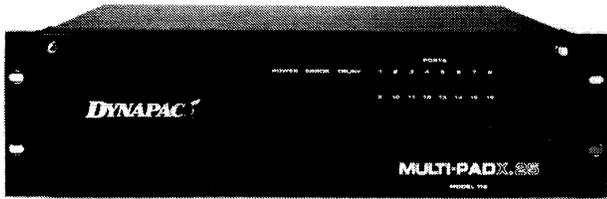# Dynapac Multi-PAD X.25 and Proto-PAD X.25

Dynapac's Multi-PAD X.25 allows asynchronous terminals to access X.25 packet networks. It features mnemonic addressing, password protection, and automatic trunk verification.

MANAGEMENT SUMMARY

Dynapac (Dynatech Packet Technology, Inc.), a subsidiary of Dynatech Corporation, is a leading international vendor of equipment for packet networks. Dynapac concentrates its efforts at the low end of the market for packet switching products and has a strong penetration in both domestic and international environments. Dynapac's distribution network in Europe, the Middle East, and Africa is handled by Dynatech Communications S.A.R.L. of France.

By concentrating its efforts on offering customers a "total network" solution, Dynapac has developed a product line that includes all of the major essentials of a packet network, including packet switches, packet assembler/disassemblers, X.25 gateway devices, an MDR (Message Detail Recorder) data link adapter, and a Small Packet Network Control Center, a comprehensive network management and control software package that runs on an IBM PC XT or compatible machine.

This report focuses specifically on Dynapac's packet assembler/disassemblers (PADs), the Multi-PAD X.25 and the Proto-PAD X.25. The company also sells a one-port Mono-PAD X.25 that allows one asynchronous device to access an X.25 public or private network. All Dynapac products are designed to operate on most public data networks both in the United States and abroad. The units fully support all three levels of CCITT Recommendation X.25, bit-oriented (HDLC) framing, LAP (pre-1980) and LAPB (post-1980) at the link level, and 18 of the 22 terminal parameters defined in CCITT Recommendation X.3.

The basic function of the Multi-PAD X.25 is to convert asynchronous traffic from DTE into a format that conforms to synchronous X.25 protocols. This involves protocol conversion and the arrangement of data into packets for transmission over the X.25 link. In addition, the unit serves as a terminal concentrator by consolidating the traffic from up to 16 terminals onto one X.25 trunk. Multi- ▷

Dynapac (Dynatech Packet Technology, Inc.), offers a broad line of X.25 networking products, including the two packet assembler/disassemblers (PADs) discussed in this report.

The Multi-PAD X.25, designed to allow asynchronous terminals to access public data networks, supports up to 16 device connections. The Proto-PAD X.25 supports both asynchronous and synchronous terminals and allows users of IBM 3270 BSC equipment to access public networks. This PAD supports up to eight asynchronous ports and one synchronous port.

MODELS: Multi-PAD X.25—Models 108, 116; Proto-PAD X.25—Models 301, 341, and 381.
TRANSMISSION RATES: Multi-PAD X.25—50 to 9600 bps bps asynchronous and 1200 to 9600 bps synchronous; Proto-PAD X.25—110 to 9600 bps asynchronous, 1200 to 9600 bps synchronous.
INTERFACE: RS-232-C, CCITT V.24, X.21 bis.
COMPETITION: Amdahl, Datagram Corp., EDA Instruments, Memotec.
PRICE: Multi-PAD X.25 Model 108— $2,205 to $2,905; Model 116—$3,415 to $5,500; Proto-PAD X.25 (all models)— $2,700 to $5,200.

CHARACTERISTICS

VENDOR: Dynapac, (Dynatech Packet Technology, Inc.), 6464 General Green Way, Alexandria, VA 22312. Telephone (703) 642-9391.

DATE OF ANNOUNCEMENT: Multi-PAD X.25—1982; Proto-PAD X.25—September 1985.

DATE OF FIRST DELIVERY: Multi-PAD X.25—1982; Proto-PAD X.25—1985.

NUMBER DELIVERED TO DATE: Multi-PAD X.25— over 4,500; Proto-PAD X.25—Information not available.

