer

The PIN 9103 is available as a packaged system or as individual components • packaged standalone models are available with 4 or 8 channels, nonexpandable; Model SM 9103 is rackmounted

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card nest packaged with 8 channels and a 9600-bps modem, expandable to 32 channels • component versions composed of empty card frame with 1 or more 8-channel modules and 1 or more 9600-bps modem modules; expandable to 32 channels maximum • card nest fits standard 19-inch equipment cabinet.

Downline Load • automatically downline loads channel configuration parameters from either end of the link • standard feature:

NC prch NC maint

PIN 9103 Packaged Systems

Packaged systems contain either 4 or 8 channels, power supply, central logic, 12K-byte RAM buffer, and composite link module.

PIN 9103-04S • multiplexer configuration packaged with link module and 4 channels, nonexpandable; standalone:

\$1,690 prch \$16.50 maint

PIN 9103-08S • multiplexer configuration packaged with link module and 8 channels, nonexpandable; standalone:

2,790 27.50

SM 9103 • multiplexer configuration packaged with card nest, link module, 8 channels, and integral 9600-bps modem with integral 4-channel multiplexer; field-expandable to 32 channels maximum; rackmount:

5,300 53.00

PIN 9103 Component Systems—Central Control

PIN 9103 component systems include a slotless, adjustable-frame card nest, power supply module, central logic board with 12K-byte RAM buffer and composite link module, and an 8-channel adapter board • additional 8-channel cards share central logic and power; each includes an interface module which fits into the back of the card nest • expandable to 32 channels maximum • composite link modem optional; card nest accommodates link modem and/or modems on lines not associated with PIN 9103; modem module mutually exclusive with a channel adapter.

PIN 9103-08R • multiplexer module with 8 channels, rackmount version • includes central logic module with integral composite link and 12K-byte RAM buffer, plus power supply module • fits adjustable 9000A card nest:

\$2,650 prch \$26.50 maint

9000A Rack • empty card nest for PIN 9103 channel adapters, SM 9600 SuperModem II modems, or combinations of both • adjustable, expanding frame accommodates modular components without card slots • channel, logic, and power modules mount from front; I/O modules mount from rear • accommodates up to 4 SuperModem IIs, 2 24-channel PIN 9103s, a 32-channel PIN 9103, or combinations thereof • fits 19-inch equipment cabinets:

100 NA

9000 FP • plexiglass door for 9000A Rack:

100 NA

B Cabinet • desktop equipment cabinet with door; holds 2 9000A racks:

220 NA

C Cabinet • desktop equipment cabinet for single 9000A rack; door not included:

170 NA

PIN 9103 Flow Control

Guards against multiplexer system overflow and against buffer overflow at terminals, resulting in loss of data; selectable on or off; type of flow control selected on a per-channel basis, can be independently selected for each channel end • controls data flow at channel inputs by generating XON/XOFF, Bell warning, or CTS on EIA RS-232C interface • detects and responds to XON/XOFF flow control characters or Bell characters from terminals by suspending/resuming data flow to channel inputs • system flow suspension threshold set at 75 percent total buffer utilization; flow resumption at 50 percent total buffer utilization •

overflow recovery via programmable hex character; sounds an audible data loss bell on appropriately equipped data terminals • standard feature:

NC prch NC maint

PIN 9103 Diagnostic Tests

Isolates failures in composite link or individual channels through selectable tests • automatic self-test verifies internal multiplexer operation upon power-up and after a system restart • user-supplied ASCII terminal supports local and remote composite link and channel loopback testing, initiated through supervisory channel • individual channel loopback tests are noninterfering with other channels or composite link operation • standard feature:

NC prch NC maint

PIN 9103 Status Reporting

LED status display panel indicates results of performance monitoring; LEDs indicate Data Carrier Detect (DCD) active from the synchronous modem, composite link active, and receive/transmit data activity; error indicator flashes for one second for each composite link error • more comprehensive status reporting available through supervisory channel on user-supplied ASCII terminal • standard feature:

NC prch NC maint

PIN 9103 Channels

Packaged systems available with 4 or 8 channels; card nest supports 8/16/24/32 channels, or 2 24-channel, 2 16-channel, or 4 8-channel PIN 9103s • operating parameters keyed into supervisory port (channel 0) via user-supplied ASCII terminal; otherwise defaults to factory-set parameters • operating parameters downline loaded from either central site or remote multiplexer • asynchronous channel rates at 50/75/110/134.5/150/200/300/600/1200/1800/2000/2400/3600/4800/7200/9600 bps; maximum aggregate input rate of 76.8K bps, 38.4K bps on 4-channel PIN 9103-04S • 5 through 8 data bits • 1/1.5/2 stop bits • odd, even, or no parity • programmable characters for LF/CR • RS-232C/CCITT V.24/V.28 electrical interface • channels included in 4- and 8-channel standalone packaged versions:

NC prch NC maint

8-Channel Expansion Module • fits 9000A card nest for SM 9103 and PIN 9103 component systems:

1,500 15.00

PIN HP Software • selectable option supports Hewlett-Packard ENQ/ACK protocol • responds to and generates ENQ/ACK characters at terminal end, reducing overhead characters normally generated by these terminals and thus increasing throughput • extra-cost option:

100 NC

Echoplex Feature • echos terminal data from remote multiplexer (local echo) instead of from CPU, improving response time • standard feature:

NC NC

Priority Channel Assignment • assigns higher priority to user-specified channels; effectively, allows bulk data devices such as printers to operate in a background mode, providing better throughput for interactive terminals.

Autobaud/Connection Protocols • regulates asynchronous channel rate to rate of dial-up line from 100 to 9600 bps; automatically adjusts speed differential by detecting a single character determined by the user • supports ASCII devices with even/odd/mark/space parity; supports 8-bit EBCDIC and 7-bit correspondence devices • auto-baud character passthrough feature allows auto-baud character to be carried through to the destination, eliminating the need to enter an auto-baud character for each communication device on link; auto-baud passthrough delay feature allows attached CPUs enough time to enable auto-baud logic when a connection is made • in conjunction with auto-baud, can accept or generate 1 of 4 different connection protocols (handshaking procedures): BREAK (minimum

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200-millisecond space condition), DTR, DSR, and RI • standard feature:

NC NC

Supervisory Port • channel 0 can be shared (front-panel switched) by a user-supplied ASCII terminal; required for channel parameter configuration and loopback testing • menu-driven • presents statistical reports including peak and average buffer utilization, individual channel character counts, and number of ARQs performed on composite link • English language command-driven • standard feature:

NC NC

PIN 9103 Composite Link

Central control module packaged link • data rates up to 19.2K bps full-duplex synchronous • external clock • HDLC Level II link protocol • CRC 16 and ARQ error detection and correction • RS-232C/CCITT V.24/V.28 electrical interface • composite link included in package or central control module (component systems) pricing:

NC prch NC maint

Integral Modem • packaged system Model SM 9103 includes integral 9600-bps modem (SuperModem II) • integral 4-channel TDM multiplexer with switch-selectable combinations of synchronous data rates at 2400/4800/7200 bps • proprietary modulation scheme featuring high bit rate, low baud rate • does not require line equalization • D-1 line conditioning recommended, but not required • standard feature included in SM 9103 package system price:

NC NC

SM9600-04R • SuperModem II 9600-bps modem module including 4-channel synchronous TDM multiplexer and independent power supply • see Integral Modem for features • mutually exclusive with single 8-channel adapter • fits adjustable 9000A card nest for component systems:

2,700 27.00

PIN 9106 Asynchronous Statistical Multiplexer

The PIN 9106 is available in 2- and 4-channel packaged standalone models; 2-channel model is expandable to 4 channels • standalone case contains 2 dedicated slots for an optional single- or dual-card Gandalf 3000 Series modem, regardless of multiplexer channel complement.

PIN 9106 Packaged Systems

Packaged systems contain either 2 or 4 channels, power supply, central logic, 4K or 8K battery-backed (2 or 4 channels) RAM buffer, and composite link module.

PIN 9106-02S • multiplexer configuration packaged with link module and 2 channels; field expandable to 4 channels maximum; standalone:

\$825 prch \$8.25 maint

PIN 9106-04S • multiplexer configuration packaged with link module and 4 channels; nonexpandable; standalone:

1,085 11.00

Downline Load • automatically downline loads channel configuration parameters from master to slave mux • standard feature:

NC NC

PIN 9106 Flow Control

Guards against multiplexer system overflow and against buffer overflow at terminals, resulting in loss of data; selectable on or off • controls data flow at channel inputs by generating XON/XOFF or CTS or EIA RS-232C interface • detects and responds to XON/XOFF flow control characters from terminals by suspending/resuming data flow to channel inputs • system flow suspension threshold set at 75 percent total buffer utilization; flow resumption at 50 percent total buffer utilization • standard feature:

NC prch NC maint

PIN 9106 Diagnostic Tests

Isolates failures in composite link or individual channels through selectable tests • user-supplied ASCII terminal supports local and remote channel and composite link digital loopbacks via integral Quick Brown Fox test pattern • standard feature:

NC prch NC maint

PIN 9106 Status Reporting

LED status display panel indicates results of performance monitoring • 8 LEDs indicate EIA signal status for CTS, RTS, DTR, DCD, Tx, and Rx; indicate DCE and DTE modes • standard feature:

NC prch NC maint

PIN 9106 Channels

Packaged systems available with 2 or 4 channels, field upgradable • operating parameters menu-selected on a per-channel basis via a user-supplied ASCII terminal; data channel 0 temporarily covered into a multiplexer configuration channel through front-panel switch • parameters downline loaded from central site to remote multiplexer • selectable asynchronous channel rates at 110/134.5/150/300/600/1200/2400/4800/9600 bps; maximum aggregate input rate of 19.2K bps • switch-selectable DTE or DCE mode per data channel; passes 2 EIA control signals per channel (DCD and CTS for DTE mode; DTR and RTS for DCE mode) • EIA RS-232C/CCITT V.24/V.28 electrical interface • channels included in 2- and 4-channel packaged versions:

NC prch NC maint

2-Channel Expansion Module • 2-channel expansion card for Model PIN 9106-02S • fits designated slot within standalone multiplexer case:

285 2.85

Auto-baud Feature • regulates asynchronous channel rate to rate of dial-up line from 110 to 9600 bps; automatically adjusts speed differential by detecting a single character determined by user • standard feature:

NC NC

Configuration Port • channel 0 can be shared (front-panel switched) by a user-supplied ASCII terminal; required for channel configuration and loopback testing • controls all multiplexer parameters except channel DTE/DCE configuration and composite link synchronous or asynchronous mode • standard feature:

NC NC

PIN 9106 Composite Link

Integrally packaged link • data rates up to 9600 bps full-duplex, synchronous or asynchronous (strap selectable) • modified SDLC Level II link protocol, synchronous or asynchronous; in asynchronous mode, can be used with bit-transparent asynchronous modems • dedicated or dial-up composite link: composite DTR will be high when channel DTR or DCD is high in **composite dial mode**; DTR always high in **dedicated composite mode** • CRC 16 and ARQ error detection and correction • composite link included in package pricing:

NC prch NC maint

Integral Modem • PIN 9106 contains an empty card slot reserved for an optional Gandalf 3000 Series limited-distance rackmount modem • not included in package pricing • requires PIN Modem Adapter Kit.

PIN Modem Adapter Kit • provides power connection and logic to allow the PIN 9106 to use an integral Gandalf local modem: RM 3120, RM 3140, RM 3309, RM 3329, RM 3409, or RM 3444:

130 NA

RM 3120 • asynchronous limited-distance modem; data rates up to 9600 bps over unloaded twisted-pair metallic circuits at distances up to 5.5 miles (wire size AWG 26) • complies with AT&T Publication 43401; conforms to Bell Canada Requirement for Connection of Equipment to Private Metallic Circuits • DC line continuity not required • occupies designated slot within 2- or 4-channel PIN 9106:

250 2.50

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RM 3140 • asynchronous limited-distance modem; data rates up to 4800 bps over loaded twisted-pair metallic circuits, or up to 9600 bps over unloaded twisted-pair metallic circuits at distances up to 6 miles (wire size AWG 26) • complies with AT&T Publication 43401 and 41004 • DC line continuity not required • occupies designated slot within 2- or 4-channel PIN 9106:

_____ 350 350

RM 3309 • synchronous limited-distance modem; data rates at 1800/2400/3600/4800/7200/9600 bps over unloaded twisted-pair metallic circuits • distances from 12 miles at 2400 bps to 4 miles at 9600 bps (wire size AWG 26) • complies with AT&T Publication 43401 • DC line continuity not required • occupies designated slot within 2- or 4-channel PIN 9106:

_____ 440 440

RM 3309 High Speed • same as RM 3309 but supports data rates to 19.2K bps:

_____ 490 490

RM 3329 • synchronous limited-distance modem; data rates to 2400/4800/9600 bps over unloaded twisted-pair metallic circuits • distances from 6 miles at 2400 bps to 2.5 miles at 9600 bps (wire size AWG 26) • complies with AT&T Publication 43401; conforms to Bell Canada Requirement for Connection of Equipment to Private Metallic Circuits • DC continuity not required • occupies designated slot within 2- or 4-channel PIN 9106:

_____ 350 350

RM 3444 • synchronous medium-distance modem; data rate of 4800 bps over loaded twisted-pair metallic circuits or dedicated Type 3002 voice channel at distances up to 200 miles • occupies dedicated slot within 2- or 4-channel PIN 9106:

_____ NA NA

□ Switchmux 2000 Switching Statistical Multiplexer

The Switchmux 2000 is available as a packaged standalone system or as a rackmount unit. Packaged standalone models available with 4 or 8 channels. Rackmounted card nest packaged with 4 or 8 channels; card nest fits standard 19-inch equipment cabinet.

Downline Load • automatically downline loads channel configuration parameters from either end of the link • standard feature:

_____ NC prch NC maint

Switchmux 2000 Packaged Systems

Packaged systems contain either 4 or 8 channels, power supply, central logic, and single composite link module.

Switchmux 2000-04S • multiplexer configuration packaged with link module and 4 channels, expandable to 16 channels; standalone:

_____ \$2,050 prch \$20.50 maint

Switchmux 2000-08S • multiplexer configuration packaged with link module and 8 channels, expandable to 16 channels; standalone:

_____ 2,650 26.50

Switchmux 2000 Component Systems—Central Control

Switchmux 2000 component systems include a slotless adjustable frame card nest, power supply module, central logic, 4 or 8 channels, and single composite link module.

Switchmux 2000-04R • multiplexer module with 4 channels, rackmount version • fits adjustable 2000A card nest • expandable to 12 channels with 8-channel I/O Expansion Module:

_____ \$1,950 prch \$19.50 maint

Switchmux 2000-08R • multiplexer module with 8 channels, rackmount version • fits adjustable 2000A card nest expandable to 16 channels with 8-channel I/O Expansion Module:

_____ 2,550 25.50

2000A Rack • empty card nest for Switchmux 2000 channel adapters • channels, logic, and power supply mount from front;

I/O modules mount from rear • fits 19-inch equipment cabinet:

_____ 100 NA

Switchmux 2000 Flow Control

Guards against multiplexer system overflow and against buffer overflow at terminals resulting in loss of data; selectable on or off; type of flow, control selected on a per-channel basis, can be independently selected for each channel end • controls data flow at channel inputs by generating XON/XOFF, Bell warning, or CTS or EIA RS-232C interface • detects and responds to terminals by suspending/resuming data flow to channel inputs • system flow suspension threshold set at 75 percent total buffer utilization • overflow recovery via programmable hex character, sounds an audible data loss bell on appropriately equipped data terminals • standard feature:

_____ NC prch NC maint

Switchmux 2000 Diagnostic Tests

Isolates failures in composite link or individual channels through selectable tests • user-supplied ASCII terminal supports local and remote channel and composite link digital loopbacks via integral Fox message test pattern • standard feature:

_____ NC prch NC maint

Switchmux 2000 Status Reporting

LED status display panel indicates results of performance monitoring • 8 LEDs indicate EIA signal status for CTS, RTS, DTR, DCD, Tx, and Rx; indicate DCE and DTE modes • standard feature:

_____ NC prch NC maint

Switchmux 2000 Channels

Packaged systems available with 4, 8, 12, or 16 channels; field-upgradable • operating parameters downline loaded from either central site or remote multiplexer • selectable asynchronous channel rates at 50/75/100/110/134.5/150/200/300/600/1200/1800/2000/2400/3600/4800/7200/9600/19,200 bps; maximum aggregate rate of 153.6K bps • selectable synchronous rates at 1200/2400/4800 bps; maximum aggregate rate of 19.2K bps • RS-232C/CCITT V.24/V.28 and DCE/DTE selectable interfaces.

8-Channel I/O Expansion Module • expands 4-channel Switchmux 2000 to 12 channels or 8-channel Switchmux 2000 to 16 channels • fits 2000A card nest:

_____ \$1,200 prch \$12.00 maint

8-Channel I/O Expansion Module & Dual Link Kit • includes 8 I/O channels, composite link module, and connector panel:

_____ 1,700 17.00

4-Channel to 8-Channel Upgrade Kit • available for rackmount and standalone versions; includes 8-channel replacement board and connector panel • requires return of 4-channel board and connector panel as trade-in:

_____ 700 7.00

8-Channel I/O to 8-Channel with Dual Link Option • includes 8-channel replacement board with additional link module • requires return of original 8-channel I/O board as trade-in:

_____ 700 7.00

Channel Routing

Switchmux 2000 supports local and remote channel routing (switching) between any 2 of up to 32 channels in a point-to-point network. In a 3-node network with a dual-link Switchmux 2000 at each node, channel routing is supported among up to 48 channels for up to 24 simultaneous connections. Routing assignments are established through simple English commands keyed at the user terminal. Network resources are selected by alphanumeric service name established by the network manager from the supervisory console. All procedures are menu driven for ease of use.

Security measures protect unauthorized access of resources

Gandalf Multiplexers

Model GLM 504, PIN Series & Switchmux 2000

through password protection, both at the user level and at the supervisory level.

Contention reduces the number of ports required per resource, both remotely and locally. Contending users are queued and dynamically assigned the next available port on the same resource.

Switchmux 2000 Composite Link • central control module packaged link • data rates up to 64K bps full-duplex, synchronous or asynchronous • HDLC Level II link protocol •

CRC 16 and ARQ error detection and correction • RS-232C/CCITT V.24/V.28 electrical interface • composite link included in package or central control module (component systems) pricing:

NC prch	NC maint
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Dual Composite Link Kit • includes composite link and connector panel:

600	6.00
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• END

General DataComm (GDC) Modems DataComm Series

■ PROFILE

Function • low- to high-speed, AT&T-compatible, and CCITT-compatible modems.

Communications/Networks • 300 bps AT&T 103/113 compatible for the DDD network • 1200 bps AT&T 202 compatible for the DDD network; 1200 bps AT&T 202 compatible and non-AT&T compatible point-to-point or multipoint over unconditioned 2- or 4-wire dedicated Type 3002 facility; 1800 bps AT&T 202 compatible point-to-point or multipoint over C2 conditioned 2- or 4-wire dedicated Type 3002 facility • asynchronous 300/1200 bps or synchronous 1200 bps AT&T 212A compatible for the DDD network • 2400 bps AT&T 201 compatible for the DDD network; 2400 bps AT&T 201 compatible and non-AT&T compatible point-to-point or multipoint over unconditioned 2- or 4-wire dedicated Type 3002 facility • 4800 bps AT&T 208A/B compatible for the DDD network; 4800 bps AT&T 208A/B compatible and non-AT&T compatible point-to-point and multipoint over unconditioned 2- or 4-wire dedicated Type 3002 facility • 9600 bps non-AT&T compatible point-to-point or multipoint over unconditioned 4-wire dedicated Type 3002 facility.

First Delivery • 1981 (103J, 202T, 202S/T, 201C, 2400 ASM, 9600, 9600QPS); 1982 (212A, 212M, 1222, 201-7, 201C-K, 4827, 208B/A, 4800); 1983 (212A/ED, 212A/L, 212A/SL); 1984 (2412, 4800S, 9600EP, 9604, 14400).

Units Delivered • unknown.

Comparable Systems • principal competition from AT&T System 103, 108, 113, 201, 202, 212A, 208A/B, and Dataphone II modems 2024A, 2048A/C, and 2096AK; Codex MX2400, CS and LSI 48P, CS and LSI 96FP, CS and LSI 4800, CS and LSI 9600 and CS 2600 series; Paradyne LSI 2400/A/C, LSI 48, MP 4800, MP 4800/208B, MP 9600, MP 9600 RP, MPX2400, MPX4800, and MPX9600; Racal-Milgo CMS 12, CMS 24, CMS 48, CMS 4801, CMS 7201, and CMS 9601, Omnimode 48 and 96; Universal Data Systems 103, 202, 201, 208, and 9600 series.

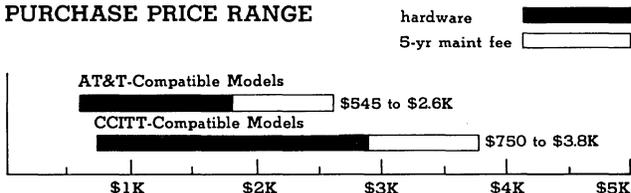
Vendor • General DataComm Industries, Inc (GDC); Middlebury, CT 06762-1299 • 203-574-1118.

Distribution • nationwide via GDC direct sales offices • Canada via sales offices in Montreal, Ottawa, and Toronto, Vancouver • Europe via sales offices in Berkshire and Rochdale, England, and Edinburgh, Scotland.

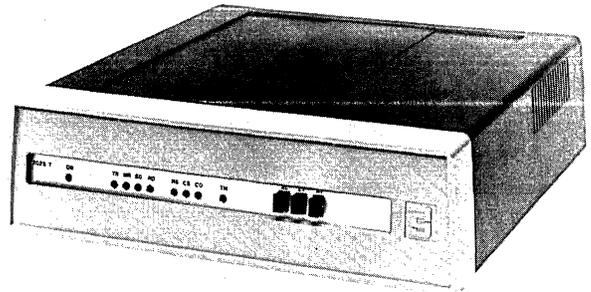
■ ANALYSIS

General DataComm has reduced prices on many of its modems

PURCHASE PRICE RANGE



GDC DATACOMM SERIES PURCHASE PRICING bar graphs cover price ranges between "small" and "large" configurations (solid bars), and for associated 5-year maintenance fees (open bars) • **AT&T-Compatible Models** small configuration consists of 300-bps Model 103J modem; large of 4800-bps Model 208B/A modem with optional eye pattern generator • **CCITT-Compatible Models** small configuration consists of 1200-bps Model 1222 modem; large of 9600-bps Model 9604 modem with integral 4-channel multiplexer.



by as much as 38 percent. And it has added new low-cost, low-profile versions of the 212A with ease-of-use features plus CCITT V.22 and V.29 modems, an AT&T 208B-compatible modem with automatic dialing and answering and an asynchronous option, a 4-channel 9600-bps, V.29 modem, and a 14.4K-bps Trellis Enclosed modem. These new products with ease-of-use features and operating flexibility are an indication of GDC's continued commitment to the modem segment of the data communications industry, as a vendor of a broad range of products that satisfy most user applications.

The DataComm Series of low- to high-speed modems represents a flexible approach to state-of-the-art modem packaging. Based on a concept it calls "DataCommonality," GDC has packaged a range of modems on analogous printed circuit cards that can all be inserted side-by-side in the same rackmounted card nest or in interchangeable standalone enclosures. This arrangement results in simplified installation, maintenance, and modem upgrading—an obvious advantage for user configurations supporting different applications and requiring various modem speeds and connections. In addition, DataComm modem users have the added advantage of increased performance and capabilities over equivalent AT&T modems at lower cost, and have the option to either lease or purchase DataComm models.

Until more recently, GDC has been oriented towards supplying data communication products—primarily modems and multiplexers—to the common carrier market. Because of recent changes in the regulatory environment, however, the company has swiftly shifted emphasis towards end-user business users of communication equipment; and the DataComm line reflects modems intended for both common carriers and end users. AT&T-compatible, non-AT&T compatible, and CCITT-compatible models are included. Company activity in the modem realm is centering on the DataComm Series with newer models introduced this year.

GDC is a reliable vendor with some innovative data communication products. The company manufactures and markets a fairly wide range of networking equipment and owns its own service company for more dependable installation and maintenance; it also offers several different service plans or customer training. Modems in the DataComm stable have an average MTBF of 35,000 to 40,000 hours, which equates to 3 to 4.5 years of continuous operation without failure. Although not the best figure in the industry, it is nonetheless on a par with other major modem vendors.

□ Strengths

Chief among the advantages of the DataComm Series is the

General DataComm (GDC) Modems DataComm Series

packaging to be gained from GDC's DataCommonality. Modems with different data rates, along with dedicated and direct-connect modems, can be combined in the same rack enclosure or inserted into similar standalone enclosures, simplifying network operations and reducing costs. GDC also offers several standard and extra-cost options for both Full-Featured and Key-Featured DataComm models, including asynchronous to synchronous conversion for boosting asynchronous terminal output to as high as 9600 bps, and anti-streaming on appropriate models which allows a streaming modem to disconnect itself from the network. The 2400-, 4800-, and 9600-bps models include manual modem fallback to a lower data rate in the case of line degradation.

DataComm models fulfill a wide range of requirements for international and domestic users of AT&T-compatible, non-AT&T-compatible, and CCITT-compatible modems. GDC provides its own service organization to install and perform maintenance on all of its communication products, often looked on as an advantage over third-party service organizations.

□ Limitations

GDC provides limited secondary data channels for its modems; only the 202T and 202S/T can contain a minimal reverse channel for line turnaround commands. GDC's Netcon 6 Network Management system contains a secondary channel for passing diagnostic and network control information, but there are no provisions for an auxiliary channel to carry digitized voice or building supervision commands. This can be a limitation for users requiring such capabilities; modern modem signaling techniques can usually leave enough spare bandwidth to provide 1 and sometimes 2 secondary channels.

Failure recovery via dial-backup for dedicated networks and hot-spare modem switching, also, is limited to users who can afford the Netcon 2 or Netcon 6 Network Management systems. Otherwise, recovery from failures is available only upon TelCo line degradation when a modem fallback rate can be selected to compensate for degraded performance.

Integral auto-dial is available for Models 201C-K, 212A/ED, 212A/L, DC 2412, and DC 4800S. Other models must rely on the rackmounted DataComm 801 A/C auto-dialer, which is only compatible with the RS-366 standard for business machines and addresses only 1 modem per CPU port. This is a serious limitation for high-volume users of polling modems.

■ HARDWARE

□ Terms & Support

Terms • GDC modems are available for purchase, or under 1-, 2-, or 3-year lease agreement • separate maintenance contract available for leased or purchased units • lease/purchase credit is 50 percent of lease paid out to 70 percent of purchase price, excluding maintenance • 1-year warranty for purchased/leased units; first-year maintenance free of charge • quantity discounts for 2 or more purchased units; larger discounts for larger quantities.

Support • installed by GDC or by user • installation charge \$80 for Models 103J, 202T, 202S/T, 212A/L, 212A/ED, 212A/SL, 1222, 201-7, 201C-K, 201C, and 2400 ASM; \$80 for options 801A/C, ASC-1, and MAU-1; \$160 for Models 4827, 208B/A, and 4800; \$200 for Models 9600, 9600QPS, 9600EP, and 9604 • maintenance available under contract for leased or purchased equipment, on-call service, or factory repair • fixed-price maintenance performed under annual contract during prime-shift hours 8:00 AM to 5:00 PM Monday through Friday, first priority; contract covers labor and spare parts; average response time for repair, 4 hours; service after 5:00 PM billed at hourly rate • on-call service billed on time-and-materials basis, second priority • factory repair available for equipment under warranty or without maintenance contract, third priority; average turnaround time 3 to 4 weeks • special services such as 24-hour maintenance, custom configurations, and training programs available on individual basis; telephone dial-in diagnostics available free of charge to all GDC customers • contract maintenance and on-call service provided by DataComm Service Corporation, a GDC subsidiary; service centers and repair depots are located in 44 major cities in the continental U.S.

□ Overview

The GDC DataComm Series modems cover a range of requirements for low- to high-speed data communication. The series contains AT&T- and CCITT-compatible models for 2 user groups: the common carrier market and end users. Full-Featured models are targeted at the common carriers and include the 103J, 202T, 202S/T, 212A/ED, 212A/L, 212A/SL, 201C, 4800S, and 208B/A; they contain all of the features and options of their AT&T counterparts plus enhancements relating to performance, features, and cost. Key-Featured models are aimed at end users and include the 212A/L, 212A/ED, 212A/SL, 1222, 2400 ASM, 201-7, 201C-K, 4800, 4827, 9600, and 9600QPS. Both AT&T- and CCITT-compatible units comprise the Key-Featured models, but GDC has deleted some AT&T features from AT&T-compatible Key-Featured models in favor of more useful end-user options. Key-Featured models in general offer significant advantages in cost and performance over equivalent AT&T units.

All DataComm models exist as single- or dual-card modems and can be purchased as packaged in rackmount or standalone versions, except for Models 202T and 202S/T which are packaged in a rackmount version only. Different rackmount units, including modems with different data rates and both dedicated and direct-connect modems can be mixed or matched in the same card nest, either the DS-1 for Full-Featured models or the DS-3 for Key-Featured models. The DS-1 is designed to hold automatic calling units and accommodate Keypad telephones; the DS-3 is not. Standalone packaged versions include power supply with modem card and are interchangeable with their rackmount counterparts. Standalone enclosures without a modem card(s) can be purchased separately, and 1 variant is increased in size to accommodate DataComm modem plus a Model 1209 multiplexer card for integral time-division multiplexing. The 1209 can also be rackmounted along with modem-card DataComm models.

□ Packaged Modems

DataComm models include both AT&T-compatible and CCITT-compatible modems; CCITT compatibility is included in some members of AT&T-compatible groups. All models are packaged as standalone version (except model 202S/T), or available on 1 or 2 printed circuit (PC) cards for rackmounting in GDC's central-site card nest, model DS1 or DS3; different models can be mixed and matched in the same card nest. Central-site card nests (Mounting Shelves) fit standard 19-inch equipment rack.

DataComm Series AT&T-Compatible Modems

Model 103J • standard DDD direct-connect 300-bps standalone modem with manual originate and manual/automatic answer mode • AT&T 103/113 compatible:

\$22/\$18 mo	\$545 prch	\$4 maint
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Model 103J Rackmount • same as Model 103J except contained on single PC card for rackmounting • inserts in DS-1 Mounting Shelf:

17/14	455	4
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Model 202T Rackmount • standard 2- or 4-wire dedicated 1200-/1800-bps modem • AT&T 202T compatible • rackmount version only; contained on single PC card for insertion in DS-1 Mounting Shelf:

17/13	395	5
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Model 202S/T Rackmount • standard 2- or 4-wire dedicated or DDD direct-connect 1200-/1800-bps modem with manual originate and manual/automatic answer mode • AT&T 202S/202T compatible • rackmount version only; contained on single PC card for insertion in DS-1 Mounting Shelf:

21/16	445	5
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MO: monthly 1-year/2-year lease charge for single units; does not include maintenance. PRCH: single-unit purchase price. MAINT: monthly maintenance charge for leased or purchased units. NC: no-cost item. NA: not available. Prices effective as of September 1984.

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Model 212A/ED • standard DDD direct-connect 300-/1200-bps standalone modem with automatic dialing (pulse or Touch-Tone) and manual/automatic answer mode • menu selectable operating parameters at terminal or modem • 2-keystroke dialing via attached terminal or manual dialing via attached 500-type phone; log-on for terminal • automatic redial and number linking features; audible call progress monitor • AT&T 212A compatible:

22/19	575	3
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Model 212A/SL • standard DDD direct-connect 300-/1200-bps standalone modem with manual originate and manual/automatic answer mode • AT&T 212A compatible:

20/18	445	3
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Model 212A/L • standard DDD direct-connect 300-/1200-bps standalone modem with manual originate and automatic answer mode (full-featured equivalent to Model 212) • AT&T 212A compatible:

28/23	675	3
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Model 212A/L Rackmount • same as Model 212A except contained on PC card for rackmounting • inserts in DS-1 Mounting Shelf:

23/19	585	3
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Model 201-7 • standard 2- or 4-wire dedicated 2400-bps standalone modem • AT&T 201B/C compatible:

30/25	695	5
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Model 201-7 Rackmount • same as Model 201-7 except contained on single PC card for rackmounting • inserts in DS-3 or DS-1 Mounting Shelf:

25/21	605	5
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Model 201C-K • standard DDD direct-connect 2400-bps standalone modem with manual originate and manual/automatic answer mode • AT&T 201B/C compatible; CCITT V.26 B compatible:

35/30	795	7
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Model 201C-K Rackmount • same as Model 201C-K except contained on single PC card for rackmounting • inserts in DS-3 or DS-1 Mounting Shelf:

31/27	705	7
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Model 201C • standard 2- or 4-wire dedicated or DDD direct-connect 2400-bps standalone modem with manual originate and manual/automatic answer mode • AT&T 201C/LIC and 201C/LID compatible; CCITT V.26 B and bis compatible:

42/33	995	7
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Model 201C Rackmount • same as Model 201C except contained on single PC card for rackmounting • inserts in DS-1 Mounting Shelf:

37/29	905	7
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Model 2400 ASM • standard 4-wire dedicated 300/600/1200/1800/2400-bps standalone modem • AT&T 201B/C compatible; CCITT V.26 B compatible:

36/30	825	5
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Model 2400 ASM Rackmount • same as Model 2400 ASM except contained on single PC card for rackmounting • inserts in DS-3 or DS-1 Mounting Shelf:

31/27	735	5
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Model 208B/A • standard 2- or 4-wire dedicated or DDD direct-connect 4800-bps standalone modem with manual originate and manual/automatic answer mode • AT&T 208A/B compatible:

74/64	1,695	15
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Model 208B/A Rackmount • same as Model 208B/A except contained on 2 PC cards for rackmounting • inserts in DS-1 Mounting Shelf:

71/61	1,605	15
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Model 4800 • standard 2- or 4-wire dedicated 4800-bps Quik-Poll standalone modem • AT&T 208A compatible; GDC

4800-bps type compatible:

61/54	1,495	15
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Model 4800 Rackmount • same as Model 4800 except contained on single PC card for rackmounting • inserts in DS-1 Mounting Shelf:

57/51	1,405	15
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Model 4800S • standard DDD direct-connect 4800-bps standalone modem with auto-dial/manual originate, auto/manual answer • async option • AT&T 208B compatible:

67/59	1,595	15
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Model 4800S Rackmount • same as Model 4800S except contained on single PC card for rackmounting • inserts in DS-1 Mounting Shelf:

64/56	1,505	15
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DataComm Series CCITT-Compatible Modems

Model 1222 • standard 2-wire dedicated or DDD direct-connect 1200-bps standalone modem with manual originate and manual/automatic answer mode • CCITT V.22 bis compatible:

NA/NA mo	NA prch	NA maint
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Model 1222 Rackmount • same as Model 1222 except contained on 2 PC cards for rackmounting • inserts in DS-3 or DS-1 Mounting Shelf:

NA/NA	NA	NA
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Model 2412 • standard 2-wire dedicated or DDD direct-connect 2400-bps standalone modem with automatic dialing and log-on and automatic answer modes • ARQ plug-in option • CCITT V.22 bis compatible:

52/46	1,195	7
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Model 2412 Rackmount • same as Model 2412 except contained on single PC card for rackmounting • inserts in DS-1 Mounting Shelf:

48/43	1,105	7
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Model 4827 • standard 2- or 4-wire dedicated 4800-bps Quik-Poll standalone modem • CCITT V.27 bis compatible:

61/54	1,495	15
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Model 4827 Rackmount • same as Model 4827 except contained on single PC card for rackmounting • inserts in DS-1 Mounting Shelf:

57/51	1,405	15
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Model 9600 • standard 4-wire dedicated 9600-bps standalone modem • CCITT V.29 compatible:

79/70	1,995	15
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Model 9600 Rackmount • same as Model 9600 except contained on 2 PC cards for rackmounting • inserts in DS-3 or DS-1 Mounting Shelf:

75/66	1,905	15
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Model 9600EP • standard 4-wire dedicated 9600-bps standalone modem with remote diagnostics • CCITT V.29 compatible:

85/75	2,150	15
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Model 9600 EP Rackmount • same as Model 9600EP except contained on 2 PC cards for rackmounting • inserts in DS-1 Mounting Shelf:

81/72	2,060	15
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Model 9600QPS • standard 4-wire dedicated 9600-bps multipoint standalone modem • CCITT V.29 compatible:

91/80	2,295	15
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Model 9600QPS Rackmount • same as Model 9600MD except contained on 2 PC cards for rackmounting • inserts in DS-3 or DS-1 Mounting Shelf:

87/77	2,205	15
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Model 9604 • standard 4-wire dedicated 9600-bps standalone modem with 4-channel synchronous multiplexer • CCITT V.29 compatible • rackmount hardware available:

114/101	2,895	15
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Trellis Encoded Modem

Model 14400 • standard 4-wire dedicated 14.4/12.0/9.6K bps standalone modem with remote diagnostics • Trellis encoding • CCITT V.29 compatible at 9600 bps:

\$225/\$220 mo \$5,995 prch \$20 maint

Model 14400 Rackmount • same as Model 14400 except contained on 2 PC cards for rackmounting • inserts in DS-1 Mounting Shelf:

220/190 5,905 20

Modem Enclosures

DS-1 Mounting Shelf • 16-slot card nest with power supply designed to accommodate Full-Featured DataComm modems, Models 103J, 202T, 202S/T, 212A/L, 201C, 208B/A, 2412, 4800S, 9600EP, and 14400 • includes 16 male RS-232C connectors for attaching DataComm 801A/C automatic calling units or Models 565 telephone handsets • different speeds and DDD network/dedicated modems can be mixed in same DS-1 enclosure; also accommodates Key-Featured DataComm modems • 2-card models occupy 2 card slots • 10.5-inch high enclosure fits standard 19-inch equipment rack:

\$44/\$35 mo \$795 prch NC maint

DS-3 Mounting Shelf • 16-slot card nest with power supply designed to accommodate Key-Featured DataComm modems, Models 212, 2400 ASM, 201-7, 201C-K, 4800, 1222, 4827, 9600, and 9600QPS • different speeds and DDD network/dedicated modems can be mixed in the same DS-3 enclosure; will not accommodate Full-Featured DataComm modems • 2-card models occupy 2 card slots • 10.5-inch high enclosure fits standard 19-inch equipment rack:

40/32 750 NC

DE-1 Standalone Enclosure • tabletop enclosure with power supply accommodates Full-Featured DataComm modems, Models 103J, 201T, 202S/T, 212A, 201C, and 208B/A (packaged models include Standalone Enclosure in purchase price):

5/4 200 NC

DE-3 Standalone Enclosure • tabletop enclosure with power supply accommodates Key-Featured DataComm modems, Models 212, 2400 ASM, 201-7, 201C-K, 4800, 1222, 4827, 9600, and 9600QPS (packaged models include Standalone Enclosure in purchase price):

5/4 90 NC

DE-4 Standalone Enclosure • tabletop enclosure with power supply accommodates Full-Featured and Key-Featured DataComm modems with 1209 TDM multiplexer card:

5/4 90 NC

□ Application

DataComm Series AT&T-Compatible Modems

Models 103J, 212A/ED, 212A/SL, 212A/L & 201C-K • designed for operation over the DDD network.

Model 202T • point-to-point and multipoint communication over unconditioned 2- or 4-wire dedicated Type 3002 voice channel, up to 1200 bps; C2 conditioning required at data rates to 1800 bps • training time delay selectable at 8.0, 30, 60, or 180 milliseconds.

Models 201-7 & 4800 • point-to-point and multipoint communication over unconditioned 2- or 4-wire Type 3002 voice channel • training time delay selectable at 7.1 or 150 milliseconds for the 201-7; selectable at 25 or 50 milliseconds for the 4800.

Model 2400 ASM • point-to-point and multipoint communication over unconditioned 4-wire Type 3002 voice channel • training time delay selectable at 0, 7.1, 12, or 35 milliseconds.

Models 202S/T, 201C & 208B/A • point-to-point and multipoint communication over unconditioned 2- or 4-wire Type

3002 voice channel, or over the DDD network; C2 conditioning required for 202S/T at data rates to 1800 bps • training time delay selectable at 8.0, 30, 60, or 180 milliseconds for 202S/T; selectable at 7.1, 35, or 150 milliseconds for 201C; selectable at 25, 50, or 150 milliseconds for 208B/A.

DataComm Series CCITT-Compatible Modems

Models 1222 & 2412 • point-to-point communication over unconditioned 2-wire Type 3002 voice channel or over the DDD network.

Model 4827 • point-to-point and multipoint communication over unconditioned 2- or 4-wire Type 3002 voice channel • training time delay 25 milliseconds.

Models 9600, 9600EP & 9604 • point-to-point communication over unconditioned 4-wire Type 3002 voice channel.

Model 9600QPS • point-to-point and multipoint communication over unconditioned 4-wire Type 3002 voice channel • training time delay 25 milliseconds.

Trellis Encoded Modem

Model 14400 • point-to-point communication over 4-wire Type 3002 voice channel; D1 conditioning recommended.

□ Operating Parameters

DataComm Series AT&T-Compatible Modems

Model 103J • asynchronous full-duplex at rates up to 300 bps • FSK modulation.

Models 202T & 202S/T • asynchronous half-/full-duplex at rates up to 1200/1800 bps • FSK modulation • compromise (statistical) equalization.

Models 212A/ED, 212A/SL & 212A/L • asynchronous full-duplex at rates up to 300 bps; FSK modulation • asynchronous or synchronous half-/full-duplex at 1200 bps; PSK modulation • compromise (statistical) equalization, Model 212; automatic adaptive equalization, Model 212M.

Model 201-7 • synchronous half-duplex at 2400/1200 bps • DPSK modulation • compromise (statistical) equalization.

Model 201C-K • synchronous half-duplex at 2400/1200 bps; asynchronous half-duplex at 1200/1800/2400 bps optional • DPSK modulation • compromise (statistical) equalization.

Model 201C • synchronous half-/full-duplex at 2400/1200 bps • DPSK modulation • compromise (statistical) equalization.

Model 2400 ASM • synchronous full-duplex at 2400 bps; asynchronous full-duplex at 300/600/1200/1800/2400 bps • DPSK modulation • compromise (statistical) equalization.

Models 208B/A & 4800S • synchronous half-/full-duplex at 4800 bps • DPSK modulation • automatic adaptive equalization.

Model 4800 • synchronous half-/full-duplex at 4800/2400 bps; asynchronous half-/full-duplex at 300/600/1200/1800/2400/4800 bps optional • DPSK modulation • automatic adaptive equalization.

DataComm Series CCITT-Compatible Modems

Model 1222 • asynchronous or synchronous full-duplex at 1200 bps • PSK modulation • compromise (statistical) equalization.

Model 2412 • asynchronous or synchronous full-duplex at 1200/2400 bps • 4-level DPSK modulation at 1200 bps; 16-level QAM at 2400 bps • automatic speed detection/selection • automatic adaptive equalization.

Model 4827 • synchronous half-/full-duplex at 4800/2400 bps; asynchronous half-/full-duplex at 300/600/1200/1800/2400/4800 bps optional • DPSK modulation • automatic adaptive equalization.

Model 9600 & 9600QPS • synchronous full-duplex at 9600/7200/4800 bps • QAM modulation • automatic adaptive equalization.

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Trellis Encoded Modem

Model 14400 synchronous half-/full-duplex at 14.4/12.0/9.6K bps • QAM modulation • 128-point eye pattern constellation • automatic adaptive and compromise equalization • Trellis encoding.

□ Channel Functions

Multiport • Model 9604 contains integral 4-channel multiplexer • other DataComm full-duplex modems from 1200 bps to 9600 bps can incorporate a GDC 1209 TDM multiplexer, mounted on a single PC card, for multiplexing 2 or 4 asynchronous data channels onto 1 synchronous composite link • requires DE-4 Standalone Enclosure to accommodate both 1209 TDM and DataComm modem, or occupies single slot in DS-1 or DS-3 Mounting Shelf • extra-cost option:

NA/NA mo	NA prch	NA maint
30/25	775	6

Netcon-6 Network Management • provides GDC and other vendor modems with monitor, control, failure recovery, and network management functions via a narrowband full-duplex secondary channel FDM multiplexed with the main high-speed data channel • implemented through a central-site network controller and wraparound units located at each remote modem site.

Remote Diagnostic Unit • wraparound device provides remote-site modems with a 75-bps secondary channel for remote diagnostics and failure recovery • operates with AT&T- or CCITT-compatible modems from 300 to 9600 bps • extra-cost option.

For Modems to 4800 bps:

30/25	775	6
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For Modems to 9600 bps:

38/33	875	NA
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Secondary Channel • 5-bps half-/full-duplex secondary channel provides control path for supervisory control or line turnaround commands • in half-duplex mode, operates in reverse direction of primary channel; in full-duplex mode, operates independently of primary channel with local copy enabled • extra-cost option for Models 202T and 202S/T only:

5/4	95	NC
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Asynchronous to Synchronous Conversion • standalone unit or plug-in module sends asynchronous terminal output through synchronous modems • buffered unit frames asynchronous data for synchronous transmission; does not strip start/stop bits • compensates for clock differences between terminal (DTE) and modem (DCE), adjusting to overspeed and underspeed conditions by deleting or adding stop bits to transmission, and then adding or deleting respective bit at opposite end • switch-selectable data character lengths or 7.5, 8, 9, 10, or 11 bits including 1, 1.5, or 2 stop bits • selectable asynchronous data rates at 300/600/1200/1800/2400/4800/9600 bps, depending on speed of synchronous modem; 1600 bps available on special order.

ASC-1 • standalone asynchronous to synchronous converter unit with RS-232C/CCITT V.24/V.28 electrical interfaces compatible with GDC and other vendor modems • 1 required at each end of transmission:

12/10	295	5
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ASC-2 • plug-in asynchronous to synchronous converter module fits motherboard on selected DataComm modems providing synchronous data rates to 2400/4800 bps, depending on the model • requires no additional slots in DS-1 or DS-3 Mounting Shelves • integral feature standard on Model 2400 ASM; extra-cost option for Models 201C-K, 201-7, 4800, and 4827:

8/7	175	5
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Local Copy • selectable option permits data to be echoed back to DTE for local printout • integral no-cost option included in package price of Models 202S, 202S/T, and 201C-K only:

NC/NC	NC	NC

Digital Interface • EIA RS-232C/CCITT V.24/V.28 • 25-pin electrical connector.

□ Control Functions

FCC Registered Modems • all GDC modems specified for the DDD network are FCC registered for direct connection under FCC Rules Part 68 • does not require separate Data Access Arrangement (DAA) • standard feature included in modem pricing:

NC/NC mo	NC prch	NC maint
24/20	575	2

Modem Sharing • standalone MAU-1 Multiple Access Unit allows up to 4 modems to share modem channel port one-at-a-time; cascaded MAU-1 units allow additional modem sharing by more than 4 terminals • manual on-site operation • compatible with GDC and other vendor equipment; accepts data rates up to 19.2K bps • extra-cost option:

24/20	575	2
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Alternate Voice/Data • all direct-connect modems can be equipped for alternate voice/data by attaching TelCo telephone, or GDC 500 and 2500 series telephones • Key-Featured DataComm models include a talk/data switch; Full-Featured DataComm models require telephones with an exclusion key which performs the same function • dedicated modems not designed for voice communication.

Model 500M • basic rotary-dial telephone:

3/2	35	NC
-----	----	----

Model 502 • basic rotary-dial telephone with exclusion key:

4/3	50	NC
-----	----	----

Model 2500M • basic tone-dial telephone:

4/3	65	NC
-----	----	----

Model 2502 • tone-dial telephone with exclusion key:

6/4	80	NC
-----	----	----

Model 565HK • rotary-dial telephone with 6-button keypad; includes data button:

8/7	130	NC
-----	-----	----

Model 2565HK • tone-dial telephone with 6-button keypad; includes data button:

9/8	150	NC
-----	-----	----

Failure Recovery • provides immediate recovery from line or modem failures via Netcon 6 or Netcon 2 Network Management systems only • switches modems at attended or unattended sites between 4-wire dedicated line and 2 dial-up lines to restore communication interrupted by line failure/degradation • switches data terminal equipment and 4-wire dedicated line between faulty modem and hot-spare modem to restore communication interrupted by modem failure/degradation • implemented via standalone (wraparound) units for each modem linked to a central-site controller; Netcon 6 secondary channel or Netcon 2 in-band transmission provides control path for passing monitor and control signals between central-site controller and central-/remote-site modems.

Auto-Answer (Automatic Answer) • Models 103J, 202S/T, 212, 212A/ED, 212A/L, 212A/SL, 201C-K, 201C, and 208B/A all include switch-selectable automatic answer function • standard feature:

NC/NC	NC	NC

Auto-Dial (Automatic Originate) • Model 212A/ED contains integral auto-dial feature • other DataComm models designed for the DDD network can accommodate a DataComm 801A/C Automatic Calling Unit • rackmount configuration for single line dialing • provides automatic dialing for CPU originated calls using pulse or tone dialing • FCC registered unit.