SERVICED BY: Dynapac.

MODELS

Models within the Dynapac PAD family differ according to number and type of ports supported.

Multi-PAD X.25 Model 108: supports four or eight ports.

Multi-PAD X.25 Model 116: supports 12 or 16 ports.

Proto-PAD X.25 Model 301: supports one synchronous 3270 port. ▶

Dynapac Multi-PAD X.25 and Proto-PAD X.25

▷ PAD also serves as a host port concentrator for a computer without its own X.25 interface. The unit supports from 4 to 16 asynchronous ports and line speeds from 50 to 9600 bps.

The Proto-PAD X.25 is one of the few PADs that handles synchronous, as well as asynchronous, device connections. Through its synchronous port, the unit supports IBM 3270 BSC device attachment, allowing an IBM BSC host to communicate with up to eight 3270-type cluster controllers over an X.25 link. Proto-PAD also supports up to eight asynchronous ports. All models are available in cluster emulator or host emulator versions. When the unit is operating with IBM BSC equipment, Proto-PAD provides communication over the packet network through local emulation, transmitting only screen information over the X.25 link. This results in reduced line use and transmission costs. (Packet network charges are billed according to number of information packets sent; therefore, charges are lower if the amount of information sent is reduced.) The unit supports synchronous transmission from 1200 to 9600 bps and asynchronous transmission from 110 to 9600 bps.

All of Dynapac's PADs can be used with one another and with other products in the Dynapac line. According to the particular application, Dynapac PADs also can communicate with similar devices from other manufacturers, and it is common to find PADs from a number of manufacturers coexisting in a large X.25 network. Multi-PAD is often used with Dynapac's Multi-Switch X.25 to build extensive local or long-haul networks. Multi-Switch X.25 routes data from one X.25 trunk to another X.25 trunk and can concentrate traffic from many X.25 trunks onto one. (See Figure 1.) Recently, Dynapac introduced the PBX.25 Gateway, designed to connect Northern Telecom's Meridian PBX to an X.25 network. Dynapac also has a joint marketing agreement with Prime Computers.

COMPETITIVE POSITION

Dynapac is an established international supplier of X.25 networking equipment, and as such, the company should reap the rewards of greatly increased activity in this market in the United States. However, Dynapac now must compete with a number of new entrants in the X.25 arena, many of whom are traditional data communications equipment vendors with sound reputations in the industry. This would include Micom Systems, ComDesign, and Timeplex. Memotec Data, a Canadian firm with a large presence in the international market, is also making a strong push for X.25 business in the domestic market.

The market for PADs and packet switches is generally split into domestic and international realms, as well as public and private arenas. Companies like Telenet and Tymnet manufacture a large amount of equipment for use in their own public data networks, while companies such as Dynapac, Memotec, Cableshare, and Timeplex market primarily to private network users. Dynapac concentrates its marketing efforts at the low end of the private network market. According to 1985 statistics published by International Data Corporation (IDC), Dynapac had 41 percent of the ▷

▶ Proto-PAD X.25 Model 341: supports one synchronous and four asynchronous ports.

Proto-PAD X.25 Model 381: supports one synchronous 3270 and eight asynchronous ports.

In addition to the Multi-PAD and Proto-PAD, Dynapac also manufactures the Mono-PAD X.25, a single-port unit that allows one asynchronous device to access X.25 public and private networks.

GENERAL DESCRIPTION

The Multi-PAD X.25 is designed for connecting asynchronous, start-stop devices to the synchronous X.25 network. In the network, the units function as statistical multiplexers or terminal/host concentrators by consolidating traffic from many terminals/hosts onto a single trunk; in the concentration application, the need for dial-in/dial-out modems is eliminated, along with the related telephone company charges.