DataComm 801A/C • rackmount unit on single PC card provides automatic dialing for single DataComm modem • RS-366 DTE interface; RS-232C or 9-pin current-loop DTE (modem) interface • fits 1 slot in DS-1 Mounting Shelf:

24/20	595	4
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Auto-Dialer Card • optional module mounts on motherboard of Model 201C-K modems; must be set at same rate as DTE, 1200 or 2400 bps • requires installation of ASC-2 asynchronous to

General DataComm (GDC) Modems DataComm Series

synchronous converter card:

4/3 75 NC

Satellite Delay • integral selectable option inserts 53- or 275-millisecond delay to inhibit RTS; enables activation of TelCo echo suppressors for use in satellite links • standard feature on Models 201C and 201C-K only:

NC/NC NC NC

Anti-Streaming • integral selectable option detects streaming condition; modem automatically disconnects itself from line; turns RTS off if RTS from DTE is on continuously for 30 seconds; 40 seconds at 2400 bps • standard feature on Models 201C, 4827, 9600, and 9600PQ:

NC/NC NC NC

New Sync • integral selectable option provides rapid resynchronization of incoming calls • required in high-volume polling operations:

NC/NC NC NC

Clock-Slaved Timing • integral selectable option on DataComm 4-wire dedicated models locks received clock signal in phase with outgoing signal; slaves modem tail circuit to that of high-speed modem or multiplexer:

NC/NC NC NC

Automatic Disconnects • direct-connect GDC modems for the DDD network contain integral strap-selectable timers that automatically disconnect call upon loss of carrier or when remote end fails to answer call:

NC/NC NC NC

Diagnostic & Status Indicators

Loopback diagnostics isolate failures in local or remote modems or dedicated line; detects failures in data terminal equipment (DTE), depending on model. Manual control of diagnostics through modem front panel or remote control via GDC Netcon 6 network control with wraparound option at each individual

modem site. Visual indication of operating and test conditions; visual warning of deteriorating operating conditions, depending on model.

Loopback Tests • local analog and remote digital loopback, all models; remote analog loopback, remote digital/loopback, and end-to-end testing, depending on model:

NC/NC mo NC prch NC maint

Remote Digital Loopback Option • plug-in module provides remote digital loopback capability for Model 201-7 only • does not require additional slot in DS-3 or DS-1 Mounting Shelf • extra-cost option:

5/4 125 NC

Test Pattern Generation • integral bit pattern generator and error detector performs bit error rate tests, all models • straight mark, 127-bit, or 511-bit patterns generated for modem self-testing and some loopbacks, depending on model; Models 4800 and 4827 can generate a mark pattern with error injection once every 3 seconds:

NC/NC NC NC

Eye Pattern Generator • add-in module for Models 4827, 208B/A, and 4800; provides test point for external oscilloscope display and measurement of analog line parameters • does not require additional slot in DS-1 or DS-3 Mounting Shelf:

2/2 45 NC

Dial-In Diagnostics • toll-free number for all GDC customers provides online diagnosis of modem failure using computerized equipment at GDC Control Center • Model 208B/A users can dial a AT&T System test center for online diagnostic testing:

NA/NA NA NA

Status Indicators • EIA interface signal activity; test mode for loopback(s); circuit distortion.

• END

General DataComm Megamux Plus T1 Multiplexer

■ PROFILE

Function • bit-interleaved TDM designed for T1 carrier facilities • supports up to 54 I/O channels; asynchronous, synchronous, and isochronous data and voice channels in any combination • point-to-point and multipoint applications; downline loading or remote multiplexer • link rates from 2400 bps to 2.048M bps over DDS, coaxial cable, fiber optics cable, digital radio, and satellite links.

Communications/Networks • supports asynchronous data rates from 50 bps to 19.2K bps; synchronous rates from 150 bps to 1.152M bps; isochronous rates to 64K bps; voice-digitized rates from 14.4K to 64K bps (CVSD) • link interfaces consist of RS-232C, CCITT V.24/V.28/V.35, AT&T 303, MIL Std-188-114, RS-422, RS-423, V.10, V.11, V.35 (for clock and data signals) • voice interface is 4-wire plus E&M signaling; transmit/receive levels selectable at -16/+7 dBm 0/0 dBm 600 ohms, balanced • T1 bipolar transmission • single composite link (trunk) with redundant backup • point-to-point and multipoint applications; supports cascaded multiplexer.

First Delivery • 1984.

Systems Delivered • over 4,000 Megamux systems.

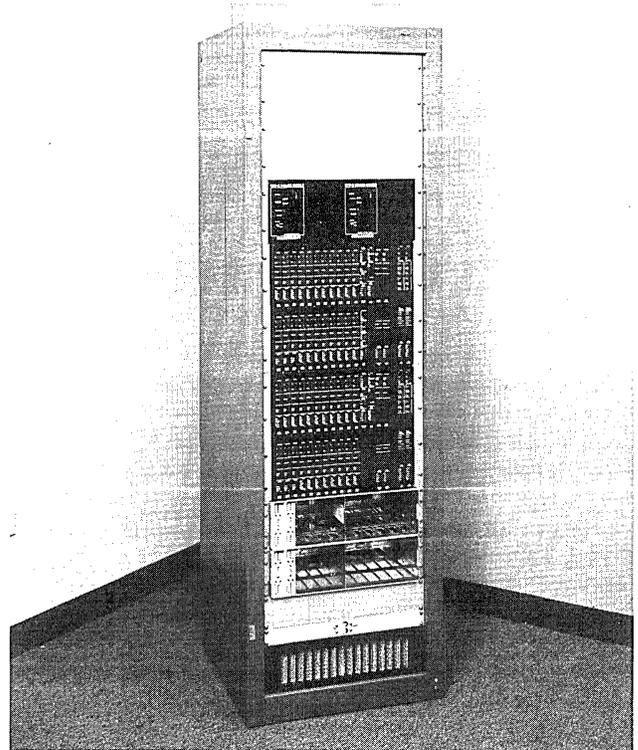
Comparable Systems • Amdahl Model 2211, Avanti Ultra Mux, Bayly Omniplexer, Codex 6240, DCA Netlink, Datatel DCP 9100, Infotron T Mux, Paradyne DCX-T1 and Timeplex Link I.

Vendor • General DataComm Industries, Inc; One Kennedy Avenue, Danbury, CT 06810 • 203-574-1118.

Distribution • worldwide through General DataComm sales offices.

■ ANALYSIS

Megamux Plus is the third iteration of the Megamux product line, the first 2 being the TDM 1257 and 1258. We first saw the 1257 about 4 years ago, and the 1258 about a year later. Both products were hardware-configured (i.e., configurations were established by switches, jumpers, and PROMs, and both supported up to 54 channels). The 1257, however, had a top aggregate data rate of 256K bps, while the 1258 supported rates up to 1.544M bps and 2.048M bps. The 1258 also met the bit density requirements of DS 1, and could be attached to AT&T Communications ACCUNET T1.5 service without requiring AT&T 306 modem. (We describe the 1257 and 1258 in past tense even though they have not officially been dropped from GDC's product line. With the new Plus model, we can't imagine why anyone would want the older models.)



The 1257 and 1258 were good products, and dominated that segment of the market until last year. While they still have the largest share, a number of products with newer designs now offer stiff competition. GDC should more than meet the challenge with its Megamux Plus.

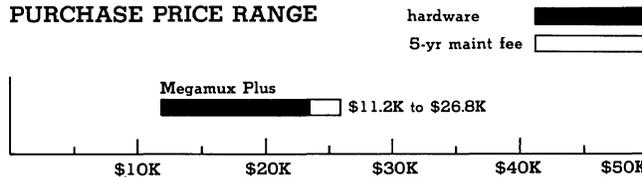
There are a number of good reasons why the 1257 and 1258 dominated the marketplace. They were rock reliable, handled a wide range of channel data rates, provided an excellent voice facility, and offered redundant control logic and power supplies. Their principal drawback, however, was that they were manually configured and controlled by switches. The configurations, in fact, were burned into PROM unless users ordered the optional Auto-frame card.

Channel card packaging was awkward and dated. The system employed 2 basic types of data cards with piggyback cards to effect enhanced functions. Fortunately, this is not the case with Megamux Plus.

The hardware configuration scheme is also different on Megamux Plus. All operating parameters are not established by the operator via a control terminal; configurations are held in RAM. Megamux Plus can also be interfaced with GDC's Netcon-6 Network Management System to provide sophisticated network management and control facilities.

With Megamux Plus, GDC has retained the best features of the older family members while adding many new features (see

PURCHASE PRICE RANGE



GDC MEGAMUX PLUS PURCHASE PRICING bar graph covers price ranges between "small" and "large" configurations for hardware products (solid bar) and 5-year maintenance (open bar) • small system consists of Model 22N chassis with 10 Data II channel cards and 7 Voice II channel cards • large system consists of Model 22R Chassis, a 16-channel expansion shell, 20 Data II channel cards, 15 Voice II channel cards, 1 synchronization test card, and a major alarm card • all prices are single-quantity purchase.

General DataComm Megamux Plus T1 Multiplexer

Strengths). As a result, GDC now has a product as good as anything currently on the market.

□ Strengths

The carryover facilities from the old Megamux consists of DS1 compatibility, redundant control logic and power supplies, and an outstanding voice channel card that employs CVSD. To this, GDC has added an "omni" data channel card that can be configured to handle asynchronous, isochronous, and synchronous data channels; a redundant high-speed link; a simple DTE/DCE channel interface designation facility; a 1.152M-bps synchronous data channel limit; and an integral bit error rate tester (BERT) on each channel card. Megamux Plus also meets the D4 framing bit format required for connection to AT&T Communications' ACCUNET T1.5 service.

The redundant control logic and power supplier operates as hot spares and virtually guarantees uninterrupted service. In the event that a primary component fails, the backup automatically takes over to maintain communication. In addition, the 2 power supplies operate in tandem, sharing the overall power load. Thus, neither power supply is operating at full capacity, which should increase the life of both components.

Employing a single card to handle all data inputs is a strong benefit for the user in many ways. The most obvious benefit is that separate cards needn't be purchased and stocked to accommodate different asynchronous, isochronous, and synchronous applications. The user merely programs the card from the control terminal to change its operating mode. This single card concept also works wonderfully with the multiplexer's time-oriented reconfiguration (TOR) facility. With it, users can specify that certain configurations "kick-in" at preset times based on hour of day, day of month, and month of year (up to 3 preprogrammed frame options are available). Thus, such exercises as card swapping are eliminated, since TOR automatically reconfigures each card.

Another channel card feature that is beneficial is the built-in BERT. With it, users can test each channel individually without interfering with other channels as is the case with a shared BERT. Of the other vendors in the market, only the Datatel DCP 9100 (and its OEMed versions) have this facility.

Users who must routinely change a channel's DTE/DCE interface designation will appreciate GDC's approach. Instead of swapping cables as is normally the case, the user merely unplugs an integrated circuit chip on the channel card, reverses the chip, and reinserts it. An even simpler technique would be to define the interface via the control terminal.

The redundant high-speed link facility is another Megamux Plus feature that emphasizes reliability. Both links terminate at the same end points, and both can be configured to broadcast simultaneously to provide a hot spare. The second link can also be a standby that is manually switched over. The hot spare approach appears to be the preferred method since it guarantees uninterrupted operation and eliminates the "ping-ponging" effect that occurs during a manual cold spare switchover. We want to emphasize that the second link is only a spare; it cannot be used as a second link to a different end point.

The D4 framing-bit format, required for connection to ACCUNET T1.5, requires that the message frame have a specific bit density and pattern, and allow for the insertion of an 8K-byte AT&T-originated signaling/diagnostic pattern every 193rd bit position. Multiplexers not conforming to D4 framing are excluded from ACCUNET. Meeting the D4 framing bit pattern, however, does not mean that Megamux Plus is D4 compatible. It is not, and we feel it is a system weakness (see Limitations).

The ability of the synchronous channels to handle rates up to 1.152M bps makes Megamux Plus well equipped to efficiently handle large file transfers between host CPUs. This rate is also suitable for digital video that does not require full modem and/or extensive detail.

□ Limitations

With all of the enhancements to Megamux Plus, GDC has rid the product line of most of its limitations. A few, however, still exist

such as no drop-and-insert, limited channel capacity, and no true D4 compatibility.

Drop-and-insert is the ability to designate that certain channels in the overall message-train composite are to be dropped at a specified intermediate site, while the other channels continue on to the ultimate destination (the latter operation is called bypass). The insert capability allows the same intermediate site to insert channels into the data stream designated for the ultimate end site. Drop-and-insert is ideal for large organizations with dispersed large branches (banks and manufacturers for example). It can also be used with PBX applications to selectively drop/insert channels. While drop-and-insert was somewhat of a novelty a year ago, many T1 multiplexer manufacturers now are either offering this capability or have announced it. GDC claims it will be included in the new Megamux II scheduled for 1986.

The absence of true D4 compatibility means that Megamux Plus cannot take advantage of the forthcoming **Digital Access and Crossconnect Service** AT&T plans for this year. Called DACS for short, it is a terminal-controlled system that allows the redistribution (switching) of individual DSO 64K-bps channels among T1 systems at a digital level. From a simple ASCII terminal, a user can direct a DACS controller to switch individual channels within a T1 stream to another T1 stream associated with the same DACS controller.

The DACS controller (AT&T calls it a "terminal") terminates up to 128 DS1 signals, one of which is used for control. The remaining 127 DS1 terminations (3,048 64K-bps channels) can be used for crossconnections. Since 2 DSO channel terminations are required for a crossconnect, the DACS controller provides a maximum of 1,524 DSO crossconnections. DS1 signals to and from DACS are provided via DSX-1.

DACS is compatible with DS1 formats found in D1D, D2, D3, and D4 channel banks, and is end-to-end-compatible with general trade channel banks meeting the requirements of PUB 43801. For a T1 multiplexer to be DACS-compatible, **its channels must be 64K-bps wide** and its DS1 format must consist of 24 8-bit words and 1 superframe bit for a total of 193 bits per frame. (A superframe is made up to 12 frames, and each superframe bit is time shared to identify both channel framing and signal framing.) A T1 multiplexer that does not employ 8-bit words and 64K-bps channels, therefore, shouldn't be DACS compatible. The Megamux Plus does not conform.

The final limitation is the channel-handling facility. Even with expansion shelves, Megamux Plus can only accommodate up to 54 channels directly. This can be increased, however, by employing a statistical or TDM multiplexer to interface multiple channels to one Megamux Plus channel port. These submultiplexers, however, do run up the costs since one is needed per end, and add another component that could fail. GDC could solve this problem by expanding the channel card from 1 to at least 2 ports. Just about all of GDC's competitors have multiport channel cards.

While the lack of DACs compatibility is an operational drawback, one should weigh the overall data-handling capabilities before rejecting the product. By not restricting its data and voice channels to strict 64K-bps channel boundaries, GDC allows greater channel handling capacity and more efficient use of the available bandwidth.

■ HARDWARE

□ Terms & Support

Terms • all standard components and options are available for purchase or on a 1-, 2-, or 3-year lease, which includes leased products maintenance • volume discounts offered.

Support • all products are offered with a monthly maintenance contract • support provided by vendor personnel • installation charge for both models • maintenance available on fixed-price, on-call, or factory repair basis • fixed-price maintenance performed under annual contract during prime-shift hours 8:00 AM to 5:00 PM, Monday through Friday, first priority; contract covers labor and spare parts; average response time for repair, 4 hours; service after 5:00 PM billed at hourly rate • on-call service billed on time-and-material basis, second priority • factory repair

General DataComm Megamux Plus

T1 Multiplexer

available for equipment under warranty or without maintenance contract, third priority; average turnaround time 3 to 4 weeks • special services such as 24-hour maintenance, custom configurations and training programs available on individual basis; telephone dial-in diagnostics available free of charge to all GDC customers • contract maintenance and on-call service provided by DataComm Service Corporation, a GDC subsidiary; service centers and repair depots are located in 44 major cities in the continental U.S. • \$275 installation charge.

□ Overview

Megamux Plus is a bit-interleaved TDM that supports asynchronous, isochronous, and synchronous data and analog voice. The latter is digitized (quantized) via the Continuously Variable Slope Delta (CVSD) technique and combined with data transmission. Megamux Plus meets the bit-density requirements of DS1 and D4 framing bit format, making it acceptable for use on AT&T Communications ACCUNET T1.5 service. It can also be used with independent T1 services, such as those available from RCA, SBS, etc.

Megamux Plus is a rackmounted system employing shelves to accommodate common logic and channel cards. The basic multiplexer is delivered with all common control logic cards, power supply, and card slots for 22 channels. For additional channels, 1- or 2-channel expansion shelves with a 16-channel capacity each can be added, for a maximum channel capacity of 54 channels.

GDC also permits the multiplexer to be configured with redundant control logic and power supplies. The power supplies are mounted on a separate shelf, and the redundant logic cards slide into reserved slots. Redundant logic **does not** decrease the number of slots available for channel cards.

One power supply can power an entire 54-channel arrangement. If redundant power is specified, the second unit operates in conjunction with the primary power supply sharing the load. Two advantages are realized using this scheme: first, load-sharing generally extends the life of both units since they are handling half the power load; second, since the second power supply is running as a "hot spare," a failure of either unit will not disrupt the power source to the multiplexer.

The common logic performs the main multiplexing/demultiplexing functions, provides the clock for data channels, and furnishes the interface to the high-speed trunk. Optional cards are available for indicating system alarms and for testing the high-speed trunk.

Megamux Plus supports single primary and secondary high-speed trunks. The secondary is strictly a backup and **cannot** be used for independent routing. To employ dual-trunking, the multiplexer must be fitted with an optional Diversity Switch card (see Central Control) that permits simultaneous broadcasting on both transmission paths, and switches only the receive end that loses synchronization. This simultaneous operation prohibits the "ping-ponging" effect that occurs with cold switchovers. However, if users specify manual switchover, it can be accommodated.

Unlike the original Megamux system, the Plus employs a terminal to configure channels and initiate system tests and monitoring. This terminal can be collocated at the multiplexer or remotely located and connected via a modem. If the application warrants it, Megamux Plus can also be controlled via the user's computer. Users that require more sophisticated testing facilities, or merely need to integrate the multiplexer into an overall network control and management facility, Megamux Plus can be interfaced to GDC's Netcon-6 Network Management System.

Megamux Plus employs only 2 different channel cards to handle voice and data. The data card can be "designated" as either an asynchronous, isochronous, or synchronous channel by merely entering the designation as part of the overall configuration scheme. Changing it is also as simple as entering a few commands from the control console. All data cards are strictly single-channel units.

The voice card, also a single channel, employs CVSD to handle voice and offers 12 different data rates ranging from 14.4K to 64K

bps. We've listened to voice at 32K bps and judge it to be toll quality.

□ Megamux Plus System

Central Control

Chassis, power supply, and common logic for multiplexing up to 22 data/voice channels over single high-speed composite link; 22 voice channels maximum • includes common logic consisting of transmit/receive (TR) logic card, clock generator card, redundant control card • single-channel asynchronous, isochronous, synchronous data and/or digitized voice cards intermixed in any combination • multiplexer message frame automatically established and held in RAM • remote multiplexer configurations downline loaded • optional common logic cards consist of clock alarm card, sync test card, and channel nest expansion card; T/R logic card, clock generator, and aggregate interface card can be made redundant • second power supply can be added for redundancy • 1 or 2 16-channel expansion nests can be added to increase channel capacity to 54 channels.

22-N Chassis • contains all features and facilities shown under Central Control • 39 aggregate data rates to 1.544M bps; also supports 2.048M bps:

<u>\$207 mo</u>	<u>\$4,350 prch</u>	<u>\$20 maint</u>
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22-R Chassis • same as 22-N, except contains redundant control logic and power supplies:

<u>343</u>	<u>7,200</u>	<u>34</u>
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Spare Common T/R Logic • provides basic multiplexing/demultiplexing functions for both data and control signals • frame geometry established in RAM • end-to-end synchronization achieved in 48 bits on 417 microseconds at aggregate transmission rate • indicator synchronization status displayed at local and remote units, alarm status or multiplexing/demultiplexing circuits, and loopback diagnostics at remote multiplexer • occupies single card slot:

<u>27</u>	<u>575</u>	<u>4</u>
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Spare Redundant Control • provides aggregate interface between multiplexer and high-composite link • local/remote loopback • contains transfer circuitry for redundant logic operation • occupies single card slot:

<u>10</u>	<u>200</u>	<u>3</u>
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Spare Clock Generator • provides standard data rates for data channels • clock generator can be master timing source, or it can be phase-locked to aggregate transmit clock, aggregate receive clock, a selected channel clock, or station clock • occupies single card slot:

<u>29</u>	<u>600</u>	<u>3</u>
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Expansion Card • isolates and buffers common multiplexer signal and control buses for optional expansion shelves • this card is standard on redundant versions of TDM 1257 and TDM 1258:

<u>7</u>	<u>150</u>	<u>1</u>
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GTS-8N Power Supply • accommodates standard AC voltage or -48 VDC main source:

<u>81</u>	<u>1,700</u>	<u>5</u>
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GTS-8R Power Supply • redundant version of GTS-8N:

<u>133</u>	<u>2,800</u>	<u>8</u>
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Major/Minor Alarm Card • major/minor alarm conditions indicated visually via LEDs or audibly by buzzers • test points provide visual and audible indication of multiplexer card test point signals using a patch cord test probe; test points for DC voltage monitoring • occupies single card slot:

<u>10</u>	<u>250</u>	<u>3</u>
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MO: monthly 1-year lease charge including maintenance. PRCH: purchase price. MAINT: monthly maintenance charge for purchase units. All prices single quantity. Prices effective as of October 1984.

General DataComm Megamux Plus T1 Multiplexer

Sync Test Card • monitors and displays high-speed data stream error rate in 1 or both directions • test data generator produces steady mark or space pattern • can be used in conjunction with loopback facilities on individual channel cards to isolate errors • occupies single card slot:

29	600	3
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ECH-N Channel Nest Expansion • provides 16 channel slots for data channels and/or voice channels • requires channel nest expansion card • maximum 2 expansion nests per system:

32	770	1
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ECH-R Channel Nest Expansion • same as ECH-N except has slots for redundant common logic:

42	880	2
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Channels

Megamux Plus accommodates just 2 types of channel cards to handle data and voice. The data card is a protean unit that can be software specified and configured to handle asynchronous, isochronous, and synchronous data. The voice card employs CVSD quantization to convert analog voice inputs to digital output and the converse. Both cards contain a single channel port.

Data/voice channels are configured and tested via the operator console. Data rates, local and remote loopbacks, channel synchronization (async/sync/isoc), async code formats/stop bit lengths, integral test/compare, alarm reporting and control status/force control functions are all software controlled for each data channel. Its DTE/DCE interface orientation is established by an ingenious card-mounted program plug. To change the designation, the user merely removes the plug from its socket, reverses it, and reinserts it. No crossover cables are required, as is normally the case. The standard data channel interfaces are RS-232C/V.24, RS-422/V.11, RS-423/V.10, and CCITT V.35. An external adapter is used for AT&T 303 and RS-449. The RS-422/423 handle clock and data; control signals are RS-232C. The data card supports 4 full-duplex control paths, remote channel loopback, display of remote channel alarm, and display of activity of 2 control paths. One control path in each direction can be selected for fast control propagation. Propagation delay is 16 bits end-to-end.

The VCH-1 is a voice-channel card that employs the highly efficient continuously variable slope delta (CVSD) method for digitizing voice. Each channel uses standard 4-wire plus E&M signaling interface. Selectable transmit/receive levels are -16-dBm input, +7-dBm output, or 0-dBm in/0-dBm out. Each voice channel supports 12 rates up to 64K bps. The user sets rates, initiates local/remote digital loopbacks, and remote VF loopback via the control terminal. It is also used for idle-channel noise testing, E&M control status, 1-KHz tone testing (for calibration) and receive level fine adjustment (plus or minus 1.5db to minus 6.0db adjustable in 0.5db steps). Course adjustment (plus or minus 7/Odb) is under hardware control, as is transmit level adjustment, Type I, II, III, IV, and V E&M signaling options, loss of power (busy/idle), loss of sync (busy/idle), and internal or external battery.

The voice signaling and terminating equipment is FCC certified under Part G8 and consists of a single plug-in module and subassembly. It performs the signaling and termination functions required for applications such as Central Office to Off-Premise Station (CO-OPS), Private Branch Exchange to Off-Premise Station (PBX-OPS), and automatic ringdown. It also performs the

function of an isolated (registered) interface in PBX tie line applications.

To aid in channel testing, both the data and voice cards have a built-in bit error rate test (BERT) generator; and the data card can have its control signals forced high or low. See Strengths for details.

Data II Channel Card • provides channel logic for single asynchronous, isochronous, or synchronous data channel; data mode established via software • asynchronous data rates from 50 to 19.2K bps; 5, 6, 7, or 8 data bits and 1, 1.5, or 2 stop bits • synchronous data rates from 150 bps to 1.152M bps • isochronous data rates from DC to 64K bps (bit rate assigned to channel in aggregate output must be at least 4 times selected maximum input channel rate) • 64-bit I/O buffer • delay settings of 2, 4, 8, or 16 bits • displays data in/out sync for local and remote channels:

\$20 mo	\$410 prch	\$2 maint
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Voice II Channel Card • provides channel logic for single voice channel • data rates from 14.4K to 64K bps; CVSD quantization • 4-wire E&M signaling interface • selectable transmit/receive levels at minus 16-dBm input/plus 7dBm or 0/OdBm: 600 ohms, balanced input and output each adjustable (trim) for plus 1.5 to minus 6dB around nominal in 0.5-db increments:

19	395	2
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Composite Link

Megamux Plus supports single primary and secondary (backup) composite links. With the proper interface, it can be attached to fiber optic cable, satellite links, digital radio, as well as AT&T Communications' ACCUNET T1.5 service. For foreign connections, a G.703 interface (64K bps and HDB3 coded at 2.048M bps) is offered. For those employing dual composite links, the Diversity Switch provided as part of the D4 framing bit interface is employed to automatically switchover from primary to secondary link. The interface between the Megamux and link is via the T/R logic card and one of the following interfaces.

EIA RS-232C/CCITT V.24 Interface:

\$5 mo	\$100 prch	\$1 maint
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CCITT V.35 Interface:

5	100	1
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AT&T 303 Modem Interface:

5	100	1
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RS-422 (CCITT V.11), RS-423 (CCITT V.10), or MIL Std-188-114 Interface:

5	100	1
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DS1/G.703 Interface:

19	400	1
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D4 Framing & Diversity Switch • meets framing bit pattern required for D4 • switch handles switchover from primary T1 link to backup link:

38	800	8
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Fiber Optic Interface • requires 50-micron cable; transmits up to 600 feet without repeater • accommodates data rate of 1.544M bps or 2.048M bps:

81	1,700	5
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• END

Graphnet Freedom Network

Freedom Express, Freedom Forward, Gold Card & Freedom Network Services

■ PROFILE

Function • message-oriented, dedicated and switched, valued-added network services.

Facilities • interstate common carrier packet organized links connecting processing nodes using satellite, microwave, and cable circuits • FCC-regulated international record carrier (IRC) • 15 Graphnet node cities.

Services • message interactive/store-and-forward, nonvoice transmissions • error detection/correction; protocol/speed/code/conversion; alternate routing • messenger/mail/phone delivery services.

Access • public dial-up and dedicated access to 1200 bps • direct connect interactive services accessible in over 200 major metropolitan cities.

First Available • 1975.

Number Users • 10,000.

Comparable Services • ITT World Communications; RCA Global Communications; TRT Telecommunications; Western Union International; Western Union Telegraph Company; FTC Communications; MCI International.

Vendor • Graphnet, Inc, Subsidiary of Graphic Scanning Corp; 329 Alfred Avenue, Teaneck, NJ 07666 • 201-837-5100.

Canadian Headquarters • none.

■ ANALYSIS

The Graphnet Freedom Network is a message-oriented, value-added carrier service based on the CCITT X.25 protocol, and in fact the firm claims to have been the first public message delivery system to use packet-switching. The network is a regulated domestic and international record carrier (IRC), and provides both tariffed message services as well as enhanced, untariffed offerings. Major services available to Freedom Network users include interactive/real-time or store-and-forward message transmission; international telex; and an electronic mail service called Freedom Express. User messages can originate from a terminal/computer, via voice telephone call, or by phone. Message delivery can be accomplished through an end-user terminal, courier, mail, or voice telephone delivery depending on the classification of service. The network accommodates any asynchronous terminal operating from 50 to 1200 bps and provides speed, protocol, and format conversions allowing different types of data terminals (Telex, TWX, word processors, personal computers) to communicate. Graphnet is also developing an IBM BSC protocol handling capability, an enhancement still in the research and development stage.

Other major Freedom Network features include English-language addressing; common formats for all services; automatic routing to an alternate number in response to an incomplete call; camp-on; store-and-forward redirect; and the ability to input information once for transmission to a large number of addresses regardless of terminal type (multiple addressing). Graphnet affords other customized services and can provide next-day transaction reports in conjunction with its domestic store-and-forward service. The company has also reportedly developed specialized terminals and modems for message communication.

Graphnet's packet organized network offers higher data integrity than the Western Union Telex and TWX networks, or the telephone company's switched direct distance dialing network. Moreover, Graphnet provides a combination of services and

Graphnet Freedom Forward Service Minimum Usage Costs

Configuration • 2 customer sites located within local exchange areas of Graphnet entry points in the continental U.S. • dial-in access • traffic volume, for comparison's sake, is 60 messages per month with an average length of 100 words each; each word is defined as 6 characters in length • excludes costs associated with user-site terminal/modem equipment.

Minimum Start-Up Costs • none.

Minimum Monthly Operating Costs • \$70 per month, total • consists of \$60 per month traffic volume charge (\$0.01 per word; service through a different common carrier is twice this cost, at \$0.02 per word); plus \$10 per month for local dial-in/DDD message unit charges • international store-and-forward costs vary greatly depending on location.

features which can satisfy an extraordinarily broad range of user needs. For cost comparisons, the potential user should match Graphnet rates with those of Western Union Telex or TWX for low-speed transmission, and with GTE Telenet or Tymnet for transmissions in the 300-bps to 1200-bps range.

□ Strengths

A multiple microprocessor packet-switching system with store and forward processing capabilities, the Freedom Network offers a very flexible set of user-oriented options. It supports all asynchronous protocols and a fairly wide range of line speeds, allowing many hitherto incompatible devices to talk to each other. Dedicated and dial-in circuits can access any terminal connected to Graphnet as well as terminals connected to the Telex, TWX, and International Telex networks. Graphnet has agreements with some PTIs (postal/telephone/telegraph authorities in foreign countries), and transmits calls through other common carriers where it has no such agreement. Mnemonic routing with English language addressing dispenses with complex dial numbers and routing procedures. The system can store repetitive texts and address lists for periodic broadcast; and automated logging and tracking of messages relieves the user of burdensome accounting overhead. Messages can be retrieved up to 30 days after transmission with archival storage of up to 7 years.

The 50-bps to 1200-bps interactive service fulfills requirements for direct connect communication across a range of terminal devices. Geographically, local access to the network is respectably broad, at least in major metropolitan areas. Gold Card Service, on the other hand, allows users to phone-in messages while on the road or from locations without a terminal. A heavily advertised benefit of the network is low-cost, particularly when compared with the Western Union Telex and TWX offerings. According to Graphnet, for example, TWX and Telex messages can save users up to 40 percent on the Freedom Network, and up to 30 percent over comparable IRCs.

□ Limitations

In common with other packet networks, information is broken up into segments, transmitted by various circuit paths, and

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Freedom Express, Freedom Forward, Gold Card & Freedom Network Services

reconstituted for addressee use. The process does not lend itself to the intrinsic continuity of voice traffic; and users requiring voice and data traffic in the same network would have to explore other alternatives. Although Graphnet provides local access in major metropolitan areas nationwide, it cannot compare with the ubiquitous geographic breadth of its arch-rival Western Union. Prospective users can obtain a list of the over 200 Graphnet access locations from the vendor. A cost comparison study would have to scrutinize subscriber locations carefully; the extension channel costs associated with accessing a Graphnet entrance city from a remote area could prove unattractive, although dial-up costs could be acceptable.

Graphnet transmissions are limited to a 1200-bps data rate to and from the user's terminal. Other message carriers are implementing or planning to implement a higher-speed message service, or advanced telex, that supports user data rates up to 2400 bps. Called **Teletex**, the new service has already been introduced by Western Union and is available in well over 25 U.S. cities; it is also operational in several European countries as well. Newly designed Teletex terminals contain an integral memory for store-and-forward applications along with other advanced features. Although it will not replace Telex in the foreseeable future, Teletex will be a boon for organizations with high volumes of message traffic. Graphnet, however, does not provide a Teletex service and informed Data Decisions that it is not working on a Teletex service component for any time in the near future.

■ NETWORK

□ Terms & Conditions

Billing Criteria • customers pay for Freedom Express services based on factors associated with usage; messenger delivery, handling, and U.S. Postal Service charges where applicable; and a monthly subscription fee • billings for Freedom Forward store-and-forward service, an untariffed service, is charged by the number of words sent (a word equals 6 characters, on the average); international store-and-forward services are subject to Graphnet's international rate structure • Gold Card charges are based on Freedom Express, or Freedom Forward store-and-forward rates (depending on the type of Gold Card service) plus an additional built-in charge for operator assistance and WATS line usage • interactive service traffic charges based on data sending rate and either transmission time or data amount transmitted; interactive access charges, based on usage or a monthly charge, contingent on network called terminal is connected to; monthly subscription fee also applicable.

Billing Conditions • services available pre-subscribed for a minimum period of 1 month (30 days) • bills rendered monthly; payable on rendition • partial month computation only at start of service for items with monthly rates • subscription and station identification charges billed monthly • originating subscriber billed for nonaccepted collect messages • finance charge of 1.5 percent per month added to all amounts outstanding more than 30 days.

Other Conditions • data accepted 24 hours a day, 7 days a week, subject to restrictions of service class • subscriber use predicated on compliance with Graphnet formats and procedures • subscribers requiring station identification code must have separate code for each station type • right to limit length of communication or temporarily discontinue service reserved by Graphnet • specified minimum delivery times refer to first delivery attempt • subscription may be terminated by written or telephone request • service may not be used for unlawful purposes.

□ Overview

The Freedom Network provides access to Telex, TWX, International Telex, Cablegram, and terminal-to-terminal transmission using dedicated lines of dial-in common carrier facilities such as DDD and WATS. The network is made up of redundant, software-driven nodal processors, connected in grid fashion to each other and to a network control center. Each group of lines is connected to the network via statistical multiplexers; the architecture permits simple expansion at the nodes to accommodate more lines without impacting existing subscriber

connections. Since each front-end processor operates independently, specialized protocol support can be added for any small group of lines. Network control is provided through redundant Network Control Processors (NCP) which, through operator command, establish configuration parameters such as passwords, device and protocol changes, and routing changes. Subnetworks are also controlled by the NCP and changed via network control consoles allowing terminals used for 1 function in a given location to backup other terminals at the same location, irrespective of protocols and speeds. Automatic speed and code conversion permits terminals, operating in the range from 50 bps or less, up to 1200 bps, to converse with each other. The communication path between connected ports is full-duplex and provides short individual character transmit delays compatible with interactive conversational traffic. The envelope for data transmission between nodes is X.25 Levels 1 and 2.

The advanced computer architecture of the Graphnet network blends store and forward transmission facilities with packet switching technology to provide an interesting array of user functions. A mnemonic routing procedure allows public and private terminal devices to be addressed with English language statements, i.e., company name, rather than a long dial number and answerback set of codes. Messages destined for a terminal device can be automatically alternate-routed to another terminal in case of malfunction or extended use. A call forwarding feature on the Freedom Network initiates automatic redirection of messages to be received so that peak origination loads can be accommodated. The camp-on function triggers a network call back, when a destination terminal is free, to assure urgent call delivery. To relieve peak loads, the user can select store and forward redirect processing after a set number of attempted connections. The network also provides multiple addressing; a single text can be sent to multiple addresses based on address lists stored in the network or lists entered with each text. A variable insert function will personalize correspondence by inserting different names, dollar figures, and other variable information. Frequently used forms and letters, as well as lists, can be stored in the network for command transmission. Transaction reporting and departmental/segment billing features provide analytical data which is helpful in optimizing user interaction with the Graphnet network.

Freedom Express (Classes 3 and 4) provides message delivery services. Destination delivery under these service classes is accomplished by first class mail, courier, or telephone. Users can enter messages via Telex, TWX, phone, or through the Freedom Network at 300 or 1200 bps. The usage-oriented pricing structure is based on delivery method, message entry device, and number of lines per message, in addition to charges for delivery in business zone.

Freedom Network service, Class 8, provides a means of exchanging data on a direct connect or real-time basis. Data rates for this service range from below 50 bps to 1200 bps. Access is on a dial-in or dedicated basis. The called terminal may be on the Graphnet network or it may be connected to Telex, TWX, or the public switched telephone network (DDD). Class 8 is an enhanced, unregulated service; traffic charges are data rate and network usage sensitive. Access charges also apply dependent on whether access is dial-up, In-WATS, or dedicated.

Graphnet provides several classes of service for acceptance of overseas originated communication from U.S. international common carriers, at their gateway locations, for forwarding to addressee locations within the United States, where appropriate prior arrangements have been made with such carriers.

Freedom Forward service, Class 9, is a store-and-forward service that provides domestic and international telex, TWX, and other nontime-sensitive message delivery services. Data rates and access are the same as Interactive service; international delivery options include full-rate telegram and night letter services. Traffic charges are assessed by the word for domestic service, and subject to tariffed rates per word or per minute for international service depending on the classification.

Gold Card service provides a means for users to phone-in messages, by voice, to a toll-free Graphnet distribution center in Texas where they can be delivered by 1 of a number of methods. Gold Card service is comparable to Freedom Express and

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Freedom Forward services but with higher rates for the privilege of phoned-in messages.

Supplementary Graphnet services designed to support network users include an information retrieval facility and a variety of offerings related to information delivery. Graphnet routinely stores for a 3-month period at no cost all data entered into the system. Subscribers can recover their data, with service charges predicated on a 24-hour dynamic or 90-day historical retrieval basis. Delivery related services include confirmation copy, certification of delivery, collect message handling, status of delivery report, Zip Code repair, and address repair.

Freedom Express Service

Freedom Express, Classes 3 and 4, consists of message delivery services. Message origination is via Telex, TWX, telephone, or via the Freedom Network (FN) at 300/1200 bps. Message delivery is via courier, first-class mail, or by telephone depending on service. The usage-oriented charges are based on delivery method, message entry method, and number of lines per message; an additional charge applies to delivery in a business zone.

Class 3A • provide same day hand delivered message within 2.5 hours in a business zone when received by 3:00 PM point of destination time • message origination from TLX or TWX; phone; or 300/1200 bps Freedom Network (FN) • basic charge is for first 2 lines (TLX or TWX); first line (phone or FN), plus an additional charge for each additional 2 lines (TLX or TWX); each additional line (phone or FN), and a Business Zone delivery charge.

	\$2.15 basic	\$0.50 addl	\$3.75 del
TLX/TWX:			
Phone:	2.65	1.00	3.75
Freedom Network:	2.15	0.50	3.75

Class 3B • similar to nonpriority telegram; provides delivery by 6:00 PM same day when accepted 6:00 AM to 12:00 noon or by 12:00 noon of next day when accepted 12:00 noon to 6:00 PM • message origination from TLX or TWX; phone or FN • basic charge is for first 2 lines (TLX or TWX); first line (phone or FN), plus an additional charge for each 2 additional lines (TLX or TWX), each additional line (phone or FN), and a Business zone delivery charge.

TLX/TWX:	2.15	0.50	3.00
Phone:	2.65	1.00	3.00
Freedom Network:	2.15	0.50	3.00

Class 3E • similar to mailgram; provides first class mail delivery by 6:00 PM when received by 4:00 PM • message origination from TLX or TWX; phone or FN • basic charge is for first 8 lines (TLX or TWX); first 2 lines (phone); or first 4 lines (FN), plus a charge for each additional 4 lines (TLX or TWX); each additional line (phone); each additional 2 lines (FN).

TLX/TWX:	1.00	0.25	NA
Phone:	1.00	0.25	NA
Freedom Network:	1.00	0.25	NA

Class 4A • provides telephone delivery of received message within 2 hours with mailed confirmation to addressee • message origination from TLX or TWX; phone or FN • basic charge is for first 2 lines (TLX or TWX); first line (phone or FN), plus an additional charge for each additional 2 lines (TLX or TWX); each additional line (phone or FN).

TLX/TWX:	2.45	0.50
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Phone:	2.95	1.00
Freedom Network:	2.45	0.50

Class 4B • provides telephone delivery within 6 hours with mailed confirmation to addressee • message origination from TLX or TWX; phone or FN • basic charge is for first 2 lines (TLX or TWX); first line (phone or FN), plus an additional charge for each additional 2 lines (TLX or TWX); each additional line (phone or FN).

TLX/TWX:	2.15	0.40
Phone:	2.55	0.80
Freedom Network:	2.15	0.40

Inbound Cable Service

Inbound telegram/message traffic is covered under Class 6 service. Graphnet does not charge rates for Class 6 service; rather, users settle their accounts through the alternate message carrier providing the service.

Freedom Network

Freedom network is an interactive service that provides the subscriber with a means of exchanging information on a direct connection or interactive basis. Within this service, designated as Class 8, there are four service variations based on data transmission rate: Class 8A offers data exchange at 50 bps maximum, Class 8B at 110 bps maximum, Class 8C at 300 bps maximum, and Class 8D at 1200 bps. The service provides an English language address scheme. Charges typically include: a traffic charge which may be either a function of amount of data exchanged, or a measure of connect time; an access charge which may be either a monthly charge, or a measure of connect time; and a monthly subscription fee. Fractional charges are rounded off to the next higher increment.

Traffic Charges

Charges are based on type of network to which the called terminal is connected; international charges based on the through rate (see international access).

Called Terminal On Graphnet Network • charge per 40 characters (6.6 words) or charge per 0.1 of a minute, whichever is greater, for Class 8A • charge per 50 words or charge per one-half minute, whichever is greater, for Classes 8B, 8C, and 8D.

Class 8A:	\$0.535 0.1 min
Classes 8B, 8C, and 8D:	0.35

Class 8LF • called terminal on FTC Network • classes 8A, 8B, 8C, and 8D • charge per 0.1 of a minute:

	0.535
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Class 8LR/8LT • called terminal on RCA Global Communications & TRT Telecommunications Networks • charge per 0.1 of a minute:

	0.535
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Class 8LW/8LI/8LU • called terminal On Western Union Telex, ITT World Communications, or Western Union International Networks • classes 8A, 8B, 8C, and 8D • charge per 0.1 of a minute:

	0.535
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Class 8W • called terminal on Western Union TWX Network •

BASIC: basic charge for Class 3/4 service. DEL: delivery charge for Class 3/4 service. MIN: charge per minute. MO: monthly charge. WD: charge per word. MSG: charge per message. USAGE: usage charge. NC: no-charge item. NA: not applicable. Prices current as of March 1985.

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classes 8A, 8B, 8C, and 8D • charge per minute:

0.535

Class 8T • called terminal on Public Switched Telephone Network • classes 8A, 8B, 8C, and 8D • charge per 100 words:

0.595

Access Charges

Charges based on type of access (dial-up, 800 Service, or dedicated), monthly subscription fee, and additional station identification codes if required.

Dial-Up Access • charge per month for port; charge per month for modem.

Classes 8A, 8B, and 8C:

\$5 mo \$10 mo

Class 8D:

5 45

In-WATS Access • classes 8A, 8B, 8C, and 8D • charge per minute; 1-minute minimum:

0.33333 min

Dedicated Access • dependent on distance between customer location and nearest Graphnet node; telco charges passed on to customer • customers dialing WATS (800) will be charged back for the call, unless otherwise waived by headquarters.

Subscription Fee • monthly fee charged to provide subscriber with 1 station identification code • \$5.00 of monthly subscription fee credited to usage charges each month, non-accumulative • charge per month:

6 mo

Additional Station Identification Codes • separate code required for each terminal type • separate code required to subtotal itemized billing by originating station • charge per additional station identification code per month:

1

Freedom Forward Service

Freedom Forward, designated Class 9, is a store-and-forward service that supports terminal-to-terminal message transmission for any 2 asynchronous devices operating from 50 to 1200 bps, in a nontime sensitive mode. Class 9 domestic service is classified as an enhanced service and is not subject to tariffs; rates established by Graphnet. As an integral part of the service, Graphnet provides next-day management reports for call details.

Class 9FB • message originated from Telex or TWX • store-and-forward service for domestic Telex or TWX, including Canada, and Mexico; 50-word minimum • optional online transaction reports next day delivery at no charge • charge per word:

\$0.02 wd

Class 9FI • message originated from Telex or TWX • international terminal-to-terminal store-and-forward service • rate based on applicable international unbundled rate; 1-minute minimum • optional online transaction reports next-day delivery at no charge:

NA

Class 9FR • full rate international telegram service • immediate hand delivered overseas • rate based on applicable international cable rate:

NA

Class 9LT • letter telegram • hand delivered overseas next morning • rate based on half the applicable international cable rate plus charge:

0.0475

Class 9FC • message originated from Telex or TWX • automated domestic Telex or TWX including Canada, and Mexico with automated cancellation notification to the terminal • optional online transaction reports for dedicated line customers and dial-up customers • 50-word minimum • rate based on per word, and charge for each delivery notification:

0.01 wd 0.10 del

Class 9FH • message originated from Telex or TWX • automated international Telex with automatic cancellation notification to terminal • optional online transaction reports for dedicated line customers and dial-up customers • rate based on applicable international unbundled rate, 1-minute minimum, plus delivery notification charge:

NA 0.10

Transaction Reports • free for Class 9FB and 9FI services only; extra cost option for 9FC and 9FH services • Graphnet provides daily reports on the previous day's messages • details messages' cost and delivery verification, and lists intercept terminal in case of rerouted messages • coded entry for each message gives the input terminal, number of words, number of connect minutes, and breakdown of charges; can be segmented into various departments within a company • users call toll-free number in New Jersey for customer service/problem determination • online message retrieval provided within 30 days of message delivery; message archival provided for 7 years after delivery.

9FB & 9FI:

NC

9FC & 9FH • Leased Line:

25 mo

9FC & 9FH, Dial-Up:

50

Gold Card Service

Users who obtain a Gold Card are assigned an account number for phone-in service with message delivery identical to Freedom Express or Freedom Forward store-and-forward services • users call a toll-free 800 number, delivering their message via voice to an operator for transmission over a Freedom Network • the Gold Card itself is free of charge; Gold Card traffic rates, higher than other Freedom Network services, reflect additional costs for operator assistance and WATS lines obtained by Graphnet • **an average line of text contains 10 words.**

Class 3A • provides Business Zone courier delivery of phoned-in message within 6 hours of reception; see Freedom Express Class 3A service for terms of service • basic charge for first 6 lines of text plus charge for each additional line; a \$3.75 Business Zone delivery charge also applies to each transmission:

\$7.95 initl \$1.00 addl

Class 3E • provides First Class Electronic Mail Delivery to nearest serving post office; see Freedom Express Class 3E service for terms of service • basic charge for first 10 lines of text plus charge for each additional line:

7.95 0.50

Class 4A • provides telephone delivery of phoned-in message within 2 hours of reception, confirmation copy mailed; see Freedom Express Class 4A for terms of service • basic charge for first 2 lines of text plus charge for each additional line:

7.95 1.00

Class 9FB • provides domestic Telex/TWX delivery of phoned-in message • assessed on number of words transmitted (average word equals 6 characters) • 50-word minimum • basic charge for first 100 words plus charge for each additional word:

7.95 0.05 wd

Class 9FI • provides international Telex/TWX delivery of phoned-in message • rate based on Graphnet country rate per minute, or "through rate" (see International Access for rates) plus the following service charge for each minute:

2.00 min

Class 9FR • provides international full-rate telegram service • rate based on Graphnet country rate per word (see International Access), 7-word minimum, plus the following service charge per message:

2.50 msg

Class 9LT • provides international night letter (letter telegram), where available • rate based on Graphnet country rate per word

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(see International Access), 22-word minimum, plus the following service charge per message:

2.50

Access

U.S. Locations

Graphnet locations provide Telex/dial-in access from over 150 U.S. locations. The Freedom Network does not recognize different city-categories; all locations have equal access to the network.

- Alabama** • Birmingham; Huntsville.
- Arizona** • Phoenix; Tucson.
- Arkansas** • Little Rock.
- California** • Anaheim; Fresno; Irvine; Long Beach; Los Angeles; Mountain View; Newport Beach; Palo Alto; Pleasanton; Rancho Bernardo; Riverside; Sacramento; San Bernadino; San Diego; San Francisco; San Jose; San Mateo; Santa Clara; Stockton; Thousand Oaks; Torrance; Van Nuys.
- Colorado** • Colorado Springs; Denver.
- Connecticut** • Bridgeport; Hartford; Stamford; Waterbury; Westport.
- Delaware** • Wilmington.
- Florida** • Ft. Lauderdale, Jacksonville; Miami; Orlando; Tallahassee; Tampa.
- Georgia** • Atlanta; Augusta.
- Idaho** • Boise.
- Illinois** • Chicago; Lombard; Springfield.
- Indiana** • Fort Wayne; Indianapolis; Osceola.
- Iowa** • Des Moines.
- Kansas** • Wichita.
- Kentucky** • Lexington; Louisville.
- Louisiana** • Baton Rouge; New Orleans; Shreveport.
- Maryland** • Baltimore.
- Massachusetts** • Amherst; Boston; Brockton; Burlington; Concord; Framingham; Hudson; Maynard; Medfield; Mendon; Springfield; Waltham; Westboro; Worcester.
- Michigan** • Ann Arbor; Detroit; Flint; Kalamazoo; Lansing; Saginaw.
- Minnesota** • Minneapolis.
- Mississippi** • Jackson.
- Missouri** • Kansas City; St. Louis.
- Nebraska** • Omaha.
- Nevada** • Las Vegas; Reno.
- New Hampshire** • Merrimack.
- New Jersey** • Cherry Hill; Greenbrook; Hackettstown; Montclair; Newark; Parsippany; Princeton.
- New Mexico** • Albuquerque.
- New York** • Buffalo; Garden City; Hicksville; New York City; Rochester; Selden; Syracuse; Tonawanda; White Plains.
- North Carolina** • Charlotte; Greensboro; Raleigh.
- Ohio** • Akron; Canton; Cincinnati; Cleveland; Columbus; Dayton; Granville; Toledo.
- Oklahoma** • Oklahoma City; Tulsa.
- Oregon** • Portland.
- Pennsylvania** • Allentown; Erie; Harrisburg; Philadelphia; Pittsburgh; Reading.
- Rhode Island** • Providence.
- South Carolina** • Charleston; Columbia.
- South Dakota** • Rapid City.