Each Multi-PAD X.25 consists of a main printed circuit board containing a Z-80 microprocessor, RAM, ROM circuitry for the X.25 link, and circuitry for four asynchronous ports, expandable in four-port increments. The Model 108 unit contains 10KB of ROM, 12KB of RAM, and for units with software versions prior to 1.9, a piggyback memory board containing space for 26KB of additional memory. Units with software Releases 1.9 and above contain a larger piggyback board with space for 14KB of additional ROM and 16KB or 28KB of RAM. Model 108 contains the circuitry for four additional asynchronous ports. Model 116 is similar to the Model 108, but contains a main, four-port expansion board, a memory board with 14KB of additional ROM and 16KB or 28KB of RAM, and provisions for two asynchronous four-port expansion boards. Memory used for statistics and configuration has battery backup; downline loading is available as an option.

The Proto-PAD X.25, a combined protocol converter and emulator, allows an IBM BSC host and cluster controllers to communicate via an X.25 network. Each unit consists of a printed circuit board that contains two independent microprocessors (one dedicated to handling link-level X.25 protocol across the trunk; the other handling X.25 packet-level and BSC protocols and host/cluster emulation functions), 32KB of ROM, 28KB of RAM, dual synchronous ports, and a single asynchronous port. An optional connector allows communication between expansion boards and system RAM through an internal data bus. The dual microprocessors operate asynchronously and use local PROM/RAM and input/output (I/O) facilities. Messages transferred between the processors are stored in a public RAM.

The Proto-PAD X.25 unit supports from one to eight separate, remote cluster controllers over a single X.25 channel. The device operates in both cluster emulation and host emulation modes. When situated at the host end of a communications link, the Proto-PAD is configured to operate in host emulation mode. In this mode, the PAD may be internally configured with up to eight separate cluster addresses, i.e., it supports up to eight remote clusters. When situated at a remote site, a Proto-PAD must be configured to operate in host emulation mode. A device thus configured can support up to eight clusters through a modem-sharing unit.

TRANSMISSION SPECIFICATIONS

Multi-PAD X.25

Physical Level: ▶

Dynapac Multi-PAD X.25 and Proto-PAD X.25

▷ United States market for asynchronous PADs, based on shares by revenue. The company had an 11 percent revenue share of the international market. In the U.S. market, Dynapac leads the list for shares by revenue in the asynchronous PAD segment. Micom, in the number two position, has a 23 percent share of U.S. revenues, and Amdahl, number three, has 15 percent in this segment. Memotec (8 percent) is in fourth place, while EDA (1 percent), Gandalf (1 percent), and DCA (1 percent) share fifth position. Other vendors make up the remaining 10 percent of the market.

With a 38 percent revenue share, Memotec is the leading vendor in the international market, followed by Micom with an 18 percent share. Dynapac, EDA, and Gandalf share fourth place in this category.

ADVANTAGES AND RESTRICTIONS

The Multi-PAD X.25 and Proto-PAD X.25 products provide the user with several cost-saving advantages. Traditionally, the connection between an IBM BSC host and its cluster controllers is via a private line. The Proto-PAD X.25 supports the connection of an IBM BSC host and cluster controllers over a less expensive X.25 link. Proto-PAD handles 3270 polling sequences *locally* rather than transmitting the information across the X.25 link. This results in a significant cost savings because X.25 network charges are billed according to the number of information packets sent through the network. The Multi-PAD provides the features of a multiplexer to devices connected to it, and it is often possible to have the PAD handle certain ▷

▶ • Interface—RS-232-C, V.24 (synchronous X.21 bis), full-duplex, continuous carrier; operates on digital or analog facilities (via modem); Multi-PAD supplies DTR and RTS; modem or DSU supplies DCD and CTS.

• Transmission rates—50 to 9600 bps asynchronous and 1200 to 9600 bps synchronous; modem or DSU supplies clock on pins 15 and 17.

Link Level:

• Framing—HDLC.

• Addressing—DTE or DCE.

• Procedure—LAP or LAPB.

• Numbering—Modulo 8.

• Parameters—K is variable from one to seven; N1 is 2104 (263 octets); N2 is 10; and T1 is variable from 1 to 127 seconds.

Packet Level:

• Services—Permanent Virtual Circuit (PVC) or Switched Virtual Circuit (SVC), configurable on per-port basis.

• Numbering—Modulo 8.

• Data fields—octet aligned.