- Tennessee** • Knoxville; Memphis; Nashville.
- Texas** • Austin; Dallas; El Paso; Fort Worth; Houston; Lubbock; Midland; San Antonio.
- Utah** • Salt Lake City.
- Virginia** • Charlottesville; Hampton; Norfolk; Richmond.
- Washington** • Seattle; Spokane.
- West Virginia** • Charleston; Huntington; Parkersburg; Wheeling.
- Wisconsin** • Milwaukee.

International Access

Graphnet store-and-forward, interactive, and Gold Card messages sent to locations beyond the continental U.S. and overseas through the Freedom Network are charged at tariffed rates. The network itself extends to over 250 international locations, including all major continents and islands; U.S. possessions and territories; Europe, the Middle East, South America, Japan, Korea, and Malaysia. Except for full-rate telegram and night letter (letter telegram) service, connections are charged by a single end-to-end "through rate," ranging from \$0.3475 to \$2.92 per minute depending on the location. The minimum charge for most calls is 1 minute, with a handful of locations incurring a 3-minute minimum.

Full-rate telegram (cable) service is charged by the word, which averages 6 characters in length. Normal cable rates average from \$0.21 to \$0.34 per word, depending on the location. Exceptions to this structure are Canada, Mexico, and St. Pierre-Miquelon where rates are \$6.50, \$4.40, and \$7.58, respectively, for the first 15 words plus a charge for each additional word.

Letter telegrams, or night letters, provide a savings over same-day, full-rate telegrams, and are usually delivered overnight. Many countries, however, do not accept night letters. Also charged by the word, night letter rates average from \$0.1525 to \$0.2175 per word, depending on the location.

For a full listing of Freedom Network international access locations and service rates, an international rate card can be obtained from Graphnet.

Supplementary Service Charges

Address Repair

At subscriber's request, Graphnet will undertake to repair the address of a message to maximum extent possible as required for proper delivery • charge per address repair:

\$1.00

Certification of Delivery

Subscriber may request delivery receipt for class 3A, 3B, 3C, 4A, 4B, and 4C services • receipt sent via First Class U.S. Mail • charge per delivery receipt:

\$0.60

Collect Messages

Subscriber may request, for 3A, 3B, 4A, 4B, and 4C services, that all transmission charges be made to an addressee; or may request that all transmission charges for information transmitted to subscriber at subscriber's request be made to subscriber • minimum transmission usage charge and delivery charge:

\$5.00 usage \$0.40 del

Confirmation Copy

Originating subscriber on class 3A, 3B, 3C, 3D, 3E, 4A, 4B, and 4C services may request a copy of the information.

Copy Sent Via First Class U.S. Mail • charge per copy:

\$0.60

Copy Sent Via Class 3 (Except 3E) or Class 4 Service • charge for service used.

Copy Sent Via Class 3E Service • charge per copy:

0.65

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Information Retrieval

All information accepted by Graphnet is stored, at no charge, as dynamic storage for 24 hours, and as historical storage for 90 days.

Dynamic Storage Retrieval • charge per request:
\$2.00

Historical Storage Retrieval • charge per request:
4.00

Status Of Delivery Report

Available for class 3A, 3B, 3C, 4A, 4B, and 4C services • message reporting the status of delivery is sent to the subscriber's originating terminal device within 24 hours, Monday through 1:00 PM Friday, point of origin time; after 1:00 PM Friday, the report may not be sent until the following Monday • where the document has been posted or forwarded to its ultimate destination

via any third party, the corresponding Status of Delivery Report will so state, giving the time and date of such forwarding • charge per report:

\$4.70

Zip Code Repair

At subscribers request, Graphnet will provide or repair the Zip Code portion of an address, as required for proper delivery • charge per Zip Code:

\$0.50

Other Network Services

Subscribers may enter bulk data, in the form of reels of magnetic tape or punched card decks, for propagation on the network, by delivering the media to the Englewood, NJ office of Graphnet.

• END

GTE Telenet TP3000 & TP4200 Series Network Interface Processors, Concentrators & Packet Switches

■ PROFILE

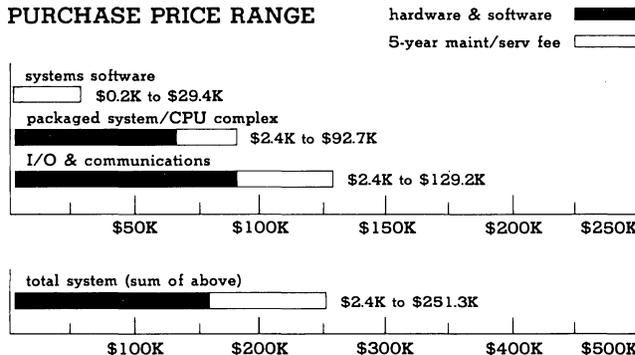
Function • concentrators and interface processors that connect terminals and host computers to Telenet or to another public or private X.25 packet-switching network • packet-switch processors provide switching functions, statistical multiplexing, and routing.

Associated Systems/Networks • GTE Telenet; asynchronous/BSC terminals and hosts • IBM 2780/3780 batch and 3270 interactive terminals; IBM System/370-compatible hosts; and Teletype-compatible terminals • other public and private X.25 networks.

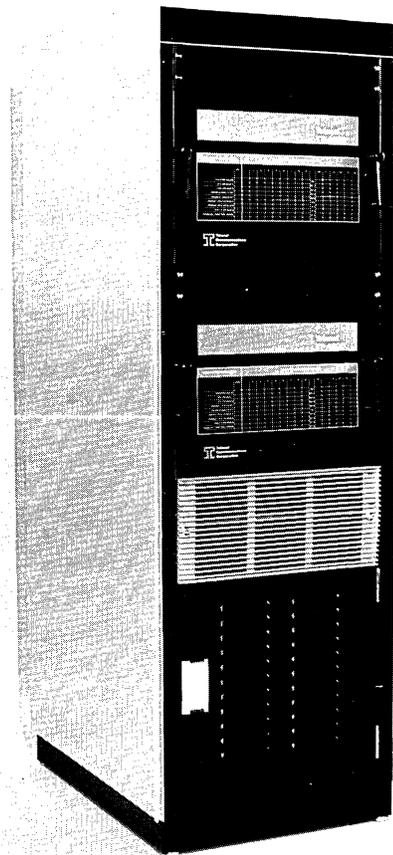
Communications/Networks • TP3000: 1 synchronous X.25 access link with BSC or HDLC framing, operating at 1200 to 19.2K bps; supports CCITT X.25 (1980 or 1976; LAP or LAPB), X.3, X.28, and X.29 protocols • TP3005 supports 4/8 asynchronous ports for connection to hosts or terminals operating at 110 to 9600 bps using asynchronous Telenet ITI-2 protocol • TP3010 supports 2 to 26 individually configurable device ports for asynchronous device lines at 110 to 1200 bps or synchronous device lines at 2400 to 9600 bps; supported network protocols include asynchronous Telenet ITI-2, 3270 DSP, BPAD, and HPAD (IBM's QLLC); supported device protocols include asynchronous, 3270, BSC, 2780/3780 BSC, and SDLC • TP4200 synchronous X.25 access links using HDLC framing operating at data up to 56K bps; non-X.25 BSC lines at 2400 to 9600 bps; and asynchronous links at 110 to 1200 bps • TP4200 systems supports from 2 to 128 links in increments of 4 or 8 lines.

Operating Systems • CP/MS (Communications Processor/Master Switch) master code on TP4200; TP3000 OS on TP3000 Series • new operating system on 4200.

Languages/Program Development • user selects Telenet software modules for communication protocol and monitoring/



GTE TP3000 & TP4200 SERIES PURCHASE PRICING bar graphs illustrate price ranges for small to large systems, with solid bars reflecting software/hardware purchase pricing and open bars reflecting 5-year maintenance or service fees associated with large systems • GTE includes the initial software license fee with the hardware price, thus the software bar shows only 5-year service/maintenance fee • **SMALL SYSTEM** includes TP3005 with 64K-byte memory, 401 ELA unit for a total of 1 network access line and 4 communications lines, and ITI software support • **LARGE SYSTEM** includes TP4253 dual processor system with 128K-byte memory per processor, 112 asynchronous line interfaces 110 to 1200 bps, 4 BSC line interfaces at 2400 to 9600 bps, and 8 HDLC line interfaces at 2500 to 9600 bps; software prices were estimated based on the TP4000 Series software prices.



diagnostic functions, downline loaded from Network Control Facility at Network Control Center; TP3010 can attach TTY console and load from its own magnetic tape housed in Front Panel.

Processors • up to 64K-byte memory on TP3000 processor; up to 256K-byte memory on TP4200 processors • TP3000 based on Zilog Z80A; TP4200 based on MOS TECH 6502, Version 2.

First Delivery • 1978 for TP4200; 1983 for TP3010; 1984 for TP4200; 1985 for 4800.

Systems Delivered • over 2,550 (TP3000); over 900 (TP4200).

Comparable Systems • Amdahl 4400 Series Network Concentrators: Models 4440, 4450, 4460 available in support 8/16/24/32/40-port versions with line speeds up to 19.2K bps; the 4410 supports multinode, large-scale networks; over 10K devices and up to 1M users; over 100 nodes, each node supporting 1 to 3 processors; 256K-byte packet sizes, 450-packet-per-second throughput expandable to 1,350 per node; supports up to 20 X.25 links per packet processor unit.

GTE Telenet TP3000 & TP4200 Series

Network Interface Processors, Concentrators & Packet Switches

Vendor • GTE Telenet Communications Corporation; 8229 Boone Boulevard, Vienna, VA 22180 • 703-442-1000.

Distribution • through direct sales/distributors throughout the U.S. • international distributorship agreements (dedicated networks): Plessey Controls in U.K. and Europe; Perseus in South Africa; Cable & Wireless worldwide, and others in Middle East and Scandinavia.

■ ANALYSIS

GTE is currently reorganizing and renaming its TP3000 and TP4XXX product lines. The reorganization should be completed first quarter 1985 and possibly as early as February 1, 1985. The product line is being reorganized to incorporate the new TP4200 and TP4800 systems. Full specifications and prices on these systems are not yet available. The TP4200 is based on the MOS TECH 3602 Version 2; the TP4000 is based on the 3602 Version 1. The 6302 Version 2 is faster than Version 1 and supports larger local memory, thus GTE no longer markets the TP4000 based on Version 1.

The TP3000 and TP4200 Series of communication processors can interface a wide range of hosts and terminals to any public or private X.25 packet-switched network and not just to Telenet. GTE provides private X.25 networks in addition to its public Telenet service. It has 25 private installations currently.

The series ranges from a small TP3005 that can interface both hosts and terminals to a packet network to large TP4200s that operate as network switches. The TP3010 can perform its own loading diagnostics without using the resources of a network control center. The TP4200 Series is primarily designed to operate in networks that use a network control center (NCC) for network management. GTE has developed the TP5000 Series to use in NCCs.

GTE uses industry-standard protocols in its TP Series hardware and software offerings. Its products support 1976/1980 CCITT X.25 and non-X.25 standards. All of its concentrators communicate with the network as X.25 devices and can communicate with other X.25 networks or devices. The X.25 Recommendation includes 3 levels of protocols: Level 1 is the physical level, Level 2 is the frame/link level, and Level 3 is the packet level.

GTE implements X.21 bis at Level 1, which corresponds to the EIA RS-232C and (CCITT) V.35 standards for synchronous, full-duplex communication of serial digital data. GTE implements HDLC at Level 2 frame level, but the interface to X.25 DTEs can be either BSC or HDLC. Level 3 specifies how logical channel numbers are assigned, how calls are established, routed, and cleared, and how data and control information is structured in the packets.

The GTE Interactive Terminal Interface (ITI) implements an asynchronous packet assembly/disassembly (PAD) using the CCITT Recommendations X.3, X.28, and X.29 protocols for interfacing asynchronous devices to a packet-switching network (PSN). The ITI converts the asynchronous protocol into X.25.

Some TP4200 models can operate as packet switches and implement the CCITT X.75 Recommendation for connecting one PSN to another. So these packet switches can not only operate as a switch on an X.25 network but operate as a gateway to other networks. The X.75 Recommendation provides for internetwork accounting, address mapping between networks, and mapping of specific network services.

The non-X.25 protocols that GTE accommodates include IBM 3270, IBM X780, and IBM HASP/MLI (Houston Automatic Spooling Program/Multi-Leaving Interface).

The GTE current PAD implementation of the IBM 3270 protocol is one called DSP3270 developed by Cambridge Telecommunications, Inc for Datapac. Cambridge Telecommunications, Inc is now part of GTE. The North American Standard called 3270 DSP for the 3270 PAD was adopted in 1981. GTE has supplied 3270 DSPs since January 1983.

The BSC Packet Assembler/Disassembler (BPAD) protocol supports the IBM X780 and HASP/MLI protocols. BPAD was jointly defined by Telenet, Datapac of Canada, and KDD of Japan.

The user defines block sizes, calling procedures, and line control characteristics through BPAD options.

GTE also offers the DMEP (Data-Network Modified Emulation Program) software to run in IBM 3704/3705 communications processors front-ending S/370-compatible hosts. DMEP essentially interfaces IBM S/370-compatible hosts to X.25 networks.

□ Strengths

GTE provides an integrated overall systems approach to the private network market. The company is not only a vendor of a public X.25 packet-switched network service, but also designs and builds private X.25 packet-switched networks. The TP Series of concentrators, interface units, and switches are the same units GTE uses on Telenet and its private networks. The user side is an industry standard interface while the other side is to the X.25 network. The TP Series units are transparent to the user and require no hardware or software changes. Remote non-X.25 terminals can communicate with non-X.25 hosts over an X.25 network using a TP Series processor on each side. Therefore, a terminal can access many different hosts or different applications on a host.

Systems are flexible. They separate PAD and X.25 functions from control functions, allowing systems to be configured to fit user needs.

Network management functions are fully integrated so systems can be configured, changed, or controlled from any remote site.

Also, systems have advanced user interfaces. They support such features as custom heralds on a per-terminal basis, symbolic addressing and privacy lists. These features are standard with any PAD type.

No other vendor offers the range of products and functions provided by the TP Series for interfacing to packet-switched networks.

□ Limitations

GTE does not market its products well. Documentation of product functionality and price lists are hard to obtain. The company appears determined to hide its products from the world rather than promote them. It also announced products rather haphazardly, without functional specifications or prices. This usually indicates a company is engineering-driven rather than marketing-driven. The TP Series includes a lot of good products that can make it easy for potential customers to use public/private X.25 networks.

■ SOFTWARE

□ Terms & Support

Terms • initial license fees for operating systems and communication software packages are bundled with hardware; there is a small monthly license fee for the software packages.

Support • the monthly software license fee includes software updates, monthly maintenance, and project management support • travel expenses are not included in the monthly fee.

□ Software Overview

GTE Telenet's CP/MS Master Code includes 3 modules: TPOS the general-purpose operating system; Proto, the X.25 packet-level control code; and the other includes the Switch code, TPOS. The Operating System performs general system management/housekeeping functions for the TP communication processors and switch. CP/MS is bundled with hardware and each system is programmed to perform specific communication and support functions. Support for software is a separate monthly charge and is not reflected with hardware support.

GTE Telenet provides software programs that are downline loaded from the TP3030 or TP5000 Network Management Facilities at the Network Control Center to each TP3000 or TP42XX processor for user-specified configurations on the X.25 packet-switching network. The TP3000 system software/diagnostic programs can be downline loaded from the TP3030 or directly from a cassette tape drive resident in the system's Front

GTE Telenet TP3000 & TP4200 Series

Network Interface Processors, Concentrators & Packet Switches

Control Panel. By connecting the optional 303 TTY Console, the TP3010 system can be configured to operate the Telenet Diagnostic Tool (TDT) program and diagnostic routines. However, online operational monitoring requires connection to the TP3030 facility or alternatively, to the TP5000 NCP. The TP42XX concentrator/switches can be controlled only by the TP5000 Network Management Facility, which downline loads software programs to the TP4200 systems. The TP5000 also supports the TP3000 Series.

Various communication interface programs are provided to support asynchronous and synchronous devices. The Data-Network Modified Emulation Program (DMEP) used to interface the IBM/370 to the X.25 network resides in the IBM front-end system, not in a Telenet system. GTE Telenet does provide special NCC software packages to facilitate the table-building, loading, and diagnostic functions generated via the Network Management Facilities on a TP5000 Series Network Control Processor.

□ Operating System

CP/MS Master Code • includes 3 modules to separate control, network, and switch functions: TPOS, PROTO, and Switch • performs system management and control functions on TP40XX network processors; supports 256K-byte memory on TP40XX systems; supports basic X.25 levels: Levels 1 (frame), 2 (HDLC), and 3 (packet) on network access line • controls intercard communications (I/O between master/slave); provides buffer management and supports certain PAD (packet assembler/disassembler) functions; provides routing functions on TP4050 network switch models • operating software is bundled with hardware on all systems • TP4200 uses a new operating system; GTE has not yet announced what enhancements it offers to the features supplied by CP/MS.

TP3000 TPOS • basic operating system supports 64K-byte memory on TP3000 processor multitasking OS with 8 task levels to separate PAD from X.25 and control functions; allows selection of particular PAD • programmed in Z80 assembler • included as standard with each PAD type:

\$10 mo

□ Networks/Communications

GTE Telenet provides several products to interface hosts/terminals to packet-switched networks and to perform PAD (packet assembly/disassembly) functions. These are the Interactive Terminal Interface (ITI) PAD for asynchronous devices; the 3270 PAD for IBM 3270 terminals/controllers; the Data-Network Modified Emulation Program (DMEP) for asynchronous devices, IBM X780 terminals and 3270 terminals; Bisynchronous Packet Assembler/Disassembler (BPAD) for IBM X780 and HASP/MLI devices, and HPAD support for SDLC. ITI runs on all of GTE's terminal interface devices: the TP3000 and TP4200 Series. The 3270 PAD runs only on the TP3010. DMEP runs on an IBM 3704/3705 front end to an IBM S/370-compatible host. BPAD and HPAD run on the TP3010 and the TP4200 Series.

Switching software for the TP4000 X.25 Host/Terminal Concentrators embedded in the operating system. The switching software also implements the CCITT X.75 protocol for internetwork switching providing a gateway between networks.

Interactive Terminal Interface (ITI) PAD • implements CCITT Recommendations X.3, X.28, and X.29; X.3 defines a set of 18 parameters to specify ITI PAD functions to control an asynchronous terminal; X.28 defines the way a terminal user controls the X.3 functions, and X.29 defines the way a remote X.25 host (or ITI PAD emulating an X.25 host) can control the X.3 functions • X.3 parameters can specify terminal speed, terminal display, flow control, break handling, and data forwarding conditions • X.3 parameters can be pre-set in network tables, set by terminal user, and/or set by the host • provides support for asynchronous devices connected to the interface concentrators and DMEP; interfaces asynchronous devices to packet-switching networks within parameters based on CCITT Recommendation X.3; includes connection mode in either real terminal, transparent terminal, or network virtual terminal (NVT) modes • in real terminal mode, host performs all code support functions as

though linked to terminal • transparent terminal mode is identical to real terminal mode except terminal user cannot enter command mode and send messages directly to PAD after virtual circuit is established • NVT mode converts characters from asynchronous terminals to standard NVT format and allows host configured in NVT mode to communicate with any type of Telenet-supported asynchronous terminal • other parameters support even/odd/no parity; ASCII, some EBCDIC, APL, and Correspondence codes (TP3010 supports ASCII terminals only); half-/full-duplex terminals • bundled with hardware for specific user configuration; runs on TP3000 and TP4200 Series:

\$20 mo

3270 PAD • implements DSP3270 protocol • NAP 3270 has been superseded by the 3270 Display System Protocol (DSP), adopted as standard for 3270 PAD functions in August 1981; GTE implementation of 3270 DSP in its DSP3270 PAD was for first delivered in January 1983 • runs on 3010-II system only; supports IBM 3270 terminals/controllers; 3270 terminals include CRT displays and/or printers; supports up to 8 lines; up to 32 control units can be multidropped on 1 line connected to a TP3010; each control unit supports up to 32 IBM 3270 terminals • requires host 3270 PAD and terminal 3270 PAD to connect IBM 3270 network to packet-switched network: host PAD emulates polling selection generated by control unit (appears as terminal to host), packetizes data portion of host-to-PAD communication, and transmits it through network to terminal PAD; terminal PAD emulates polling/selection sequences of front end (appears as host to terminals) and establishes individual virtual circuit for each point-to-point or multidropped terminal; packetizes data it transmits • provides error recovery between device and PAD on BSC lines; packet network supplies error recovery over its network • bundled with hardware for specific user configuration:

25

Data-Network Modified Emulation Program (DMEP) • resident in standard IBM 3704/3705 front-end processor to IBM S/370-compatible computer to provide IBM host (or equivalent) access to X.25 packet-switching networks via front end configured with DMEP; provides all functions protocol for host connection of X.25 • IBM Emulation Program (EP) to support BSC devices runs as a subsystem of DMEP; no changes are required in host software • performs all host PAD functions, such as call supervision, flow control, error recovery, data transmission, and protocol conversion for host link; supports Network Operator Control Program (NOCP), multiple hosts, multiple network access links, and application subsystem selection; all terminals supported by the IBM EP are also supported by DMEP whether over point-to-point or multipoint communication lines, through switched network or leased private lines, and using ASCII or EBCDIC transmission code • terminals that can communicate through X.25 network to DMEP include: ASCII TTY, IBM 2741/3767/2780/3780, and IBM 3270-clustered terminals • as 3270 PAD host, emulate a polling and selection sequences generated by control units and looks like terminals to the host:

750

Network Operator's Control Program (NOCP) • control feature for DMEP front-end software; supports 1 or more asynchronous terminals for direct connection to front-end hardware; each NOCP console terminal can perform most of the IBM 370X front-end control panel functions and provide DMEP status and trace information, independent of host operating system software • provides commands for altering line trace options such as: stop/start trace activity, display control blocks, and front-end storage, use NOCP console as online trace logging device; provides remote diagnostic capability when used with auto-answer dial modem • console terminals connect to IBM 370X over switched or dedicated communication link at speeds up to 9600 bps • options selectable at subscription time; included with DMEP:

NA

MO: monthly license fee. NA: not available. Prices are current as of December 1984.

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Bisynchronous Packet Assembler/Disassembler (BPAD) • based on protocol developed by Telenet, Datapac of Canada, and KDD of Japan to convert BSC protocol to X.25 protocol; transparent to user • assembles/disassembles synchronous I/O packets; provides host-to-host, terminal-to-terminal, terminal-to-host, and host-to-terminal communications; handles such control functions as data integrity, flow control, error-handling, time-outs, and delay request locally; transmits only data to terminal/host • available on TP3010 and TP40XX systems which support such terminal-types as IBM 2780, 2770, 3780, 3740, 3770, as well as UNKNOWN (designation for terminals using a BSC protocol other than X780); data blocks are 400 or 512 characters long; supports X780 terminal in point-to-point configuration only • TP3010 allows any ASCII IBM X780 device to communicate with any EBCDIC IBM X780 device through ASCII code conversion to EBCDIC • support for HASP/MLI available to TP4200 only; when configured for BPAD support, block sizes can be up to 4000 characters • bundled with hardware for specific user configuration:

20

HPAD • GTE calls it support for SDLC but it is compatible with IBM's QLLC (Qualified Logical Link Control):

25

□ Program Development/Languages

Program development is performed at a network control center or facility and downline loaded to the TP3000 or TP4200. The TP3030 Network Control Facility, can be used only for the TP3000; the TP5000 Network Control Processors can be used for both TP3000 and the TP4200 Series. The TP3030 is being phased out and all of its capabilities have been added to the TP5000. The TP3010 can support a TTY console with a configuration tape for local loading for a local network control facility.

Network Control Center (NCC) • table-building facility; provides user-specified parameters (protocols) for terminal interface; determines primary and alternate routing paths between devices in the networks; defines user groups for data security • provides support programs and edit tables, translates programs into binary format, transfers them from NCC computer and load them into each concentrator and switch • loader program resident in NCC; supplies remotely located processor with tables and software for easy monitoring and reloading within minutes of system failure; no operator intervention required to reload failed processor; operator can initiate downline load on request • includes TPRF and TDT (see below) on TP40XX processors and switch • optionally available on TP3010 processor.

TP3010 NCC Control Option • for the TP3010 only; TTY console operates in place of TP3030 NCF; in such a case, user receives a configuration tape for local loading and a one-time \$75 table-building charge for each TP3010:

\$60 mo

ELA Software Support • Network Control Center (NCC) option for each Extended Line Adapter used on the TP3010 processor; supports downline loading from NCC:

15

■ HARDWARE

□ Terms & Support

Terms • available for purchase only from GTE Network Systems with a choice of service plans • GTE Telenet leases systems for interfacing to its Telenet carrier services.

Support • monthly service charges under various Principal Period of Maintenance (PPM) plans: Plan A covers service during hours between 8:00 AM and 4:00 PM; Plan B, between 8:00 AM and 12:00 PM, Plan C, 24 hours per day; Option I provides service 5 business days per week, exclusive of GTE Telenet holidays; Option II, 7 days per week including holidays • service required outside selected PPM (for example, Plan A or B and Option I) requires no additional charge for maintenance parts, but service is subject to charges according to applicable hourly rates and with 4-hour minimum including travel time • there is a nonrecurring equipment installation charge as follows: \$400 for

the TP3000 processor system; \$900 for the TP4200 processor systems; installation time and labor for parts is at no charge if included as part of basic processor at time of installation; upgrade installations are \$250 per site, excluding travel and expense costs from maintenance point to site.

□ Overview

The GTE Telenet TP3000 processors function as concentrators for access to an X.25 packet-switching network. The TP4251 and TP4252 can also operate as packet switches. The TP3010 operates as both host and terminal concentrators, and the TP4250 models function as X.25 host or terminal concentrators and packet switches. The concentrators accommodate from 27 to 128 communication lines; various models support one or more lines to an X.25 network. Some models have redundancy options providing backup if a system module fails.

The TP4200 Models are all based on the MOS TECH 6502 Version 2 Microprocessor. The TP3000 is based on the Zilog Z80 Microprocessor.

The TP4200 Models require a TP5000 Network Control Processor (NCP) to perform network management functions. The TP3000 can be supported by, but does not require, the TP3030 Network Control Facility (NCF) or the TP5000 NCP for network management. The TP3010 accommodates a TTY console and the support software and diagnostics can be loaded from a cassette tape on the TP3010 front panel. The TP3030 is being phased out and all its functions will be performed by TP5000 NCPs. The TP5000s are based on the Prime Series 50 computers.

All of the software except DMEP runs in the data concentrators. DMEP runs in an IBM 3704/3705 communications processor operating as a front end to a S/370-compatible processor.

□ CPU & Memory

TP3000 Network Interface Processors (NIPs)

A Zilog Z80A-based intelligent communication processor with 64K-byte memory; functions as low-cost concentrator and interfaces asynchronous and BSC (3270 and X780) computers and terminals to X.25 packet-switching networks; it requires no modification for user software • performs PAD (packet assembly/disassembly) functions • basic TP3010 system provides 1 synchronous X.25 network access link port and 3 terminal/host ports; maximum system supports 3 Extended Line Adapter (ELA) boards, each adds support for 8 terminal/host lines; maximum support includes 1 X.25 network access link and up to 27 lines • each port configured to support specific protocol: HDLC, BSC (ASCII/EBCDIC); DMA standard on network link; supports ITI (interactive terminal interface), 3270, 2780/3780, DTE, and TTY devices; features comprehensive diagnostic tools online/off-line via TP3030 NCF console • TP3010 system not attached to TP3030 NCF can load software and diagnostic programs from cassette tape; TP3005 loaded from EPROM • memory cycle time of 400 nanoseconds (standard); 250 milliseconds optional; error detection/correction; 2 interrupt levels • drive unit located on TP3010 Front Control Panel; optional 303 TTY console can configure system and perform diagnostic routines • online operational monitoring requires TP3030 NCF connection • optional redundant Communication Line Processor (CLP) with 64K-byte memory; automatic switching to backup system in event of failure • basic TP3005 supports one network access line with BSC or HDLC framing at 1200 to 19.2K bps, 4/8 asynchronous devices ports with line speed of 150 to 9600 bps; maximum aggregate throughput is 4000 cps.

TP3005 Asynchronous Host/Terminal Concentrator • includes 64K-byte RAM, 48K-byte EPROM (for loading), 2K nonvolatile EPROM (stores configuration), 4 user ports, and 1 X.25 Network Access Port • includes 3-year software license:

\$2,350 prch \$30 maint

PRCH: purchase price. MAINT: monthly maintenance charge for purchased units; Plan A, Option I, Zone A. NA: not available or not applicable. Prices are current as of December 1984.

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Network Interface Processors, Concentrators & Packet Switches

TP3005-8 Asynchronous Host/Terminal Concentrator • same as TP 3005 except includes 8 user ports • includes 3-year software license:

3,250	30
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TP3010 Host/Terminal Concentrator • includes TP3010 processor, 64K-byte memory, 2 user ports expandable to up to 26 ports, X.25 Network Access Port • redundancy/back-up is optional; requires software license fee • includes Network Access Facility (NAF):

7,500	65
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306 Rack Mount Kit:

300	NA
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TP4200 Host/Terminal Concentrators & Packet Switches

An intelligent communication processor with 256K-byte memory; it functions as concentrators interfacing asynchronous, BSC 2780/3780, or HASP/MLI terminals/host computers to X.25 packet-switching network; perform PAD functions and statistical multiplexing; supports X.25, HDLC, asynchronous, and IBM bisynchronous protocols for IBM 2741, 2780/3780, and HASP II multileaving terminals; also supports ASCII, EBCDIC, APL, or Correspondence code set with any parity • can support from 8 LPUs (64 lines) to 16 LPUs (128 lines) asynchronous/synchronous operation; 10 to 12 lines can accommodate BSC communication • redundant configuration options available for some models • connect to TP5000 for comprehensive diagnostics and program downline loading • it can also function as a packet switch; and can perform routing functions; provides event reporting/accounting and statistical data services; supports up to 16 online LPUs for a maximum 128-line configuration • MOS TECH 6502-based processor with 2 interrupt levels (maskable/unmaskable); 7 interrupts; and error detection and correction.

TP4031 Host/Terminal Concentrator • supports up to 8 LPUs with 64 asynchronous/synchronous ports in single chassis • includes no ports in basic unit; no longer marketed.

TP4032 Host/Terminal Concentrator • supports up to 16 LPUs with 128 asynchronous/synchronous ports in dual chassis; can be configured with 411 CLR; no longer marketed.

TP4041 X.25 Host/Terminal Concentrator • supports up to 8 LPUs with 64 asynchronous/synchronous ports for X.25 packet-mode devices in single chassis, supports CLR; no longer marketed.

TP4042 X.25 Host/Terminal Concentrator • supports up to 10 LPUs with 128 asynchronous/synchronous ports; X.25 packet-mode devices in dual chassis; can be configured with CLR; no longer marketed.

TP4051 Host/Terminal Concentrator & Packet Switch • supports up to 8 LPUs with 64 asynchronous/synchronous ports in single chassis, supports CLR; no longer marketed.

TP4052 Host/Terminal Concentrator & Packet Switch • supports up to 16 LPUs with 128 asynchronous/synchronous ports in dual chassis; can be configured with CLR; no longer marketed.

TP4251 X.25 Host/Terminal Concentrator & Packet Switch • replaces 4051; supports up to 8 LPUs with 64 asynchronous/synchronous ports; supports CLR • includes 128K-byte local memory:

\$38,500 prch	\$200 maint
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TP4252 X.25 Host/Terminal Concentrator & Packet Switch • replaces 4052; supports up to 16 LPUs with up to 128 asynchronous/synchronous terminals; supports CLR • includes 128K-byte local memory:

49,000	250
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TP4253 X.25 Host/Terminal Concentrator & Packet Switch • replaces 4053; includes dual TP4200 central processors; each processor includes 128K-byte local memory • supports 18 LPUs or 128 ports; throughput is 1,640 packets per second:

70,500	370
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TP4255 X.25 Host/Terminal Concentrator & Packet Switch • dual cabinet version of TP4253:

NA	NA
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TP4800 X.25 Host/Terminal Concentrator & Packet Switch • dual processor system; no details have been released on the system:

NA	NA
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Memory

Main memory available in 8K- or 16K-byte memory modules • main memory to 64K bytes on TP3000; from 128K to 256K bytes on TP4200; redundant configuration provides up to 512K bytes • size of memory depends on protocols supported, number of ports, network topology, and redundancy criteria.

☐ Communications Lines

The TP3000 communication processor consists of a Communication Line Processor (CLP) board which provides one X.25 access link to the network and three host/terminal connections. Three Extended Line Adapters (ELAs) are used on TP3010 to provide the system with a maximum 27-line configuration: each ELA supports up to eight ports, providing a total 24 lines in addition to the three lines provided by the CLP. The TP3000 supports half-duplex communication at synchronous data rates from 1200 to 19.2K bps and asynchronous data rates from 75 to 9600K bps. Network access line supports full-duplex communication at data rates from 1200 to 19.2K bps. Automatic speed detection for speeds of 110 to 1200 bps is included as a standard feature, as well as internal/external clocking.

TP4000 Series support data communication through Line Processing Units (LPUs). The LPUs use microprocessors, and are programmed for support of asynchronous, BSC, and X.25 traffic. Basically, three types are provided: a low-speed LPU with four to eight ports for lines operating at up to 2400 bps; a medium-speed LPU that supports four lines operating at 9600 bps; and a high-speed LPU that supports eight HDLC lines at 19.2K bps or a combination of RS-232C and V.35 line speeds greater than 19.2K bps.

TP4031 supports one or two network access links at up to 56K bps. With one network link, up to seven LPUs can be added. With two network links, only six LPUs can be added. With one network link, a 1- to 4-port non-X.25 BSC synchronous link can be added with six LPUs. One LPU can be used as a backup if an LPU fails, but common logic redundancy is not supported.

TP4032 supports one or two network access links and two or three 1- to 4-port BSC synchronous links; supports two BSC links if two network access links are configured and three BSC links if one network access link is configured. Up to 8/9/10 LPUs can be added depending on the number of network access or BSC links. LPU redundancy can be for the network access or BSC link cards or for the LPUs or for both. Backups for both network access and BSC links require marketing approval. Common logic redundancy is supported.

TP4041 supports one or two network access links at up to 56K bps. If only one network access link is configured, a high-speed link can be used for the user's application. Up to six or seven LPUs can be added depending on whether one or two links are used for network access or customer's high-speed application. An LPU can be used as a backup for the network access link, high-speed application link, or the LPUs. Common logic redundancy is not supported. HDLC is supported.

TP4042 supports one or two network access links, two or three high-speed user application links, and eight, nine, or 10 LPUs depending on configuration. Network access links operate at up to 56K bps. Two additional LPUs can be connected to operate as backup for the network access link or high-speed application link and the LPUs. Backups for both network access and high-speed application links require marketing approval. Common logic redundancy and HDLC are supported.

TP4051 supports one or two network access links or the second link can be used for the user's high-speed application link. Up to six or seven LPUs can be added depending on the configuration of network access or user application links. Two LPUs can be added to backup the network access or user application link and the LPUs. Backups for both network access and user application links require marketing approval. Network access speed is up to

GTE Telenet TP3000 & TP4200 Series Network Interface Processors, Concentrators & Packet Switches

56K bps.HDLC is supported, but not common logic redundancy. System handles up to 610 packets per second.

TP4052 supports one or two network access links, three or four high-speed customer application links, and 12/13/14 LPUs depending on configuration. Network access speed is up to 56K bps. LPUs can be added to backup either the network access link or user application links and the LPUs. Backups for both network access and high-speed user application links require marketing approval. Common logic redundancy and HDLC are supported. System handles up to 610 packets per second.

TP4251 operates as a concentrator and packet switch. Provides up to 64 ports. Handles up to 820 packets per second. Uses 4200 processor.

TP4252 operates as a concentrator and packet switch. Provides up to 128 user ports. And handles up to 820 packets per second. Uses 4200 processor.

TP4253 dual processor model that replaces 4053; operates as a concentrator and packet switch. Provides up to 128 user ports. Handles up to 1,640 packets per second. Uses 4200 processor.

TP4255 dual cabinet version of TP4253.

TP4800 is a dual processor system. Operates as concentrator and packet switch.

301 Extended Line Adapter (ELA) • each board provides 8 ports • up to 3 ELAs on TP3010:

\$1,730 prch	\$15 maint
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302 Communication Line Processor (CLP) • includes 64K-byte redundancy; for TP3010 processor redundancy:

2,655	25
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401 LPU • asynchronous, 4 lines 110 to 1200 bps:

5,000	35
-------	----

402 LPU • asynchronous, 8 lines 110 to 1200 bps:

5,500	35
-------	----

403 LPU • synchronous (BSC), 4 lines 2400 to 9600 bps:

5,500	35
-------	----

405 LPU • synchronous (HDLC), 8 lines 2500 to 9600 bps:

11,000	70
--------	----

Common Logic Redundancy (CLR) • for TP4252:

NA	NA
----	----

303 Local/Remote Teletypewriter Connection • for TP3010-II:

100	3
-----	---

B900 Synchronous Modem Cable:

75	NA
----	----

B904 Synchronous Modem Eliminator Cable:

75	NA
----	----

B906 Asynchronous Modem Eliminator Cable:

75	NA
----	----

B907 Asynchronous Modem Cable:

75	NA
----	----

B0119 RS-232C Female-to-Female Adapter:

40	NA
----	----

B0120 RS-232C Male-to-Male Adapter:

40	NA
----	----

• END

GTE Telenet TP5000 Network Control Processor

■ PROFILE

Function • network control processor (NCP); host computer in Telenet Network Control Center (NCC) • provides commands and management for TP3000/TP4000 network concentrators and switches on dedicated packet-switched network; builds tables with user-specified parameters; downline-loads programs into each concentrator or switch • performs diagnostics and maintenance functions.

Associated System/Networks • the GTE Telenet TP3000 and TP4000 Network Interface Concentrators and Packet-Switches • GTE Telenet dedicated packet-switched networks • X.25 interface to public packet-switching networks.

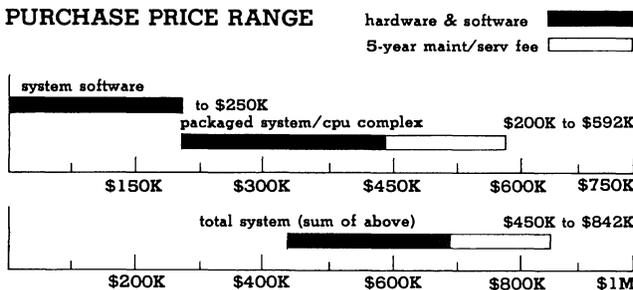
Communications/Networks • synchronous full-duplex lines with data rates up to 9600 bps • Asynchronous Multi-Line Controller (AMLC) board supports up to 16 asynchronous display terminals used as consoles for TPRF and TDT applications • Multi-Data Link Control (MDLC) board provides up to 4 X.25 links (BSC or HDLC format) to packet-switching network.

Operating Systems • Prime's PRIMOS operating system with Telenet enhancements.

Languages/Program Development • user-selected Telenet software modules for communication protocol and monitoring/diagnostic functions, downline loads TP network processor from TP5000 at NCC.

Processors • Prime Series 50 minicomputer: Models 250-II, 550-II, and 750; supports from 2M- to 8M-byte memory, 80M- to 300M-byte disk storage • basic system includes 9-track magnetic tape hard copy or CRT console, 2-line Multiple Data Link Controller (BSC or HDLC) and 16-line Asynchronous Data Link Controller • optional 300- or 750-lpm printer, up to 3 additional, and up to 8 additional disk drives.

PURCHASE PRICE RANGE



GTE Telenet TP5000 Series Purchase Pricing bar graphs illustrate price ranges for "small" to "large" systems, with solid bars reflecting hardware/software purchase pricing (software includes 5-year maintenance), and open bars reflecting 5-year service/maintenance fees associated with hardware of large systems • **SMALL SYSTEM** pricing is based on the TP5011 Network Control Processor and a hardware package including Prime 250-II minicomputer, 2M-byte memory, 16-line AMLC, 2-line MDLC, 80M-byte disk storage, tape subsystem, CRT console, 10-board chassis and cabinet, and 120-amp power supply; the software package includes the PRIMOS operating system and standard Prime software, TDT, TPRF, Tpload, NCC table building (price calculations include an initial license fee plus monthly license fee which includes maintenance) • **LARGE SYSTEM** is based on the TP5031 Network Control Processor and a hardware package that includes the Prime 750 microcomputer with 2M-byte memory, 16-line AMLC, 2-line MDLC, 300M-byte disk, tape subsystem, hardcopy console, 26-board chassis and cabinet, 3 120-amp power supplies plus an additional magnetic tape drive; the software package is identical to the **SMALL** systems software package • software license includes maintenance.

First Delivery • 1978.

Systems Delivered • 25 (estimated).

Comparable Systems • no systems on the market today offer quite the same facilities as the TP5000 Series; this may be due to the fact that no other company offers quite the same kind of services as GTE Telenet, a vendor-independent public packet-switching network as well as private packet-switching networks • the system is most comparable to the collection of network control facilities distributed network architectures vendors offer to control their networks such as IBM offers to control SNA and Honeywell offers to control DSA • local area network (LAN) vendors Ungermann-Bass and Sytek offer a network control centers for NET/ONE and LocalNet 20 LANs, respectively.

Vendor • GTE Telenet Communications Corporation; 8229 Boone Boulevard, Vienna, VA 22180 • 703-442-1000.

Distribution • direct sales/distributors throughout the U.S. • internal distributorship agreements (dedicated networks); Plessey Controls in U.K. and Europe; Perseus in South Africa; Cable & Wireless worldwide.

■ ANALYSIS

The TP5000 Network Control Processors (NCPs), used to manage private packet-switching networks, are the same systems GTE uses to manage Telenet. In fact, private network customers can use Telenet's Network Control Center (NCC) to manage the private network. In this case, the customer does not buy an NCP, but licenses the Customer Network Control Console (CNCC) software and interfaces his control consoles to it. GTE restricts the access of the customer's consoles to the status data, commands, and addresses applicable to the user's private network. This service is used primarily by companies with small networks or by companies that are just beginning to use private networks.

Private networks are expensive to build, and most companies begin slowly and cautiously. They require a certain amount of hand-holding from GTE in the initial phase while the personnel is being trained and the company is gaining experience. Initial investment for a small private network is \$600,000 to \$800,000 while large networks can run into millions of dollars. Large companies use one or more NCCs to control the network.

The NCPs are implemented using Prime Computer's 50 Series minicomputers. The power of the 50 Series ranges from about 0.2 MIPS for the 250-II (the basis of the 5011 NCP) to about 1 MIPS for the 750 (the basis of the 5032 NCP).

GTE has used Prime computers as control processors since the inception of Telenet in the mid 1970s. The 50 Series, announced in 1980, are upward-compatible versions of the older Prime 200, 300, and 400 models. Thus, GTE has long experience with the Prime hardware and software.

GTE is in the process of reorganizing its TP3000 and TP4000 product lines. Some of this reorganization will undoubtedly cause some changes in the TP5000 line as well. The reorganization is expected to be completed during the first quarter of 1985, possibly as early as February 1.

□ Strengths

The greatest strength of the TP5000 Series of Network Control Processors is in the vendor. GTE has as much experience as, if not more experience than, any company in the United States, and perhaps even in the world, with packet-switching networks. In addition to Telenet, GTE has 25 private network installations: divided about equally between the United States and Europe, South America, Mexico, and Japan. Although the number of

GTE Telenet TP5000 Network Control Processor

networks is small, the networks are large. GTE has implemented the largest private packet-switching network in the United States. It is Southern Bell Telephone's packet-switching network, which it offers to customers as a public network. To GTE, however, Southern Bell is a private network.

GTE has had a long working relationship with Prime computers. The NCP configurations that GTE offers scarcely tap the expansion potential of the Prime systems. Memory can be expanded to 8M bytes on the 750 used in the 5031 NCP. Either 80M- or 300M-byte drives can be added to the disk controller included in the basic system, and the disk controller can handle 8 drives. The magnetic tape controller can handle 4 drives. All basic systems include a console and Asynchronous Multi-Line Controller to support a maximum of 16 devices. Thus, a user can connect up to 16 control consoles to a single NCP. The console can be almost any type of terminal the customers wants to use. The potential upgrade of the TP5000 processor should satisfy the needs of any customer for years.

Limitations

GTE does not market the TP5000 Series as general-purpose network control processors. They are marketed primarily for GTE private network customers.

■ SOFTWARE

Terms & Support

Terms • Network Control Center (NCC) is offered as network management facility under various plans: Telenet NCC Services owned and operated by Telenet; Telenet owned and operated NCC with Customer Network Control Console (CNCC) service for a monthly license basis; customer owned and operated NCC that includes the purchase of NCC equipment with Telenet training support; and backup NCC capability owned and operated by Telenet while customer owns and operates primary NCC • **purchased software:** initial nonrecurring license fee plus a monthly fee for complete software package.

Support • included in monthly license fee • optional CNCC requires basic monthly service fee plus monthly charge for each customer console system address.

Software Overview

Management of a dedicated packet-switched network supporting GTE Telenet TP3000 and TP4000 network interface concentrators and packet switches is provided by a collective facility called the Network Control Center (NCC). This facility offers a user partial or full control of a dedicated network, thereby providing complete independence from the GTE Telenet Public Data Network. At the heart of the NCC is the TP5000 Network Control Processor (NCP), which functions as host computer capable of supporting up to 16 asynchronous terminals and printers. Terminals are used as consoles for Telenet Processor Reporting Facility (TPRF) and Telenet Diagnostic Tool (TDT) applications.

The TP5000 Network Control Processor runs under the PRIMOS operating system with Telenet-designed enhancements. Prime system utilities are provided for such standard computer operations as magnetic tape and disk utilization. PRIMENET controls the X.25 interface. The GTE Telenet software is modular and provides specialized programs generated by the NCC operator for table building, program loading, and diagnostic functions to accommodate specific network concentrator or switch applications. Two software programs, the Telenet Processor Reporting Facility (TPRF) and the Telenet Diagnostic Tool (TDT), reside in the TP5000 computer and provide monitoring, diagnostic, and maintenance functions for the TP3000 and TP4000 network interface concentrators and packet-switches. The TP5000s are connected to the network via a synchronous communication line operating at 9.6K bps.

A basic software package provided with each model includes the PRIMOS Operating System, Standard Prime software (bundled), the TDT and TPRF programs, Telenet Processor Loader (TPLOAD), NCC enhancements for table building, and PRIMENET X.25. Optional software includes other PRIME software (unbundled), the CNCC Alarm Filtering and Reporting and the GTE Telenet

Public Network Backup Service. Purchase of a complete basic software package requires an initial nonrecurring license fee of \$10,000 plus a monthly fee of \$4,000, which includes maintenance. The optional CNCC costs \$400 per month for basic service plus \$200 per month for each customer console system address.

Network Control Center (NCC) • table building facility; provides user-specified parameters (protocols) for terminal interface; determines primary and alternate routing paths between devices in the networks; defines user groups for data security • provides support programs and edit tables, translates programs into binary format, transfers them from NCC TP5000 computer and loads them into each TP concentrator and switch • loader program resident in TP5000 NCP; supplies remotely located processor with table and software for each monitoring and reloading within minutes of system failure (see below) • includes TPRF and TDT (see below) • Tpload (Telenet Processor Load Program) responds to network node load requests • start-up and utility software.

Telenet Processor Reporting Facility (TPRF) • automatic problem-reporting facility; collects reports of system malfunctions and change-of-status from network switches and concentrators; translates the coded message into English-readable form; indicates that event has occurred • maintains detailed records of time/date/circumstances/diagnostics as a result of failure • provides accounting information that includes length of call between user and network and number of packets exchanged during call.

Telenet Diagnostic Tool • used to diagnose and correct the problems reported by TPRF.

Program Development/Languages

Network configuration tables are created at the Network Control Center via a loader program residing in the TP5000; then the program is downline loaded into each concentrator or switch in the network. The program runs automatically and continuously. It requires no operator intervention to reload a failed processor; however, an operator can initiate a downline load.

Other Program Modules

Customer Network Control Console (CNCC) • software package available to Telenet customers in place of NCC: users on dedicated network using own terminals can use CNCC to monitor events and perform limited diagnostics with dedicated network • Telenet utilizes its own NCC, which is accessible through public data networks • includes accounting, table building, downline loading programs, and alarm filtering and reporting • customer has limited access to NCC facilities, limited to the private network status, command, and addresses.

■ HARDWARE

Terms & Support

Terms • available for purchase; leasing arrangements are also offered with purchase options during leasing period • installation charges are as follows: \$4,400 for the TP5011; \$5,900 for the TP5021; \$7,900 for the TP5031; \$900 for an 80M-byte disk expansion unit; \$1,200 for a 300M-byte disk expansion unit; \$900 for each additional magnetic tape subsystem.