• Logical group number—O-F (full range); user configurable.

• Logical channel number (LCN) used—accepts calls on any LCN, 0 through 4095; PVC ports can be assigned individual LCNs. ▶
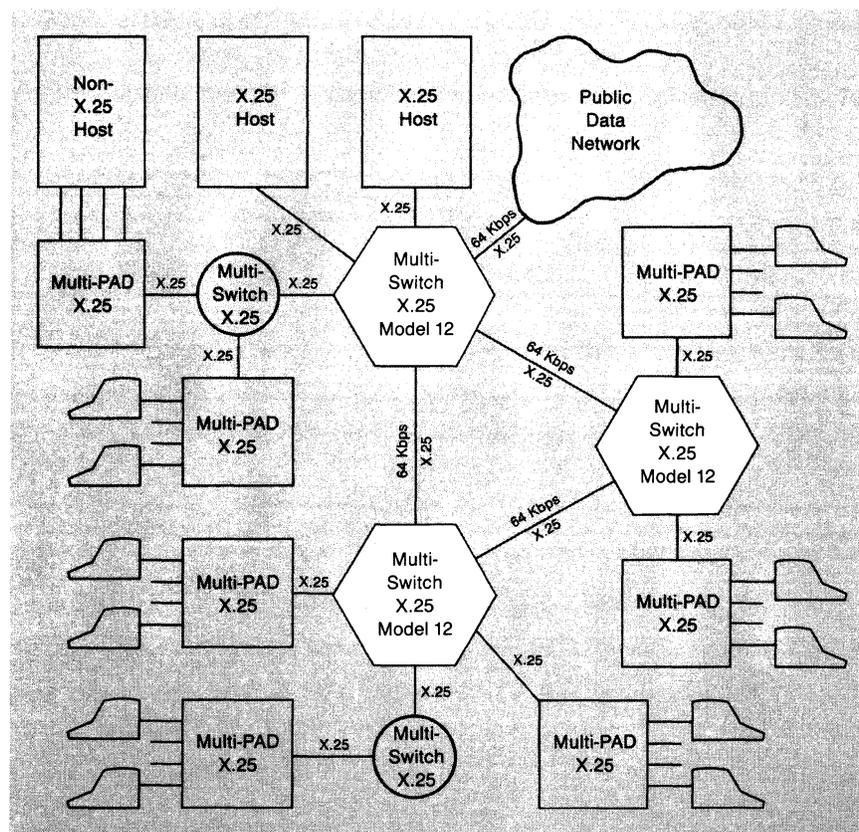

Figure 1. The Multi-PAD X.25 is often used with Dynapac's Multi-Switch X.25, which routes data from one X.25 trunk to another. Pictured here is an example of a large private data network incorporating Multi-Switch Model 12s and a number of Multi-PAD X.25s linking asynchronous terminals, hosts, and a public data network.

Dynapac Multi-PAD X.25 and Proto-PAD X.25

▷ functions locally, thereby off-loading general communications functions from the host computer and eliminating some overhead and resulting throughput degradation on the network. For example, since the unit guarantees correct delivery of data in either direction, the host does not have to supply character-by-character echoing and other error-checking techniques to ensure the integrity of data communicated over the link. Savings result because the need to transmit one character per packet in each direction (necessary when echoing is used on a packet network) is eliminated.

Dynapac PADs have been designed with versatility in mind. They provide support for a variety of modems, including AT&T 113 and 212 and compatible units. The PADs also can be configured to support ASCII autodialers, terminals with various flow control schemes, printer delay characteristics, type font distinctions, and many types of host computers and front-end processors. PAD ports are configurable for dial-in modem connections with optional autospeed and autoparity and for direct connections with asynchronous host and front-end processor ports. Ports can both accept and place calls and be set up to automatically establish a connection to a matching port at the other end of the X.25 trunk. Mnemonic addressing capability allows users to set up addressing by name rather than numeric code; this is a clear advantage, particularly in large networks supporting thousands of terminals.