Support • provided by Prime personnel contracted by GTE Telenet • monthly service charges under various Principal Period of Maintenance (PPM) plans: Plan A covers service during hours between 8:00 AM and 4:00 PM; Plan B, between 8:00 AM and 12:00 PM; Plan C, 24 hours per day; Option 1 provides service 5 business days per week, exclusive of GTE Telenet holidays; Option II, 7 days per week including holidays • service required outside selected PPM (for example, Plan A or B and Option I) requires no additional charge for maintenance parts, but service is subject to charges according to applicable hourly rates and with 4-hour minimum including travel time.

Overview

The TP5000 Network Control Processor (NCP) consists of 3 models—TP5011, TP5021, TP5031. The TP5000 NCP functions

GTE Telenet TP5000 Network Control Processor

as host computer in the Network Control Center (NCC), and provides commands and management for the TP3000 and TP4000 Network Interface Concentrators and Packet-Switch on packet-switched networks. The processor is designed to provide access to as many as 16 NCC operators simultaneously. Hardware components of the TP5000 include a programmable Prime minicomputer equipped with disk storage, magnetic tape, and communication ports for operator display and printing terminals.

The basic TP5000 processor provides 2M-byte memory expandable to 6M bytes and disk storage capacity of 80M bytes expandable to 300M bytes. An Asynchronous Multi-Line Controller (AMLC) board supports connection of up to 16 asynchronous display terminals and printers to the TP5000 for network monitoring by NCC personnel and for controlling TDT and TPRF programs. A Multi-Data Link Control (MDLC) board resident in the TP5000 provides up to 4 X.25 links to a public packet-switching network. The TP5000 Series can support 300- and 750-lpm printers.

The TP5011 NCP, the smallest member of the TP5000 family, is designed to manage networks supporting less than 10 switching nodes. It features virtual memory and high-speed (80-nanosecond access) 2K-byte bipolar cache memory. The TP5011 handles diagnostics (TDT), table building, online accounting collections (TPRF), downline loading. Table building functions and noncritical TDT applications are best performed off-hours to ensure unimpaired accounting collection online. The system provides memory security via a hierarchical multiring protection mechanism. A Process Exchange Facility automatically transfers the central processor's attention from one user process to another. At system initialization, small verification routines are automatically invoked, and programs operate in a multisegment environment.

The mid-range TP5021 provides management for packet-switching networks supporting from 10 to 100 nodes. It can be used, however, for smaller networks that require increased diagnostics and/or table-building applications. Table building and TDT should be used cautiously during peak hours, especially on large networks. The TP5021 includes the hardware features of the TP5011 plus such enhancements as 8K-byte cache memory, floating-point arithmetic implemented in hardware, and memory capacity of 4M bytes.

The high-capacity TP5031 is used for management and control of packet-switching networks supporting from 100 to 200 nodes. It provides a 16K-byte cache memory, and a significantly greater disk I/O throughput for more intensive applications than those handled by the TP5021 model. An instruction preprocessor unit improves execution speed and a high bandwidth (8M-byte) burst mode increases I/O throughput and reduces CPU overhead. Maximum memory capacity is 8M bytes, although 2M bytes of memory will generally be sufficient even for a large network.

□ CPU & Memory

TP5011 Network Control Processor

The package includes a 32-bit Prime 250-II minicomputer with

PRCH: purchase price. MAINT: monthly maintenance charge for purchased equipment; Plan A, Option I, Zone A. Prices are current as of December 1984.

Virtual Control Panel, 2M-byte ECC MOS memory, 16-line AMLC, 2-line MDLC (BSC, HDLC), 80M-byte disk subsystem, tape subsystem (75 ips, 800/1600 bpi, 9-track), CRT system console, 10-board chassis and cabinet, and 120-amp power supply • available option: 300-lpm printer, disk extension, and additional magnetic tape drives:

\$200,000 prch \$1,100 maint

TP5021 Network Control Processor

The package includes a Prime 550-II minicomputer with Virtual Control Panel, 2M-byte memory (1M-byte boards), 16-line AMLC, 2-line MDLC, 300M-byte disk, tape subsystem (75 ips, 800/1600 bpi, 9-track), hardcopy console, 24-board chassis and cabinet, 2 120-amp power supplies • available option: 300- or 750-lpm printer, and additional magnetic tape drives, and more disk storage:

\$325,000 prch \$1,800 maint

TP5031 Network Control Processor

The package includes a Prime 750 minicomputer, 2M-byte memory (1M-byte boards), 16-line AMLC, 2-line MDLC (BSC or HDLC), 300M-byte disk subsystem, tape subsystem (75 ips, 800/1600 bpi, 9-track), hardcopy console, 26-board chassis and cabinet, 3 120-amp power supplies • available options: 300- or 750-lpm printer, additional magnetic tape systems, and more disk storage:

\$400,000 prch \$2,350 maint

□ I/O & Communications

The TP5000 Series processor is connected to the network via synchronous full-duplex line with data rates up to 9600 bps. Asynchronous Multi-Line Controller (AMCC) board in the TP5000 supports up to 16 asynchronous display terminals used as consoles for TDT and TPRF programs as well as printers to the TP5000 for network monitoring by Network Control Center (NCC) personnel. Also, a Multi-Data Link Control (MDLC) board resident in the TP5000 provides interface to 4 X.25 links (BSC, HDLC) to the packet-switching network.

□ Disk & Tape

The basic TP5000 provides 80M bytes of disk storage expandable to 300M bytes, and a magnetic tape subsystem of 75 ips, 800/1600 bpi, 9 tracks; up to 3 magnetic tape subsystems can be added optionally.

80M-Byte Disk Expansion • add-on drive; maximum of 8 disks:

\$40,000 prch \$225 maint

300M-Byte Disk Expansion • add-on drive; maximum of 8 disks:

72,000 400

Magnetic Tape Subsystem Expansion Unit • 75 ips, 800/1600 bpi, 9 tracks; add-on drive; up to 4 maximum:

42,000 150

• END

HP AdvanceNet

■ PROFILE

Architecture • HP AdvanceNet; see Figure 1.

Network Configuration Summary • any number of HP 3000 Series Processors can operate as nodes on AdvanceNet • AdvanceNet interfaces to DS 1000 local networks through HP 1000 which connects to HP 3000 through hardwired direct connect cable or a remote communications link • AdvanceNet access to IBM S/370-compatible host is through either HP 1000 or HP 3000; both emulate IBM 2780 RJE terminal and HASP II workstation; HP 3000 also emulates 3780 RJE terminal, Network RJE (NRJE), Multileaving RJE (MRJE) HASP Workstation, and IBM 3270 CRT terminals operating under SNA/SDLC and BSC protocols • Intelligent Network Processor (INP) models provide support for HP 3000, offloading communications tasks; up to 7 are supported by HP 3000 • HP 3000 supports up to 14 (Series 37), 28 (Series 37XE), 56 (Series 39), 92 (Series 42), 152 (Series 48), and 400 (Series 68) online point-to-point and multipoint terminals • HP 9000 Series desktop computers and HP Series 100 and 200 personal computers and HP 250 office computers operate as terminals to HP 3000 on HP AdvanceNet.

Network Management • resides in Distributed System/3000 (DS/3000) software which runs on all Series 3000s in network; control distributed throughout network • cross network facilities include Remote Command Execution (RCE), Remote File Access (RFA), Remote Peripheral Access (RPA), Remote Database Access (RDBA), and Program-to-Program Communication (PTOPC) • resides in DS/1000-IV software on HP 1000 for HP 1000 networks.

Job/Batch Processing Management • SNA NRJE, RJE/3000, and MRJE/3000 can be used with programs on an IBM host to submit and receive jobs for execution; SNA NRJE communicates with JES2 using the SNA architecture; RJE/3000 is a BSC product communicating with JES2, JES3, ASP, HASP II, RSCS, POWER, and JES1; MRJE/3000 communicates with JES2, JES3, ASP, HASP II using the BSC protocol • Program-to-Program Communications (PTOPC) facility provides 9 intrinsics that allow users to write applications programs where master program on local computer controls execution of slave program on remote computer.

Transaction Processing Management • Query and IMAGE database management system can be used with REMOTE command to access remote database as though it were local; Remote File Access (RFA) facility allows access to remote HP 3000 or HP 1000 files; Program-to-Program Communications (PTOPC) allows indirect file transactions by initiating remote slave programs from a local master program • a Remote Query facility is available for HP 3000 to HP 3000 database accesses.

Gateways to Other Networks • to SNA through SNA NRJE or IMF: SNA NRJE makes HP 3000 appear to be a PU2 LU1 SNA node on an SNA network; IMF allows interactive communication between HP 3000 and IBM host using SDLC PU1 3270 protocols • to public packet-switched network through support of CCITT X.25 Standard LAP B protocols, and to X.21 circuit-switched networks • Hewlett-Packard has announced intentions to support Open Systems Interconnection (OSI) recommendation to International Organization for Standardization when adopted • Hewlett-Packard also has announced support for IEEE Committee 802 on local area networking standard; HP provides an Ethernet interface on its 9000 Series Desktop Workstation.

Security • network manager responsible for network security and for assigning security codes to obtain exclusive use of network links or resources • HP AdvanceNet provides full data security; password required to invoke Query facility of IMAGE database management systems; data access protection at data set level down to each data item.

Support of Foreign Terminals • HP-IB (HP-Interface Bus) implements IEEE Standard 488 so all instruments and terminals that conform to that standard can interface to HP 3000, HP 1000, and other HP systems • supports BSC protocol so terminals conforming to that discipline can connect to HP systems • supports IBM 3270 terminals with passthrough facility to IBM S/370-compatible host • supports most XON/XOFF or ENQ/ACK terminal protocols, ASCII, RS-232C, and RS-422 terminals over direct-connect, dial-up, leased, or X.25 communication facilities.

Announced • DSN 1977; HP AdvanceNet 1984.

First Delivery • DSN 1977; AdvanceNet 1985.

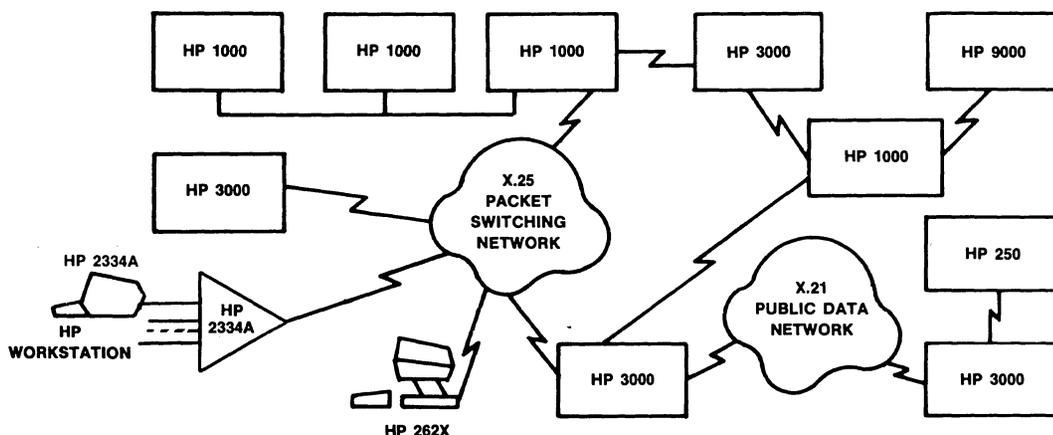


Figure 1 • sample HP AdvanceNet network.

HP AdvanceNet

Systems Delivered • over 19,000 computer system network nodes: one-half HP 3000s and one-half HP 1000s.

Comparable Systems • Digital Equipment DNA (Digital Network Architecture), Sperry DCA (Distributed Communications Architecture), Honeywell DSA (Distributed System Architecture), Burroughs BNA (Burroughs Network Architecture), and IBM SNA (System Network Architecture); systems based on OSI (Open Systems Interconnection) • for limited application areas PRIME Primenet, Tandem EXPAND, Data General XODIAC.

Vendor • Hewlett-Packard Corporation; 19420 Homestead Road, Cupertino, CA 95014 • 408-725-8111.

■ ANALYSIS

HP AdvanceNet is the successor to and superset of the HP Distributed System Network (DSN). According to HP, DSN relied primarily on proprietary protocols while AdvanceNet will support interconnection of multivendor computer systems through compatibility with the Open Systems Interconnection (OSI) Reference Model of the International Organization on Standards (called ISO). HP has undertaken a major effort to develop new networking software products conforming to the OSI model but retaining the same end-user network services as provided under DSN. The first products will be announced around March 1985.

The stated HP objectives for HP AdvanceNet architecture are the implementation of the 7-layer OSI model, a flexible architecture to interconnect very different networks, an assured migration path for its installed user base, and an easy-to-use and transparent network.

HP, as well as various standards groups and communication experts, believe that many different kinds of computers will share networks and many different kinds of network protocols will be developed at the Applications, Transport, DataLink, and Physical layers of the OSI model. International standards will not merge into one simple protocol for each OSI layer. Many different protocols will be developed for various applications and for various communication media. Furthermore, protocols will not remain static but will be modified over time. One set of protocols will not satisfy customer's application requirements. Some environments will require high performance while others will require flexibility and comprehensive services.

Network architectures will need to support upgrades as well as emerging standards. This means the architecture must allow for continuous evaluation.

With all the network changes that will continue to be introduced, the architecture must be easy-to-use and transparent to the user. Nodes and protocols can be added, changed, or deleted without disrupting the network causing grief and inconvenience to the network user.

The task Hewlett-Packard has undertaken with AdvanceNet is a substantial one, but necessary. It is essential for any computer company that expects to remain competitive through the 1980s and beyond. Multivendor environments and multiple protocols and standards are a fact of life with which computer vendors' products must be compatible.

Hewlett-Packard was one of the first companies to develop network support with its HP 2100 (now HP 1000) line of minicomputers for industrial applications, where the "dirty" (both electrical and physical) environment made it unwise to place disks and magnetic tape units on a factory floor. Furthermore, peripheral requirements were small enough to allow a number of minicomputers to share expensive units such as printers, plotters, and disks.

HP developed a Real-Time Executive (RTE) to support networks of HP 2100s in 1973. That first network, now called Distributed System-1A (DS-1A), evolved through DS-1B in 1975, DS-1000 in 1977 and DS/1000-IV in 1980. The DS/1000 network software operates in conjunction with the DS/3000 software to provide fully integrated networks. See Figure 2.

Hewlett-Packard developed DS not only to connect HP 3000 systems together but to connect the HP 3000 business/commercial environment with the HP 1000 real-time/industrial environment. The emulation of RJE terminals allowed HP to bring

the mainframe environment of IBM S/370-compatible hosts into networks with HP systems. The emulation of IBM 3270 terminal controllers in an SNA/SDLC environment draws HP systems closer to the IBM SNA environment.

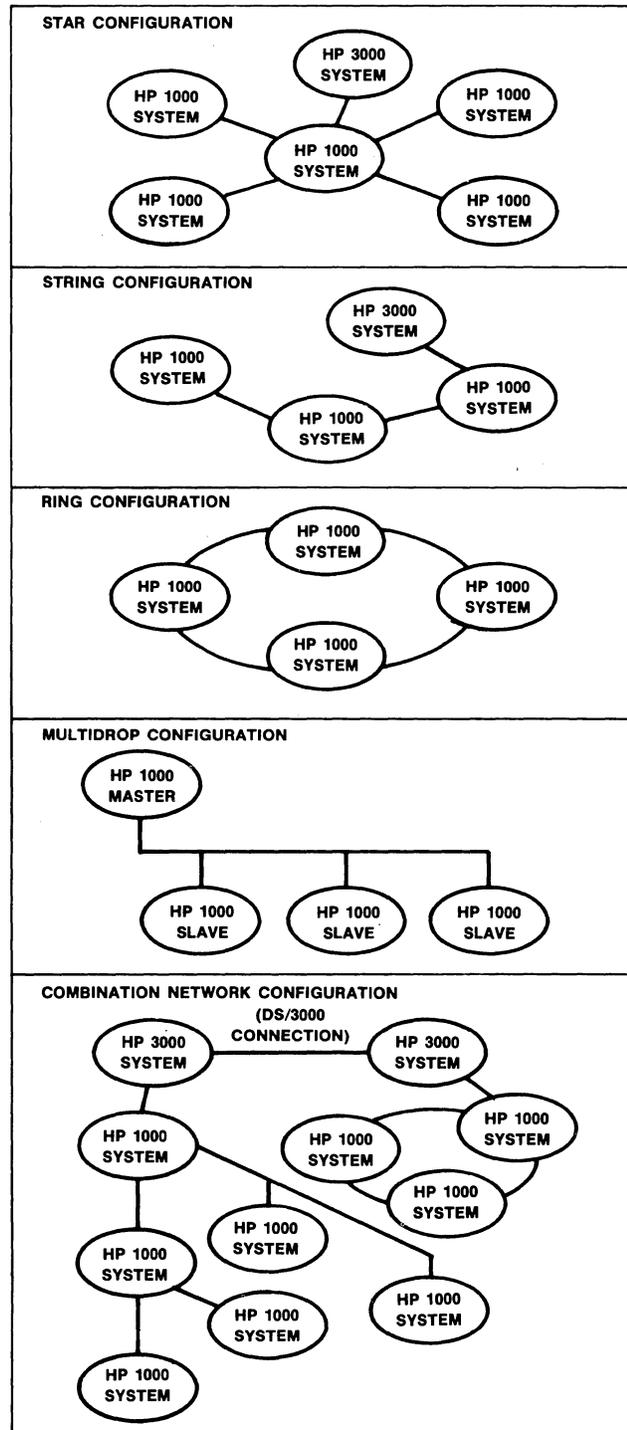


Figure 2 • DS/1000-IV network configurations.

HP AdvanceNet

Hewlett-Packard has not ventured into the mainframe computer business, but has cautiously increased its emphasis on business data processing with its HP 3000, HP Series 100, Series 200, and 250 computers. The HP 3000 Series 64 announced in October 1981 was the first Hewlett-Packard system to utilize 32-bit word hardware. All previous models were 16-bit word systems. The HP 3000 Series 68, which uses the same processor as the no longer marketed Series 64, is in the 1.6 MIPS (millions of instructions per second) performance range. It is between the performance ranges of the IBM 4361-5 and 4381-1 processors. Hewlett-Packard has also replaced the Series 40 with Series 39, and the Series 44 with the Series 42 and 48 and added the low-end Series 37 and 37XE.

Hewlett-Packard has introduced a number of high-performance small computers. The HP 1000 A Series, unveiled in 1982, is in the 1 MIPS range. The A900 model, announced in October 1982, is in the 1.3 MIPS range making it well suited for scientific calculations.

One of the most interesting systems HP has ever announced is the HP 9000 Series of Desktop Workstations. The HP 9000 is a 32-bit processor and is being offered in uniprocessor, dual-processor, and triple-processor configurations. HP claims the uniprocessor version is in the 1 MIPS performance range. In fact, it is being touted as a "mainframe-on-a-desk." So far, it is being marketed for computer-aided engineering applications. The HP 9000 Series runs under the UNIX timesharing operating system which is incompatible with all of the operating systems running on other HP computers. It can also emulate an IBM 2780 RJE batch or an IBM 3270 interactive terminal for communication with an IBM host.

HP 9000 workstations can be interconnected with an Ethernet local area network (LAN). They can also interconnect in clusters with other HP 9000s and HP 9000 Series 200 desktop computers under HP's Shared Resource Manager (SRM) for sharing files and peripherals. The HP 9000 can communicate directly with an HP 1000 or 3000 system, via terminal emulation or file transfer facilities. HP has indicated the IMAGE database management system will be made available for the HP 9000.

The Series 100 systems have been marketed as personal office computers and the Series 200 as personal technical computers. The Series 100 runs under CP/M operating system, while the Series 200 supports BASIC, Pascal, and HPL. HP has announced its intention to offer a version of the UNIX operating system for it and is considering offering CP/M for the low end of the Series.

HP has changed its marketing emphasis for its personal computers from vertical industry marketing to general-purpose marketing. This move was designed to make HP's personal computers more competitive with Apple and IBM personal computers. How well this will succeed is not yet known. The Touchscreen (HP 150) is the first general-purpose PC to be offered under this policy. Up to 100 Touchscreen personal computers can share peripherals and information on an Ethernet LAN.

The HP 9000 and Touchscreen now interface with Ethernet and HP has announced support for an Ethernet-like IEEE 802.3-based local area network. Thus, it is likely that all of HP's important systems will be able to reside on a LAN and communicate globally with networks of remote systems using HP AdvanceNet.

Hewlett-Packard has become one of the largest, if not the largest, supplier of graphics terminals. Graphics terminal support is available on almost all its systems. Many software packages relating to engineering calculations and design are now being offered. Thus, HP is at the forefront of what many believe will be one of the largest applications growth areas in the computer field.

Hewlett-Packard is continuing to evolve its computer and terminal products as well as its network products to remain competitive in a crowded market place. The company has a myriad of good products that can fit into almost any computer environment.

□ Modes of Operation

Hewlett-Packard networks can run in various ways. The HP 1000 can operate as nodes on a standalone real-time network to control and monitor the operation of an industrial plant or laboratory. The

HP 3000 can operate as nodes on a standalone commercial network handling all the data processing and distributed functions for a business.

The HP 1000 running DS 1000-IV software can connect to AdvanceNet to allow the HP 3000 to handle the business side of a factory or industrial plant while the HP 1000 handles the operating side. The SNA NRJE (Network Remote Job Entry), IMF (Interactive Mainframe Facility), MRJE/3000 (Multileaving Remote Job Entry), RJE/3000 (Remote Job Entry), and HP AdvanceNet products allow HP 3000s to interface to an IBM S/370-compatible mainframe host that handles the corporate level data processing. SNA NRJE emulates an SNA Physical Unit 2, Logical Unit 1 device and IMF emulates an SNA Physical Unit 1 device to enable connection of HP 3000 to an SNA network. MRJE/3000, RJE/3000, and IMF allow connection via bisync protocol. In addition, the HP 9835 and HP 9845 desktop computers and the HP Series 100, Series 200, and 250 Small Business Computer can function as terminals on AdvanceNet.

□ Ease of Use Features

Hewlett-Packard has been emphasizing user-friendly software for its systems for several years. For example, the MRJE commands are English words with relevant meanings. Many network functions, such as Remote File Access, are handled by micro-coded intrinsics, which are high-level system macros, to make programming network applications easy. The Interactive Mainframe Facility (IMF) handles low-level screen control character manipulation. The Pass Through Facility (PTF) switches terminals attached to the HP 3000 to the host mainframe with a single command. Accessing another system and its facilities is done simply by typing "Remote" and the system. The user can then operate as a local terminal to the remote system.

Hewlett-Packard is well known for the quality of its documentation. Attention to this important area of support makes HP systems easy to use. With its RAPID/3000, HP claims it has improved programmer productivity from 2 to 10 times for programming transaction processing/database applications.

Hewlett-Packard has also been adding applications software for its computer lines. Some of the software has been developed by HP and some by outside software vendors. The HP PLUS program makes third-party software available for HP computers through the HP sales force.

The new AdvanceNet will make protocols and network configurations transparent to the user. A node will need to know only its own name and the protocols it supports. Names are completely independent of addresses and named resources can be moved with modifying application programs.

□ Strengths

Hewlett-Packard has been in the network business a long time. Starting as a high-technology instrument company, it began building minicomputers in the mid-1960s as a natural expansion for its control devices. Networking began in 1973 was in turn an outgrowth of its minicomputer control business. Networks of computers could operate cooperatively to control and monitor the operations of an industrial plant or laboratory. The development of DSN in 1977 was a natural extension of real-time industrial networking to provide the business control needed by industrial companies. The addition of the connection to an IBM mainframe was required because HP processors were not in the mainframe performance class and large companies needed large computers to execute centralized data processing tasks.

Hewlett-Packard is a well managed company which has flourished because it has produced high-technology quality products. In most instances the company pays close attention to details and brings products to market with the hardware, software, and documentation well tested and ready to use, and its maintenance force well trained and in place.

DSN was simple in concept and easy to implement as networks go. It provided the functions performed by networks in a simple way: Network File Access (NFA), Network Data Base Access (NDBA), Network Peripheral Access (NPA), Network Inter-Program Communications (NIPC), Network Terminal Access (NTA), and Network File Transfers.

HP AdvanceNet

AdvanceNet provides the same application services as DSN. In addition, it will be compatible with the OSI model and be able to reside compatibly on multivendor networks. The announced AdvanceNet support for ease-of-use facilities, multivendor networks, evolutionary development of protocols, and upward network compatibility addresses the main issues in networking for the next few years. If the new network system software can fulfill this promise, Hewlett-Packard can continue its networking winning ways.

With the introduction of the HP 3000 Series 60 and the HP 9000 Series, HP has crossed the barrier from 16-bit word computers to 32-bit word computers. The 32-bit word allows development of higher performance computers that are competitive with the distributed processor models from the mainframe vendors such as the IBM 4300 Series. The HP 3000 Series 68 and HP 9000 are 1 MIPS systems. The HP 1000 A Series is also a 1 MIPS system. The HP 9000 can provide 2 to 3 times its current performance in multiple-processor configurations. Hewlett-Packard appears to have adapted an overall strategy toward distributed processing. Further, the company is orienting its products toward its strengths—real-time control and scientific applications—and using commercial data processing to complete the factory/laboratory environment.

Hewlett-Packard produces many products so the company can be a sole source supplier for most of the components needed to build a network. HP builds terminals, modems, multiplexers, computers, and peripherals. Its terminals are some of the most popular on the market today. Also, Hewlett-Packard guarantees 99% "uptime" for its computers.

□ Limitations

The lack of a 32-bit word computer and the low performance of its top-of-the-line models have been the greatest weakness of Hewlett-Packard's offerings. The 32-bit HP 3000 Series 60 and 32-bit HP 9000 have increased power substantially. The power of mainframe computers, however, has increased dramatically so that 5 to 10 MIPS mainframes are commonplace with configurations available in the 25 MIPS range. Thus, HP computers vis-a-vis mainframe computers have not advanced very much.

The bridge between 16-bit systems and 32-bit systems has not always been a smooth one, but HP claims the Series 60 is fully compatible with previous HP 3000s. The performance of Series 68 (about 1.6 MIPS) does not make it competitive with the mainframe computers from IBM, Honeywell, Burroughs, and Sperry. It is competitive with those systems used primarily for distributed processing. Thus, HP 3000s will continue to require a cooperative venture with a mainframe computer to fulfill the data processing needs of a large company. Users may tend toward the mainframe vendor's distributed processor rather than the HP 3000. One feature of AdvanceNet, however, will negate that predisposition; the HP 1000 can control the industrial environment and interface to AdvanceNet.

The biggest concern with HP has to be its incompatibility problem. The HP 1000 E/F and A/L models, for example, are not completely compatible with each other, although they all run versions of the RTE operating system and support the DS/1000-IV software. The HP 3000 runs under MPE and is incompatible with the HP 1000. The HP Series 9000 Series 200 is incompatible with the HP 9000 which runs UNIX, and both are incompatible with the HP 1000 and 3000. The HP Series 100 runs under CP/M and is incompatible with all of the above, but it does include its HP 125 predecessor.

The HP 9000 Series 200 includes models which were previously in the 9800 line and which run under a Basic Operating System (BOS). HP has indicated it will eventually offer UNIX and perhaps CP/M for Series 200, thus adding to the incompatibility within the product line. In addition, the HP 3000 Series 60 and the HP 9000 use 32-bit word processors and all the others use 16-bit processors.

HP has the 3 top systems of its main product lines operating in the 1 to 2 MIPS performance range: HP 3000 Series 68, HP 9000, and the HP 1000 A Series. Such power makes sense only if HP is correct in the assumption that dedicated high-performance

distributed processors interconnected into Manufacturing Productivity Networks is the way future data processing installations will be organized. The HP 3000 can handle the commercial processing, HP 1000 real-time processing, and HP 9000 scientific processing. The lower-performance Series 100 and 200 can function as business/technical workstations. Eventually, HP must develop some higher-performance computers. Rumor has it that introduction of such a system is imminent.

■ ARCHITECTURE SUMMARY

Prior to 1977, Hewlett-Packard had DS/3000 networks that distributed processing among HP 3000 systems, and DS/1000 networks that distributed processing among HP 1000 (and earlier HP 2100) systems. In 1977, distributed processing was extended to HP 3000 and HP 1000 systems residing on the same network.

DS/1000 networks for real-time industrial control date back to 1973 (DS/1000 1A) when the systems were limited primarily to star configurations for peripheral sharing. This was extended in 1975 (with DS/1000 1B) to include unattended computer and dynamic master/slave nodes. In 1977, DS/1000 expanded the HP 1000 networking capability to store-and-forward operations, nodal addressing, and topological independence allowing star, ring, and string configurations. In 1980, HP added DS/1000 IV, which extends networking facilities to include HDLC protocol, message accounting, dynamic message routing, remote I/O mapping, and support for HP 1000 L-Series microcomputers.

HP 3000 and 1000 systems can be connected together by hardwired serial or communications links, including X.25 public data networks; see Figure 3. The HP 1000 will usually interface to real-time instruments or terminals in a laboratory, industrial, or manufacturing environment. The HP 3000 will usually interface to terminals, workstations, and peripherals in a commercial transaction processing business environment, including the automated office and beyond to what HP calls "the interactive office." The HP 3000 can communicate with other 3000s in many different ways; see Figure 4.

In addition, the HP 1000, HP 3000, and HP 9000 can connect to IBM S/370-compatible mainframes through emulation of IBM. Both the HP 1000 and HP 3000 can emulate the IBM 2780/3780 RJE terminal and HASP II workstation. The HP 3000 can also emulate the IBM 3780, MRJE (multileaving RJE), batch, and IBM 3270. HP 9000 can emulate IBM 2780/3780 RJE terminals or 3270 interactive terminals.

The 3270 emulator is called the Interactive Mainframe Facility (IMF). It allows the HP 3000 to appear to an IBM host as a BSC or SNA/SDLC IBM 3271, 3274, or 3276 Terminal Controller. A passthrough facility for HP 3000 allows HP 264X terminals to operate as though they were connected to the cluster controller and directly into the IBM 3705/3725 front end. The HP 3000 operating in 3270 emulation mode can share a multidropped line with IBM 3270 terminals. The HP 3270 emulator looks like a Physical Unit Type 1 on an IBM SNA network. It supports 32 concurrent sessions.

The newest gateway to SNA is the SNA NRJE, which allows the HP 3000 to look like a PU-2, LU-1 SNA node to an IBM host. This node is the same as the IBM 8100 DPPX/RJE workstation.

The HP 3000 can also interface to X.25 packet-switched Public Data Networks (PDNs) to interconnect HP 3000 computers and interactive terminals. The HP X.25 implementation provides support for the CCITT X.29 terminal connection standard. HP is also supporting X.21 for European digital circuit-switched data networks for communication between HP 3000s, and for RJE from HP 3000s to IBM S/370-compatible systems. The HP 1000 also supports X.25 for communication between HP 1000 nodes, HP 1000s and HP 3000s, terminals and HP 1000s, and other vendors' computers and HP 1000s.

Hewlett-Packard has offered its HP-IB (Hewlett-Packard-Interface Bus) for the HP 1000 for several years; the HP-IB currently is an implementation of the IEEE 488-1978 and ANSI MC1.1 digital interface standard for programmable instruments. HP has now extended support of the HP-IB interface to HP 3000, 9000, 9000 Series 200, Series 100, and Series 200 computers. HP 1000 can

HP AdvanceNet

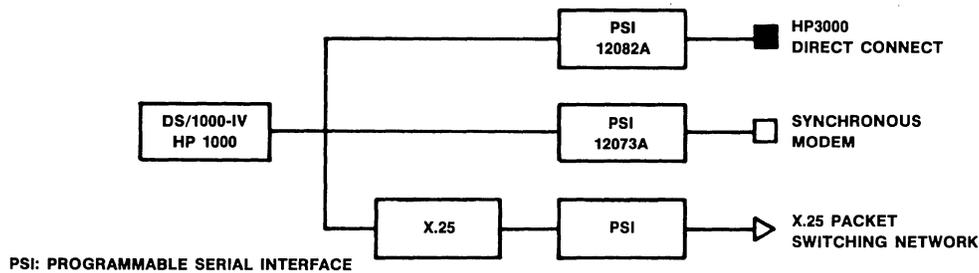


Figure 3 • DS HP 1000 to HP 3000 communication support.

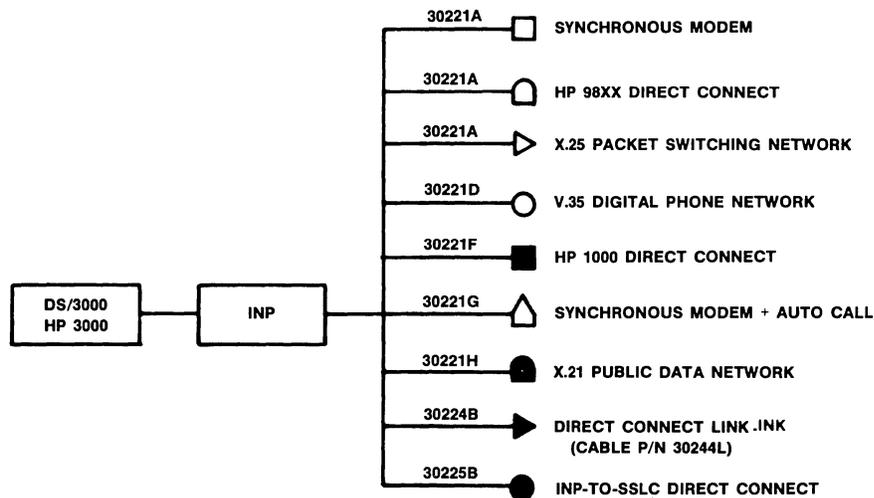


Figure 4 • DS HP 3000 to HP 3000 communication support.

also interface to up to 8 Allen-Bradley data highways for connection to up to 1,512 program controllers for various instruments.

Hewlett-Packard has announced its support for the interconnection of computers from multiple vendors. The products developed for AdvanceNet will follow the Open Systems Interconnection (OSI) recommendation.

Hewlett-Packard also announced its support of the IEEE 802 local networking scheme, using the Carrier Sense-Multiple Access with Collision Detection (CSMA/CD) access method. The first HP product that has an interface to Ethernet is the HP 9000 Series 32-bit Desktop Workstations.

HP-to-IBM software includes MTS (Multipoint Terminal Support), DS (Distributed Systems), IMF (Interactive Mainframe Facility), MRJE (Multileaving Remote Job Entry), RJE (Remote Job Entry), and NRJE (Network Remote Job Entry).

In Addition to the HP 3000 and HP 1000 systems, AdvanceNet hardware also includes the INP (Intelligent Network Processor) and the ATP (Advanced Terminal Processor) for connection of multipoint point-to-point terminals to the HP 3000.

■ DISTRIBUTED SYSTEM MANAGEMENT

Networks are set up to handle at least 3 data processing tasks—sessions, jobs, and transactions. All of these fall within the realm of the application environment.

For sessions, a terminal or applications program is connected to a subsystem in one of the processors on a network for conversation; the terminal or application logs on for the duration of the conversation, then logs off. Primary products associated with session control are the DS (Distributed System) software modules

running under MPE (HP 3000 systems) or RTE (HP 1000 systems) operating systems.

For jobs, batch entry subsystems route jobs through the network to the processor which will then execute them and return results. Primary products that implement job entry applications on HP processors are the Network File Transfer (NFT) and Network Inter-Program Communications (NIPC) facilities. Jobs can be submitted to IBM-compatible hosts through RJE, MRJE, and SNA NRJE facilities running on HP 3000 processors. HP 1000 and HP 9000 Series also provide RJE access to IBM hosts.

For transaction processing, the network routes transactions according to system node addresses given in the REMOTE command. Transactions are managed by the system on which they are run. Primary products are Query/3000 and VPLUS/3000 on the HP 3000, and RTE operating system, IMAGE/1000 with built-in Query facility and Datacap/1000-II on the HP 1000.

□ Network Management

The network management is distributed through the Distributed System (DS) software running on the HP 1000 and HP 3000 at network nodes. HP 3000 nodes implement all network facilities. HP 1000 nodes can route only to the HP 3000 node adjacent to it and cannot perform store-and-forward functions for HP 3000 nodes. HP 1000 nodes, however, can perform store-and-forward functions for adjacent HP 1000 nodes.

The DS software running on HP 3000 essentially operates as if it were controlling a network of HP 3000s; an HP 1000 on that network operates as a gateway to networks of HP 1000s running under control of DS/1000-IV. The DS/3000 software can function cooperatively with DS/1000-IV software, but each

HP AdvanceNet

software package can also operate independently of each other and control 2 totally separated networks.

The DS software running on any HP system provides the network services available to that system. The DSLINE command allows a user to address another node and the REMOTE command allows the user to enter commands directly into the computer at the addressed node. These commands provide Network Terminal Access (NTA), Network File Access (NFA), Network Peripheral Access (NPA), Network Data Base Access (NDBA), Network Program-to-Program Communications (PTOP), and Network File Transfers (NFTs). The NDBA commands are restricted to HP 3000 systems only. Access to HP 1000 databases from HP 3000 is through the PTOF facility. Thus, the database access is available but indirectly.

Distributed Systems (DS)/1000-IV Software • provides integrated set of high-level network facilities and procedures; supports network resource sharing, remote database access, distributed data file management, communications between applications programs, and the coordinated distribution of workloads among processors within the network • used with RTE-A, RTE-XL, RTE-6/VM, RTE-IVB, and RTE-IVE operating systems; requires 256K bytes minimum of memory • uses 12007A/12044A/12794A/12825A interfaces for HP 1000 to HP 1000 communications; uses 12793A/12834A/12889A interfaces for HP 1000 to HP 3000 communications.

For L-Series:

	\$17,000 lcns	\$75/\$30 serv
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For A600+:

	2,500	75/30
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For A700 or E-/F-Series:

	4,200	75/30
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For A900:

	6,000	75/30
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Distributed Systems (DS)/3000 • network control manager; supports communications among all 3000 Series systems and HP 1000 systems • permits all 3000 Series network members full access to each others' facilities, including database access and program-to-program communications; various hardware options permit dial-up, leased, and direct connections among HP systems, supportable in any combination under DS/3000; maximum data transfer rate under DS/3000 is 2.5M bps for direct coaxial connections up to 1,000 feet • HP 1000 systems operate as gateways to subordinate networks of HP 1000s under DS/1000 IV • subordinate subsystems such as HP 120s, HP 125s, HP 250s, HP 9835As, and HP 9845A connected as terminals to 3000 Series systems under DS/3000 have full network access through their respective hosts • supports X.25 packet-switched network connections:

	5,000	125/35
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□ Session Management

Under control of DS (Distributed System) software running on the HP 3000 or HP 1000 system located at the network nodes. The network access method initiates and terminates a session through the facilities of the network manager.

□ Host Access Methods

The hosts/nodes on a network are accessed through the network services facilities in the Distributed Systems (DS) software running on each computer at a network node. A terminal user on a local node accesses a remote facility through the address in DSLINE command and the REMOTE command. DS/3000 host node access is through Network File Access (NFA), Network Data Base Access (NDBA), Network Terminal Access (NTA—virtual terminal access), Network Peripheral Access (NPA), Network Inter-Program Communication (NIPC), and Network File Transfer (NFT). Intrinsics (macros) implemented in the local system facilitate programming the application.

HP implements all DS/3000 access methods on HP 3000 systems, which treats all other computer systems on the network as if they were HP 3000s. The other systems, however, do not implement all DS capabilities.

The HP 1000 provides NTA, NFT, and NIPC facilities between applications programs running on the HP 3000 and HP 1000. The HP 250 Virtual Terminal Access from HP 3000 is not supported on HP 1000, and the HP 9000 Series 200 computers provide NTAs and NFTs to HP 3000s and HP 1000s and from the HP 250 or HP 9800 system to HP 3000.

DS/1000-IV provides Remote Command Processing, Remote Database Access with Remote Query, Program-to-Program (PTOP) data exchange, Remote File Access, Remote Executive Calls, Remote FORTRAN Read/Write, Remote Node Generation, Remote Node Development, and Other Network Utilities between HP 1000 nodes.

Access to an IBM S/370-compatible mainframe is through Interactive Mainframe Facility (IBM 3270 Emulation), Multileaving Remote Job Entry/3000 (HASP II/JES/ASP Workstation Emulator), Remote Job Entry/3000 (2780/3780 Emulation) and SNA NRJE. HP/1000 also has an RJE/1000-II (IBM 2780/3780) Emulator for RJE and MRJE (multileaving RJE) for batch communications. PMF/1000 allows programmatic communication to 3270 applications. HP 9000 also has an RJE facility to an IBM host as well as 3270 interactive terminal emulation.

□ Message Management

Message Management resides in the communication management software at each node. It includes master and slave facilities, and retry modules. DS uses the transaction control block (TCB) and the datagram to control messages. DS implements both master and slave TCBs.

The master and slave designation is established only for a session, and each node can operate many masters and slaves simultaneously. Other architectures sometimes call the master a "primary" node, and the slave a "secondary" node.

Communication control builds a master TCB for each request for services. The slave module builds a slave TCB for each request it receives. A sequence number is assigned to each master TCB to connect it to the appropriate reply from a remote slave.

The datagram is a self-contained unit that contains all the information needed to route it through the network. In addition, it contains the sequence number of the master TCB that originated the request for service.

When the slave node receives the datagram, it builds a slave TCB with a local sequence number. The request for service is forwarded to the appropriate server. A single server is provided for each of the services available at the node—network file access, program-to-program communications, etc. Each node contains an interface to each server, and provides a queue to hold the requests waiting for service.

When a server fulfills a request, it relates back to the corresponding slave TCB to build the reply datagram which is forwarded back to the requester. When the datagram is received, the sequence number is used to relate it to the appropriate master TCB and the program waiting for the reply.

□ Interactive Processing Management

Hewlett-Packard offers system programs to support interactive processing as well as interactive applications programs. The HP 3000 MPE and HP 1000 RTE Operating Systems provide for local and remote interactive terminal management. Programming development is interactive on HP 3000, and can be done concurrently with data processing with interactive debugging aids.

The DS software provides for accessing a remote HP 1000 or HP 3000 system from a terminal on a local HP 1000 or HP 3000 as if the terminal were directly connected to the remote system. The user then has access to virtually all the facilities on the remote system.

LCNS: license fee. **SERV:** first number is monthly charge for customer support service; second number is monthly charge for software subscription service. **NA:** not available. Prices effective as of February 1985.

HP AdvanceNet

Interactive office system software for the HP 3000 includes the Interactive Design System (IDS/3000), and the Interactive Formatting System (IFS/3000). These were designed to function with the HP 2680A Intelligent Page Printer. Materials Management/3000 is also a highly interactive application package for planning and control in a discrete manufacturing company.

The Interactive Mainframe Facility (IMF) for 3270 Emulation allows interactive access to IBM S/370-compatible mainframe.

Interactive Design System/3000 (IDS/3000) • menu-driven to allow user to design characters, forms, and features to tailor the output of the HP 2680A Intelligent Page Printer to the application:

\$4,000 lcns \$45/\$20 serv

Interactive Formatting System/3000 (IFS/3000) • menu-driven program for developing page formats for the HP 2680A Intelligent Page Printer by designing a custom format or by choosing a predefined format:

2,500 45/15

Materials Management/3000 • a fully integrated system for materials planning and control, designed to be used with HP CRT terminals • user is guided through each application by simple selection method • uses IMAGE/3000 Data Base Management system and Query/3000 to generate reports and to retrieve data:

9,000 35/10

Interactive Mainframe Facility (IMF) • sophisticated 3270 emulator software that allows HP 3000 to appear as a Physical Unit Type 1 on SNA network • allows terminal users on HP 3000 to exchange data interactively with CICS, IMS, DB/DC, TSO, CMS/VM, or other application programs running on the IBM S/370-compatible host • IMF Pass-Thru Facility allows an HP terminal to switch between the HP 3000 and the IBM Mainframe • also allows HP 3000 to share multidropped line with IBM 3270 terminals • uses the BSC link to offload the 3270 communications from the HP 3000 • communicates with host using BSC or SNA/SDLC protocols.

□ Job/Batch Processing Management

The Network File Transfer (NFT) and Network Inter-Program Communication (NIPC) provide facilities to enter jobs at one node for execution at another node. Jobs can be submitted for execution on an IBM S/370-compatible mainframe through Multileaving Job Entry (MRJE), Remote Job Entry (RJE), and SNA NRJE.

Network File Transfer (NFT) • can copy a disk file to or from any other HP 3000 that has NFT capability • can be initiated from session, job, or program; the user/program can be on a third system and not on the system with the file or the system to which file is being transferred • included with DS software.

Network Inter-Program Communications (NIPC) • user can write applications program using 9 intrinsics (macros/subroutines); programs can be coded in 2 different languages • one program is always the master and maintains control; the other is the slave and can reject or accept requests from the master • included with DS software.

Multileaving Remote Job Entry (MRJE)/3000 • software allows multiple jobs to be submitted to one or more IBM S/370-compatible hosts; if IBM mainframe is using HASP II, JES2, JES3, or ASP subsystems, job output can be routed to any file on HP 3000 • used with BSC link to offload communications from HP 3000 • supports up to 22 concurrent-usage data streams: 1 operator console, 7 logical printers, 7 logical card readers, and 7 logical card punches; manages multiple-host and multiple-line/single-host environments; permits unrestricted use of I/O devices • supports dial-up or leased-line communications at transfer rates up to 9600 bps (modem dependent) • implements a spooling facility for off-line job entries and automatically queues entries into the multileaved job stream • see Figure 5:

\$2,520 lcns \$75/\$20 serv

MRJE/1000 Software • allows computer to function as a HASP workstation • uses IBM multileaving binary synchronous protocol; up to 9600-baud line speed • used with RTE-A or

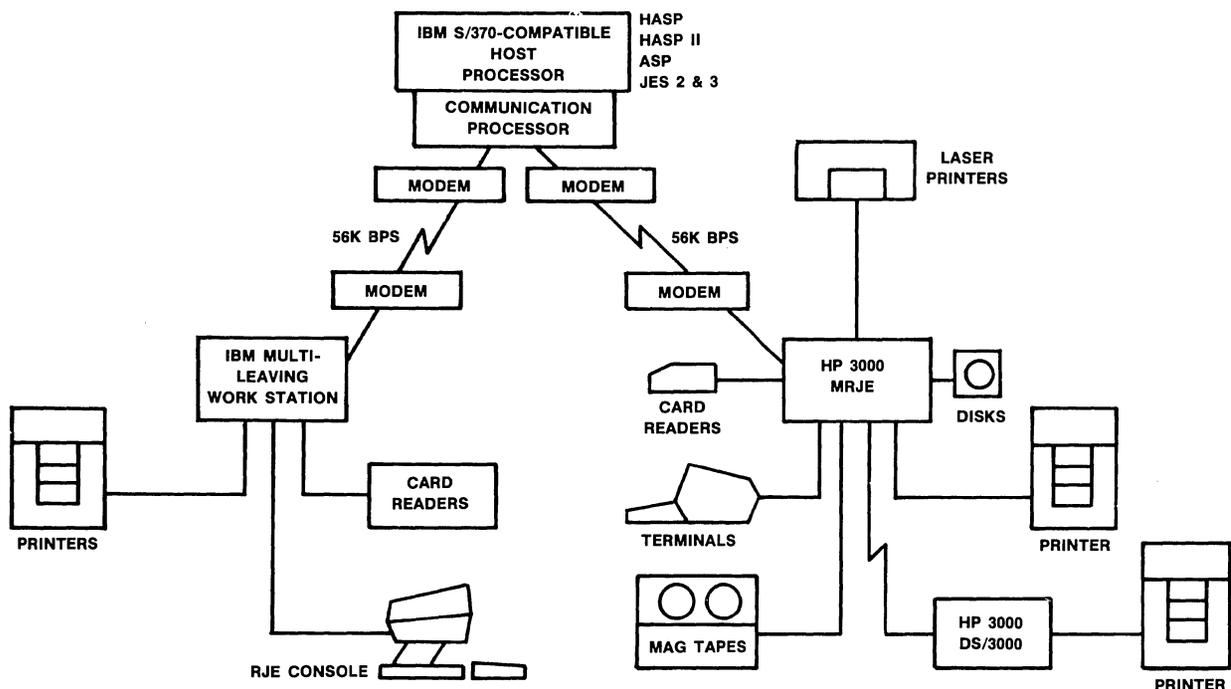


Figure 5 • MRJE gateway to IBM host.

HP AdvanceNet

RTE-6/VM operating system.