Present users of Dynapac PADs have noted a performance limitation associated with the products. Dynapac units use a single Z-80 microprocessor, which is not as fast as those employed on competing products. The result is a limitation in the amount of aggregate data processed through the PAD. Products from competing manufacturers, such as Micom and ComDesign, use a multiprocessor that can handle a greater aggregate. Dynapac is reportedly in the process of upgrading its PADs to achieve higher performance, using multiple Z-80 microprocessors.

The Dynapac PAD users we spoke with cited X.25 communications software as a possible problem area on PADs from any vendor. There are often discrepancies in the implementation of X.25 from vendor to vendor, and even the slightest difference can be problematic. Dynapac PADs (as well as those from other vendors) often must undergo software changes to accommodate these differences. The company works closely with customers to iron out difficulties in software implementation. In fact, Dynapac currently maintains over 70 different PAD software releases to meet the specific needs of its customers. The company reportedly does a good job of managing these releases, despite the headaches involved in the process.

Finally, the Proto-PAD X.25 operates with IBM 3270 equipment, which does not generally support Read commands for remote applications. However, some operating systems require the use of these commands, which stipulate that text being transmitted as an "answer" must come from the remote end of the link and, therefore, cannot be generated by the local PAD. The commands must be forwarded ▷

▶ • **Address format—up to 15 digits; supports abbreviated addressing conversion for Telenet and other public networks.**

• **Window size—one to seven.**

• **Packet size—128 or 256 bytes.**

• **Reverse charge—accepted; optionally refused; terminal user can originate.**

• **Fast select—accepted; terminal user can originate.**

• **Throughput class—accepted at any value; originated by terminal user.**

• **Closed user group (CUG)—M-bit supported; D-bit accepted; Q-bit indicates X.29 command; terminal user can specify CUG ID.**

Terminal User Interface:

• **User interface—asynchronous RS-232-C, V.24 female as AT&T 103, 113, or 212 compatible modem or as terminal for dial-in modem connection.**

• **Transmission rates—50 to 9600 bps; autobaud to 9600.**

• **Stop bits—two for 110 bps; one or optionally two for all other rates.**

• **Character set—ASCII or 8-bit transparent, Baudot.**

• **Parity—odd, even, transparent, or autoparity.**

• **Incoming call rotary—10; any or all ports in any rotaries or individually addressed.**

• **Flow control—X-on/X-off character (DC1/DC3 or user-defined); HP ENQ/ACK; physical CTS/RTS, BSY/DTR.**

• **Incoming call indication—RI, DCD/DSR, or DTR.**

• **Call clearing—dropping DTR or DSR or via X.28 command or watchdog timer.**

• **Make busy—port can make modem busy; feature operated remotely through the diagnostic port.**

• **Break generation—upon receipt of interrupt packet.**

• **Local switching—between all ports without using trunk; between any port and the diagnostic port; transfer or attach call to another port on the unit.**

Proto-PAD X.25

Physical Level:

• **Interface—Synchronous RS-232-C, V.24 (X.21 bis), full-duplex, continuous carrier. Proto-PAD supplies DTR/RTS; modem supplies DCD, CTS.**

• **Transmission rate—1200 to 9600 bps; modem supplies clock on pins 15 and 17.**

Link Level:

• **Framing—HDLC.**

• **Addressing—DTE or DCE.**   ▶
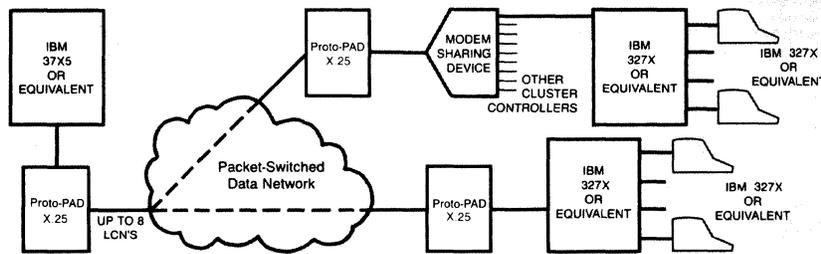
Dynapac Multi-PAD X.25 and Proto-PAD X.25

Figure 2. Dynapac's Proto-PAD X.25 allows IBM 37X5 or compatible machines to communicate with 327X controllers over an X.25 link.