For A600+; 91782A-600:

3,000	75/25
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For A700 or E-/F-Series; 91782A-700:

4,000	75/25
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For A900; 91782A-890:

6,000	75/25
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Remote Job Entry (RJE)/3000 • software that emulates IBM 2780/3780 batch terminals • it can be used to pass information between HP 3000 and IBM S/370-compatible host or any other system emulating IBM 2780/3780 • has more flexibility than IBM 2780/3780; jobs can be entered from an HP input device and output received by any HP output device • controls remote job entry batch operations to any IBM host equipped to handle IBM 2780 or 3780 terminals • permits any I/O device on a 3000 Series system running under RJE/3000 to enter or receive job data to/from the host; can support multiple hosts and multiple lines to a single host • supports dial-up or leased-line connections to the host at rates up to 19.2K bps • includes all 2780 features except 6-bit transcode and all 3780 features except conversational mode • user-specifiable optional selections include ability to transfer more than 7 records per block; 2780/3780 vertical format control and horizontal tab control; internal blank suppression for message compression and trailing blank suppression for message truncation; ASCII/EBCDIC transparency and print/punch component selection at the host:

1,350	60/15
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RJE/1000 • allows computer to function as an IBM 2780 data transmission terminal • uses IBM binary synchronous protocol; accommodates ASCII and EBCDIC line code; up to 9600-baud line speed • used with RTE-6/VM and RTE-IVB operating system • pricing includes 2-card synchronous modem interface:

3,150	65/20
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RJE/9000 • allows HP 9000 to function as IBM 2780 data transmission terminal; uses BSC protocol; handles ASCII and EBCDIC codes; line speeds up to 9600 bps; requires RJE Interface

• for multiuser system:

5,045	35/10
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SNA NRJE/3000 • software that emulates IBM 8100 DPPX/RJE allowing HP 3000 to operate as a PU-2, LU-1 SNA node • provides functions of transmission control, path control, and data link control SNA layers on an HP 3000 • provides access to IBM host system running under MVS/SP 3.1, JES2 3.1, and ACF/VTAM 1.3 or later versions with 3705/3725 running under ACF/NCP V.1 R2.1 or later version • supports multiple logical units; can be initiated from keyboard/display or keyboard/printer; accepts input from disk, diskette, or card reader for transmission to host; returned output can be to disk, card punch, or printer; output data sets can be spooled to disk for later output to cards or printers • allows HP 3000 to be used as batch workstation, as distributed processor on SNA network, or as a gateway between AdvanceNet and SNA networks • requires HP 30246A SNA Link • connection is through a switched or nonswitched line with data rate up to 56K bps • see Figure 6:

4,500	NA/NA
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SNA Link • includes SNA Link hardware (INP) and software to support NRJE; software emulates the transmission control, Path Control, and Data Link SNA layers on an HP 3000; connects to switched or nonswitched line through synchronous modem operating at data rates up to 56K bps • hardware price is \$3,600 and hardware maintenance is \$53 per month:

7,500	10/2
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BSC Link • includes BSC Link hardware (INP interface card and cable) and software; supports RJE, MRJE, or IMF; a separate link is required if 2 are used concurrently; data rates are up to 9600 bps for IMF and 56K bps for RJE or MRJE • hardware price is \$3,600 and hardware maintenance is \$53 per month:

5,000	5/1
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Transaction Processing Management

Transaction processing is managed by the system on which the transactions are running. Once a terminal user gains access to a local or remote computer, the terminal operates as if it were

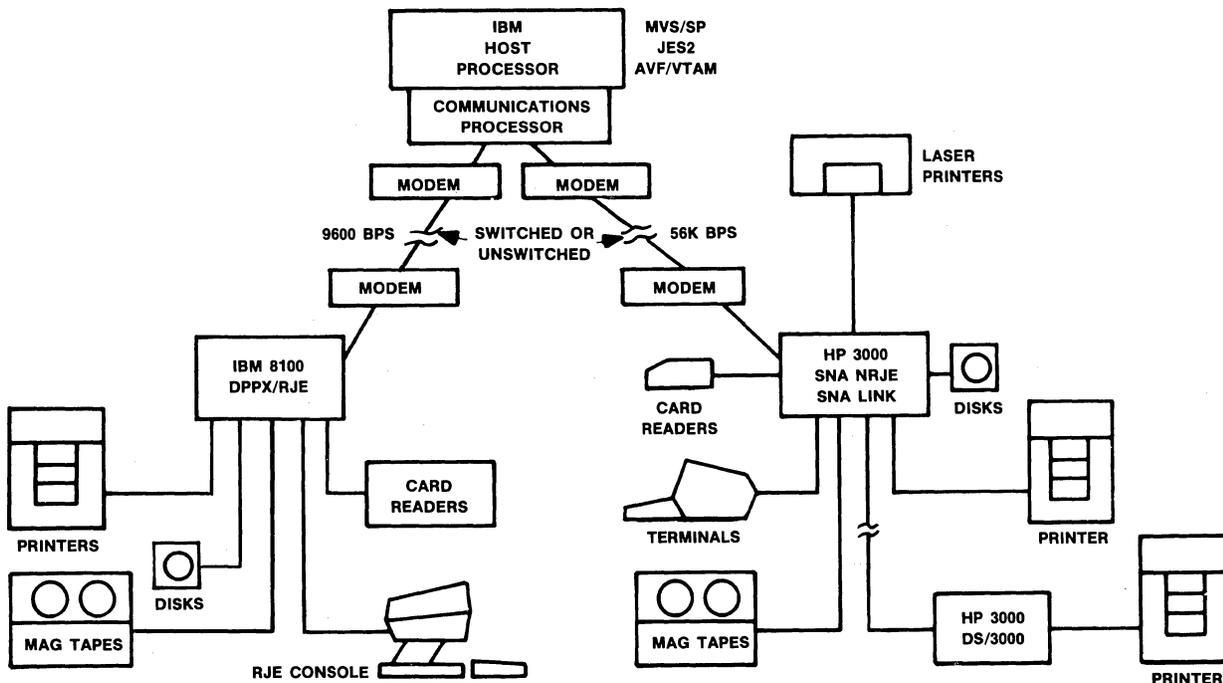


Figure 6 • SNA NRJE gateway access to IBM host.

HP AdvanceNet

locally attached, and the user has access to all the computer's resources. QUERY/3000 and VPLUS/3000 handle terminals on the HP 3000 and provide the interface between terminal users and the system facilities.

The RTE Operating System of the HP 1000 has integral multiterminal monitor and session monitor. The DATACAP/1000-II supports data entry from multiple data capture and time reporting terminals; works in conjunction with the IMAGE/1000 Database Management System. IMAGE/1000 also has a built-in Query facility.

QUERY/3000 • database inquiry facility for IMAGE 3000; self-contained language of 23 commands usable by nonprogrammers as well as programmers for casual inquiry, online data updates, report generation, and application program debugging.

HP VPLUS/3000 • software subsystem to implement and control source data entry and to interface terminals or files to transaction processing applications • provides data entry program for entering data without user programming and allows user to design forms that incorporate data editing and validation; allows user to modify program or to develop new one • interface to transaction processing application provides procedures to design forms, enter data, modify programs, reformat data, and implement language interface between higher level languages and terminals, files and forms.

DATACAP/1000-II • online management for up to 54 data capture terminals; provides data entry, validation, and serial recording of transactions; supports data entry/retrieval for up to 4 databases.

□ Database Management

IMAGE is the primary database management system for HP computers. IMAGE/1000 version runs on HP 1000 and IMAGE/3000 version runs on HP 3000. So committed to database management is Hewlett-Packard that it includes IMAGE 3000 as software bundled with a system. Keyed Sequential Access Method/3000 (KSAM/3000) is also offered as a file subsystem. QUERY/3000 is also offered to query IMAGE/3000 databases.

IMAGE/1000 Database Management System • uses chain approach to data retrieval; allows database restructuring independent of applications programs; handles remote database access requests using Distributed Systems/1000 software • utilities build, maintain, restructure, and backup the database; QUERY provides interactive facilities for accessing data files • used with RTE operating system; host language subroutines callable from Pascal, FORTRAN, BASIC, and assembly languages • up to 960M-byte database capacity; up to 16 search keys per data set; up to 50 data sets.

KSAM/3000 • provides indexed sequential access method • creates and maintains data files with variable-length records and creates and maintains a separate index file with 1 primary key and up to 15 auxiliary keys; each key can consist of up to 255 characters; KSAM files are accessible through all languages except APL/3000; handles all common data types including byte string and packed decimal.

IMAGE/3000 • network organization with simple master-detail hierarchy based on KSAM features; bottom-to-top data structure names are data item (field), data entry (record), data set (file); top-down organizational maximums are: 99 named data sets per database; 8.4 million entries per data set; 127 named variable-length data items per aggregate maximum total of 4094 bytes per data entry; up to 255 unique data item names per database; logical organization of a data set is independent of the physical storage devices and can span up to 32 extents • structured linkages are based on many-to-many master-detail relationships; a master data set can reference (point to) up to 16 separate master data sets; master data sets can reference other master data sets, and detail data sets can reference master data sets, but data sets cannot directly reference other data sets • data can be accessed by serial, direct, chained, and calculated access methods; multiple concurrent users are supported for batch and transaction applications, and multiple user access is permitted to multiple local or remote databases in systems with DS/3000

software; all high-level languages, except APL, can operate as host languages for IMAGE; linkages are managed automatically whenever data is added, deleted, or modified • privacy and security provisions, in addition to those provided by MPE, can be applied to any structural level down to discrete data items; up to 63 distinct classes of user access can be defined and managed • IMAGE consists of several groups of accessible procedures: database design and definition (develops a root file through a schema processor); database creation (creates the data sets from the root file); database management (permits active data storage and retrieval relative to users' applications programs through IMAGE intrinsics); maintenance (permits ongoing database restructuring); backup and recovery (relies on a logging facility that records all modifications and develops a database history file); the log file used by the recovery system to reexecute user transactions against a database backup copy to recover from a system failure; logging is global and functions independently of the users, but can be disabled by the Database Administrator • IMAGE does not permit complex manipulations on the retrieved data; logical comparisons, conditional syntheses, and other data processing operations must be executed in the host language.

QUERY/3000 • inquiry facility for locating, reporting, and updating values in an IMAGE database; provides 23 commands in 7 categories: environment, utility, location, updating, reporting, procedure, and operation • environment commands pinpoint data set, procedure file (if used), output device, and password/access mode; 8 access modes define user capabilities in terms of various find, replace, add, and delete combinations and concurrent multiple access • utility commands include an important capability to display the database structure • location capability consists of a single FIND command that permits up to 50 logical relationships to be specified • updating and reporting commands include the capability to list retrieved data in a one-time or pre-defined format • procedure and operation commands permit often used QUERY commands to be consolidated into procedure sets; procedures can then be stored, modified, called, and executed as independent subroutines; processing capabilities consist of direct column summing and cross footing.

Dictionary/3000 • data dictionary and data directory facility; documents IMAGE, KSAM MPE, and VPLUS forms files, programs, security, and more; provides user interactive commands and prompts for input; produces reports using built-in documentation capability; supports relational views of the data through Inform/3000; supports data definition extraction for COBOL, Pascal, Transact/3000, and Report/3000 programs; supports selective unloading and loading of IMAGE databases; reports on IMAGE database usage statistics for maintenance decisions:

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INFORM/3000 • provides interactive inquiry and report generation for accessing databases and files • interfaces through Dictionary/3000 • supports access to multiple IMAGE/3000, KSAM/3000, and MPE sequential files:

6,000	15/3
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REPORT/3000 • provides nonprocedural report writer for use with Dictionary/3000 • has access to IMAGE/3000, KSAM/3000, and MPE sequential files:

5,000	15/3
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□ Gateways to Other Networks

The IMF (Interactive Mainframe Facility) and SNA NRJE provide gateways to IBM SNA networks. The RJE (Remote Job Entry) and MRJE (Multileaving Remote Job Entry) provide indirect entry into SNA through BSC communication with a front-end processor for IBM S/370-compatible host.

Support of the CCITT X.25 standard on the HP 3000 provides a gateway into public-switched data networks (PDNs).

Support of a Satellite Network Link allows the HP 3000 user to link HP 3000s using satellite communications.

HP has publicly stated that it will support the Open Systems Interconnection (OSI) recommendation to International Organization for Standardization (ISO) when it is adopted.

HP AdvanceNet

The company has also stated it intends to develop a local network implementation of the Carrier Sense-Multiple Access with Collision Detection (CSMA/CD) recommendation of the IEEE committee 802. So far, HP offers an interface to Ethernet on its 9000 Series Desktop Workstation and the Touchscreen personal computer. RJE, NRJE, and MRJE are described under Job/Batch Processing Management section.

IMF (Interactive Mainframe Facility) • emulation of IBM 3270 SNA/SDLC and bisync protocols to permit interactive exchanges between COBOL, BASIC, FORTRAN, or SPL application programs on the HP 3000 and IBM S/370-compatible host programs such as CICS, IMS, TSO, and BTAM/TCAM-based programs; combined with IMAGE, VIEW, KSAM, and DS/3000 functions in a HP 3000 program, HP terminal can switch between HP local access and remote IBM access; IBM host applications could be written or modified to use HP 3000 capabilities • requires BSC link • supports 246X series terminals; supports 3270 mode with 1920-character screens, 2048-character or less blocks, bisync protocol • see Figure 7:

\$7,000 lcms \$35/\$7 serv

PMF/1000 • allows HP 1000 to programmatically access IBM 3270 applications • uses IBM BSC protocol • line speed up to 9600 bps.

For A600 Series:

4,000 125/35

For A700 & E-/F-Series:

5,000 125/35

For A900 Series:

7,000 125/35

3270 Terminal Emulation • allows HP 9000 to emulate a 3278/9 workstation • connects directly to a 3274 or 3276 cluster controller via Type A coaxial cable.

CCITT X.25 Support • allows HP 1000s and HP 3000s to be connected through packet-switched data networks (PDNs); also allows HP 1000 and HP 3000 to support remote, interactive, character-mode terminals connected through PDNs; terminal-to-HP host and HP host-to-HP host can be intermixed on a link • implements X.29 terminal-connection standard • HP 3000 also

supports European X.21 digital circuit-switched data networks for HP 3000-to-HP 3000 communication.

For HP 1000:

4,000 90/30

For HP 3000:

4,500 65/20

Satellite Network Link • allows HP 3000 Models 4X and 6X to be connected through satellite link using Vitalink Communications Corporation earth station at data rates up to 56K bps over unlimited distances in the United States • totally transparent to the user; full support of networking capabilities over the satellite link • for volume transmissions, it is cost effective if distance between systems is 800 miles or more • Vitalink supplies earth station equipment and sells the satellite transponder time; HP supplies the rest of the hardware and software for the link, see Figure 8 • includes hardware and software for satellite connection; without hardware, cost is reduced by \$3,600:

20,000 10/2

Support for Foreign Terminals

HP supports the HP-IB (HP-Interface Bus), an implementation of the IEEE 488 standard, for instrumentation devices on HP 1000, HP 3000, 9000, 9800, Series 100, and Series 200 computers. Thus, any instrument conforming to the standard can interface to these systems. The IMF facility supports IBM 3270 terminals.

HP 1000 also interfaces to the Allen-Bradley data highways. Thus, any instrument with the Allen-Bradley programmable controller interface can connect to the HP 1000.

HP supports most XON/XOFF or ENQ/ACK terminal protocols, ASCII, RS-232C, and RS-422 terminals over direct-connect, dial-up, leased, or X.25 communication links.

SECURITY

System Security

In general, system security depends on management establishing security policy and access rules and assigning responsibility for

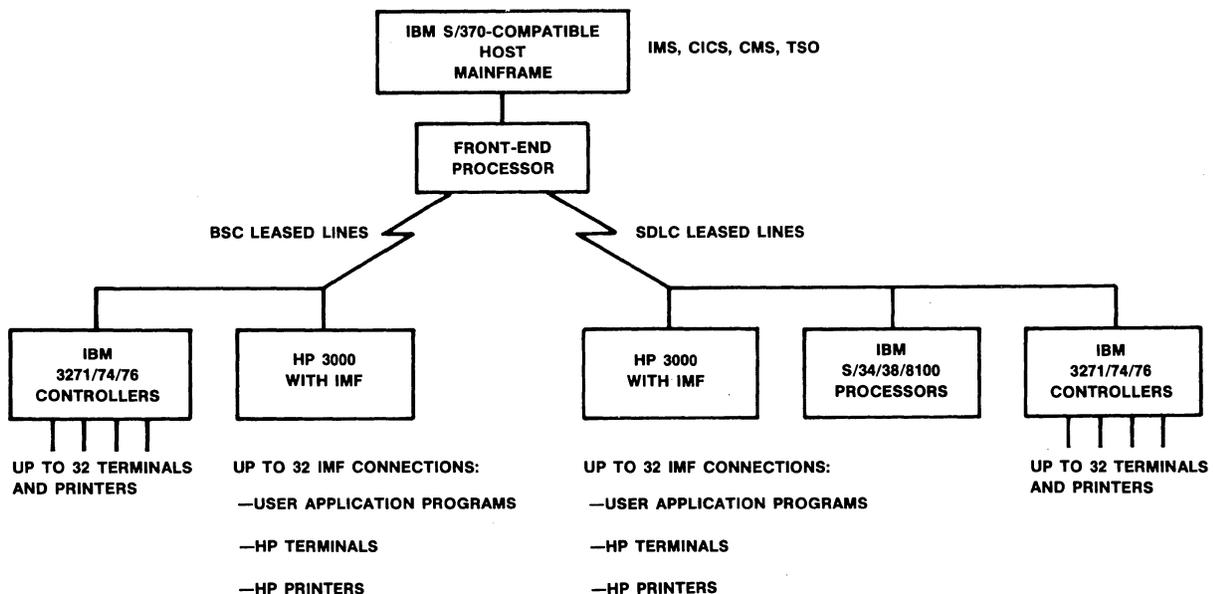


Figure 7 • IMF gateway to IBM host.

HP AdvanceNet

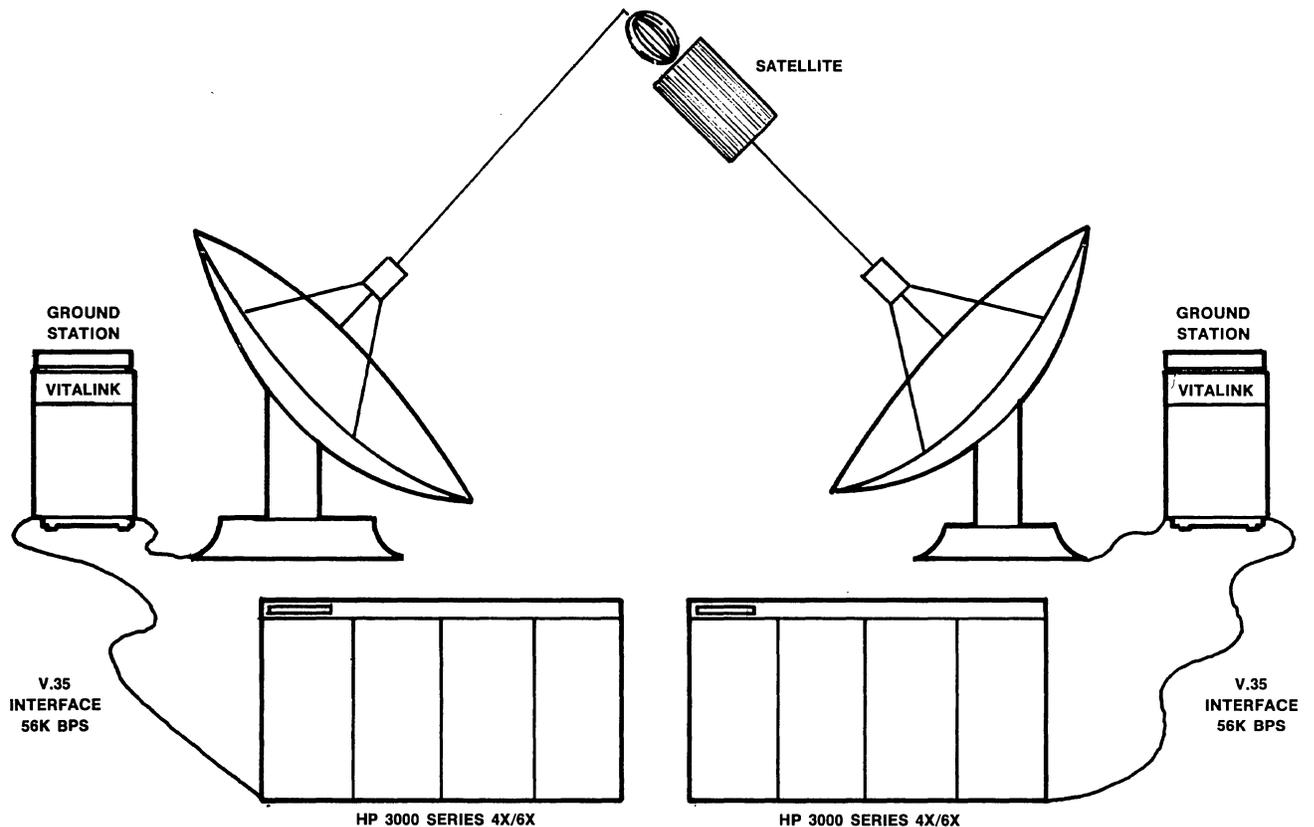


Figure 8 • satellite network link connecting HP 3000s.

implementing them. The MPE operating system divides users of HP 3000 into end users and administrators. Administrators are categorized as system manager, system supervisor, and account managers. Other user attributes can be specified, such as account librarian and group librarian with special file access privileges to maintain files and diagnose hardware components. File access attributes include save or share. Capability-class attributes define the system facilities available to a user: batch, interactive, remote batch, process handling, data segment acquisition, privileged mode, logging, multiple resource identification number, private volumes, data communications and so on.

The system manager creates accounts and delimits resource use. System supervisor manages system on daily basis. Account manager defines valid users and file groups for the accounts and delimiting resource use.

The RTE (real-time executive) operating system implements a session monitor that allocates resources to online users. It handles multiple users and offers protection for each user. Session activity includes program development, data entry, test control, and query access to database. Real-time activity offers response to real-time events: data processing on network, data capture, external events, and time-critical control responsibilities.

Data Security

The IMAGE database management systems and their Query facilities provide data security.

IMAGE provides 6 access modes to files and 6 user types. The access modes are reading, appending, writing, executing, locking with exclusive access, and save files (permanent disk files). The user types are anyone, account member, account librarian, group member, group librarian, and creator. IMAGE

offers file security down to the item level.

IMAGE also offers a logging and recovery system that allows users to restore databases after an interruption in processing. The logging procedure records transactions on a log file on tape or serial disk. The recovery system reads the log file and performs transactions against database backup copy to restore database.

Query adheres to all the IMAGE database security provisions.

■ PHYSICAL NETWORK

Network Nodes

All network nodes consist of HP 1000 or HP 3000 computer systems running the Distributed Systems (DS) software. HP 3000 nodes can be connected together with hardwired serial link, leased or switched communications lines, X.25 packet-switched or X.21 circuit-switched public data networks (PDNs), and Satellite Communication Links.

The HP 1000 can connect to multiple HP 3000 systems by hardwired or modem communications link but cannot store-and-forward requests from one HP 3000 to another. It offers store-and-forward and message routing facilities to another HP 1000.

HP 1000 systems can be connected together via hardwired serial link, leased or switched communications lines, or X.25 public data networks.

HP 1000 systems can store-and-forward information and perform message routing from one node to the next. Thus, a request for service from a remote system can traverse the HP 1000 nodes in-between.

The HP 1000 operates as a bridge system between real-time, local

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control networks and the commercial networks of HP 3000 systems. The HP 3000, in turn, operates as a bridge to the outside world of IBM SNA.

Each node has an address and all units have logical unit numbers. Each node contains a network routing vector (NRV) table, which is part of an overall global network description table (NDT), giving the routing from one node to another. The node uses its NRV for routing messages to their ultimate destination.

□ Session Control

Addresses on the network consists of the network node name/number and the logical unit at that node. Thus, the user (program or someone at a terminal) requests a remote service by designating the remote node name or number or the service. The user program is the master program. The network service intrinsic (subroutine/macro) interprets the requests, performs error checking, and builds a message block to send over the communications link. The block contains request-type identifier, function-type number, control request definitions, and control information.

The message block then goes to the network manager and message protocol layers, and the operating system of the local system suspends the user program if it cannot continue until a reply is received. The network manager adds the source node address, destination node address, local sequence number, and control information to form a request datagram.

The datagram is self contained and includes all the information needed for the network to route it to its destination. It does not require initiating and clearing procedures.

Concurrently, the network manager/message protocol layers build a transaction control block (TCB), which contains a memory buffer tag (MBT) to which the reply to the request can be linked, the local sequence number (LSN) (same as in datagram), ID segment address (IDSA) in the master program making request, and a countdown timer. The MBT and IDSA uniquely define the master program and where the reply is to go. The TCB is the mechanism that allows the node to identify incoming communications, no matter in what order, to the proper user.

The countdown/watchdog timer protects a program from being hung-up indefinitely because a reply never arrives. The timer is managed by communications software that runs periodically.

The communications manager uses its nodal route vector (NRV) table to obtain the route the request is to take to its destination. An NRV table is at each node. NRV relates each route to specific communications links.

The datagram is then passed to the communications link protocol layer which controls and implements the link protocol and passes the message to the next node on the network.

If the destination is not the next node, the datagram is stored in the node's buffer. The communication software at the node examines the nodal destination address. If the address does not match the node, the NRV table is consulted and the next hop on the route is selected and the datagram sent on its way.

When the datagram reaches its destination, the node builds a TCB containing information about the requesting program and services the request as a slave node. A reply datagram is built and sent back to the master node and the slave node deallocates the buffer space used for the TCB.

DS/1000-IV provides for multiple routing between nodes, for retries when a transmission fails, and for queuing and pacing traffic over network links.

□ Network Control

Although the processing power is distributed, the network can be centrally controlled by a single manager at the central EDP site. The remote command processing feature allows the manager to reside anywhere. The manager can assign and delimit user capabilities on each computer on the network. The operating system on each computer will enforce the restrictions. The manager can change network topology without affecting applications programs.

The network manager is responsible for data security and the accounting for resource use. The systems automatically log CPU time, disk space, and connect time for all users. They also keep log files of device problems and failures.

□ Network Problem & Change Management

The network management level software handles request queues, dispatching modules and retry facilities when a communications error occurs. Retry logic continues retransmission until the communication is successfully received, or until the system-specified number of retries have been attempted. When a control message is successfully transmitted, a diagnostic message is printed out on the local console.

DS uses the transaction control block (TCB) for flow control. Users must specify the maximum number of TCBs that can reside in a node. The system then creates a storage pool for TCBs which can be used for master or slave functions. When the pool at a node is exhausted, requests for service are sent back to the originating or intermediate node with a busy reject code. The request then waits a few milliseconds before a retry.

TCBs also have built-in times to prevent the locking up of the network if a reply to a request is not received. Datagram sequencing suspends a user program until a reply is received, or a time-out occurs. Thus, the network cannot be loaded down with messages pertaining to unfulfilled requests.

□ Protocols

Hewlett-Packard implements 6 layers in its Distributed System Software.

User Language Programs • applications level where user develops applications providing terminal and system services.

Network Access Method • gives the application access to the network through Distributed Systems (DS) software which provides system services and I/O operations through high-level programming language • services include network file/database/terminal/peripheral access, network file transfer, and network inter-program communication.

Network Manager • knows network topology and the various topology-dependent functions, such as polling on multipoint line • responsible for routing requests and replies from node-to-node and for managing error recovery • manages flow control, contention, and lock-up problems.

Message Control • provides control, addressing information, message type, and whatever else is needed to set up end-to-end transmission.

Communication Line Protocol • handles the type of transmission between 2 systems that are exchanging information; discipline can be asynchronous, bisynchronous or modified bisynchronous; responsible for error-free, efficient transmission.

Communications Line Control Electrical Interface • physical connection can be X.21, CCITT X.29, V.35, RS-232, RS-449, or V.24/28.

HP AdvanceNet Comparison With OSI Model

Hewlett-Packard has publicly stated the company intends to support the Open Systems Interconnection recommendation when it is adopted.

OSI Application Layer (End-User Access to Network) • corresponds to HP AdvanceNet User Language Programs.

OSI Presentation Layer (Formatting, Converting Information) • corresponds to HP AdvanceNet Network Access Method.

OSI Session & Transport Layers (End-to-End Initiate, Maintain, Terminate & Addressing, Data Assurance, Flow Control) • combined to correspond with HP AdvanceNet Network Manager.

OSI Network (Routing & Transmission) Layers • combined in HP AdvanceNet Message Control.

OSI Data Link Layer (HDLC) • corresponds to Communications Line Protocol which supports X.25 and in turn HDLC as link protocol.

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OSI Physical Layer (X.21 & X.29) • corresponds to HP AdvanceNet Communications Line Control Electrical Interface which supports X.21 (digital circuit-switched data networks) and X.29 terminal connection standard.

Another way to look at the AdvanceNet architecture is that shown in Figure 9. This combines layers 1 and 2, 3 and 4, and 5 and 6 into a 4-layer architecture. The protocols AdvanceNet now offers are those shown in Figure 10.

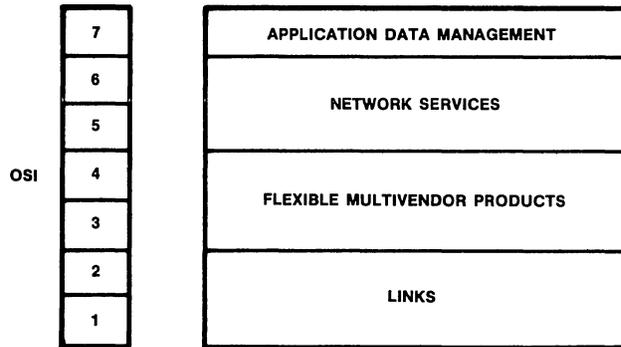
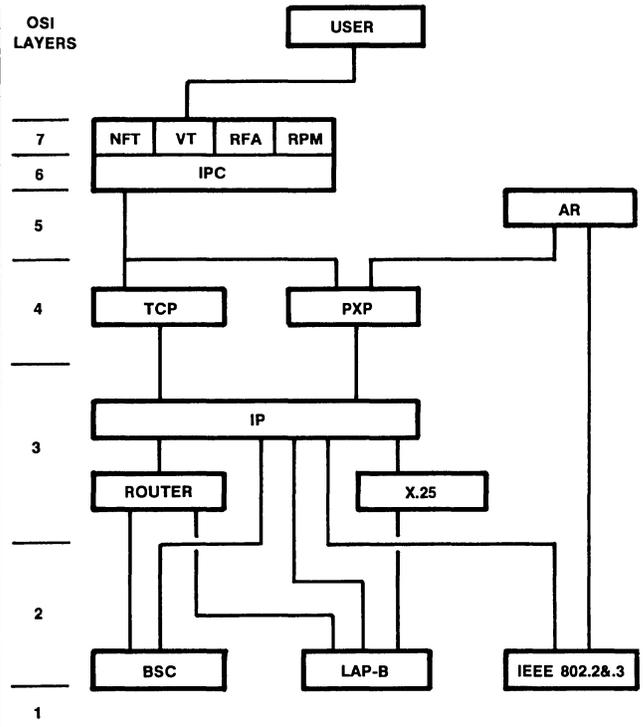


Figure 9 • HP AdvanceNet architecture.

EQUIPMENT SUMMARY

Hosts

HP 1000 Computers • consist of 4 series of computers currently marketed: E-and F-Series of 16-bit minicomputers and A- and L-Series of microcomputer-based systems • operate in the power range for real-time applications of about 0.08 MIPS (E-Series), 0.2 MIPS (F-Series), 1.0 MIPS (A-Series), and 0.3 MIPS (L-Series) • F-Series uses E-Series CPU with floating-point hardware, scientific instruction set, and FORTRAN accelerator; L-Series is hardwired microcomputer with bus-oriented architecture implemented with SOS LSI CPU chip; A-Series Models 600 and 700 use architecture similar to L-Series implemented using bipolar bit-slice technology for CPU; A-Series Model 900 implemented with Schottky TTL discrete logic • E-/F-Series use same I/O architecture with bandwidth of 2.3M/3.2M bytes per second; A-/L-Series use I/O processors with bandwidth of 2.7M bytes per second (L-Series, A600 Series, and A700 Series) and 3.7M bytes per second (A900 Series) • A900 Series is designed as high-performance, real-time processor for data acquisition, image and signal processing, and process monitoring and control; includes 4K-byte high-speed cache memory, up to 6M-byte main memory, 32-bit-wide memory bus, 2-level instruction pipeline, standard floating-point processor, HP's Scientific Instruction Set (SIS), and Vector Instruction Set (VIS) firmware; executes single-precision Whetstone instructions at a rate of 1200K instructions per second • A-Series processors are all software compatible; run under RTE A.1 real-time operating system, which supports IMAGE/1000 database management system, DS/1000-IV networking software to connect to other HP 1000 and HP 3000 systems and to X.25 packet-switching communication software, FORTRAN 77, Pascal, BASIC, and Macro/1000 languages, and Graphics/1000 2D and 3D graphics software • A900 supports 9 models of HP graphics terminals including the new 2627 color graphics terminals, 6 HP CRT display terminals, variety of printers and disk drives including HP's 3.5-inch 270M-byte floppies; all A-Series processors support up to 250M bytes of mass storage • the A-Series is higher performance than the older 1000 E-and F-Series models, uses higher-density LSI components, supports more memory, costs less for comparable configurations, and should be more reliable; thus, the A-Series essentially replaces the E- and F-Series • the switchover to A-Series is complete with the release of RTE A operating system, which contains all the



NOTES:

- AR—Address Resolution, resolves names into addresses.
- BSC—bisynchronous communication, connection-oriented ("Conversational Bisync" on HP 1000 and HP 3000).
- IP—ARPA Internet Protocols.
- IPC—Inter-Process Communication.
- IEEE 802.2—Logical Link Control Standard.
- IEEE 802.3—CSMA/CD Media Access Control Protocols Standard.
- LAP-B—Link Access Protocol Balanced—X.25 link level protocol.
- NFT—Network File Transfer.
- PXP—Packet Exchange Protocol.
- RFA—Remote File Access.
- RPM—Remote Process Management.
- TCP—ARPA Transmission Control Protocol.
- VT—Virtual Terminal.
- X.25—CCITT packet-switched network protocol, includes LAP-B.

Figure 10 • protocols currently implemented in the HP AdvanceNet architecture.

features of the RTE6/VM available for E-/F-Series.

HP 1000 High-Availability Systems • currently based on dual HP 1000 Model 60 (E-Series processors) or HP 1000 Model 65 (F-Series processors) systems with one primary CPU and one backup CPU using Systemsafe/1000 configuration; both systems read all input data from selected devices or processors, but only the primary system outputs data and gives control commands; if failure is detected in primary, serial I/O control is switched to backup system through an I/O Switch Module; a system can support 6 I/O switch modules • Datasafe/1000 software provides for up to 960M bytes of mirrored disk storage • a typical Datasafe 1000 configuration includes dual HP 1000 60/65 systems; each system runs RTE-6/VM, 2M-byte memory, 19.6M-byte disk storage, and system console; programming is done using FORTRAN 77 and Pascal • currently, A-Series cannot be configured into high-availability systems because the series cannot run RTE-6/VM; RTE A.2 will support high-availability configurations when it becomes available.

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HP 3000 Series 40, 44 & 64 • no longer marketed; replaced by Series 39, 42, 48, and 68.

HP 3000 • bus-centered system consists of 5 Series: 37, 39, 42, 48, and 68 and is based on 3 CPUs • Series 37, 39, 42, and 48 Intermodule Bus (IMB) interconnects CPU which includes a memory controller, general I/O channels (GIC) to connect peripherals and asynchronous data communication controllers (ADCCs) to attach interactive terminals; Series 37 and 48 also connect an Advanced Terminal Processor (ATP) to attach interactive terminals to the bus • Series 39, 42, and 48 CPU is 16-bit word microcoded processor that uses Schottky TTL technology with 105-nanosecond microinstruction cycle time • Series 37 CPU same as for other 16-bit Series except microinstruction execution time is 170 nanoseconds • Series 68 CPU is configured with same 32-bit CPU as the earlier Series 64; is a Central System Bus (CSB) system with up to 3 IMBs (2 optional); CPU module with cache memory, main memory module, and I/O adapter module which interfaces the CSB to the IMB(s) • all data communication links into a network are through Intelligent Network Processors (INPs) which are connected to I/O channels through an HP-IB interface; the INPs in conjunction with Multipoint Terminal System (MTS) software can attach interactive terminals • all models include diagnostics and control facilities to diagnose and control functions • Series 39, 42, and 48 include Control and Maintenance Processor (CMP) to perform self-test; Series 68 includes Diagnostic Control Unit (DCU) and Power Distribution and Monitor (PDM) Unit; DCU can interrogate, modify, and diagnose all registers and most data paths in CPU and run diagnostic tests on main memory, cache memory, I/O adapter, and 80 percent of the I/O chain; PDM monitors the power supply and reports on its faults and failures • all systems have a remote diagnostic capability so an HP customer engineer at another site can identify and solve hardware problems • all run under the MPE Multiprogramming Executive virtual memory operating system.

Series 37 & 37XE • interactive business systems; both use the CPU but Series 37 is smaller; both include Peripheral Interface Channel (PIC) for HP-IB connections and an ATP 37; main memory is 512K/2M bytes (Series 37) or 1M/2M bytes (Series 37XE) • basic system supports 6 devices/PIC with data rate of 1M bytes per second and 7 point-to-point terminals • systems can be expanded to support 8 disk drives (2.1G bytes of storage), 2 magnetic tape drives, cartridge tape drive with disk system, 28 point-to-point terminals, 2 line/character printers or 2 laser printers, and 1 (Series 37)/3 (Series 37XE) synchronous communication lines (56K bps) • performance of both systems is about 6.4 MIPS.

Series 39 Computer System • low-end model; supports up to 92 point-to-point and multipoint terminals, 512K to 3M bytes of main memory, 8 disk drives (up to 3.23G bytes of storage), 4 magnetic tape drives plus cartridge drive supported by hard disks, 2 character/line printers, 2 laser printers, and 3 synchronous communication lines • performance is about 0.53 MIPS.

Series 42 Computer System • midline model of HP 3000 line with power of about 0.4 MIPS • supports up to 92 point-to-point and multipoint terminals, 1M to 3M bytes of memory, 8 disk drives (up to 3.23G bytes of storage), 4 magnetic tape drives plus cartridge tape supported by hard disks, 2 character/line printers, 2 laser printers, and 3 synchronous communication lines • performance is about 0.66 MIPS.

Series 48 Computer System • midline model of HP 3000 line • supports 152 point-to-point and multipoint terminals, 1M to 4M bytes of memory, 16 disk drives (up to 4.2G bytes of storage), 8 magnetic tape drives plus cartridge tape supported with hard disks, 4 character/line printers, 2 laser printers, and 7 synchronous communication lines • performance is about 0.66 MIPS.

Series 68 Computer System • replaces Series 64 as the top of the HP 3000 line • supports up to 400 point-to-point and multipoint terminals, 3M to 8M bytes of main memory, 8K bytes of cache memory, 24 disk drives (up to 9.7G bytes of storage), 8 magnetic tape drives plus tape cartridge supported with hard disks, 8 character/line printers, 2 laser printers, and 24 synchronous communication lines • performance is about 1.6 MIPS.

Local Network Subsystems

Any number of HP 1000s operating with DS/1000-IV software under RTE operating system can run as a local or distributed network subsystem. The HP 1000 network can operate as standalone system or HP 1000 can connect to an HP 3000. Any HP 1000 can also emulate an IBM 2780/RJE terminal and communicate with an IBM S/370-compatible mainframe.

An HP Programmable Controller Link (PCL)/1000-AB interface card can connect up to 8 Allen-Bradley data highways to an HP 1000 processor. Each data highway can connect to up to 63 programmable controllers. An HP 1000 can support 3 PCL/1000-AB interfaces for connection to up to 1,512 programmable controllers.

HP has announced the company will implement an IEEE 802.3 local area network. An Ethernet interface is available for the 32-bit high-performance 9000 Series Desktop Workstations and for the Touchscreen personal computer.

HP can also interconnect all models of the HP 9000 (32-bit) and 9000 Series 200 (16-bit) desktop computers together under a Shared Resource Manager (SRM) running on one of the systems to act as a controller. SRM allows the interconnected desktop computers to share common databases and peripherals such as disks, plotters, and printers.

Distributed Systems/1000-IV Software • provides integrated set of high-level network facilities and procedures; supports network resource sharing, remote database access, distributed data file management, communications between applications programs, and the coordinated distribution of workloads among processors within the network • used with RTE-L, RTE-XL, RTE-IVB, RTE-IVE, RTE-6/VM, and RTE-A operating systems; requires 256K-byte minimum memory; see Network Management section.

Multipoint Terminal Subsystem (MTS) Software • provides support package for multipoint terminal communications with display, data capture, and time reporting terminals; supports up to 8 multipoint interfaces with up to 32 terminals per single communications line or up to 256 terminals:

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Asynchronous Multiplexer Subsystem Software • provides support package for asynchronous communications with display and printing terminals; supports up to 2 multiplexer interfaces with up to 16 channels per interface or up to 32 terminals.

Communications Processors

Hewlett-Packard does not use communications processors as nodes network; they are used only as front-end processors. The only communications processors are the Intelligent Network Processor (INP) which handles one data communications protocol for one synchronous line for the HP 3000 and the Advanced Terminal Processor (ATP) which provides RS-232C or RS-422 workstation connections. Data communication lines are also interfaced to the HP 3000 Series 39, 42, and 48 through the Asynchronous Data Communications Controller (ADCC).

Intelligent Network Processor (INP) • 16-bit SOS microprocessor with 32K-byte memory designed to link HP 3000 computers to other computers in distributed data processing environment and to support multipoint terminals • supports modem and hardwired interfaces operating at up to 56K bps • includes 4-channel DMS controller, HDLC/SDLC protocol controller, BSC protocol controller, and HP-IB (IEEE-488) interface; software downline loaded from HP 3000 determines use; handles data rates up to 56K bps • handles data transmission, buffering, error checking, retransmission and terminal polling; supports Bisync, full-duplex HDLC (X.25 LAPB), and IBM-compatible SDLC protocols; interfacing compatible with RS-232C, CCITT V.35, RS-422, and U.S. and international auto-dial equipment • used as interface between HP 3000s, HP 3000 and large mainframes, and HP 3000 and multipoint terminals.

Advanced Terminal Processor (ATP) • for use with HP 3000 Series 39, 4X, and 6X processors; supports local directly connected terminals or full-duplex modem connected terminals

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and supports serial printers; provides 12 to 384 ports • provides direct memory access (DMA) • supports point-to-point communication at up to 19.2K bps at distances up to 4,000 feet using RS-422 and up to 50 feet using RS-232C • supports up to 96 local terminals on Series 48 and up to 384 local/remote terminals on Series 68 • consists of 1 ATP System Interface Board (SIB) and up to 8 direct connect or modem port controllers.

ATP 37 • for HP 3000 Series 37 only; provides 6 direct connect RS-232C ports for local workstation and 1 RS-232C port for remote workstations • data transfer line speeds are up to 19.2K bps • 1 included with basic Series 37 and 3 additional ATPs are optional for total of 28 workstations.

Asynchronous Data Communications Controller (ADCC) • connects up to 4 point-to-point terminals to HP 3000 Series 39, 42, and 48; can be extended to support up to 8 ports; maximum transmission rate is 9600 bps • provides RS-232C interface and supports half- and full-duplex modes of operation.

□ Distributed Computers

HP 1000 and HP 3000 Series systems operate as distributed as well as host computers. Other distributed processors include the HP Series 100 Personal Office Computers, HP Series 200 Personal Computers, HP 250 Series Office Computers, HP 9000 Series Desktop Workstations, and HP 9800 Desktop Computers.

HP Series 100 Personal Office Computers • includes HP 110 Portable and HP 150 Touchscreen personal computers • HP Portable uses Intel 8086 CMOS 16-bit processor, runs MS-DOS • features 384K ROM for built-in software, including Lotus 1-2-3, MemoMaker, and data communications software; Personal Application Manager (PAM) included in operating system • built-in 300 baud modem, 1 RS-232C port, and 1 HP-IL port; weighs 8.5 pounds; completely battery powered with battery status; 272K RAM built-in • supports ThinkJet printer and 710K-byte microfloppy disk drive; flip-up 16-line by 80-character liquid crystal display • HP 150 Touchscreen uses Intel 8088 16-bit processor, runs MS-DOS; has 9-inch display with touch-screen user interface; 256K to 640K bytes of RAM memory; provides 1 RS-232C port, 1 RS-422 port, and 1 HP-IB port to connect up to 14 peripherals including printers, plotters, and modems • supports double-sided 3.5-inch disk drives, each with 710K-byte capacity • local area networking provided by 3Com Ethernet allowing electronic mail, shared disks and printers, and shared applications; optional internal printer • software features Personal Application Manager, HP Message for electronic mail, HP MemoMaker for word processing, and many third-party packages for spreadsheets, data communications, accounting, word processing, and other applications • HP Touchscreen Max includes 1 double-sided microfloppy disk and 1 15M-byte Winchester hard disk.

HP Series 200 Personal Computers • see HP 9000 Series 200.

HP 250 Series Office Computers • supported as terminal to HP 3000 by LK 3000 Utility and DS 250 Distributed System • supports 6 workstations/tasks: 1 local and up to 5 remote; memory up to 512K bytes, disk storage up to 260M bytes, 1.2M bytes diskette storage • runs under Basic Operating System (BOS) and supports IMAGE/250 database, which is compatible with IMAGE/3000 • connects to IBM S/370-compatible host mainframe through RJE/250 facility.

LK3000 Utility • asynchronous communication for interactive operations; supports ASCII file transfers between 2 systems.

DS 250 Distributed System • supports interactive link to HP 3000; bidirectional file transfers at rates up to 19.2K bps; features log-on/log-off, remote command and program execution, peripheral access, backup and retrieval of HP 250 data/program files to/from HP 3000, and auto-dial • runs with INP hardware • direct connect or modem interface to HP 3000.

RJE/250 • runs on INP/250 configured to handle only data communications; makes HP 250 look like IBM 2780/3780 batch terminal to host; HP 250 can operate in multiuser mode in conjunction with synchronous communications and can also transfer files to/from another 2780-/3780-compatible terminal.

HP 9000 Series Desktop Workstations • 32-bit single- or multiple-user workstations designed primarily for computer-aided

engineering applications; offered in Series 500 uniprocessor models, Series 600 dual-processor models, and Series 700 triple-processor models; can be configured with color-graphics CRT display, keyboard, printer, 10M-byte Winchester disk drive, 256K-byte flexible disk drive, and up to 2.5M-byte error checking and correcting memory • uniprocessor claimed to be in 1 MIPS performance range • based on HP's NMOS-III superchips which provide 70 times the packing density of HP's NMOS-II chips; CPU chips contain equivalent of 450,000 transistors and 128K RAM contains equivalent of 660,000 transistors; other chips include I/O processor, memory controller and clock • runs under an HP version of UNIX called HP-UX or high-performance version of HP's Enhanced BASIC • HP-UX is multiple-user system; includes IMAGE/9000 database management system and Graphics/9000 software; supports Pascal, FORTRAN, and C languages; also provides communication capability through a terminal emulator for asynchronous data communications, interface to Ethernet for networking and HP's Shared Resource Manager (SRM) for linking clusters of HP 9000s with each other and with HP 9800 Series desktop computers • HP 9000 BASIC-language operating system is single-user; implements the Enhanced BASIC language developed for the HP 9800 16-bit desktop computer, thus application programs for HP 9800 can run on the HP 9000; a runtime compiled BASIC as well as interpretive BASIC is available on HP 9000; also includes 2-D and 3-D graphics, IMAGE database management system with conversational Query language, asynchronous terminal emulator, and SRM clustered networking capability • applications packages include HPSPICE for circuit simulation, HP-FE II finite analysis system, HP DESIGN for mechanical engineers, and other programs through HP PLUS, HP's third-party software program.

HP Series 9000 Series 200 Engineering Workstations • 16-bit single-user system based on the Motorola MC68000 CPU chip with memory ranging from 128K to 7.3M bytes; system interfaces for up to 14 peripherals at one time through support of HP-IB (IEEE-1978) bus that is compatible with more than 130 instruments • connects to host via hardwired or modem link, asynchronous or synchronous (RJE Bisync) mode • particularly applicable to technical, engineering, and laboratory environments • mass storage includes 264K-byte flexible disk and optional 5.25-inch Winchester disk drives • includes Model 216 (formerly 9816), 220 (formerly 9920), 226 (formerly 9826), and 236 (formerly 9836) • Model 216 has built-in graphics capability on its 9-inch screen, up to 768K-byte memory, HP-IB and RS-232C I/O ports • Model 226 includes disk drive and up to 2M bytes of memory • Model 236 has 12-inch monochrome/color display, dual disk drives, and 2M-byte memory; color model uses a 4-bit frame buffer to provide 16-color display • can be programmed using HP-extended BASIC, HPL, and Pascal; Forth language also available through independent software vendor; available applications software packages include computer-aided engineering tools for AC Circuit Analysis and Digital Filter Design, Mathematical Modules for Numerical Analysis and Graphics Presentations, and VisiCalc • connect to variety of peripherals such as printers, plotters, and mass storage devices through HP-IB (implementation of IEEE-488 standard bus) and to serial devices through RS-232C interface; other interfaces to various HP instruments are optional • can connect to up to 68 other Series 200 models and HP desktop computers engineering workstation in a network to share disk drives and printers using HP's SRM (Shared Resource Management) software.

□ Cluster Controller Subsystems

Hewlett-Packard uses its communications processors as terminal controllers: INP, ATC, ATP, and ADDC. These systems are discussed in the Communications Processors section. In addition, HP provides a multipoint cluster controller and a multiplex multiplexer/cluster controller for connection of remote workstations.

The Multipoint Terminal Software (MTS) allows multiple terminals to gain access to HP 3000 resources through a single communications link. The link can be local hardwired or remote through a modem. A bypass cable is available for use with MTS; it enables the system to go around a terminal with no power so the system can continue running and communicating with the other terminals on the daisy chain; see Figure 11.

HP AdvanceNet

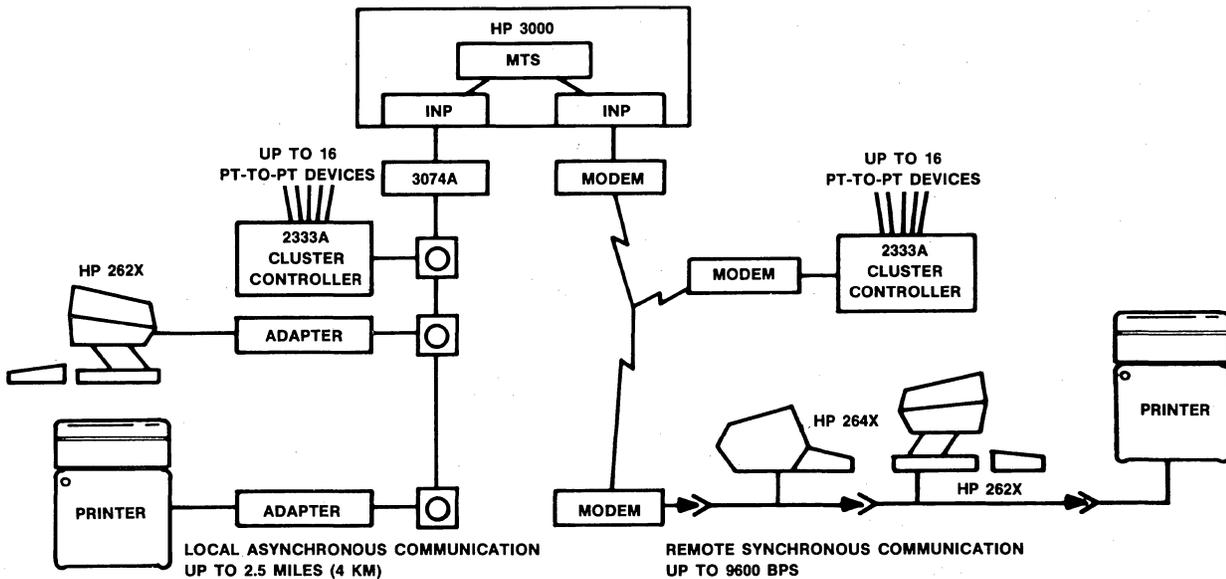


Figure 11 • Multipoint Terminal Software (MTS) support on HP 3000.

HP 2333A Multipoint Cluster Controller • connects to Data Link and to modem; provides local or remote control for up to 16 asynchronous point-to-point terminals; uses RS-232C interface and operates at data rates up to 9600 bps; supports HP 262X, 264X, 307X, and 2382A Series terminals as well as HP 125 Business Assistant • automatically converts multipoint format to point-to-point and vice versa; totally transparent to HP 3000 MPE system and to terminals.

HP2334A Multimux • connects up to 16 remote workstations (terminals, personal computers, printers, plotters) to a host computer; can be used as a statistical multiplexer or as a cluster controller; connections can be over a dial-up or leased line, a digital line or an X.25 packet-switching network; supports HP 3000 and HP 1000 computers and most HP workstations; allows remote connection of spooled printers; certified with most X.25 Public Data Networks • also called X.25 cluster controller.

□ Terminals

Terminals interface to DSN through the HP 3000 or the HP 1000. Both support point-to-point and multipoint terminal configurations connected to leased or switched data communications lines or local cable data links. HP markets the HP 30037A Asynchronous Repeater (AR), a standalone device to extend asynchronous point-to-point communication between HP 3000 and a single asynchronous RS-232 device to 4,000 feet.

HP offers a wide variety of terminals in addition to its personal computers, which can operate as terminals to host systems. HP terminals include 4 hardware families: 238X, 262X, 264X, and 2700. All offer block mode editing, graphics, and data entry features with varying amounts of intelligence. All are fundamentally compatible; most are HP 3000 data entry compatible. The range is from the character mode HP 2621 alphanumeric terminal to the powerful HP 2700 graphics workstation.

HP 2382A Office Display Terminal • standalone with 12-inch screen with detachable keyboard and numeric keypad; 24 lines x 80 columns; edit and format features; supports no peripherals • asynchronous full-duplex communication at up to 9600 bps; ASCII code; RS-232C interface • small size with aesthetic styling; contains human engineering features to appeal to casual user • operates in both conversational and block mode.

HP 2621B Interactive Terminal • character-mode terminal • 24-line x 80-character format (1920 characters); 7x9 dot matrix

within a 9x15 cell; detachable 68-key keyboard; 6x8.5-inch screen; 4K-byte buffer (2 pages); 8 preprogrammed function keys; upper-/lowercase • keyboard selection of speed, parity, and other parameters (stored in nonvolatile RAM) • asynchronous; RS-232C or CCITT V.24 interface; local or remote attachment; up to 9600 bps on Series 3000 • typewriter-style detachable keyboard; user-definable softkeys • 2621L is OEM version of 2621B.

HP 2622A Display Terminal • block-mode terminal • standalone with 10.4-inch screen; 7x11 matrix; 24 lines x 80 columns with lines 25 and 26 for labeling function/softkeys; asynchronous, full-duplex communication at up to 9600 bps; RS-232C interface • 60-cps printer with thermal printer optional.

HP 2623A Graphics Terminal • low-cost terminal for integration of graphics into business reports; supported by HP DSG/3000 Decision Support Graphics software running on HP 3000 and HP Graphics 1000/11 running on HP 1000 to produce line graphs, bar charts, pie charts, and scattergrams • will also operate with other independent graphics software • hardcopy optional on thermal printer • asynchronous, full-duplex communication at data rates up to 9600 bps; EIA RS-232C interface or 20-mA current loop; 8 user-definable softkeys • 6.5-inch x 8.5-inch screen; 24 lines x 80 columns; full ASCII keyboard.

HP 2624B Display Terminal • data entry terminal designed for high user productivity with low system and data communication overhead; also suited for data retrieval and program development applications; includes forms cache memory, local edit checks, and local display memory for 4 pages with 5 additional pages optional • full ASCII data entry keyboard with numeric keypad, screen-labeled user definable keys, "friendly" error messages; 10.4-inch screen for display of 24 rows x 80 columns; dual asynchronous communication ports for full- or half-duplex transmissions at up to 9600 bps • integral thermal printer with 60-cps throughput; 1 multipoint line printer can operate in terminal bypass mode with host CPU control • RS-232C or 20-mA current-loop interface.

HP 2625A Dual-System Display Terminal • provides facilities of HP 2622 block mode data entry terminal supported by VPLUS software on HP 3000 in HP data entry mode and the facilities with BSC protocol of the IBM 3276 Model 2 (24 lines), Model 3 (32 lines), or Model 4 (43 lines) display station in IBM terminal mode • data communications rate on HP port is up to 19.2K bps and with both IBM port and HP port active, data communication rate is 9600 bps • supports Graphics and Word Processing options; integral

HP AdvanceNet

thermal printer; optional HP-IB port available with the graphics option for attachment of printer or plotter.

HP 2626A Display Terminal • multiwindow display; designed for office applications requiring high performance, data entry using low-speed communication lines; includes 10.4-inch screen, data entry keyboard with numeric keypad • screen can be divided into up to 4 windows; 80 to 160 columns by up to 118 rows; 16-character labels for 8 user-definable softkeys; function keys available for interactive forms design; character sets and keyboards for 6 optional languages • programmable audio feedback • dual communication ports for point-to-point or multipoint, synchronous or asynchronous full- or half-duplex communication at up to 9600 bps; RS-232C interface • integral forms copy printer.

HP 2627A Color Graphics Terminals • designed as online graphics terminal; compact, low-cost terminal for business and technical graphics; features vector graphics and polygonal area files for creation of complex shapes, symbols, and typestyles; 12-inch nonglare, high-contrast display with resolution of 512x390 pixels; produces 8 basic colors which can be mixed to create additional colors; 8 additional colors redefined to HP plotter pen colors • full-duplex asynchronous point-to-point communication through RS-232C or HP Direct Connect 422 at 110 to 9600 bps; includes block/format mode transmission; includes RS-232C port for printer or other peripheral; video interface optional • supports graphics software on HP computer systems: HP DRAW on HP 3000, GRAPHICS 9000/II on new HP 9000 family of 32-bit computers; also supports HP PLUS third-party software packages.

HP 2628A Secretarial Workstation • for HPWORD word processing, data processing, and graphics in one terminal • offers all the functions of HP 2625A except IBM compatibility.

HP 2631/2635 Printing Terminals • RO/KSR; 180 cps, bidirectional; impact 7x9 matrix; keyboard includes numeric keypad; 16, 7, 10, and 5 cpi; accommodates 6-part forms; 8-channel vertical format control in ROM; asynchronous, full-duplex RS-232C interface; up to 9600 bps • remote/local attachment.

HP 264X Family Displays • 12-inch screen; 24-line x 80-character format (1920 characters); 7x9 dot matrix within 9x15 cell; detachable keyboard; 5x10-inch screen; 48K-byte screen buffer standard, expandable; up to 4 plug-in 128-character sets; 8 program keys; inverse video, blinking, half-intensity optional, all modes; foreign language character sets available on some models • character or block mode; RS-232C asynchronous • local/remote attachment • 8K-byte screen memory maximum; 110 to 9600 bps; APL version available; TTY/ASCII compatibility optional; asynchronous/synchronous multipoint interface optional.

HP 2645A Display Station • sophisticated display station with extensive standalone facilities; optional in-board cartridge tapes provide 220K bytes of local storage for off-line operation • includes multiple local editing and communications capabilities; RS-232C interface with communications data rates up to 9600 bps • other versions available with character sets for various foreign countries.

HP 2647F Intelligent Graphics Terminal • interactive keyboard-graphics display with flexible mini disk storage, 470K bytes • 1920-character display; 24 lines of 80 characters each; stores up to 75 lines • raster-scan graphics; 720 dots x 360 rows of addressable resolution; 100-vector-per-second maximum plotting speed • hard-copy output options include graphics printer,

plotter/printer, daisywheel printer, and thermal graphics printer; uses shared peripheral interface • 9600-bps maximum data rate; point-to-point half-duplex, full-duplex, or echoplex communications • extensive software support including BASIC.

HP 2648A Graphics Terminal • interactive keyboard-graphics display with device support firmware • 1920-character display; 24 lines of 80 characters each; stores up to 37 lines • raster-scan graphics; 720 dots x 360 rows of addressable resolution; stores up to 360 rows; 100-vector-per-second maximum plotting speed • hard-copy output options include graphics printer, plotter/printer, daisywheel printer, and thermal graphics printer; uses shared peripherals interface • 960-cps maximum data rate; point-to-point or multipoint communications • for point-to-point communications, requires external asynchronous communications option.

HP 307X Data Capture Terminals • family of terminals for shop floor or other factory data collection use • general terminal can have numeric/alphanumeric display/keyboard; multifunction and badge reader; strip printer; user definable prompting lights/special function keys; tabletop or wall mount • time reporting terminal available with badge reader, time display, data display/keyboard, 20-lpm (20 positions) thermal printer • RS-232C/CCITT V.24 interfaces at up to 9600 bps • supported under DSN/MTS for asynchronous multipoint communication.

□ Support Equipment

Modems

13265A Modem • 300-bps modem for 262X terminals.

37230A Short-Haul Modem • synchronous short-haul modem for data rates up to 19.2K bps.

4800-bps Modem • microprocessor-controlled, automatically equalized, synchronous modem • 4800 bps, fallback to 2400 bps; handles RS-232C and CCITT V.24/V.28 data interfaces; supports point-to-point and multipoint configurations over 4-wire leased lines in half- or full-duplex mode and point-to-point operation over 2-wire dial-up lines in half-duplex mode; requires 2-/4-wire telephone circuits at least equal to 3002; equalizer initialization time is 50 to 708 milliseconds • usable with INP or SSCL.

9600-bps Modem • LSI circuitry but not microprocessor-controlled • 9600 bps, fallback to 4800 bps; handles RS-232C and CCITT V.24/V.28 data interfaces • operates only in 4-wire full-duplex mode; requires 4-wire leased lines at least equivalent to 3002; permits local/remote loopback tests with visual check • equalizer initialization time is 2.8 seconds • usable with INP or SSLC.

Multiplexers

HP 30018A Asynchronous Multiplexer • provides connection for up to 8/16 asynchronous devices with 30019A extender.

HP 39301A Fiber-Optic Multiplexer • for connection of 8 full-duplex channels • each channel provides RS-232C interface and can operate asynchronously at 9600 bps • pair can be used to establish 8 RS-232C full-duplex data links over HP 39200B fiber-optic cable for distances up to 3,280 feet; data rate can be up to 19.2K bps; channels can be optionally extended to 16 • can be used in electrically noisy environment.

• END

Hewlett-Packard HP 2627A Color Graphics Terminal

■ PROFILE

Function • general-purpose, nonprogrammable color graphics/alphanumeric display terminal • displays vector graphics, polygon area fills, and graphics text • local/remote modes • optional ANSI-mode and DEC VT52 operation.

Graphics Display • raster scanning • 512 dots x 390 rows in 3 color planes (red, green, blue); scaled or unscaled support of 1024 x 780 addressable points through halving or subsetting, respectively • 8 foreground/background color combinations of red, green, blue, cyan, magenta, black, and white.

Graphics Software • HP DSG/3000, HP Graphics 1000/II, HPDRAW, HPEASYCHART; Tektronix 4010 and Plot 10; Precision Visual DI-3000 and GRAFMAKER; ISSCO's DISSPLA and TELL-A-GRAF; SAS's SAS/GRAPH.

Architectures Supported • any architecture supporting ASCII terminals and the above graphics software • Tektronix 4010 compatible • ANSI 3.64 and DEC VT52 compatible with F17 option.

Communications • full-duplex, asynchronous, point-to-point, 110 to 9600 bps • character, line, page, block modes • RS-232C or 20-mA current-loop interfaces • HP direct connect type 422.

Operating System • none.

Database Management • none; only in association with host processor.

Transaction Processing Management • none; only in association with host processor.

Support Software • graphics only.

Processor • separate microprocessor for alphanumerics and graphics • 32K-byte RAM graphics memory; 2K-byte RAM display/scroll buffer • local/remote initiated printing.

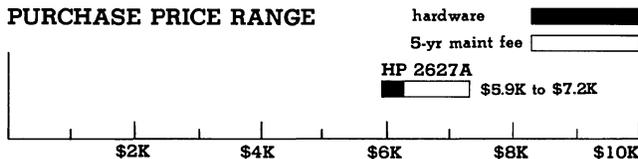
Terminals/Workstation • single keyboard, 1920-character display with auxiliary RS-232C port.

First Delivery • November 1982.

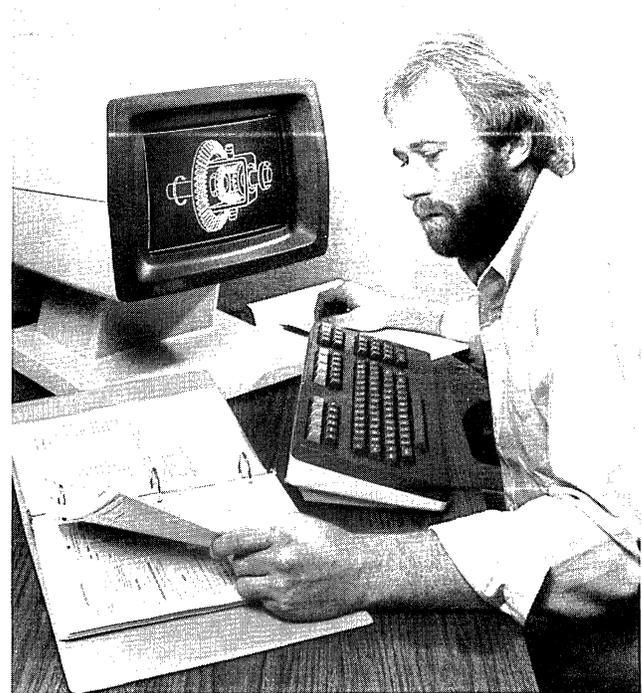
Systems Delivered • about 5,000.

Comparable Systems • competitive with a number of monochrome alphanumeric displays including DEC VT100, IBM 3101, Televideo 900, Lear-Siegler ADM, etc • graphic competitors include AED-512; Colorgraphic MVI-7 and MVI-100; Data General Dasher D450; DEC VSV11 and VS11, DEC VT125; Electrohome EGT04-R/RM; IDT-1800; Lexidata 3400; Ramtek 6211, 6212, 6214; Tektronix 4027A.

PURCHASE PRICE RANGE



HEWLETT-PACKARD HP 2627A PURCHASE PRICING bar graph covers price range between "small" and "large" configurations for hardware (solid bar) and for associated 5-year maintenance (open bar) • **HP 2627A SMALL** configuration consists of color display with associated detached typewriter-style keyboard, 2K-RAM display buffer, 32K-RAM graphics memory, RS-232C communication interface, 20-mA current-loop interface, HP 422 direct-connect interface, and RS-232C auxiliary I/O interface • **LARGE HP 2627A** adds a 15-foot modem cable • all prices single-quantity purchase; discounts available.



Vendor • Hewlett-Packard; 3000 Hanover Street, Palo Alto, CA 94304 • 415-857-1501.

Distribution • nationwide through Hewlett-Packard sales offices.

■ ANALYSIS

Hewlett-Packard's HP 2627A is an online color graphics terminal that accommodates a wide variety of computer-based software. It offers a high-quality color presentation of vector graphics with full alphanumeric support at an economical price. Targeted at general business and technical applications, the compact terminal is supported by a broad range of graphics software including many prominent third-party packages in addition to HP's own powerful graphics software. The terminal's high-contrast, high-resolution (199,680 pixels) display uses raster scan technology to produce sharp, bright colors and images. The HP 2627A is also Tektronix 4010 compatible, and runs the graphics packages designed for that terminal as well.

The HP 2627A is focused on the low end of the graphics terminal market. It is intended to satisfy the limited graphic requirements of business and simple engineering applications at a cost-justifiable price. It is not intended to satisfy the requirements of sophisticated graphic applications fulfilled by top-of-the-line products. But as a simple graphic terminal, the HP 2627A has several attractive features that translate to user benefits. Among these are image maneuverability, graphic compatibility with competitive terminals, text and image presentation flexibility, and support for either binary or ASCII coordinate formats.

Translation facilities display an image at several different screen positions using a single set of data and drawing commands. An

Hewlett-Packard HP 2627A Color Graphics Terminal

image can be relocated to any screen position, or through zoom facilities, it can be expanded beyond screen boundaries to view a selected portion of the image.

Graphic compatibility with other terminals with up to twice the number of addressable points allows the use of graphic programs developed for other terminals with a minimum of reprogramming. Images can be scaled to one-half size or reduced by a programmable factor to fit within screen boundaries.

Graphic presentation is enhanced by polygon area filling and fill patterns. Polygon area filling, combined with fill patterns and color, substantially enhances information presentation to illustrate trends and relationships for quick and easy perception by the viewer.

Graphic text can be presented in 8 sizes in a vertical or right-slanted position, either upright or rotated in 90-degree increments through 360 degrees through programming. Text can be automatically right or left justified or centered about a specific point. Colors are independently programmed.

Vector formats can be expressed in ASCII or binary for operating flexibility. ASCII formats can be derived from simple print statements and facilitate communication with a remote terminal. Binary formats facilitate computer generation via a directly connected host computer.

Alphanumeric support is comparable to top-of-the-line alphanumeric terminals. Full function cursor controls, cursor sensing/addressing, scroll up/down, next/previous page, text highlighting, and foreground/background color pairs facilitate manipulation and display of alphanumeric data. Split screens are not supported. However, a line-lock feature retains data on the screen from the cursor upwards; data entry and/or scrolling can be performed in the remaining screen segment. This feature allows the user to retain page titles or tabular headings while entering data below.

Comprehensive editing functions and format control for data entry applications are also supported. A line drawing character set enables the construction of forms with protected and unprotected fields for data entry. Left/right margin control and tabulation are also provided.

Alphanumeric display memory accommodates up to 2 full pages of text (48 lines at 80 characters per line). The user can scroll through display memory or display either page. A selectable locking feature prevents data loss when attempts are made to enter data into a full memory. All this gives the user better than average operating flexibility.

HP provides a valuable, no-cost option which allows the 2627A to also operate in ANSI and DEC VT52 modes. The F17 option permits the terminal to respond to a subset of the control signals specified in ANSI standards X3.64 (1977) and X3.41 (1974). The addition of F17 in no way interferes with the HP 2627A's normal compatibility with the Tektronix 4010.

The HP 2627A is constrained to point-to-point communication with a host; multipoint communication is unsupported. However, communication support is flexible to meet user needs. Character, line, page, or block transmission is selectable to satisfy different applications. The terminal is restricted to asynchronous transmission, which increases communication inefficiency at higher data rates.

Strengths

The principal strengths of the HP 2627A are its high-contrast high-resolution display, its graphic flexibility, its full alphanumeric support, graphics compatibility with terminals having a substantially larger number of addressable points, its compatibility with prominent graphics software packages, its triple-mode operation with the F17 option, and its overall flexibility and ease of use. High contrast, high resolution means sharp, bright colors and images. Full alphanumeric support eliminates the need for a separate alphanumeric terminal for applications that need both graphic and alphanumeric support. What's more, the support is comprehensive to also satisfy editing and data entry requirements. Graphic compatibility with large-screen terminals allows the use of existing graphics

software with minimal changes. Versatile graphics and graphic text features satisfy a broad range of user applications. Overall, the HP 2627A is an impressive package at its low price.

A separate graphics memory and a "rubberband" line mode are strong features that increase operating flexibility. The separate graphics memory allows users to manipulate graphic data without interfering with alphanumeric data. The rubberband line mode is used to draw a temporary line so that the user can visualize an image before storing its coordinates.

Besides the product, Hewlett-Packard has gained a solid reputation for sound, reliable products and is well known as a supplier of quality graphic components. The user should strongly consider this as part of a buying consideration.

Limitations

The HP 2627A is not intended to support sophisticated graphics applications. Restricted to vector line drawing and "pen" plotting, it is intended to satisfy general business applications, such as the display of histograms and pie charts, and simple engineering applications satisfied by line drawings. Images can be translated, but not rotated. It does not support a light pen.

The terminal is also limited in the number of displayable colors to 8 foreground and 8 background colors. Although adequate for simple applications, it may be a strong consideration for some.

The use of escape sequences as graphic commands as a substitute to function keys may also be considered a limitation by some users.

Also, the relatively small screen size may also be considered a limitation.

The user must put these limitations in perspective with the terminal's price. If your needs are not totally satisfied by this terminal, you should consider a more powerful terminal, **at a higher price.**

COMMUNICATIONS FACILITIES OVERVIEW

The HP 2627A is a general-purpose color graphics/alphanumeric display terminal for point-to-point communication in full-duplex mode. Transmission rates are asynchronous at 110 to 9600 bps. Operating modes are local, remote, character, line, page, and block modes. Both forms and nonforms modes are supported. Terminal interface printers, plotters, etc via RS-232C. Optional video interface for connection to monitors and cameras. Communication interface is RS-232C; both 20-mA current-loop and HP direct-connect Type 422 interfaces are furnished for local (to host) connection.

SOFTWARE

Software support provided by Hewlett-Packard consists of the HP DSG/3000, HP Graphics 1000/II, HPDRAW, and HPEASYCHART. In addition, the 2627A will run graphics packages written for terminals with 1024 x 780 addressable points through substitution. The HP software is priced separately with prices quoted on a systems basis.

Operating System

None.

HARDWARE

Terms & Support

Terms • available for purchase only with separate maintenance contract • volume discounts available.

Support • on-site support through local Hewlett-Packard service centers • on-site maintenance contracts offered for 4-hour response; next-day response • return-to-vendor service contract available • NOTE: maintenance figures shown in this report are for next-day service; 4-hour service is priced at \$34 per month; return-to-vendor service costs \$10 per month.

Overview

The HP 2627A is a dual-purpose graphics color terminal which

Hewlett-Packard HP 2627A Color Graphics Terminal

supports standard alphanumeric display functions and raster-scan vector graphics. In alphanumeric mode, the terminal displays 95 ASCII characters plus line graphics. In graphics mode, the 2627A supports graphic text, vector graphics via "pen" drawing, and rectangular/polygonal filling.

The terminal employs separate memories for alphanumeric display functions and graphics. The latter is bit mapped with a capacity of 32K bytes. Both absolute and incremental addressing establish X-Y coordinates. A relocatable feature displays the graphic image at selected locations on the screen. Windowing can be used to display images exceeding the displayable area. The raster scan image area is 512 dots x 390 rows.

The HP 2627A color generation is built around a tri-gun CRT; each gun produces a primary (red, green, or blue) color. The terminal has 8 programmable color pairs (white, red, green, yellow, blue, magenta, cyan, and black) that are available as alphanumeric color enhancements on a per character basis. Each color pair consists of a foreground and background color; each is programmed through an escape sequence to select any of the basic 8 colors. While 64 color pairs are possible, only 8 can be displayed at one time.

Terminal parameters are selected via a menu, and the selected parameters are stored in nonvolatile memory. Parameters can be entered directly from the keyboard, or can be downloaded from the host. In the latter case, such changes are held in volatile memory.

The HP 2627A supports character, line, page, and block transmission modes. Transmission is point-to-point only in full-duplex mode; transmission speeds range from 110 to 9600 bps. The terminal also contains an auxiliary RS-232C interface to accommodate printers, plotters, etc. The peripheral interface speed is also 110 to 9600 bps, and is independently set. It also is ANSI and DEC VT52 compatible when equipped with the F17 option (see I/O & Communications).

Model Package

HP 2627A Color Graphics Terminal • keyboard-display terminal with 1920-character, 24-line x 80-column capacity • 95 ASCII character set with line-drawing set • upper-/lowercase characters; slant characters with graphics • 2K-byte RAM display buffer • 32K-byte RAM graphic memory • RS-232C communication interface; 20-mA current-loop and HP direct-connect Type 422 interfaces • RS-232C serial I/O port for auxiliary printers, plotters, etc:

\$5,975 prch \$20 maint

□ CPU & Memory

Separate microprocessors control alphanumeric display and graphic functions. A separate 32K-byte RAM is employed for graphics functions; a 4K-byte RAM handles the alphanumeric displays. The graphics memory is bit mapped, with addressing being absolute and/or incremental. The graphics data is displayed by addressable points in a 512x390 array.

□ I/O & Communications

The HP 2627A supports point-to-point asynchronous ASCII communication at rates of 110/134.5/150/300/600/1200/1800/2400/4800/9600 bps in full-duplex mode. Transmission parity is user selectable odd, even, 1, 0, and none. Operation with control codes, escape sequence, or data rates above 4800 bps may require CPU-supplied delays or handshakes.

In graphic mode, the vector drawing time is 4 milliseconds for full-screen vector or 3 milliseconds for half-screen vector at 9600 bps. Operation in pure graphics text mode above 2400 bps can require CPU-supplied delays or handshakes.

The no-charge F17 option allows the terminal to operate in ANSI, DEC VT52, and standard HP 2627A modes. Users switch between modes directly from the keyboard. Thus, the HP 2627A with the F17 option actually combines 3 terminals in 1 unit. F17 must be specified when the terminal is ordered.

In ANSI mode, the terminal responds to a subset of the ANSI control sequence specified in ANSI X3.64 (1977) and X3.41

(1974) standards. In addition, the terminal also responds to some non-ANSI sequences used by the host system to handle operations like cursor positioning. The DEC VT52 mode compatibility, called EM52 mode, allows the HP 2627A to respond to DEC VT 52 control sequences.

The F17 option also has an answerback capability. The user can configure a character string up to 40 characters, which is transmitted to the host in response to an enquire character. The answerback can be disabled with a disable/enable field, and can be generated manually in either HP mode or ANSI mode operation. For the security conscious, the answerback character string can be protected from view via an 8-character security field.

Another useful option is the video interface which allows the HP 2627A output to be routed to a monitor and/or camera. The interface is a noninterlaced RGB (Red, Green, Blue) with separate SYNC 24.9-KHz scan rate, and is otherwise comparable to EIA RS170.

The asynchronous communication interface and auxiliary printer port are RS-232C/CCITT V.24. Flow control signals issued are XON/XOFF. The communication receive buffer is 256 bytes, user partitioned into a working buffer and overflow buffer areas.

Standard direct-connect interfaces consist of 20-mA current-loop and HP direct-connect Type 422 interfaces. The latter is intended for use with the DSN/Advanced Terminal processor used with HP 3000 Model 44 or 64 computers, and allows the HP 2627A to be located up to 4,000 feet from the host processor.

301 Modem Cable • male (50 pin)/male (25 pin), 16 feet; U.S. version connects to AT&T 103A, 202, 212A and Vadic 3400 modems:

\$79 prch NC maint

302 Modem Cable • same as 301, but for European market:

79 NC

304 RS-232C Direct-Connect Cable • connects terminal to host processor (HP 3000):

79 NC

306 HP Direct-Connect Type 422 Cable • male (50 pin)/male (5 pin) cable connects terminal to host processor (HP 3000):

79 NC

F17 Option • provides ANSI and DEC VT52 mode operation; not a field upgrade:

NC NC

□ Terminals/Workstations

The HP 2627A is both a color graphic and alphanumeric display terminal. The unit utilizes raster-scan technology and provides a graphic resolution of 512 dots x 390 rows in 3 color planes (red, green, and blue). The terminal has 8 programmable color pairs available as alphanumeric color enhancements on a per character basis. Each color pair consists of a foreground and background color, and can be programmed for each character through escape sequence which selects any of the basic 8 colors (white, red, green, yellow, blue, magenta, cyan, and black). A total of 64 color pairs are possible, but only 8 can be displayed concurrently.

The terminal employs standard ASCII character codes to generate characters and character strings. A separate 2-page memory (1920 characters each page) stores alphanumeric characters; a separate 32K-byte RAM graphic memory stores vectors and graphic text. Alphanumeric data and graphics are displayed in the same area on the screen, but through separate memories, can be modified separately.

In alphanumeric mode, a single memory page refreshes displayed data, while a second page stores scrolled data. A raster

PRCH: purchase price. MAINT: monthly maintenance charge. NA: not available. NC: no charge. All prices single quantity; discounts are available. Prices effective as of July 1984.

Hewlett-Packard HP 2627A Color Graphics Terminal

memory handling 512 dots (bits) x 390 rows refreshes graphics data. This memory is composed of 3 planes of bits; each plane corresponds to 1 of 3 electron guns which produces the primary (red, green, and blue) colors.

When equipped with the F17 option (see I/O & Communications), the terminal can function as an ANSI- and DEC VT52-compatible unit, as well as in native HP mode. In ANSI mode, the HP 2627A is also compatible with the Tektronix 4010. F17 provides line drawing and Roman Extension character sets; tab settings are saved in nonvolatile memory.

The numeric keypad furnished with F17 has 3 modes of operation: numeric mode, graphics mode, and application mode. In numeric mode the keypad generates numbers, decimal point, minus sign, and comma. In graphics mode, the keys perform the graphics control inscribed on the key itself. In applications mode, the numeric pad keys generate special application control sequences, such as initiating specialized application software from the host.

Graphic data is composed of vectors (line segments). There is no explicit draw vector command; the terminal uses a pen concept to draw vector data. Each vector is drawn with 1 of 8 "pens;" 4 milliseconds are needed for a full-screen vector. The vector position is specified in points (addressable areas on the screen), and the pen is moved from one point to another to draw the line. There is no limit on the length of the vector. More than 1 point can be given in a command to minimize communication overhead. Both absolute point addressing and incremental point addressing are supported. In the latter case, the new point position is derived by adding it to the existing point position. The values specified for positioning can range between -16384 to 16384, but the X range can only be 0 to 511 and the Y range 0 to 389 for display purposes.

A relocatable origin feature allows users to display a figure at several different positions on the screen with 1 set of coordinates and drawing commands. The value of a relocatable origin is added to the relocatable data to obtain the coordinates used to draw the data. A figure that extends beyond screen limits can be displayed through a window. A window can be positioned at any 512x390 unit portion of the figure.

An extremely useful feature provided by the HP 2627A is a "rubberband" line which allows a vector to be previewed before storing it in graphic memory. In rubberband mode, the terminal displays a temporary line connecting the graphic cursor to the current pen position. As the cursor is moved, the temporary line moves, stretches or contracts as required to maintain connection.

The HP 2627A supports 2 types of area fills: rectangular and polygonal. Area filling is done by fill patterns and dithering. Area fill patterns are drawn using the 8 basic colors, according to the values of the primary, secondary, and background pens. Dithering is specified in densities for each of the 3 color planes (red, green, and blue) without regard to primary or secondary pens. (Thus area fill patterns and dithering are mutually exclusive). Up to 11 predefined dither patterns are supported. User area pattern is defined using 8 patterns, 1 for each row of

dots in the pattern. Each parameter ranges from -32768 to 32767. The user can define any polygon up to 148 sides, and fill it with a current area fill pattern.

The terminal also supports the HP 17623A graphics tablet. The tablet has an 11.6x8.5-inch active digitizing area and a resolution of 2048x1560 points (fine) or 512x390 points for coarse. The latter matches the CRT's resolution. Repeatability is plus or minus 1 resolution unit, and the cursor tracking rate is 30 points per second (in local mode).

The tablet employs a stylus for generating coordinate points. Pressing the stylus once generates a single point; pressing and holding the stylus generates points continuously. Users can also choose coordinate transfer modes (binary or ASCII) and transfer speeds. Up to 15 points per second can be generated in ASCII at 2400 bps, and up to 60 points per second can be generated in ASCII at 9600 bps. The binary transfer mode generates up to 34 points per second at 2400 bps, and up to 60 points per second at 9600 bps. Interface between the tablet and terminal is RS-232C.

Configuration • tabletop keyboard-display with modular detached typewriter-style keyboard • separate keypad includes graphic cursor positioning and graphic control keys • separate alphanumeric cursor control keys.

Display • 12-inch diagonal • displays 1920 characters at 24 lines x 80 columns; 25th status line and 26th line for function key labeling • "rubberband" line • graphic resolution is 512x390 dots • 7x11 dot matrix; upper-/lowercase characters; slant characters for graphics • 95 ASCII character set plus line-drawing graphics; Finnish/Swedish, Danish/Norwegian, French, German, Spanish, and UK character sets • 8 foreground/background color pairs; 64 combinations of 8 basic colors • rectangular and polygonal area fills; fill patterning and dithering • blinking/underline alphanumeric cursor; crosshair graphics cursor • raster scanning for graphics.

Edit & Format Features • cursor up, down, left, right, home; diagonal cursor for graphics • insert/delete character/line; set/clear tabs; forward/backward tab • scroll up/down • line lock • reverse video • windowing • typematic keys • auto-feed lines • protected field/characters • 8 programmable function keys • clear EOL/EOS • local print.

Peripherals • auxiliary RS-232C interface supports local printer/plotter devices • independently set print speeds from 110 to 9600 bps • optional video interface outputs screen data to video monitor and/or camera.

17623A Graphics Tablet • permits stylus-controlled operation • supports ASCII or binary-formatted coordinate-data transmission:

\$1,920 prch \$6 maint

Printer

No printer is supported.

• END

Honeywell DSA

Distributed Systems Architecture

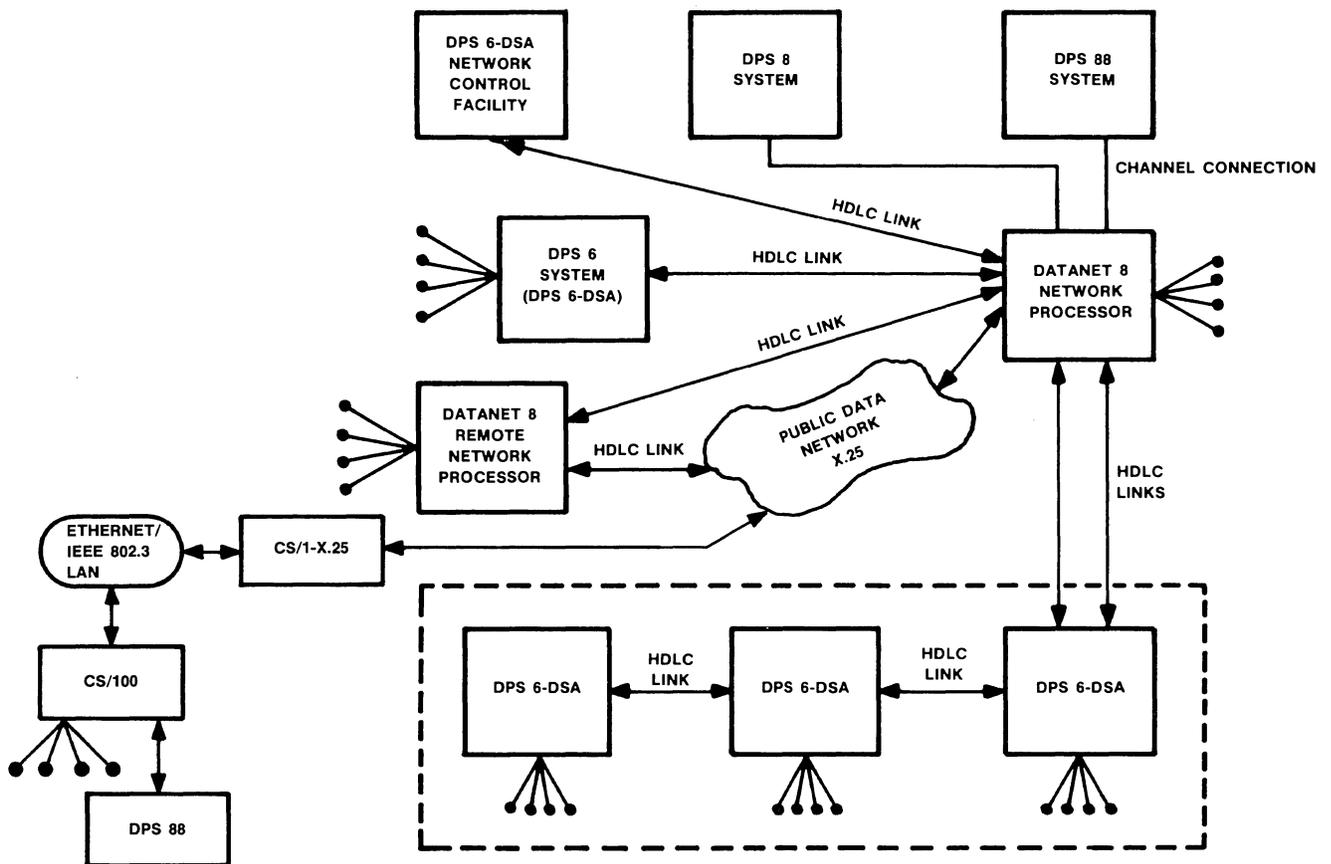
■ PROFILE

Architecture • Distributed Systems Architecture (DSA) products support Distributed Systems Environment (DSE) • evolution includes DSE (1977); DSA 100 (1981); DSA 200 (1982); DSA Network Control Facility (1983).

Network Configuration Summary • host processors (DPS 8/88 large systems or DPS 7 medium systems) using Datanet 8 Network Processors as front ends running Distributed Network Supervisor (DNS) executive software; Datanet 8 supports up to 4 large-system host connections; DPS 8 systems can interface to network through 8 Datanet 8s, DPS 88 systems can interface to up to 16 Datanet 8s, DPS 7 systems can interface to network through up to 2 Datanet 8s • Datanet 8 also functions as terminal concentrator or network switch • DPS 6 processor can operate as Distributed Systems to control secondary terminal network functions in addition to distributed processing system functions • hosts with Datanet 8 front-end Datanet 8 operating as

concentrator, and DPS 6 processors can all function as nodes on primary networks; secondary networks include terminals operating under control of 1 processor • 66 DPS and 64 DPS can also function as hosts through emulation program in Datanet 8 that makes them appear as DSA hosts • DSA devices can also interface to Ethernet or IEEE 802.3 LAN through CS/1 or CS/100 Communications Servers, and can interconnect 2 or more LANs through X.25 networks or through microwave or fiber optic links • can interface MS-DOS PCs to DSA networks through software package that allows PC to emulate VIP 7800 Series Terminal • see **Figure 1**.

Network Management • medium systems running DPS 7 GCOS (DPS 7) or large systems running GCOS 8 (DPS 8/88) perform message management functions and Datanet 8 running DNS performs communication management functions • all components (Datanet 8, DPS 6-DSA, DPS 8, and DPS 7) contain modules that work together to provide a comprehensive administration and control system for the network.



NOTE: ● = Terminal interfaces for async/sync devices including PCs running PC 7800 software to emulate VIP 7800 terminal.

Figure 1 • typical DSA network configuration.

Honeywell DSA Distributed Systems Architecture

Job/Batch Processing Management • through Remote Batch Facility (RBF) Host System; an RBF utility operates on a DPS 6 processor in conjunction with a corresponding RBF utility on a DPS 7 or DPS 8/88 host.

Transaction Processing Management • on DPS 8/88 and DPS 7 • Distributed Processing Facility (DPF) running on DPS 6 operates with Transaction Processing (TP) on DPS 8 or 88 and with Transaction Driven System (TDS), Interactive Operation Facility (IOF) on DPS 7.

Database Management • via IDS-II on DPS 7 and DPS 8/88; IDS-II bundled with TP on DPS 8/88 and called DM IV-TP.

Gateways to Other Networks • interfaces to X.25 packet- and X.21 circuit-switching networks currently available throughout world, see **Figure 2** • SNA Networks through SNA Interactive Facility, SNA RJE Facility, and SNA Transport Facility for DPS 6 system • to secondary networks using non-DSA protocols.

Announced • DSE 1977, DSA 100 1981, DSA 200 1982, DSA Enhancements (NCF) 1983.

First Delivery • 1980 (France), 1981 (United States).

Systems Delivered • about 900 host nodes using Datanet 8 front ends worldwide.

Comparable Systems • IBM SNA (System Network Architecture), Digital Equipment DNA (Digital Network Architecture), and Sperry DCA (Distributed Communications Architecture).

Vendor • Honeywell Information Systems; 200 Smith Street, MS486, Waltham, MA 02154 • 617-895-3246.

■ ANALYSIS

Honeywell has come a long way in developing the products to implement the Distributed Systems Environment (DSE) described at the company's announcement in 1977. In many ways, Honeywell has experienced the same difficulties in developing its Distributed System Architecture (DSA) as IBM faced in developing its SNA. In other ways, Honeywell's experience is very different from IBM's.

Honeywell, like IBM, has a large installed base of diverse computer systems mostly incompatible despite labels. The IBM S/360 line also contained a number of incompatible systems. The Level 6, Level 62, Level 64, and Level 66 are incompatible despite the implied bridge of the word "Level." Level 6 was designed in Massachusetts, Level 62 in Italy, Level 64 in France, and Level 66 in Arizona. Plus in the Honeywell acquisition of GE, the old Honeywell 200 Series was replaced with the incompatible predecessor of the Level 66. Also, despite the common Generalized Comprehensive Operating System (GCOS) label, the operating systems are also incompatible.

As SNA is the "glue" that binds all IBM products together, DSA is the glue that binds all Honeywell products together.

On the "good news" side, Honeywell had better base material to work with than IBM had for developing a comprehensive distributed network architecture. The GCOS operating system for Honeywell's mainframes was already transaction oriented, not batch oriented like IBM's OS and DOS. Honeywell already operated most of its mainframes in a telecommunications environment and users experienced excellent throughput.

Honeywell has taken a relatively simple approach with DSA. First, the company has followed the Open Systems Interconnection (OSI) model of International Standards Organization (ISO). Most other vendors, including IBM, are also following the OSI model.

Second, Honeywell provides only 2 interfaces to DSA networks: Datanet 8 and the Distributed Processing System 6 (DPS 6). Datanet 8 is based on the DPS 6 minicomputer, successor to Level 6. Datanet 8 systems operate as front-end processors for the DPS 7 medium systems and DPS 8/88 large systems processors, successors to the Level 64 and Level 66, respectively. Honeywell's DPS 4 small business system is not a DSA product.

Honeywell implements all 7 layers of DSA in the DPS 6. Datanet 8 and the host processor, however, with 3 notable exceptions, split the implementation. The host implements the Application and Message Management layers and Datanet 8 implements the Communication layers. Datanet 8 essentially shields the host from any knowledge of the DSA network. The host operates as though terminals are connected directly to the front-end processor.

The 3 exceptions where Datanet 8 implements all 7 layers of DSA are the Network Operator Interface (NOI), Terminal Manager, and Gateway Modules. The NOI module interfaces the operator console to the Datanet 8 node. The Terminal Manager allows the Datanet 8 to function as a terminal concentrator. The Gateway Module provides compatibility with older processors running GCOS 3 operating system executive software.

Both Datanet 8 and the DPS 6 can support non-DSA products on secondary networks. In addition, Honeywell offers a software Gateway module to emulate earlier front-end operating system functions for connection to pre-DSA hosts so they too can operate as hosts on DSA networks.

With DSA, Honeywell provides a virtual service as standard.

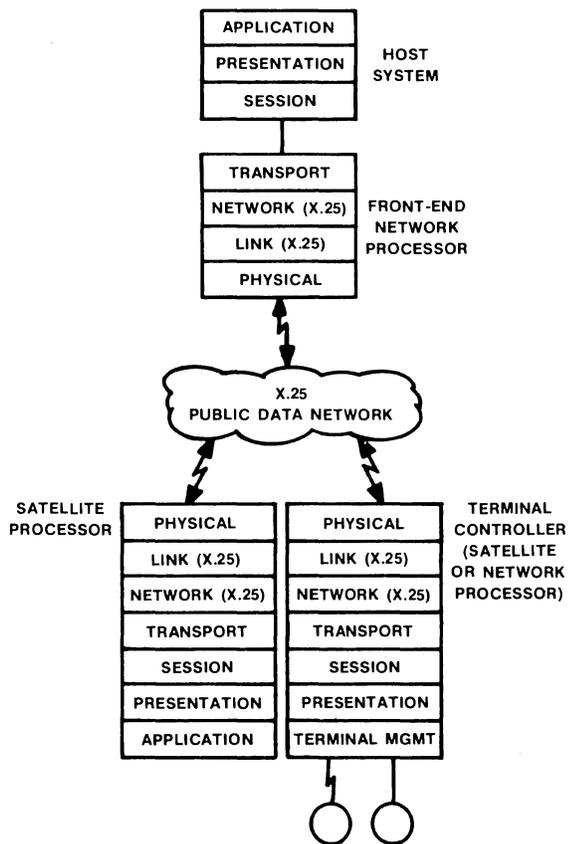


Figure 2 • Honeywell X.25 interface.

Support of Foreign Terminals • Teletype-compatible, IBM 2780, and IBM 3270.

Security • user establishes security policy and access control rules; user implements security with Honeywell products • security is responsibility of 2 correspondents over a network; primary Honeywell security method is through password identification for access to network management directories, files and services and to data files and programs • both DNS on Datanet 8 and DPS 6-DSA on DPS 6 can create permanent connection so terminals can access only 1 host; DPS6-DSA can screen network access requests and refuse access.

Honeywell DSA

Distributed Systems Architecture

Because Honeywell follows the OSI model, its lower layers follow the X.25 standard for packet-switching networks, and X.21 standard for circuit-switching networks. Thus, DSA can operate over virtually all the currently available public data networks throughout the world as well as over leased lines on the public telephone network.

Honeywell has developed a number of standards to support DSA users: COBOL that spans across all lines, a universal file structure for file exchanges, a common database, transaction processing modules for cooperative data processing, remote job entry modules, data entry facilities, and a gateway to SNA networks through DPS 6 systems.

In addition, all DSA nodes contain standard software modules for node administration and for sending operating statistics to a centralized storage facility. A Network Operator Interface (NOI) module can be located anywhere in the network to access the network node statistics and management functions for monitoring and control.

Overall, DSA provides a relatively simple and flexible network architecture. It provides compatibility with older Honeywell products and should be adaptable to new developments. The layered architecture minimizes the impact of changes with new products at all levels and prevents perturbations throughout the whole network. Users of DSA are no longer limited to the facilities available on the local system, but can access information and applications located anywhere in the network.

□ Modes of Operation

A DSA Network can operate as a distributed processing system with independent systems performing local processing as well as cooperative processing with other remote subsystems. Cooperative processing facilities include database, transaction processing, data entry, and remote job entry applications.

□ Ease of Use Features

Honeywell provides a high-level Network Generation Language (NGL) to allow users to describe the network topography and the software and hardware required at each node.

A Node Generation Language is used to describe all the "objects" at a node: mailboxes, logical lines, physical lines, virtual circuits, and logical connections. Each object has a name and description which provides the node with a complete view of it, including the mapping to the physical network.

A Network Control Language (NCL) provides operators with commands to monitor and control the network. The Administrative Exchange Protocol ensures standard formats for exchanges throughout the network.

□ Strengths

DSA is a flexible and truly distributed architecture. Resources are not in a domain, owned by a host processor as they are in SNA with all the attendant difficulties and throughput degradation encountered when going from one domain to another. Any node on a DSA network can access any other node as long as it was initially configured to do so. DSA places no restrictions on communication.

DSA follows the OSI model which will eventually become the worldwide standard for network architectures. Because it follows the standard, DSA networks are totally compatible with X.25 and X.21 public and private data networks around the world.

The GCOS transaction-oriented operating system is more advanced (modern) than batch-oriented operating systems, such as IBM's OS and DOS. IBM has added modules to make its operating systems more transaction oriented, and these modules have succeeded largely due to the increased performance and memory size of modern IBM mainframes. Basically, GCOS requires less overhead in a transaction-oriented DSA environment than IBM's OS in an SNA environment.

Honeywell has a Network Design Center in Phoenix to offer consultant service to users who want to build DSA networks.

Honeywell is continuing to round out its networking problems for DSA. It now has microSystem 6 computers at the bottom and NEC

S-1000 mainframes at the top. In addition, Honeywell now offers products to interface Ethernet and IEEE 802.3 LANs to DPS 8 and 88 hosts to other Ethernet and 802.3 LANs, and to DSA networks. In addition, the links between LANs or devices and the LAN can be an X.25 link.

□ Limitations

Honeywell's greatest weakness for the last few years, particularly since the cancellation of the disappointing 66/85 in 1980, has been lack of power in its mainframe processors. Honeywell adjusted to the situation by using multiprocessor configurations, but 2 processors operating in tandem do not give twice the performance of a single processor operating in standalone mode. The DPS 8 systems can operate in multiprocessor configurations with up to 4 processors under control of 1 GCOS 8 operating system.

The introduction of the DPS 88, which is upward compatible with DPS 8, gives Honeywell a truly large mainframe to top off the DPS line. The Model 88/81 single processor model is in the 7.2 MIPS range. The dual processor Model 88/82 is in the 13.8 MIPS range.

For further growth, Honeywell will begin marketing the NEC S-1000, which is largely DPS 8-compatible. Single processor S-1000 models are in the 10 MIPS range in commercial environments and 15 MIPS in scientific environments.

Honeywell currently offers no standard encryption/decryption modules although users can insert commercially available modules with no effect on DSA. Users may wish, however, to remain with a single vendor. Honeywell is reportedly working on such modules.

Currently, DSA has no classes of traffic, thus file transfers have the same priority on links as interactive communication. The OSI Model Transport layer does specify traffic classes, and Honeywell has already completed its design for DSA. Products should be available for shipment by 1984.

All OSI layers have been thoroughly discussed and a consensus reached on most issues, many of which are now de facto standards. Full standardization of all 7 layers appears to be a few years away. Development cannot wait on the standardization, but eventually all vendors following OSI will have to adjust their architecture to conform to whatever standard is developed. Honeywell has already had to contend with this problem once. Honeywell adapted the initially introduced High-Level Data Link Control (HDLC) and had to change products when a later slightly different version was introduced. The older version is now called Logical HDLC (LHDLC). Honeywell is active on the ISO and other standards committees so the company should not be faced with any major surprises in conformity to standards.

■ ARCHITECTURE SUMMARY

Honeywell developed its Distributed System Architecture (DSA) to provide a generalized method to distribute data storage, access, and processing among its many computers and terminals. Unlike IBM's SNA, which was developed as a host-controlled architecture, DSA was developed as a distributed architecture with distributed control. The development of DSA proceeded in 3 distinct phases.

In 1977, Honeywell announced the Distributed System Environment (DSE), which amounted to little more than a declaration of intent to develop an architecture to serve the DSE philosophy. From that time on, Honeywell spokesmen discussed DSA and what it would be, but specific products were not delivered until 1981 when DSA 100 products appeared in the United States. CII-HB had delivered the DSA 100 products 6 months earlier in Europe. The DSA 100 products were relatively short-lived and quickly replaced by DSA 200 in 1982 followed by major enhancements in 1983. DSA follows the OSI model recommendation of ISO for system interconnection.

DSA 100 • interconnects L66 DPS, DPS 8, Level 64-DPS, DPS 7, DPS 6 Satellite (DSS), and Datanet 8 processors; available as RPQ only; withdrawn from active marketing.

DSA 200 • extends and replaces DSA 100; connects to all

Honeywell DSA Distributed Systems Architecture

public X.25 packet-switching and X.21 circuit-switching networks; supports host connection and Datanet 8 use as a network switch and concentrator in addition to host front end; supports file transfers between hosts; between satellites and between satellites and hosts, provides cross-net load/dump and enhanced network administrative facilities • supports cooperative processing between satellites and hosts and between hosts in transaction processor or remote batch entry environment • provides gateway to SNA through DPS 6 • extends support to virtually all Honeywell terminals on secondary networks.

DSA Enhancements (1983) • Unified File Transfer (UFT), Electronic Mail, and Network Control Facility (NCF) for DPS 6 running under DPS 6-DSA; Application Interface Facility allows users to exchange information over the DSA Network; and enhancements to terminal support provided for secondary networks.

■ DISTRIBUTED SYSTEM MANAGEMENT

Networks accommodate at least 3 types of data processing: interactive, remote batch, and transaction processing. Honeywell's General Comprehensive Operating System (GCOS) is an interactive-oriented, multimode operating system that performs all 3 types of processing, simultaneously. Unlike IBM's SNA, host processors do not maintain absolute dominion over network resources in domains. By contrast, Honeywell host processors are totally unaware of DSA networks. Host processors do not require programs like IBM's VTAM (Virtual Telecommunications Access Method) because the Datanet 8 front end maps messages into application program mailboxes in the host.

Honeywell provides access to programs across hosts and satellites to support cooperative processing, remote job entry, file transfers, and transaction processing. Terminals can also access timesharing and transaction processing application programs in host processors. Primary products are the timesharing option to GCOS in host, Remote Batch Facility in hosts and satellites, Transaction Processing facility in hosts and satellites, and the Data Management (DM-IV) database facilities in hosts.

□ Network Management

DSA distributes network management among all nodes in a network. A DSA network includes one or more large DPS 8/88, medium DPS 7, or small DPS 6 processors. All large and medium processors require a Datanet 8 front end. DPS 6 and Datanet 8 processors perform network management functions. Datanet 8 running under the Distributed Network Supervisor manages the network for the host.

The Distributed Network Supervisor (DNS) supports remote job entry, remote access, and file transfer facilities for large and medium systems and remote access and file transfer facilities for DPS 6 systems. It also provides interactive terminal connections to timesharing and transaction processing on the host. And it supports the Distributed Processing System 6 (DPS 6) facilities running under GCOS 6 MOD 400: terminal concentration, file transfer, cooperative transaction processing, and remote batch in addition to local functions, such as data entry, word processing, and other automated office applications.

DNS supports public data networks, value added networks, and private networks. Honeywell products are certified to interface the majority of the currently available X.25 public data networks. DNS also supports the X.21 circuit-switching networks in Scandinavia.

DNS running on the Datanet 8 provides tools to manage and control the network. Functions include network monitoring, local and remote software loading, memory dumping, logging statistical data for billing and maintenance, in-line testing, software generation, turnover and confidence tests, and dump formatting.

Standard administrative modules are implemented: Node Administration (NAD), Network Operator Interface (NOI), and Network Administrative Storage Facility (NASF). DNS operates with host resident Network Administrative Utilities (NAUs) for analysis and verification of network configuration descriptions.

DNS also can operate with the Terminal Manager and Gateway modules. Terminal manager operates as a terminal controller when Datanet 8 is operating as a standalone concentrator. The Gateway module is required when non-DSA hosts reside on a DSA network.

Host and Satellite processors manage sessions between terminals and computers and between computers. The Session layer functions establish the logical connection between 2 correspondents and negotiate the parameters for the information exchange. Because control is distributed, DSA requires no program such as IBM's Multiple System Network Facility (MSNF) to allow communication across domains. Hosts do not own network resources, thus DSA hosts have no domains and no System Service Control Point (SSCP) programs. Network resources are shared and totally transparent to hosts.

Terminals cannot interface to the DSA network directly, but must always interface through a Datanet 8 or DPS 6. The Datanet 8, except when it operates as a concentrator or switch, in turn connects to a host processor that contains the Session layer software. DPS 6 systems implement all seven layers of DSA, thus they can establish sessions between local or remote terminals and any site on the network as long as the DPS 6 contains the site name in its directory.

□ Host Access Methods

DSA hosts do not use control programs such as IBM's VTAM or TCAM to provide communication access to applications running on the host and to control the network. Network control is distributed and Datanet 8 interfaces Communication Management layers to the Message Management layers in the host.

Each application or service the host performs for other network components has an assigned network name which is used to establish a logical connection. The logical connection is then mapped into a virtual connection, which reserves the physical resources required to establish and maintain a session between 2 correspondents. Distributed Network Supervisor (DNS) running on the Datanet 8 performs Communications Management so the host is totally unaware of a DSA network. The interface to the host application can be queue driven so multiple connections can be mapped to an application.

□ Message Management

According to Honeywell terminology, message management resides in hosts and DPS 6s in the Presentation and Session layers.

The Distributed Network Supervisor (DNS) running on the Datanet 8 provides the interface between DSA components and applications running on host processors. DNS compares to IBM's NCP running on an IBM 3705 front end.

Honeywell also provides facilities to interface older Honeywell terminals and hosts with DSA networks through Gateway software modules running on Datanet 8. Older hosts running under the GCOS 3 operating system used a Datanet 6661 front end running NPS or GRTS-II network software. Gateway modules running under DNS on Datanet 8 make the DSA network appear as a network under control of NPS or GRTS-II to the GCOS 3 host. In turn, software modules under DNS make the GCOS 3 host appear as a GCOS 8 host to the DSA network. These facilities are comparable to the Emulation Program (EP) running with NCP on an IBM 3705.

The Gateway modules running under DNS also support non-DSA terminals on secondary networks: Logical HDLC (LHDLC), asynchronous character mode, synchronous polled VIP emulation (PVE), Incoterm SPD 320, Interactive 3270 BSC-compatible, IBM 2780 BSC Remote Batch, and Remote Computer Interface (RCI) terminals. These software modules are comparable in function to NTO running under NCP on an IBM 3705.

The DNS also provides the interfaces to public and private data networks. Interfaces have been certified for PAD connections to Telenet, Tymnet Transpac (Canada), DDXP (Japan), Auspac (Australia), Telepac (Switzerland), DN-1 (Netherlands), Euronet

Honeywell DSA

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(Europe), Datex-P (West Germany), and PSS (United Kingdom) public X.25 packet-switched networks. Interfaces also have been certified for PAD connection to NPDN (Scandinavia) public X.21 circuit-switched network. DNS supports of PDNs accommodate up to 16 virtual circuits and an extension option raises that limit beyond 16.

Applications for DSA networks are developed on the host processor and DNS loaded from the host (DPS 8/88) into Datanet 8. The DNS executive software can also be loaded into the Datanet 8 from a local diskette.

□ Interactive Processing Management

Interactive processing is managed by the host operating system. GCOS 8 running on a DPS 8 or 88 processor supports a timesharing option that can accommodate 180 to 720 concurrent timesharing users. On DSA networks, each application program running in the host has a logical identifier which is a mailbox for jobs to be executed on the host. Access to the application is supported through the Datanet 8 front end, which recognizes the mailbox identification. As far as the host application program is concerned, it is communicating with a terminal directly attached to the Datanet 8; the DSA network is transparent. The host addresses the terminal according to the Direct Access Conversational (DAC) or Direct Access Conversational Queue (DACQ) Line Addresses. One DAC line corresponds to one logical connection while one DACQ line corresponds to multiple logical connections. The DAC line requires the terminal's ID to identify messages sent to the host. The ID identifies the correspondent, its access rights, and the application to which it is attached.

The DACQ line requires a Logical Identifier (LID) with each message. The LID contains the same information as the ID; a remote correspondent may have multiple LIDs, but only one can be in use at a time.

□ Job/Batch Processing Management

Remote batch operations are performed through a DPS 6 processor that functions as an RJE workstation to 64 DPS, DPS 7, and DPS 8/88 hosts. The remote batch station requires a file or card reader for input, a file or printer for output, and a 30K-byte memory pool. The program support for RJE on DPS 6 is the Remote Batch Facility (RBF). A separate RBF utility is provided for DPS 7 and DPS 8/88.

The hosts can accommodate 16 DSS processors running in DSA environment. Each DSS processor can accommodate 8 logical lines defined as RBF ports, thus a host can support 128 RB terminals. The number of logical connections are defined by the operator at system initiation.

The RBF workstation can operate in attended or unattended mode. An Input Output Facility (IOF) operator anywhere in the network can function as a File Transfer Facility (FTF) or RBF operator.

The host retains one RBF mailbox to exchange information with the RBF application. The DSS processor's RBF utility assigns one mailbox per logical connection. To allow the host mailbox to support multiple RBF users, the logical connection between user and host RBF remains only as long as it takes to process a command.

□ Transaction Processing Management

Transaction processing can be performed through the Distributed Processing Facility (DPF-DSA) in a DPS 6 system or directly from terminals connected to host via DN 8 or DPS 6-DSA. It operates in conjunction with transaction processing executive software on a host system: Interactive Operation Facility (IOF) on a DPS 7 host system and Data Management-IV (DM-IV) Transaction Processor (TP) in a DPS 8/88 host system. The DPF-DSA can also operate interactively with another DPS 6 system running DPF-DSA.

DPF-DSA supplies terminal service facilities so it operates as a distributed concentration facility (DCF) and handles local or 2-level transactions. To the host system, the DPF-DSA system appears as a cluster of pseudoterminals.

The Network Terminal Manager (NTM) under DPS 6-DSA

multiplexes messages from multiple synchronous or asynchronous lines onto one DSA data link, and forms one logical link between each terminal and the host system.

Through NTM, terminals can access the Time Sharing Subsystem (TSS), or DM-IV TP running on DPS 8/88. On DPS 7 or Level 64/DPS, NTM interfaces to IOF and Message Control System (MCS).

All distributed functions can run simultaneously on a DPS 6 processor in conjunction with local processing. Thus, DPF can run simultaneously with the File Transfer Facilities and Remote Batch Facility.

The NTM supports the complete line of Honeywell general-purpose terminals: asynchronous VIP 7300, VIP 7200, VIP 7801, VIP 7802, TWU PRU 1003-1005; synchronous single station VIP 7804, VIP 7805, VIP 7814, VIP 7700R, TWUPRU 1901; clustered subsystem, VTS 7710-7760, and Honeywell industry-specific terminals.

The network topography can support one or more DPS 6-DSA processors connected to one or more hosts, or a host can support a number of DPS 6-DSA processors. In addition, DPS 6 systems running DPS 6-DSA can be interconnected to form a network composed solely of DPS 6 systems.

□ Database Management

IDS-II (Integrated Data Store-II) is the database management system used in the DPS 7, DPS 8, and DPS 88 systems. GCOS 6 MOD 400 does not support IDS-II. GCOS 6 MOD 400 does support the Data Entry Facility II (DEF II) for data entry applications and the Distributed Processing Facility (DPF) for cooperative processing with DPS 7, 8, or 88 hosts on a DSA network.

Honeywell packages IDS-II with other software to provide various Data Manager-IV (DM-IV) functions: DM-IV Query and Reporting Processor, DM-IV Procedural Language Processor, and DM-IV Transaction Processor.

Honeywell also offers the Personal Data Query (PDQ) family of user-friendly software facilities for query, retrieval, and report writing. PDQ includes a Relational Access Manager (RAM) to locate information and deliver it to the user. Query facilities are available for both the data processing novice and the professional. RAM can access online databases: DM-IV, IDS-II, as well as UFAS (universal file access system) files.

Honeywell also provides bridges to older IDS-I database systems so a DSA network can support hosts running either IDS-I or IDS-II databases.

□ Gateways to Other Networks

Honeywell is compatible with virtually all public and private X.25 packet-switching and X.21 circuit-switching networks. Honeywell interfaces have been certified to connect to the majority of public data networks available around the world today. Honeywell interfaces support 16 virtual circuits as a standard facility. Support for more than 16 virtual circuits is optional.

Honeywell provides gateways to IBM's SNA through SNA connect facilities in addition to emulation of IBM 3270 terminal controllers. Honeywell also provides IBM 2780 Terminal emulation.

In addition, Honeywell provides an SNA File Transmission Facility to exchange large amounts of data, control information and programs between an IBM S/370-compatible host and a DPS 6 minicomputer. The DPS 6 appears to IBM Host as an SNA Physical Unit Type 2, Logical Unit Type 1 and conforms to Function Management Profile 3 and Transmission Services Profile 3. The DPS 6 can also respond to host NCCF/NPDA operational statistics.

□ Support For Foreign Terminals

Honeywell supports IBM 3270 terminals directly and as part of its IBM 3270 Terminal controller emulation package.

Honeywell also supports TTY-type ASCII terminals.

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Honeywell terminals (including older terminals) can interface to DSA networks through connection to secondary networks controlled by Datanet 8 and DPS 6 systems.

■ SECURITY

□ System Security

DSA provides 3 levels of security: 1 at the local node level, 1 at the Network Operator Interface, and 1 at the host site.

Terminal users are limited to the facilities specified in the node at system initialization time.

Network operators are limited by password and privilege descriptors supplied by the network administrator to the Network Operator Interface module. A network operator may be confined to monitoring a node or group of nodes and may have no ability to change parameters.

At the host site, part of the ID of an "object" seeking access to host applications is its privileges. The host confines access to those specified. The ID is attached by software at the originating node and the descriptor is a node parameter specified at initialization.

□ Data Security

The X.25 standard provides for error-free node-to-node communications. DCA provides at various levels, facilities to ensure error-free delivery of messages.

Currently, Honeywell does not provide standard encryption/decryption modules to prevent malicious data tapping or tampering. Other vendor's modules can be inserted in DSA connection paths and are transparent to the network.

■ PHYSICAL NETWORK

□ DSA Nodes

A DSA network consists of the primary network of nodes connected together by data links. Host computers (with front-end processors), minicomputers (DPS 6), and network processors can implement nodes. Hosts include DPS 7, DPS 8, and DPS 88 systems. Datanet 8 is the network processor, and DPS 6 running DPS 6-DSA software is the multifunction minicomputer processor. By Honeywell's definition, all host computers interface to the primary DSA network through Datanet 8 front-end network processors and can perform functions for other components on the network. Minicomputers operate as local or remote systems to hosts and network processors can operate as front-end processors, concentrators, or network switches. A modified version of DPS 6 is used as the basis of Honeywell's Datanet 8 network processor.

Terminal controllers are either DPS 6 systems or network processors.

The data links between nodes use HDLC for transmission control. Nodes can also connect to secondary networks that implement other non-DSA transmission protocols over local, switched, or dedicated links. Control in DSA networks is distributed, thus each node must contain a Node Administration (NAD) module to provide administration services to a network operator. A node may or may not contain a Network Operator Interface (NOI) although an NOI is required in the network so an operator can interface to the NAD module. A network also requires at least one Network Administration Storage Facility (NASF) to store and retrieve network statistics used for network administration. NASF resides on a host, Datanet 8 Network Processor, or a DPS 6 system.

DSA implements a 7-layered architecture that conforms to the Open Systems Interconnection (OSI) recommendation to the International Standards Organization (ISO). Each layer contains interfaces to the adjacent layer above and adjacent layer below it as well as to the corresponding layer in another node. Honeywell divides the 7 layers into 3 broad functional categories: application management, message management, and communications management. Application management contains only the Application layer. Message management contains the Presentation and Session layers. Communications management contains the Transport, Network, Data Link, and Physical layers. See **Figure 3**.

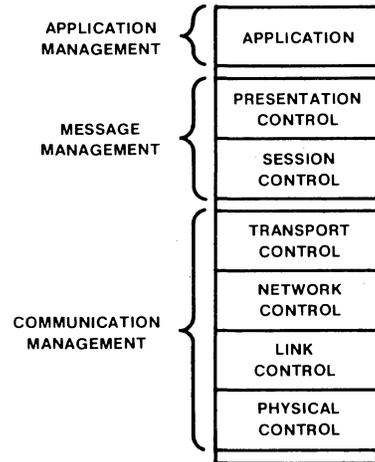


Figure 3 • layered functions.

Honeywell has formally labeled the types of messages exchanged between like DSA layers. Application layers exchange "messages." Presentation layers exchange "record segments." Session layers exchange "letters." Transport layers exchange "fragments." Network layers exchange "packets." Data link layers exchange "frames." Physical layers exchange "bit streams." See **Figure 4**.

Interaction between processes (application programs) in the Application layer, the only layer dedicated to the network user, and the delivery system (the network) is through data areas called "mailboxes." Both the process and the delivery system have access to the mailbox. Mailboxes have "addresses" and processes have "names," and the network maintains directories of mailbox names and addresses.

Users address the network components through English-like names. The network administrator maps the names into addresses which the network understands. Address mapping is performed at different levels at the various nodes. All nodes do not contain the full directory of network addresses. A local directory requires only the addresses used by processes at that node. Also, the internal system uses addresses and addressing schemes that the user never sees. Network address changes can be transparent to the user. For example, an address of a process using a virtual circuit is shortened by the system once the circuit is established and space is allocated for it over a physical circuit that carries a number of multiplexed virtual circuits. Also, addresses can change because a physical component changes that implements a process.

Routes between end users are established as virtual routes. Multiple virtual routes can use one physical route. Virtual routes can be assigned fixed physical routes or the physical route can be switched—selected when a virtual circuit is established.

Honeywell does not implement global flow control on DSA. Flow control between end points is through "transport credit control," which is in addition to the acknowledgement provision in the HDLC protocol. Transport credit control uses a parameter established at initialization; it can be changed for network tuning. When a session (end-to-end connection) is set up between 2 application processors (correspondents), the transmitting correspondent has a credit of "X" messages. The receiving correspondent can simply acknowledge the received messages, acknowledge receipt of message and commit to use the messages, or extend credit to the transmitting correspondent allowing it to transmit more messages.

The Session layer of DSA contains a buffer that functions as a "data sink" to store data passing between the Application layer and the network. The data sink is helpful in smoothing out traffic

Honeywell DSA

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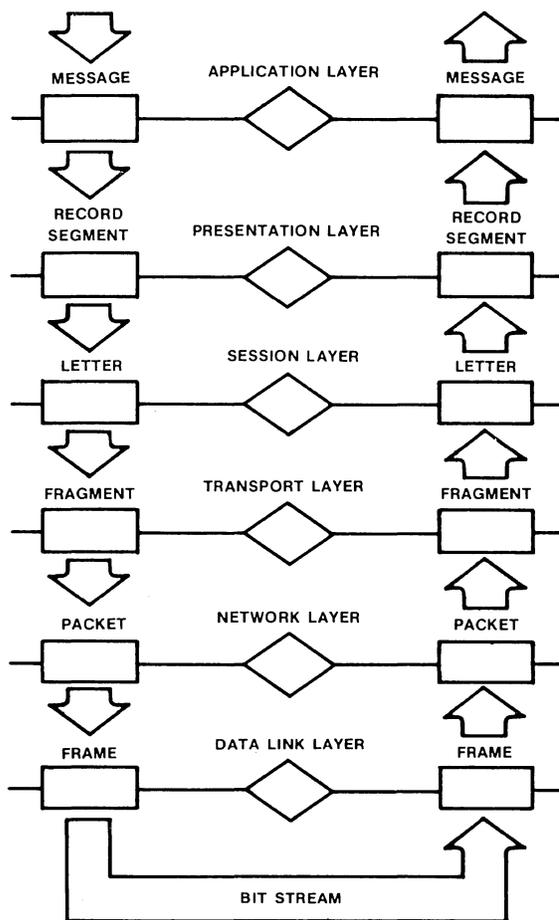


Figure 4 • units of exchange between DSA layers.

through the network and increases the utilization of network capacity.

The HDLC protocol used for data transmission between nodes allows 7 frames to be transmitted before the transmitting node requires an acknowledgement of the data received at the receiving node. This is a type of "credit authorization" between nodes at the link level, but it is a separate facility from the one used for end-to-end flow control.

DSA has error checking and recovery services at various layers. Transmission errors are corrected through retransmission. Sometimes errors are caused by a faulty unit and a backup unit is required. Network operators have a number of facilities to test and diagnose faults to reconfigure the network and to dump/reload memory at a node. Errors are detected through data integrity, sequence, and time-out checks.

DSA supports centralized or decentralized network management by configuring network management modules at one or more central control site(s). These include NAD and NOI modules for each node in the network, and one or more NASF modules to store network statistics. The user can add software to analyze the statistics gathered at the NAD. A Networking Accounting Utility processes log files and calculates the cost of each data exchange according to amount of data transmitted and length of time a logical connection was made, or a combination of traffic and connect time, with a minimum connection cost.

A Network Administration Utility with Log File Editor processes log files and produces reports for administrators and operators to evaluate network performance.

Configuration definition can be centralized. Network processors can operate unattended; their software can be loaded and initialized remotely from a remote site, such as a control center.

Access to NOI modules is through passwords distributed by the administrator. The network can have multiple operators who have access to certain password-controlled nodes and services.

Currently DSA does not support data encryption as a service, but users can insert commercially available encryption/decryption units in the transmission path with no effect on DSA.

□ Session Control

The session layer of DSA resides in host and in DPS 6 processors. In special cases, it can also reside in Datanet 8. Session control establishes "logical connections" between processes (correspondents) in one system or between correspondents in different systems and performs other services/options that are **negotiated** at connection. The connection service uses the connection protocol and the options negotiation uses the dialog protocol.

The connection sequence begins when a process in an application layer passes a Logical Connect Request Letter to session control. The letter contains the name of the system where the called process is located and the name of the process within the called system. The process name is the mailbox name. Session control consults a site catalog to determine if the called process is in the same system or a different system.

If the called process is in the same system, session control uses a chaining technique to associate the 2 processes and assigns a number to each logical connection, eliminating the need for a full address each time data is passed between them.

If the called process is in a different system, the site catalog is used to select the transport service to generate a "context" for the logical connection: the context includes the "plug" number which identifies the access point of the mailbox for the calling process.

The transport service (in the Transport layer) consults a network table (catalog) to identify the appropriate routing service (in Network layer) to be used to make connection to the remote system. The routing service checks if a path between the 2 systems is available. If a path is not available, the routing service establishes a path, and the first message over the path is the connection request letter.

The called transport service generates and sends back its plug number. This allows the transport services to call each other by plug number. The called transport service passes the connection request letter up to connection service in the Session layer, which builds the local context for the session. The connection checks a local application catalog to determine if the application is in memory. If it is not, connection service requests that the application be loaded. Once the application is loaded, the connection service sends back to the calling session an Acknowledge Initiate Logical Connection Request Letter.

Only one transport connection identified by the 2 end-point plug numbers corresponds to a logical connection at a time. A transport connection can be left open, however, and used by another logical connection after the first logical connection is released. A transport connection can be closed without releasing the logical connection. This happens if a physical path fails and another transport connection is made over an alternate path. Successive sessions can use the same logical connection. A multiplexing facility can be used to accommodate several sessions over a single logical connection.

Besides establishing the logical connection, the initiate and acknowledge letters establish the options the session will use and the transmission mode: 2-way simultaneous, 2-way alternate, or 1-way. Any 2-way transmission mode can include passing 2-way interrupt signals in addition to data flow. The letters establish the common presentation services used for format or code and assign responsibility for initiating recovery in case of failure.

Other session control connection services are available; letters can be sent to terminate, to restart, or to re-establish a logical connection. These are needed for termination and recovery procedures.

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The dialog protocol is used to control interaction between correspondents. It is implemented by imbedding records inside session quarantine units (SQUs) which are in turn imbedded inside session interactive units (SIUs). The end flag of an SIU operates as the "your turn" signal. An SIU can contain multiple SQUs, and an SQU can contain multiple records. The SQU signals completion with an end-of-SQU flag, which tells the receiving dialog service to pass the data to the receiving correspondent. An end-of-record flag is also used to signal the completion of a record. See **Figure 5**.

A record can be any length. It is a logically complete unit of data. Session control can divide a record into segments to fit constraints of physical buffer size.

Besides data records, the 2 correspondents can transmit "interrupts" between them. The Attention interrupt signals the receiver to do something. The Demand Turn interrupt signals the receiver to do something and turn control back to caller. The Purge interrupt signals the receiver to do something and suppress records of current SQU.

Session control also provides a recovery service comparable to checkpoint/restart mechanisms used in file management programs. The Session Recovery Unit corresponds to the interval between 2 checkpoints. All the Application layer processes specify where a recovery unit ends, and session control numbers the recovery units so it can be used to identify where retransmission is to begin.

□ Network Control

Honeywell distributes control throughout the DSA network. The administration uses applications layer processors. Standards have been defined for network administration and include: Network Generation Language, Node Generation Language, Network Control Language, and Administrative Exchange Protocol. Three software modules provide the basic Administrative services: Network Operator Interface, Node Administrator, and Network Administration Control Center. DSA does not dictate any specific network structure, but a user can centralize network administration in a network control center using Honeywell's network administration products. Network Control Center products are under development.

In mid-1983, Honeywell announced the Network Control Facility (NCF), an option for the DPS 6 to allow it to function as network control center to manage the entire network. The NCF provides an easy-to-use menu-driven interface for the network operator to perform network control functions.

Network Generation Language • describes network topography and hardware/software products at the nodes.

Node Generation Language • describes objects the node software must handle: mailboxes, logical lines, physical lines, virtual circuits, network subscription (gateway to PDNs), nodes, paths, and logical connections • each object has unique identifier • object descriptions include each object's attributes in the same format for each object type and maps correspondence between

objects: remote node to virtual circuit, virtual circuit to logical line, and logical line to physical line • set of object descriptions defines the node's network environment.

Network Control Language (NCL) • used by operators to monitor and control the network; subset of Executive Control Language, a developing Honeywell standard for system control and provides 6 basic commands that can operate on all objects in the network: number, list, display attributes; display history; update; and get detailed attributes; these can be combined with node identifier, object identifier, and other parameters to perform any inquiry or command function • specific commands handle specific functions such as initializing node, access network, online testing, and verification, and other administrative functions.

Administrative Exchange Protocol (AEP) • defines formats for exchange between administrative programs even in the most complex networks; for example, a response always includes the origin and the command that elicited the response.

Network Operator Interface (NOI) • gives operators access to administration services; one required for each Node Administration (NAD) although it can be remotely located both from the NAD and from the operator's terminal; requires only a logical connection to the device mailbox for operator's terminal • access control is through assigned password, list of nodes to which operator has access, and unsolicited operator messages; NOI refuses access if password is invalid or if services are unauthorized • translates valid operator commands into messages according to Administrative Exchange Protocol and sends to appropriate NAD; also translates output responses into operator format.

Node Administrator (NAD) • provides administrative services for a node; acts on operator commands through NOI, controls neighbor nodes at initialization or after failures, provides timing, performs diagnosis, monitors operations, records errors, accumulates statistics, and forwards them to NASF • operator can specify level of statistics gathered and forwarded to NASF.

Network Administration Storage Facility (NASF) • usually resides on a host system but can reside on Datamet 8 or DPS 6 • includes software and network data storage facility • network data includes statistics for accounting and network operation analysis, error information, network and node configurations, and access control data.

□ Network Analysis

Other network control functions can be performed by the network administrator including performance evaluation, configuration, accounting, global flow control, diagnosis, and initialization.

Performance Evaluation • the operator can use the Log File Editor to process the data in the NASF log files; allows operator to filter raw data and prepare formatted output reports according to user-specified parameters • reports used to evaluate resource use, detect bottlenecks, and underused facilities, plan changes and additions, and analyze causes of error rates or problems.

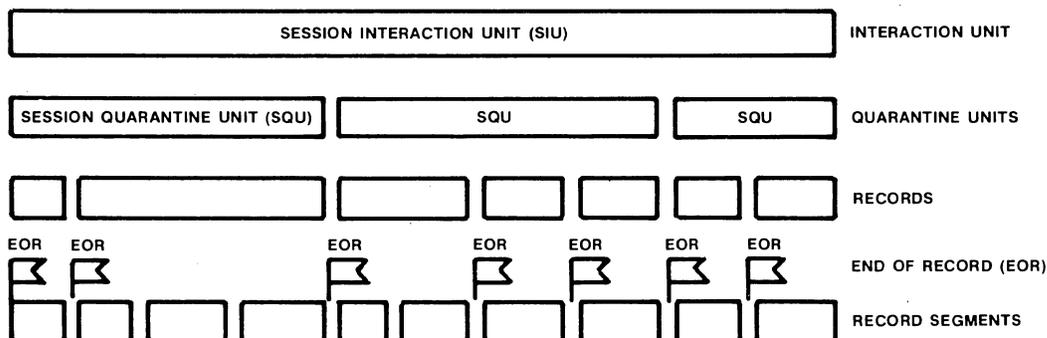


Figure 5 • session interaction and quarantine.

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Configuration • usually centralized on a system with good text editing and file management to build and update configuration files; local node software can be generated and initialized from remote node.

Global Flow Control • no generalized mechanism provided; usually based on network planning, monitoring, and tuning • flow control provided on end-to-end connections and on node-to-node transmissions.

Diagnosis • operator can initiate online tests and diagnostic routines in response to unacceptable error levels reported through NAD modules to NASF • operator can switch units off-line, dump memory to remote site, load software from remote node, or reconfigure system to bypass failing element.

Initialization • network processors can operate unattended • operator can load and initialize node or entire network.

□ Network Problem & Change Management

Honeywell provides the group of products contained in the Network Control and Network Analysis sections to manage network problems and changes; include NAD, NASF, Log File Editor, and NOI to manage network problems and changes.

□ Protocols

Honeywell DSA follows the Open System Interconnection (OSI) model recommended by the International Standards Organization (ISO). Only the lower 2 layers of the 7-layer OSI model have been adopted as de facto standards in the X.25 specifications. Thus, Honeywell has designed DSA to implement the upper 5 layers according to the **principles** of the OSI model. The 7 layers of DSA are the same as the layers in the OSI model: Physical, Data Link, Network, Transport, Session, Presentation, and Application. Each layer performs a specific network function independent of all other layers. Each layer provides an interface into the next lower and next higher layer. The specific implementation within a layer has no effect on other layers as long as the interface between layers remains the same. Layers at comparable levels at each end of a connection communicate with each other.

Honeywell divides the 7 DSA layers into 3 classes: application management, message management, and communication management. Application management includes only the Application layer. Message management includes the Presentation and Session layers. Communication management includes the Transport, Network, Data Link and Physical layers. DPS 6-DSA processors implement all 7 layers. In a host node, the Datanet 8 implements the communication management layers and the host implements the message management and application layers. When operating as a terminal concentrator, Gateway to non-DSA products, switch or NOI, Datanet 8 implements all 7 layers.

Application Management

Application Layer • provides interface between user and system application programs running in a Host, Datanet 8, or DPS-DSA system and the DSA Session layer • Honeywell has developed the Administrative Exchange Protocol for exchanging administrative information and is developing other protocols for database management and distributed job processing • at the system level, Honeywell has developed standard DSA utilities for terminal operators to use: File Transfer Facility (FTF), Remote Batch Facility (RBF), Distributed Concentration Facility (DCF), Unified File Transfer (UFT) for DPS 6, and Distributed Transaction Facility with Display Formatting and Control (DFC).

Message Management

Message Management formats messages so that processes (applications) can communicate with each other in both local and remote environments. It includes Presentation and Session layers.

Presentation Layers • provides set of data transformation services to ensure mutual comprehension of message; a standard interface so data can be sent unambiguously even though the 2 processes use different formats and data codes • includes 3 protocols: Standard Device Protocol (SDP), Transparent Protocol, and Data Description Protocol • can also perform code

conversion and data compaction/decompaction; encryption/decryption services are planned • at logical connection time, the correspondents (end points of connection, which are system or user application programs) negotiate which services are used; protocol and subset class (such as device type), compaction algorithm, character set, data structure, encryption algorithm, or code conversion • offers standardized way for Application layer to request services from the Session layer.

Standard Device Protocol (SDP) • allows user to ignore the specific characteristics of devices that can perform the same functions • supports 3 classes of terminals: Minimum class, Text class, and Forms class • currently restricted to alphanumeric data or pseudographic data; extension to graphics terminals planned • allows application to treat terminal as a memory with which a single device or multiple devices are associated • groups similar functions into subsets and an SDP profile indicates which subsets are provided by the terminal; application can use device if it contains required subsets • includes control functions as well as data, such as "line feed," "horizontal tab," and so on; Application layer gives commands to idealized terminal and the terminal manager module translates them into specific commands to type of terminal in use.

Transparent Protocol • used when application layer needs to use both control codes and data or when device is not covered in SDP; Presentation layer performs no transformation and does not attempt to detect control codes.

Data Description Protocol • currently under development • will offer a data formatting service similar to the schema in CODASYL database management standard.

Session Layer • provides services that allow 2 Application layer correspondents to cooperate with each other: connection services and data transfer services • see Session Control section • implements Connection Protocol, Dialog Protocol, and end-to-end Flow Control.

Communications Management

Honeywell's primary DSA communication network uses leased lines, and public or private circuit or packet-switching networks. Honeywell facilities have been certified to interface the majority of circuit and packet-switching public data networks currently available throughout the world.

The purpose of Communication Management is to mask the physical nature of the communication medium from Application Management and Message Management while making optimum use of the telecommunication resource and allowing users to choose a suitable telecommunication medium. Ideally, Application programs should be able to function as if they have exclusive use of a telecommunication medium that is always there. Ideally from the economic point of view, the medium should be operated at full capacity all the time. Communication Management provides a balance between these 2 ideals. It establishes exclusive multiple logical connections between 2 correspondents so the connection appears to be exclusive and always there and multiplexes multiple logical connections over a physical connection so the medium can be used at full capacity. The Transport and Network layers provide the multiplexing services as well as the routing services to separate data following different end-to-end paths. The Data Link layer provides the node-to-node communication control and the Physical layer provides the interface to the telecommunication medium.

Transport Layer • object is to provide a transport service that moves data between Session layers in 2 different systems without error; if it is not done, however, the transport service will notify session control • handles identification and connection, fragmentation and assembly, error checking and recovery, and flow control • optimizes use of telecommunications resource by multiplexing multiple logical connections on a single physical connection • responds to transport connection requests from Session layer using 4 types of control messages: connection request, connection confirm, disconnection request, and disconnection confirm • a transport connection carries only 1 logical connection at a time • a correspondent is identified by a network plug number consisting of the system number and the local plug number within the system • options are negotiated

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when a transport connection is established: maximum size of transport unit, type of error checking, flow control, responsibility for recovery, and maximum credit for flow control • if transport unit size does not conform to network unit size, transport level fragments message and numbers fragments sequentially; checks fragment sequence numbers for error control • implements credit value algorithms for flow control.

Network Layer • also called routing or path control layer; performs routing or switching functions for Transport layer • path can be dedicated line, connection across circuit-switching network, path through datagram packet-switching or virtual circuit through an X.25 packet-switching network • for dedicated lines, maps transport service directly to appropriate link • for circuit-switching network, follows technique described by CCITT X.21 recommendation; for circuit-switching PDN, supplies automatic call number • for packet-switching networks, supplies virtual circuit service which reserves physical resources along physical path to ensure in-sequence delivery of message without congestion on connection • virtual circuits can be permanent or switched; given identifier so address is abbreviated; flow control is provided for virtual circuits; several virtual circuits can be multiplexed on the same link • support computer-to-computer and computer-to-terminal links • facilities are provided for dialog between users through interrupt packets; recovery mechanisms allow for recovery from link failure or loss of synchronization; and data qualifier allows control packets to be distinguished from data packets.

Data Link Layer • handles communication between adjacent nodes; uses X.25 LAP-B High-Level Data Link Control (HDLC); either node can initiate transfer • uses HDLC Frame Format; provides frame separation and synchronization, addressing, dialog facilities, and error checking and recovery • see **Figure 6**.

Physical Layer • provides electrical interface to telecommunication medium; uses CCITT and/or EIA modem interfaces.

■ EQUIPMENT SUMMARY

□ Host Computers

DPS 7 • upward-compatible successor to Honeywell's Level 64 medium-sized mainframe systems, designed, developed, and manufactured by CII-HB, a French company owned by Honeywell at one time but now only partially owned by Honeywell; CII-HB in France now absorbed into Bull Systems; Honeywell owns 19.9% of Bull which may be reduced to 10% through proposed new capitalization scheme • Level 64 is 32-bit processor with architecture similar to the IBM S/360 and S/370 architecture; Level 64 is incompatible with Level 66, but the systems have many compatible facilities, such as file structures (both use IDS-II database management system), both use same front-end processors, and both use DPS 6 processor • currently marketed Series is DPS 7 line, which includes a number of

systems but only the DPS 7/35E, 7/45E, 7/55E, and 7/65E are offered in the United States; performance range is from about 0.3 MIPS to 1.2 MIPS • memory capacity range is 3M bytes on 7/35E to 4M bytes on the DPS 7/45E and larger systems • disk capacity ranges from 7.4G bytes on DPS 7/35E to 21G bytes on DPS 7/65E • runs under DPS-7 or GCOS-ES (Entry System) GCOS operating system which supports DSA, Datanet 8 Network Processor, and DPS 6 processor • system uses same IDS-II database management system as the DPS 8.

DPS 8 • upward-compatible successor to Honeywell's Level 66 mainframes; DPS 8 is currently marketed line; 66 DPS can co-reside on DSA networks, however, through Gateway emulation software on Datanet 8 front-end processors so Datanet 8 DNS software looks like older GRTS-II software • DPS 8 available in uniprocessors and multiprocessor models; DPS 8/20, 8/44, 8/50, 8/47, 8/49, 8/52, and 8/62 available in uniprocessor and dual processor configurations; DPS 8/70 also available in 1- to 6-processor configurations; power range is from about 0.3 MIPS for uniprocessor version of DPS 8/20 to 10.0 MIPS for 6-processor configuration for DPS 8/70 • maximum memory capacity ranges from 16M bytes on the DPS 8/20 and 8/44 to 32M bytes on DPS 8/47, 8/49, 8/52, 8/62, and 64M bytes on 8/70 • disk capacity range is from 16.5G bytes on DPS 8/20 to over 130G bytes on DPS 8/50 and larger models • DPS 8M and DPS 8C Series models cannot function as hosts on DSA networks because they run under the MULTICS (DPS 8M) and CP-6 (DPS 8C) operating systems, respectively; MULTICS is a timesharing operating system that can interface to ARPANET; CP-6 is a timesharing operating system upward compatible with the Xerox Sigma CP-V operating system • DPS 8 processors run under GCOS 8 operating system which supports DSA, Datanet 8 Network Processors, and DPS 6 processors • system uses IDS-II database management system imbedded in its DM-IV data management facilities.

DPS 88 • very-large-scale mainframe computer systems in the same performance range as IBM's large-scale 3081 Series: DPS 88/81 single processor model with performance in the 7.2 MIPS range, and the DPS 88/82 dual processor model with performance in the 13.8 MIPS range; future releases of 3- and 4-processor models will provide comparable increases in throughput (these versions overlap S-1000, thus, may not be developed) • upward compatible with the DPS 8 line and runs under the same GCOS 8 operating system; applications that run under either GCOS 3 or GCOS 8 on the DPS 8 can run without recompilation on the DPS 88 • GCOS 8 enhancements include user-friendly inquiry facilities that use a relational access manager for database applications, advanced system console functions, software disk cache buffer, and Data Management IV transaction processor facilities • DPS 88 Architecture includes support for 64M-byte memory on DPS 88/81 and 128M-byte memory on DPS 88/82, available in 16M-byte increments • systems are network and communications oriented, designed to

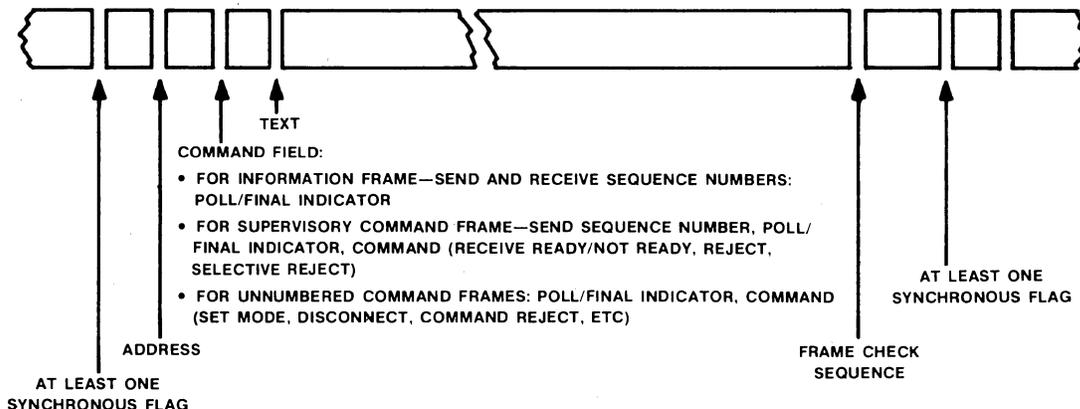


Figure 6 • HDLC frame format.

Honeywell DSA Distributed Systems Architecture

operate within Honeywell's Distributed System Architecture (DSA) • can support up to 320 DPS 6 satellite processors • DPS 88 functions with the Datanet 8 Network Processor operating as a front-end processor, remote concentrator or network switch; up to 16 Datanet 8s can function as front-end processors for the DPS 88 and each Datanet 8 can connect to 128 communication lines for a total of 2,048 lines • implemented using current mode logic (CML) which Honeywell has developed in its own semiconductor facility in Minneapolis; Honeywell's CML technology was selected by the Department of Defense as one of those supported for its Very High Speed Integration (VHSI) project; also, CII-HB, a French company partially owned by Honeywell uses the Honeywell CML chips in its DPS system • CML is faster than Emitter Coupled Logic (ECL), requires only 2 transistors in its circuit (versus 4 for ECL circuits), and operates at -3.3V (versus -5.2V or -4.5V for ECL); lower power dissipation and fewer components allow CML circuits to be packed more densely than ECL circuits; CML micropackage stores 60 to 110 chips on a 3.2 by 3.2-inch multilayer substrate; lid seals the substrate and provides power to it; 240 I/O contacts are arranged as pads around the periphery of the substrate • uses a liquid cooling system to dissipate the 200 BTUs per hour generated by a single micropackage.

S-1000 • compatible with DPS 8/88 systems; developed by Nippon Electric Corporation (NEC); under an agreement between NEC and Honeywell made in March 1984, Honeywell has manufacturing and distribution rights for S-1000; GCOS 8 will be available for delivery with S-1000 first quarter 1985 • performance of S-1000 is about 10 MIPS for commercial applications and 15 MIPS for scientific applications in single processor versions • Honeywell will begin marketing S-1000 in U.S., Canada, Italy, United Kingdom, and Australia once GCOS 8 is available for it; available for delivery in late 1985 • will also be manufactured and distributed by CII-HB in France, other European countries, the Middle East, and South America; available for delivery there in 1986.

Communications Processors

Honeywell uses the Datanet 8 as its network processor; front end, terminal concentrator, and switch. A Datanet 8 running under the DNS operating system can function as one facility or as all 3 simultaneously. See **Figure 7**.

Datanet 8 (DN8) • based on a Honeywell 16-bit DPS 6 minicomputer; minimum system includes 512K bytes of MOS memory, diskette drive, chassis for up to 16 communication lines, and system control facility; basic system requires a 30-/120-cps communication console • when functioning as a front-end processor, it also requires a 66/DPS/DPS 8/DPS 88, 64/DPS/DPS 7 host connection • maximum configuration can include communication console, 1.5M bytes of MOS memory, 2 diskette drives with 256K bytes of storage each, 4 host connections, and up to 128 communication lines; power module enhancement increases performance from about 0.5 MIPS to 0.8 MIPS • lines are connected to the DN8 through Communication Interface Base (CIB) and channel interface; CIB can support up to 4 channel interfaces depending on transmission mode, board size, and throughput; channel interface can connect 1 or 2 lines; CIB can accommodate 2 different data transmission modes from synchronous, bisynchronous, asynchronous, or HDLC; Channel interfaces are contained in half or quarter boards • each CIB is limited to a total load factor of 150 based on throughput; HDLC 56K-bps full-duplex line equals a load factor of 126; thus, a CIB can support only 1 of these lines; full-duplex asynchronous line has a load factor of only 9.2, thus the CIB can accommodate 2 of these lines with the HDLC 56K-bps line • runs under Distributed Network Supervisor (DNS); provides front-end control and node administration (NAD); in conjunction with the appropriate hardware and software options, front-end can operate in an environment with up to 4 host connections per front-end and up to 8 (DPS 800 or 66/DPS), 16 (DPS 88), or 2 (DPS 7 or 64/DPS) front ends per processor complex; options support DPS 6-DSA interfaces to X.25 public data networks, satellite transmissions, networks, private networks, and coexisting pre-DSA secondary networks • DNS and DPS 6-DSA support 1 physical link between nodes and 100 logical links per physical link; an alternate preconfigured backup physical link is supported but not concurrently with primary link • DNS can support up to 20 remote nodes; no path between endpoints can be routed through more than 4 nodes; node-to-node connections through public data network or value added networks are restricted to 2 physical access lines • any DPS 6-DSA can access any host and can access 2 hosts concurrently.

Distributed Processors

Honeywell's DSA is a layered Architecture for hierarchical or

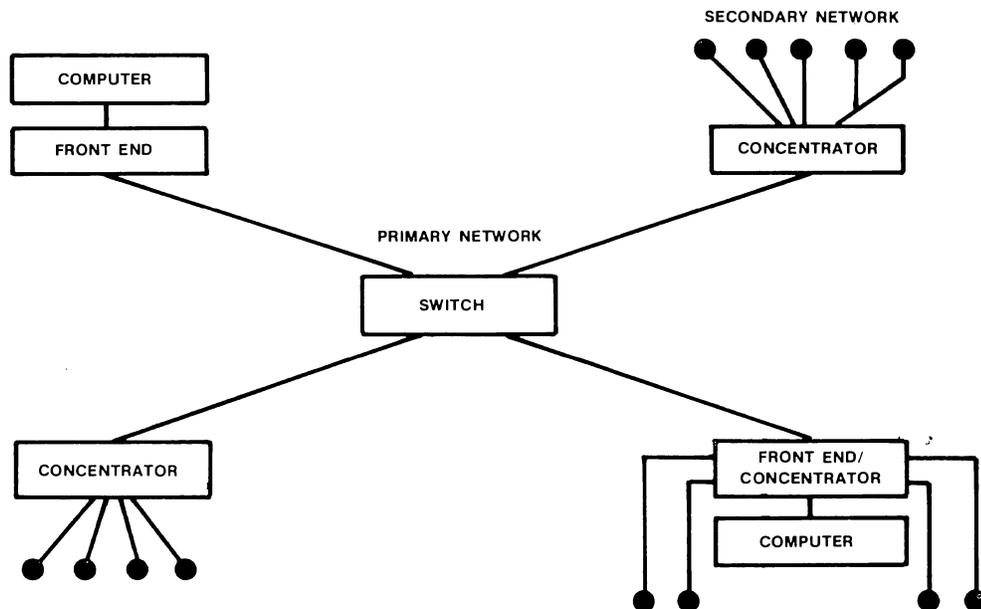


Figure 7 • Datanet 8 network processor roles.

Honeywell DSA

Distributed Systems Architecture

distributed environments. In a distributed environment, any mainframe processor can operate as a distributed processor. In addition, Honeywell's small-system product line of DPS 6 systems running DPS 6-DSA software can be fully integrated into a distributed systems environment. DPS 6-DSA software, which incorporates the layered architecture of DSA, functions under the GCOS 6 MOD 400 executive software for DPS 6 systems. DPS 6 systems running DPS 6-DSA software in a distributed systems environment can function as a network switch or end point. The system supports file transfer, remote job entry, terminal concentration, 2-level transaction processing and electronic mail.

DPS 6 • base system used for DPS 6-DSA software; modified version used as CPU in Datanet 8 • includes models DPS 6/40, 6/45, 6/75, and 6/95; all except the 6/90 Series models use 16-bit word processors; 6/90 Series models use 32-bit word processors; power ranges from about 0.2 MIPS to 1.2 MIPS • memory capacity range is from 512K bytes to 16M bytes • disk capacity range is from 40M bytes to 3G bytes • runs under GCOS 6 MOD 400 Executive that supports DSA; Satellite software provides support for DSA network, Datanet 8 network processors, and distributed processing in cooperation with DPS 7, DP 8, and DPS 88 mainframe host computers.

microSystem 6 Computers • include 3 models, microSystem 6/10, microSystem 6/20, and DPS 6/40, based on Honeywell's own LSI-6 microprocessor chip • designed for the office environment, they range from a single or dual workstation 6/10, through 4-workstation 6/20, to the 28-terminal 6/40 • operate as DSA network nodes and interface to DSA networks for RJE, application-to-application communication, and 2-way message transmission for electronic mail; in addition, they can run the Remote Network Processor (RNP)/6 software and participate in remote RNP networks communicating as LHDLC (Logical HDLC) unit, remote concentrator or remote file/batch/application/electronic mail facility • all also can interface to X.25 packet-switched networks (Telenet, Tymnet, and Uninet) • all provide support for IBM SNA—interactive, RJE, and file transfer facilities—the interactive facility makes the system appear to the host IBM system as IBM 3277/78 display station attached to 3274 Model 1C; the RJE batch facility makes the system appear to IBM host as an IBM 3777-3 terminal; IBM BSC support provides BSC 3270 terminal emulation, BSC 2780/3780 emulation, HASP multileaving, 2780/3780 workstation, and 3271 programmable facility • run under GCOS 6 MOD 400 Release 3.1 of operating system • **microSystem 6/10 Professional Business System** is single workstation system based on LSI-6; second workstation optional; includes 128K to 512K bytes of RAM, printer port, synchronous interface, asynchronous interface, and optional synchronous modem • 650K to 1.3M bytes of diskette storage, and 20M bytes of Winchester-type disk • Intel 8086 processor optional; can run MS-DOS and CP/M-86 operating systems; bundled with GW BASIC implementation of BASIC-86 • **microSystem 6/20 Multistation Office System** is 5 workstation/printer port system based on LSI-6; maximum of 4 workstations; includes 512K to 1M bytes of memory, workstation/printer controller for up to 5 RS-232C interfaces, dual line communication controller for 2 asynchronous/synchronous RS-232C ports at 9600 bps running BSC, PVE, or TTY protocols, networking controller for one synchronous RS-232C port at 19.2K bps running HDLC/SDLC protocols, 650K bytes of diskette storage, and 40M/80M bytes of hard disk storage • **DPS 6/40 Business System** is microprocessor-based minicomputer designed for heavy transaction processing and data communication supporting from 4 to 18 users; includes 512K-byte memory expandable to 1M bytes, 650K-byte diskette, high-speed Commercial Instruction Processor (CIP), disk controller for up to 2 40M-byte Winchester-type disks, and 16-line communication controller • 2 slopes are available for 2 optional features: a second 12-line communication controller, Scientific Instruction Processor (SIP), Multiple Device Controller for up to 4 peripheral devices (diskettes, line printers, or card readers), second disk controller for up to 2 additional 40M-byte disks, mass storage controller for up to 4 67M/80M/256M-byte mass storage devices, magnetic tape controller, and a controller for 830-/1200-document-per-minute MICR document handler • in distributed networks the DPS 6/40 can function as an intermediate node (switch point or as an end point) • can support one to 4 high-speed communications lines operating at 19.2K bps

and from 1 to 2 lines at 100K bps • performance of the DPS 6/40 is about 0.2 MIPS for commercial applications.

□ Local Network Subsystems

A Honeywell Satellite processor can support a secondary network and provide all the local services provided by a standalone system as well as functioning as a satellite to host computers residing on DSA. Honeywell does provide a communication gateway interface to allow computers to communicate with up to 31 Honeywell UDC 500 universal digital controllers. The UDC 500 is a single-loop controller. Distance between gateway and controller can be up to 2,000 feet. Distance between computer and gateway can be 50 feet. Transmission rate between computer and gateway is up to 19.2K bps.

Honeywell provides hardware products to connect DPS 8, DPS 88, DPS 6, and microSystems 6/10 and 6/20 to Ethernet Version 1.0 and IEEE 802.3 local area networks. These products also support the Xerox Network System (XNS) high-level protocols (ISO Levels 3 to 5) for compatibility. The products are also compatible with DSA.

Communications Server 100 (CS/100) • a communication processor that supports up to 10 asynchronous ports; can function as terminal server, cluster controller, and/or interface between LAN and computer systems • runs on DPS 6 under GCOS 6 MOD 400, on Datanet 8 under DNS, and on Datanet 6600 under GRTS, GRTS-II, or Multics Communications System.

Communications Server 1 (CS/1) • larger version of CS/100 • supports up to 32 asynchronous and/or synchronous ports; can include host communication channels.

Communications Server 1-X.25 (CS/1-X.25) • supports up to 4 ports to connect Datanet or DPS 6-DSA processors to LAN using X.25 interface; allows multiple virtual circuits over each physical connection in conjunction with an X.29 PAD; supports DSA file transfer.

Gateway Server 1 (GS-1) • interconnects 2 or more LANs via X.25 network; supports up to 4 ports; device connections are also supported to and from LAN through X.25 network • certified by Telenet and Tymnet.

Gateway Server 3 (GS-3) • point-to-point gateway server to interconnect LANs using a variety of communication media such as microwave or optical fiber • supports up to 8 ports.

□ Cluster Control Subsystems

VTS 7710 Video Terminal Subsystems • consists of communications controller for up to 8 terminals, keyboard display terminals, and printers • maximum configuration has 4 displays and 4 printers • microprocessor-based controller for communications to host computer; synchronous transmission rates up to 9600 bps • VDU 7010 Keyboard Display Unit 1,920 characters arranged in 24 lines of 80 characters each; 95 characters • PRU 1018 Printer option provides 160-cps receive-only printer.

VIP 7800 Display Subsystem • 2000-character 24-line x 80-character with 25-line terminal status line display terminal with modular typewriter-type keyboard; numeric keypad, 139 displayable characters including 11 line graphic symbols, 12-/15-inch diagonal display, 7x9 dot matrix • asynchronous/synchronous communications in character or block transmission up to 19.2K bps • asynchronous 12-/15-inch display terminal with RS-232C or current-loop interface, compatible with AT&T 103, 113, and 212 • synchronous 12-/15-inch display terminal with RS-232C interface, compatible with AT&T 201A, 201C, 208A, 208B, and 209A modems • Multistation Interface (MIU 7001) option provides control for up to 5 VIP 7800 synchronous display or printer terminals; MIF 7001 Expander option extends control to 10 terminals • 30-, 110-, and 120-cps printers optional • includes models for console workstation and word processing workstation.

□ Terminals

VIP 7200/7205 Display Terminals • 1920-character 24-line x 80-character display terminal with modular typewriter-type keyboard, numeric keypad 64/96 characters displayed, 5x7 dot

Honeywell DSA

Distributed Systems Architecture

matrix, 12-inch diagonal display • asynchronous, RS-232C, 60-mA or 20-mA current-loop interfaces and 110- to 9600-bps data rate • local/remote attachment through FNP.

VIP 7300 Visual Display Stations • standard 24-line x 80-character display with various keyboards including standard, data entry, and word processing • asynchronous terminals that transmit via RS-232C, RS-422A, 20-mA current-loop or MIL-STD-188C interfaces at data rates up to 9600 bps.

VIP 78XX Terminal Family • consists of 4 major groups.

VIP 7813 Group • asynchronous; character, text, and forms modes; 781X presentation.

VIP 7814 Group • asynchronous/synchronous; character, text, and forms modes; 781X presentation.

VIP 7816/26 Group • 12-inch screen; asynchronous/synchronous; character, text, and forms modes; 781X or 7700 presentation • 7816 includes high-profile style keyboard while 7826 includes low-profile keyboard.

VIP 7817/7827 Group • 15-inch screen; asynchronous/synchronous; character/text and forms modes • 7817 uses high profile style keyboard and 7827 uses low-profile style keyboard.

Asynchronous Printer Terminals • 30-/120-cps 7x9 matrix impact • 96 ASCII set • 132-column at 10 cpi; 6 lpi • 4- to 15-inch 5-part forms • local/remote half-/full-duplex 300-/1200-bps RS-232C or current-loop interface.

Synchronous Printer Terminals • 120-cps 7x9 matrix impact • 96 ASCII set • 132 column at 10 cpi; 6 lpi • 4- to 15-inch 5-part forms • local/remote half-/full-duplex 4800 bps; RS-232C interface.

Personal Computers • running under MS-DOS (IBM PC and their look-a-likes, Honeywell microSystems) can run the PC 7800 software package that allows PC to emulate a VIP 7800 Series terminal and to function as professional workstation • these independent workstations can be integrated into DSA networks.

□ Support Equipment

Modems

Honeywell does not offer any modems for its DSA network. Customers will buy modems from other vendors.

Multiplexers

Honeywell offers no multiplexers for its DSA network. Both the DN8 and Satellite processor can function as concentrators • Honeywell also offers the Remote Network Processor (RNP)/6 software for DPS 6; RNP/6 combines functions of RJE, terminal concentration, and file transmission.

Network Control Systems

Honeywell's approach to network control is through consoles connected to Network Operator Interfaces to Node Administrator (NAD) software at each node. A Network Administration Storage Facility stores network statistics for accounting, and analysis, error data, network and node configuration information, and access control data • DPS 6/9X models and DPS 6/40 offer a System Control Facility (SCF) to allow a Honeywell Technical Assistance Center to dial in (with customer permission) to operate system to diagnose hardware and software problems.

• END

Honeywell Datnet Network Processors

Models DN8 & DN8C

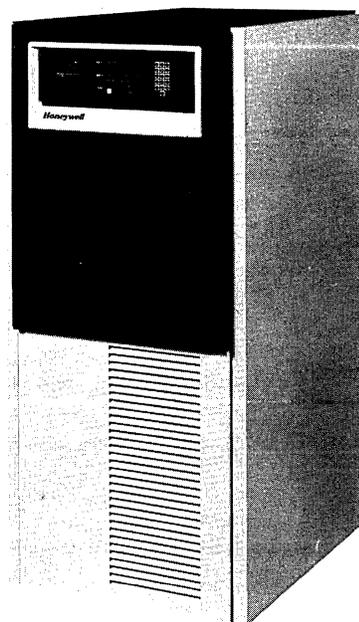
■ PROFILE

Function • front-end network processor, network switch, or terminal concentrator.

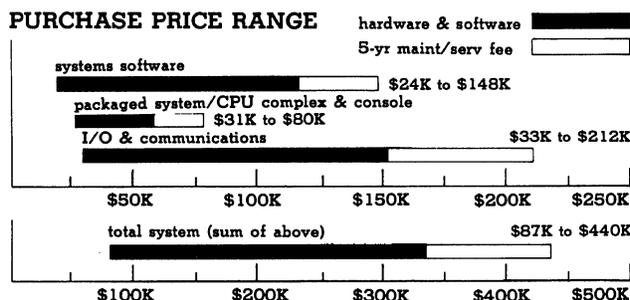
Associated Systems/Networks • Honeywell DPS 8, DPS 88, and DPS 90 large systems and DPS 7 and 64/DPS medium-scale hosts in Distributed System Architecture (DSA) networks; DPS8C with DN8C • X.25 and X.21 gateways to packet-switched and circuit-switched private and public data networks in North America, Europe, and Asia: TELENET and TYMNET (United States), AUSTPAC (Australia), DATAPAC (Canada), DATEX-P (Germany/Austria), DDX-P (Japan), DN-1 (The Netherlands), EURONET (European Economic Community), NPDN (Scandinavia), PSS (United Kingdom), Telepac (Switzerland), and TRANSPAC (France).

Communications/Networks • supports up to 128 half-/full-duplex asynchronous/synchronous lines at 300 to 9600 bps; synchronous wideband HDLC full-duplex lines supported at 10.8K, 19.2K, 40.8K, 50K, and 56K bps • DN8 supports up to 4 host connections but DN8C supports only 1 host connection; each DPS 8 supports up to 8 DN8s; each DPS 88 and DPS 90 support 16 DN8s; each DPS 7 and 64/DPS supports only 2 DN8s, each DPS8C includes 1 integral DN8C and supports up to 11 additional DN8Cs.

Operating System • Distributed Network Supervisor (DNS) supports up to 4 hosts in DSA networks • optional features provide DSA node-to-node support, interfacing to circuit and packet switching networks, remote terminal support, host-to-host file transfers, and network administration and control • DNS/E entry-level version supports single host • supports multiple (up to 20) physical links between nodes which can be used for load leveling with automatic backup; physical link supports up to 100 logical links • supports communication with up to 20 nodes • primary network support between DN8 and DPS 6; secondary network support between DN8 and DPS 6 operating as RNP 6; primary network supports HDLC; secondary network supports



Datnet 8 Network Processor is the nucleus of Honeywell's Distributed Systems Architecture (DSA). It operates as a front-end network processor, network processor, and terminal concentrator.



HONEYWELL DATANET 8 PURCHASE PRICING bar graphs cover price ranges between "small" and "large" configurations for hardware and software products (solid bars) and for associated 5-year period maintenance/service fees (open bars) • **SMALL SYSTEM** based on DNS8/E/8 entry-level system software, DCU8010 Datnet 8, DCE8006 DPS 8 Host Connection, 4 DCF8007 Communication Interface Bases, DCF8001 Console (100 cps), DCF8022 HDLC 56K-bps line, 15 DCF8024 Direct Connect 9600-bps lines, and 15 DCF8026 Universal Modem Bypasses for a total of 16 communication lines • **LARGE SYSTEM** based on DNS operating system and full networking software for 4 host processors with host-to-host file transfers and cross-net load/dump, interface to Telenet, and support of secondary networks; hardware includes DN8 with DCP8010 Extended Processor Performance Enhancement, 1.5M bytes of memory, second diskette drive, 4 host connections, and 100 communication lines; does not include terminals.

LHDLC • DPS8C is not a DSA network product.

Languages/Program Development • Node Generation Language (NGL) used to describe system parameters and assemble networking software modules.

Processor • based on single/dual Honeywell DPS 6 central processors; 512K to 1.5M (DN8) or 2M (DN8C) bytes of memory range; 256K to 512K bytes of diskette storage; 16 to 128 full-duplex communication lines • dual processor configuration provides 1.7 times performance of single processor.

First Delivery • 1981; dual processor 1983.

Systems Delivered • over 900.

Comparable Systems • no other system provides support for DSA networks • performs same function for DSA as the IBM 3705/3725 do for SNA and as DCP-10/20/40 do for the Sperry DCA.

Vendor • Honeywell Information Systems; 200 Smith Street, Waltham, MA 02154 • 617-895-3246.

Canadian Headquarters • Honeywell Information Systems; 155 Gordon Baker Road, Willowdale, ON M2H 3N7 • 416-499-6111.

Distribution • through Honeywell sales/service offices in USA,

Honeywell Datanet Network Processors

Models DN8 & DN8C

Canada, U.K., Australia, and Mexico • through CII/HB in Europe and Africa; Honeywell now owns only 19.9% of CII/HB.

GSA Schedule • listed.

■ ANALYSIS

The Datanet 8 (DN8) is the primary product used for DSA networks. It can function as a front-end processor (remote concentrator terminal controller) or network switch. All hosts interface to DSA networks through Datanet 8 running DNS software. Terminals can use either the DPS 6-DSA (previously called DSS) Distributed System Satellite or Datanet 8 to connect to DSA networks.

Up to 20 physical links can connect DNS systems to each other or to DPS 6-DSA systems. Physical backup is automatic by an adjacent link when a line fails. Communication between pairs of end points such as terminal-to-application or application-to-application requires a logical link. Network control resides in a network operator at a console interfaced to a Datanet 8 through the Network Operator Interface (NOI). The operator has access to the Node Administrator (NAD) facilities implemented at all nodes on DSA networks. An operator connected to NOI on a DN8 cannot control a DPS-DNA node. A Network Control Facility (NCF)-DSA allows a DPS 6 node to perform network administration for both DN8 and DPS 6 nodes.

Utilities that support the network operator run on a host system. Administrative services provided between nodes on a network also count as logical links. Primary DSA networks conform to the OSI (Open System Interconnection) committee recommendation to the International Standard Organization (ISO). The OSI recommendation has been outlined, but it is not yet fully defined. Its overall structure has been formally adopted; the lower 2 levels represented by X.25 incorporate HDLC (High Level Data Link Control) protocol. Honeywell was one of the first mainframe vendors to declare support for HDLC. The early support of HDLC has caused Honeywell some grief. The specifications for HDLC changed over time and Honeywell developed products based on the earlier version. Thus, Honeywell has 2 HDLCs: the current one and the earlier one which Honeywell calls LHDLC (Logical HDLC).

All communication between nodes on primary DSA networks use the HDLC link protocol. Older HDLC network products can reside on secondary DSA networks and interface to the primary network through a Datanet 8/DNS system or through a DPS 6-DSA system. Remote Network Processor/6 (RNP/6) can reside on a secondary network and communicate with DN8 through up to 4 HDLC physical links. Each LHDLC link can support up to 100 logical links.

Datanet 8 can also interface to older Honeywell hosts running the GCOS III operating system by emulating GRTS-11 and NPS which are older front-end processor operating systems.

The Datanet 8 can also serve as end-points on all public packet or circuit switched networks currently available.

Datanet 8C is not a DSA product. It operates as a local or remote front-end for the DPS 8C which is the upgrade system from the Xerox Sigma line Honeywell acquired in the late 1970s. The DN8C processor is the same as the DN8, but the 2 systems run different software. They also differ somewhat in the communications lines and number of host connections supported.

□ Ease of Use

Honeywell uses a Node Definition Language (NDL) to specify the parameters of a system and assemble the software modules provided by Honeywell to control the network. Each node implements a Network Administration (NAD) module to perform network monitoring, software loading, dumping and statistics logging to allow a network operator to control the network. Network Operator Interface (NOI) can be added to any node. Password control can confine an operator to local network control or can give the overall network operator global network control. NAD statistics are stored using a Network Administrative Storage Facility (NASF). Utilities are provided on host systems to allow an operator to manipulate and use the NASF files.

In addition to NOI and NAD, Honeywell now offers a Network

Control Facility to manage all DSA network nodes through a central source.

Datanet 8 includes a TACDIAL feature, which allows a Technical Assistance Center (TAC) to use a remote console for system test and maintenance.

□ Modes of Operation

DNS software supports the Datanet 8 (DN8) as a front-end processor, communication network switch, or terminal concentrator. A DN8 can be dedicated to a single function or it can perform all 3 functions simultaneously. As a front-end processor, it can connect to 4 DPS 8, 66/DPS, DPS 7, or 64/DPS systems. A system can interface to a network through 2 (DPS 7 or 64/DPS), 8 (DPS 8 or 66/DPS), or 16 (DPS 88) Datanet 8s. The primary host operating system is GCOS 8 for DPS 8/88, and 66/DPS and GCOS 64 for DPS 7 and 64/DPS. Support for GCOS 3 is through emulation of earlier NPS and GRTS II Operating Systems for front-end processors.

□ Strengths

Honeywell has long been one of the strongest mainframe vendors in providing communication support for its systems. GCOS was one of the earliest operating systems oriented toward transaction processing. DPS 6 and its predecessor the Level 6 are good minicomputers to implement mini networks and to perform network control functions. All of Honeywell's front-end processors are based on the DPS 6/Level 6 line.

Honeywell announced its master networking plan called Distributed System Environment (DSE) in 1977. Like the other mainframe vendors, Honeywell was slow to develop the Distributed System Architecture (DSA) products to implement DSE. The first set of products called DSA 100 were announced in October 1981. These products were quite elementary. The second set of products to implement DSA 200 were introduced in July 1982; they represent a major advance for Honeywell. These products support transaction processing, file transfers, and remote batch operations on a network-wide basis. Virtually all of Honeywell's older systems that are still actively used can interface to DSA networks. Also nodes in the network can communicate with each other over all the public packet and circuit switched networks now in place.

Honeywell is committed to support the OSI recommendation to ISO; adoption of that standard is mostly a matter of formality. Like other vendors, Honeywell has elected to develop products following the OSI overall outline without waiting for all the standard specifics to be adopted.

Honeywell provides a broad line of products to implement distributed processing networks. Datanet 8 is an integral part of that broad array. Honeywell continues to enhance the DNS operating system for the DN8. The most recent revision called Update 3 offers considerable improvements over earlier versions. It extends support for 20 physical links between nodes as compared to 1 in earlier versions. At 100 logical links per physical link, the logical-link support has increased from 100 to 2,000.

The OSI standard calls for 4K logical links between nodes. Honeywell believes DSA can support 4K logical links, but it has not yet been tested or certified. The limitation would be a physical configuration due to the number of buffers available.

Honeywell almost doubled the DN8 throughput with the addition of the attached processor as a performance enhancement. The dual processor configuration provides no more memory or communication line support, but it does increase throughput for large networks.

□ Limitations

Honeywell's greatest weakness in distributed processing for several years was the limited power of its mainframe processors. Honeywell overcame this weakness by developing tightly coupled multiprocessor configurations. The DPS 88 line of processors introduced in 1982 provides enough power to lay to rest any doubts about Honeywell's mainframe performance. The DPS 88 can be configured as a 13.8-MIPS dual-processor system; triple- and quad-processor systems promise performance up to

Honeywell Datanet Network Processors Models DN8 & DN8C

25 MIPS. The new DPS 90 provides 9 (COBOL) to 15 (FORTRAN) MIPS of power per processor depending on applications. Up to 4 processors can be coupled to run under one operating system, giving 32 to 51 MIPS of power.

100S 8 is one of the best and most efficient mainframe operating systems around today and requires less powerful processors than other systems using operating systems with more overhead.

■ SOFTWARE

□ Terms & Support

Terms • partially bundled • operating system and other software available on monthly license fee basis with optional software support service charge.

Support • software support charge entitles customer to assistance by telephone and mail; includes release bulletins and updates • on-site support is provided as available in accordance with Honeywell's rates then in effect • DN8C service is included in monthly license fee.

□ Operating Systems

Data communication for Honeywell systems is governed by the Honeywell Distributed Systems Architecture (DSA) products. DSA networks are host-controlled, with some peer-to-peer relationships between hosts and some distributed control throughout the network. DSA defines a 7-level reference model that corresponds directly to the OSI (Open System Interconnection) model recommendation to the ISO (International Organization for Standardization): Applications, Presentation, Session, Transport, Network, Data Link Control (X.25, LAP-B HDLC, LHDLC) and Physical levels.

DSA Networks operate under control of the Distributed Network Supervisor (DNS) software residing in Datanet 8 front-ends hosted by processors running GCOS 8 or GCOS 64. DNS software is the primary facility for expansion of DSA capabilities.

Prior to the formal announcement of DSA in 1976, and the development of the DPS/8-Datanet 8 host complex, the primary network control vehicle was the Network Processing Supervisor (NPS). NPS, and its predecessor Remote Terminal Supervisor II (GRTS-II) are still supported as control modules for secondary networks; they reside separately or together in the Datanet 6661 Front End, which can connect to the same host as a Datanet 8/DNS front end. NPS and GRTS II both support HDLC protocols, and can run under MULTICS. Datanet 8 front ends are not supported on DPS 8M Multics systems.

In April 1982, Honeywell restructured the software for the Datanet 8/DNS System to conform to Distributed Systems Architecture Level 200, and the Level 100 products were dropped.

The Level 200 version of the DNS/DSA removed certain RPQ restrictions of DNS/DSA 100 and provides additional functionality. New functions allow a Datanet 8 to operate as a standalone concentrator or switching node; support X.25 interfaces to international value added and public data networks; support host-to-host file transfers, and crossnet load/dump. New interfaces connect to L66 DPS and DPS 8 hosts running GCOS or GCOS 8 (no RPQ required); support VIP 78XX Series terminals, RNP-6 satellite, and TPS on DSS satellite; also facilities help to coexist with or migrate from GRTS 11 or NPS. The DSA 200 DNS has gone through 8 updates with Update 8 being the most recent.

The DN8C runs under the SFC 6120 Basic Communications Software.

SNC8020 Distributed Network Supervisor (DNS) • for operation in a Datanet 8 front end, X.25 packet switch, or terminal concentrator, implementing Honeywell's Distributed Systems Architecture Level 200; provides front-end control and node administration (NAD); in conjunction with the appropriate hardware and software options, front end can operate in an environment with up to 4 host connections per front end • options support Distributed Systems, DPS 6 with DPS6/DSA software, other large systems with DN8 as front end, interfaces to X.25 public data networks, satellite transmissions, private networks, and coexisting pre-DSA secondary networks • DNS and DPS6

with DPS6/DSA executive support 1 or more physical links between nodes and 100 logical links per physical link • DNS can support up to 20 remote nodes but is restricted to 2 physical access lines • any DPS6 with DPS6/DSA software can access any host and can access 2 hosts concurrently • requires Datanet 8 with 512K bytes of memory.

DSA 200 DNS (DNS 2.5) • supports DN8 with 512K to 1.5M bytes of memory; supports DN8 operating as front end to 4 DPS 8 hosts; provides cross net load/dump feature for remote DN8; includes communication channel options for BSC, RS-422 for VIP 7300, MIL 188C for synchronous and HDLC links, and current-loop connections • secondary network can support VIP 7300, IBM 2780 terminals, IBM 3270 terminals, and RCI devices • supports multiple primary network HDLC links with automatic backup of primary network paths or links • provides network control and administration of DNS and DSS nodes through Network Operator Interface (NOI) • provides administrative utilities (DNS Dump Editor and Log File Analyzer) resident under GCOS or GCOS 8 • extended public data network (PDN) and value added network (VAN) support to Telenet, Tymnet, Datapac, DDX-P, PSS, Auspac, Euronet, Datex-P, Transpac, and NPDN.

DSA 200 DNS Update 1 • corrected known software problems.

DSA 200 DNS Update 2 (DNS 2.6) • extends support to LHDLC link to RNP/6 Release 2.0; XON/XOFF paper tape control; and printer on 3270 cluster • enhances GCOS/GCOS 8-resident DNS Dump Analyzer and File Analyzer and Turnover and Confidence Package.

DSA 200 DNS-Update 3 • includes all features of previous updates and supports new DN8, DPS 6-DSA, and RNP/6 products • primary network support of 20 HDLC physical links between DN8 (as front end, remote concentrator or switch) and DPS 6-DSA Release 3.0 running under GCOS 6 MOD 400 Release 3.0 operating system; provides load leveling, automatic link backup, and 100 logical links per physical link • secondary network support of 4 LHDLC physical links between DN8 and RNP/6 Release 3.1 running under GCOS6 MOD 400 Release 3.0 operating system; provides load leveling, automatic link backup, and 100 logical links per physical link • supports VIP7700 with printer attachment, VIP7804 printer option, VIP7801 in block mode, and turn indication for asynchronous intelligent terminals on secondary network • supports extended processor performance enhancement for DN8 • HDLC and LHDLC links can be private or switched • primary network links from DN8 to DPS 6 can also be over private point-to-point or packet-switched private networks or over PDNs/VANs supporting X.25 interface standards:

\$490 mo \$86 serv

DSA 200 DNS Update 8 (DNS 8) • incorporates all feature of previous updates and provides support for additional PDN/VAN connections: Infoswitch in Canada, Uninet and Compuserve in U.S., Venus-P in Japan, and ITAPAC in Italy:

490 86

SNC8095 Distributed Network Supervisor/Entry (DNS/E/8) • a combination package that includes an entry-level version of DNS designed to operate in a Datanet 8 without multiple host connections and with a maximum of 1 or 2 Datanet 8s locally connected to the DPS 8/20 or DPS 8/49 host • DNS/E/8 modules include the SNC8020 supervisor, SNC8090 ADMIN, or SNC8091 8 MIN (as appropriate for GCOS 3 or GCOS 8, respectively), SNC8021 NOI, and the SNC8023 GCOS 3/GCOS 8 host connect:

396 70

SNC8096 Distributed Network Supervisor/Entry (DNS/E/7), GCOS 64 • same as SNC8095 except for DPS 7:

396 70

SNC8090 GCOS 3 Admin • host administration utility; requires SNC8020, 8023, and 8093:

136 24

MO: monthly software license fee without service. SERV: monthly software service charge. NA: not available/applicable. NC: no charge. Prices current as of May 1985.

Honeywell Datanet Network Processors Models DN8 & DN8C

SNC8091 GCOS 8 Admin • host administration utility; requires SNC8030, 8023, and 8093:

136 24

SCC1220 GCOS 64 Front-End Network Processor Support (FNPS) • host utility; requires SNC8020 and SNC8024:

15 5

SNC8093 GCOS 3/GCOS 8 Log File FORMATTER • host executable utility providing formatted administrative and statistical records; accepts parameters determining the type and range of records to be reported • requires SNC8090, SNC8091, SNC8095, or SNC8096:

NC NA

SNC8094 DPS Host-to-Host File Transfer Facility (FILTRN) • host utility that supports file transfers between 2 DPS 8 or Level 66/DPS hosts communicating via Datanet 8s supported by GCOS 3 or GCOS 8; must be licensed on both hosts; can use host channel connections to a single Datanet 8 or HDLC transfers over a primary network • requires SNC8020 and SNC8023:

15 5

SCU1618 GCOS 64 Distributed File Transfer (DFT) • host utility; requires SCC1220 for each host:

15 5

SNC8023 Host Connection: GCOS 3, GCOS 8 on 66/DPS or DPS 8 • single connection to host system running GCOS 3 or GCOS 8; mutually exclusive with SNC8024; requires SNC8020:

42 7

SNC8024 Host Connection: GCOS 64 on DPS 7 • single connection to host system running GCOS 64 on DPS 7 or 64/DPS; mutually exclusive with SNC8023:

42 7

SNC8028 Multiple Homogeneous Host Connection • allows single Datanet 8 to communicate with up to 4 hosts, including DPS 7/64/DPS or DPS 8/66/DPS; hosts cannot be mixed:

20 8

DN8C Operating System

SCF6120 Basic Communications Software • resides in Datanet 8C front end; includes line handlers for implementing asynchronous lines up to 19.2K bps and synchronous lines up to 56K bps • HDLC used for high-speed communication with remote front end • also includes local peripheral handlers for card readers and line printers, directly attached to Datanet 8 • resident editing and custom keyboard capability; allows front end to combine communications control with functions of batch terminal and interactive terminal cluster controller:

\$104 mo NA serv

SFC6121 Remote Communications Module • same functions as SFC6120 but resides in remote DN8C front end:

115 NA

EDIT • creates, modifies, and maintains source files; users can perform character/string manipulation within a file, or copy, merge, replace, print, or delete files; employs the front end to present and edit individual records; included with SFC6120.

FPL • Forms Processing; COBOL-like language residing in the front end; source language compiled in the host is downloaded and interpretively executed; directly communicates with user terminals included with SFS6121.

SFU6121 Forms Processor • local interface with terminals in transaction processing environment; initiates request, formats answer, and interfaces directly with terminal user; designed to operate in conjunction with SFS6122 TPA, but resides in local or remote DN8C front-end processor:

173 NA

□ Communications/Network

Honeywell supports both primary and secondary networks. Primary networks support current products. Secondary networks support older products which can also interface to DSA networks.

SNC8031 HDLC Primary Network Support • point-to-point;

required for each Datanet 8 utilizing 1 or more communication links between DSA nodes • supports SNC8035 through SNC8054 connection packages • requires SNC8020:

\$82 mo \$15 serv

SNC8073 LHDLC (Logical HDLC) • provides secondary network support for data communication exchanges with DPS 6/Level 6 remote network processor (RNP 6) running under GCOS 6-400 communicating with DPS 8/Level 66/DPS under GCOS 8 or GCOS 3 • requires SNC8020:

85 15

SNC8021 Network Operator Interface (NOI) • provides interface to NAD administration and control facilities of the Distributed System Administration and Control (DSAC) functions of the basic DNS software; one NOI is required for each network • NOI requires SNC8020 DNS:

10 5

SNC8022 Cross-Net Load/Dump Facility • allows network operator to initiate loading or dumping of remote DN8 nodes; via NOI, this SNC8022 module required in each node to be remotely loaded; also requires SNC8020 and SNC8031:

10 5

SNC8057 Asynchronous Terminal Support • allows operation of asynchronous character mode terminals within a secondary network • requires SNC8020:

NC NA

SNC8058 VIP Synchronous Terminal Support • allows operation of synchronous VIP devices within secondary network • supports remote network processors utilizing polled VIP emulation (PVE) protocol • requires SNC8020:

NC NA

SNC8060 Interactive BSC (3270) Terminal Support • allows operation of IncoTerm SPD320 terminals within a secondary network communicating with GCOS 3 or GCOS 8 • requires SNC8020:

76 14

SNC8061 Remote Batch BSC (2780) Terminal Support • allows operation of IBM-2780-BSC compatible terminals within a secondary network communicating with GCOS 3 or GCOS 8 • requires SNC8020:

52 9

SNC8062 Remote Computer Interface (RCI) Terminal Support • allows operation of RCI terminals within a secondary network communicating with GCOS 3 or GCOS 8 • requires SNC8020:

20 5

SNC8033 Primary Network Private Virtual Circuit Endpoint • allows Datanet 8 to function as an endpoint in a private virtual circuit packet-switched network • requires SNC8031:

166 29

SNC8034 Primary Network Private Virtual Circuit Switching • allows Datanet 8 to function as a packet-switching node in a private virtual circuit network, or as a packet-switching interface node between a private virtual circuit network and X.25 public or value-added network • requires SNC8031:

170 30

SNC8025 Primary Network Connection for CompuServe, U.S. • requires SNC 8031:

166 29

SNC8026 CompuServe Asynchronous PAD Support • requires SNC8025:

20 5

SNC8035 TRANSPAC Limited Connection • CCITT X.25-type connection to French TRANSPAC public data network; maximum of 16 virtual circuits • requires SNC8031:

166 29

SNC8036 TRANSPAC Extended Connection • extends SNC8035 to more than 16 virtual circuits:

20 5

Honeywell Datnet Network Processors

Models DN8 & DN8C

SNC 8043 Primary Network Connection for Infoswitch in Canada • requires SNC8031:

166 29

SNC8032 Infoswitch Asynchronous PAD Support • requires SNC8043:

20 5

SNC8048 Primary Network Connection for Venus-P in Japan • requires SNC8031:

166 29

SNC8049 Primary Network Connection for Uninet • requires SNC8031:

166 29

SNC8079 Uninet Asynchronous PAD Support • requires SNC8049:

20 5

SNC8050 Primary Network Connection for ITAPAC in Italy • requires SNC8031:

166 29

SNC8029 ITAPAC Asynchronous PAD Support • requires SNC8050:

20 5

SNC8065 Asynchronous PAD Support for TRANSPAC • for terminal messages to a packet assembly/disassembly function provided by TRANSPAC • requires SNC8035 or SNC8036:

20 5

SNC8037 TELENET Connection • CCITT X.25-type connection to TELENET value-added, packet-switching network • requires SNC8031:

166 29

SNC8067 Asynchronous PAD Support for TELENET • for asynchronous terminal messages to a packet assembly/disassembly function provided by TELENET • requires SNC8037:

20 5

SNC8038 TYMNET Connection • CCITT X.25-type connection to TYMNET value-added network • requires SNC8031:

166 29

SNC8068 Asynchronous PAD Support for TYMNET • for asynchronous terminal messages to a packet assembly/disassembly function provided by TYMNET • requires SNC8038:

20 5

SNC8039 DATAPAC Connection • CCITT X.25-type connection to Canadian DATAPAC public data network • requires SNC8031:

166 29

SNC8069 Asynchronous PAD Support for DATAPAC • for asynchronous terminal messages to a packet assembly/disassembly function provided by DATAPAC • requires SNC8039:

20 5

SNC8040 DDX-P Connection • CCITT X.25-type connection to Japanese DDX public data network • requires SNC8031:

166 29

SNC8070 Asynchronous PAD Support for DDX-P • for asynchronous terminal messages to a packet assembly/disassembly function provided by DDX-P • requires SNC8040:

20 5

SNC8041 AUSTPAC Connection • CCITT X.25 connection to Australian AUSTPAC public data network • requires SNC8031:

166 29

SNC8071 Asynchronous PAD Support for AUSTPAC • for asynchronous terminal messages to a packet assembly/disassembly function provided by AUSTPAC • requires SNC8041:

20 5

SNC8044 EDWP Connection • CCITT X.25-type connection to Swiss EDWP public data network • requires SNC8031:

166 29

SNC8074 Asynchronous PAD Support for EDWP • for asynchronous terminal messages to a packet assembly/disassembly function provided by EDWP • requires SNC8044:

20 5

SNC8045 DN-1 Connection • CCITT X.25-type connection to Netherlands DN-1 public data network • requires SNC8031:

166 29

SNC8075 Asynchronous PAD Support for DN-1 • for asynchronous terminal messages to a packet assembly/disassembly function provided for DN-1 • requires SNC8045:

20 5

SNC8046 EURONET Connection • CCITT X.25-type connection to EURONET public data network for the European Economic Community • requires SNC8031:

166 29

SNC8076 Asynchronous PAD Support for EURONET • for asynchronous terminal messages to a packet assembly/disassembly function provided by EURONET • requires SNC8046:

20 5

SNC8047 DATEX-P Connection • CCITT X.25-type connection to West German DATEX-P public data network • requires SNC8031:

166 29

SNC8077 Asynchronous PAD Support for DATEX-P • for asynchronous terminal messages to a packet assembly/disassembly function provided by DATEX-P • requires SNC8047:

20 5

SNC8052 PSS Connection • CCITT X.25-type connection to British PSS public data network • requires SNC8031:

166 29

SNC8072 Asynchronous PAD Support for PSS • for asynchronous terminal messages to a packet assembly/disassembly function provided by PSS • requires SNC8072:

20 5

SNC8053 Basic NPDN Connection • CCITT X.21-type connection to Scandanavian Nordic Public Data Network (NPDN); maximum of 16 virtual circuits • requires SNC8031:

166 29

SNC8054 Extended NPDN Connection • extends SNC8053 to more than 16 virtual circuits • requires SNC8031 and SNC8053:

20 5

SNC8056 Extended X.25 Public Data Network Interfacing • extends SNC8037, SNC8038, SNC8039, SNC8040, SNC8041, SNC8044, SNC8045, SNC8046, SNC8047, or SNC8052 to more than 16 circuits:

20 5

Program Development

Program development is performed on a host processor using the Node Generation Language (NGL). The program is loaded into the Datnet 8 through the host channel connection or downline loaded over a data communication link. Once developed, the DNS Program Modules can be stored on the Datnet 8's diskette so the system can be rebooted locally.

Each hardware and software component on a Datnet 8 is called an "object." An object can be used to configure or operate a node, and each object has a name and set of attributes: type, status, and relationship to other objects.

Node Generation Language (NGL) • set of commands used to define all the objects for a node and to assign explicit and default values to attributes.

Honeywell Datanet Network Processors Models DN8 & DN8C

■ HARDWARE

□ Terms & Support

Terms • available on purchase or on 1-, 3-, and 5-year leases • Basic Monthly Maintenance Charges cited in text are for purchased systems; maintenance is included in monthly rental charges.

Support • monthly maintenance charge includes on-call service for 5 days per week; 9 hours per day • other service contracts are available for extended maintenance up to continuous on-site service • warranty is 90 days from date of delivery • training courses on software, hardware, and maintenance are provided in Wellesley, Massachusetts; Phoenix, Arizona; McLean, Virginia; the United Kingdom; and France.

□ Systems Overview

The Datanet 8 (DN8) is based on a modified Honeywell 16-bit DPS 6 minicomputer. The minimum system includes 512K bytes of MOS memory, diskette drive, chassis for up to 16 communication lines, and system control facility. This basic system requires a communication console. When functioning as a front-end processor, it also requires a 66/DPS/DPS 8/88 or 64/DPS/DPS 7 host connection.

A maximum configuration can include communication console, 1.5M bytes of MOS memory, 2 diskette drives with 256K bytes of storage each, 4 host connections, and up to 128 communication lines.

Lines are connected to the DN8 through Communication Interface Base (CIB) and channel interface. A CIB can support up to 4 channel interfaces depending on transmission mode, board size, and throughput. A channel interface can connect 1 or 2 lines. A CIB can accommodate 2 different data transmission modes: synchronous, bisynchronous, asynchronous, or HDLC. Channel interfaces are contained in half or quarter boards.

Each CIB is limited to a total load factor of 150 based on throughput. An HDLC 56K-bps full-duplex line equals a load factor of 126. Thus, a CIB can support only 1 of these lines. A full-duplex asynchronous line has a load factor of only 9.2, thus the CIB can accommodate 2 of these lines with the HDLC 56K-bps line.

□ Processors

Datanet 8/DCU8010 Network Processor • includes modified DPS 6 CPU, 512K bytes of memory, integrated diskette, logic to support up to 16 communication lines and system control facility for remote maintenance • can attach to DPS 8/88, DPS 7, Level 66/DPS and Level 64 processor complexes • supports DSA 200/DNS software and the following terminals: TWU/PRU 1003, TWU/PRU 1005, VIP7100, VIP7200, VIP7300 as VIP7200, VIP7801/7802 as TTY, VIP7700, VIP7700R, VIP7760 as 7700, VIP7804, VIP7805, VIP7813, VIP7814, VIP7816 • VTS7710, VTS7740, TWU 1901, PRU 1901, and RCI Terminals • requires console and appropriate host connection feature when operating as front end:

\$1,123/\$1,049/\$937 mo \$29,000 prch \$135 maint

DCP 8010 Extended Processor Performance Enhancement for DN8 • provides additional processor module to DCU 8010 to increase performance by up to 1.7 times; operates as a slave processor; resides in the same chassis as base DN8; requires DCE 8003 and DCE 8004:

664/620/554 18,500 86

Datanet 8C/DCU 8011 Data Communications Subsystem • for DPS8C Systems only • includes processor, 1M-byte memory, controller, and 256K-byte diskette, and connections for up to 16 communication lines, 1 host, and 1 console:

1,124/1,050/939 29,000 138

□ CPU

The DN8 is based on the DPS 6 CPU, a general-purpose system built around a 16-bit word and a 16-bit wide central data bus called the Megabus. The DN8, however, cannot run DPS 6 standard software because it has been modified to include a

PROM loader in the lower memory address locations. The system features a large instruction set, multiple sets of internal registers, and 64 priority interrupt levels.

□ Memory

DCM8005 512K-Byte Memory Increment • to increase memory from 512K to 1M bytes on DN8 and from 1.5M to 2M bytes on DN8C:

\$622/\$585/\$534 mo \$6,000 prch \$21 maint

DCM8008 512K-Byte Memory Increment • to increase memory from 1M to 1.5M bytes on both DN8 and DN8C:

622/585/534 6,000 21

□ I/O & Communications

Maximum aggregate I/O data rate is 6M bytes per second over the DN8 Megabus. Initial system includes provision for 16 communication lines. Additional lines can be added to a maximum of 128 lines.

I/O & Communications Modules

DCE8002 • additional line enhancement for DCU8010 for both DN8 and DN8C and DCU8011 • increases line capacity to 64 lines:

\$106/\$98/\$86 mo \$3,000 prch \$5 maint

DCE8003 • power module enhancement (cache memory) for DCU8010 and DCU8011 • requires DCE8002:

293/274/245 7,400 40

DCE8004 • additional line enhancement for DCU8010 and DCU8011 • increases line capacity to 128 lines; maximum of 1 per DCU8010 • requires DCE8002 and DCE8003:

179/166/147 5,000 10

DCF8007 Channel Interface Base (CIB) • for DCU8010 and DCU8011 • each CIB attaches up to 4 channel interface options which can be of 2 transmission types • up to 16 CIBs (128 lines total) per DCU8010 or DCU8011 FNP; requires DCE8002 for more than 4 CIBs; requires DCE8002, DCE8003, and DCE8004 if more than 8 CIBs are configured:

99/93/83 2,500 14

DCF8009 Dual Asynchronous Channel • EIA-RS-422A interface; up to 9600-bps transfer rate • requires DCF8007:

41/38/35 1,000 7

DCF8011 Dual Synchronous Channel • EIA/RS-232C interface; up to 9600-bps transfer rate • requires DCF8007:

58/55/49 1,500 8

DCF8012 Dual Asynchronous Channel • EIA/RS-232C interface; up to 9600-bps transfer rate • requires DCF8007:

39/36/32 1,000 8

DCF8020 Single Synchronous HDLC EIA/RS-232C Channel • up to 9600-bps transfer rate • requires DCF8007:

58/55/49 1,800 8

DCF8022 Single Synchronous HDLC Wideband Interface • up to 56K-bps transfer rate • requires DCF8007:

118/110/98 3,000 16

DCF8023 Single Synchronous HDLC Wideband CCITT V.35 Channel • up to 56K-bps transfer rate • requires DCF8007:

118/110/98 3,000 16

DCF8024 Direct Connect Capability • for 1 asynchronous or 1 synchronous line; up to 9600-bps transfer rate; for use with RS-232C channels only • requires DCF8026 and DCF8007:

14/13/12 350 2

MO: 1-yr, 2-yr, and 3-yr lease charges including maintenance. PRCH: purchase price without maintenance. MAINT: monthly maintenance charge. NA: not available/applicable. Prices current as of May 1985.

Honeywell Datanet Network Processors Models DN8 & DN8C

DCF8026 Universal Modem Bypass • synchronous up to 19.2K-bps transfer rate; asynchronous up to 1800-bps transfer rate • requires DCF8024 and DCF8007:

16/15/13	415	2
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DCF8036 Dual Asynchronous Current-Loop Channel • up to 9600-bps transfer rates • requires DCF8007:

41/38/35	1,000	6
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I/O & Communications Modules for DN8 Only

DCF8014 Single Synchronous Channel • MIL-188C interface; up to 9600-bps transfer rate • requires DCF8007:

\$40/\$37/\$33 mo	\$1,000 prch	\$6 maint
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DCF8015 Dual Asynchronous Channel • MIL-188C interface; up to 9600-bps transfer rates • requires DCF8007:

41/38/35	1,000	7
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DCF8016 Single Synchronous HDLC Wideband MIL-188C Interface • up to 56K-bps transfer rate • requires DCF8007:

83/79/70	1,995	15
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DCF8017 Single Synchronous HDLC Wideband MIL-188C Interface • up to 9600-bps transfer rate • requires DCF8007:

99/91/82	2,500	12
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DCF8018 Dual Bisynchronous EIA/RS-232C Interface • up to 9600-bps transfer rate • requires DCF8007:

58/54/49	1,500	7
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I/O & Communications Modules for DN8C Only

DCF8030 CIB & 8 Asynchronous Ports • RS-232C-compatible with modem cable:

\$142/\$227/\$204 mo	\$6,000 prch	\$37 maint
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DCF8032 CIB & 8 Synchronous Ports • RS-232C-compatible with modem cable:

313/294/264	7,700	49
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DCF8034 CIB & 8 Current-Loop Ports • current-loop interface:

242/227/204	6,000	37
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DCF8038 CIB & 1 Broadband Synchronous Port • AT&T 301-/303-compatible with modem cable:

177/165/148	4,500	23
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DCF8040 CIB & 1 Broadband HDLC Port • V.35 CCITT-compatible with modem cable:

216/201/180	5,500	28
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DCF8042 CIB & 1 Broadband Synchronous Port • V.35 CCITT-compatible with modem cable:

177/165/148	4,500	23
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DCF8044 CIB & Broadband HDLC Port • AT&T 301-/303-compatible with modem cable:

216/201/180	5,500	28
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Disk & Tape

Mass storage is limited to an integral diskette drive and an optional additional diskette drive. Capacity is 256K bytes each.

DCE8005 Additional 256K-Byte Diskette • 1 maximum per DCU8010 or DCU8011:

\$79/\$75/\$68 mo	\$1,785 prch	\$18 maint
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Consoles & Printers

A console can and must be selected to control the DN8.

DCF 8001 Communications Console for DN8 • consists of 24x80 visual display terminal; 100 cps, 80-column RO printer, table, and associated cables:

NA/NA/NA mo	\$2,065 prch	\$40 maint
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Other Features

DCE8006 DPS 8 Host Connection • maximum of 4 per DCU8010 and 1 per DCU8011:

\$339/\$319/\$288 mo	\$8,000 prch	\$65 maint
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DCE8007 DPS 7 Host Connection for DCU8010 • maximum of 4 per DCU8010:

314/295/267	8,000	65
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DCF8019 Cross-Net Load/Dump Feature • for DCU8010 only; supports cross-net load/dump software:

47/37/33	1,000	6
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• END