▷ across the X.25 link, and the local PAD must await a reply that must be returned within the 3270 protocol time-out period (typically 3 seconds). This entire procedure slows down the network considerably.

CASE STUDIES

We recently interviewed two current users of Dynapac PADs and other X.25 networking equipment concerning their experiences with the products. Both gave Dynapac's PADs good to excellent ratings in overall performance, ease of installation and operation, device reliability, and maintenance and technical support. One user did note that installing a Model 12 Multi-Switch was far more difficult than setting up a corresponding Multi-PAD X.25.

SITE ONE: The first user we contacted was the telecommunications manager of a large financial institution located in New York City. The company has an extensive international network with major centers in New York, London, and Hong Kong and satellite offices located throughout the world. This institution used about 90 Model 108 and Model 116 Multi-PADs in its network, as well as Multi-Switches at busy remote locations. (This figure does not include redundant equipment.) A Northern Telecom SL-10 packet switch was used at the major network hubs. During the initial selection process of network equipment, this institution reviewed products from Dynapac and Cableshare. Dynapac products were chosen because they were priced well and could be easily modified through software changes.

In the large network centers and many satellite locations, the institution services its own equipment, although Dynapac service is used at some international locations. In some foreign areas, e.g., Mexico and South America, service is generally slow although domestic response to calls for assistance is very good. The user reported that the mean time between failures for Dynapac's equipment was excellent, and the PADs were extremely reliable. Therefore, there was often little need for service.

This user cited protocol discrepancies that "caused the company many headaches" as his largest problem. He pointed out that although Dynapac had done a fairly good job developing software for its PADs and switches, one doesn't experience many problems until the equipment is actually up and running in the field. This is generally due to the differences in X.25 implementation among vendors. ▷

▶ • Procedure—LAPB.

• Numbering—Modulo 8.

• Parameters—K variable from one to seven; N1 is 2024; N2 is 10; and T1 is variable from 1 to 49 seconds.

Packet Level:

• Services—SVC.

• Numbering—Modulo 8.

• Data fields—octet aligned.

• Logical channel number used—configuration option.

• Address format—up to 15 digits.

• Window size—variable one to seven.

• Packet size—128 bytes.

• Reverse charge—configurable to accept or originate.

• Closed user group—M-bit supported and used; D-bit accepted but never transmitted; Q-bit not applicable.

Synchronous port:

• Physical interface—RS-232-C, V.24.

• Transmission rate—2400 to 9600 bps; supplies clock on pins 15 and 17.

• Protocol—IBM 3270 BSC; supports multidrop mode with external modem sharer; emulates both host or cluster configuration option.

Diagnostic port:

• Physical interface—RS-232-C, V.24.

• Transmission rate—100 to 9600 bps.

• Code—ASCII, seven data bits, one stop bit, even parity.

CONTROLS AND INDICATORS

Multi-PAD X.25: Configured and monitored via terminal connected to Multi-PAD's diagnostic port; switches on main board select trunk configuration and port default options; DTE/DCE programming plug on PCB selects pins for sending/receiving RS-232-C signals; each port configurable as DTE (for dial-up modem connections) or DCE (for modem emulation) and for individually set or automatically detected speed and parity. ▶

Dynapac Multi-PAD X.25 and Proto-PAD X.25

▷ Dynapac was very accommodating concerning software problems, but slow to actually deliver new releases to solve difficulties. The user felt that this slowness was due to the fact that it is difficult to find programmers that are adept at handling X.25 implementations. He also noted that it is very hard to come up with good communications software, and he sympathized with any problems Dynapac encountered in responding to his requests for assistance.

When asked to note the major advantages of Dynapac PADs, this manager noted mnemonic addressing, which allows PADs to be addressed by name rather than 10-digit codes, the ability to modify the Multi-Switch software, and competitive pricing. He also cited Dynapac's willingness to work with his department to solve equipment and software problems and respond to requests for additional features. In fact, in response to his request to add ID passwords support to the Multi-PADs, Dynapac included this feature on the product. In this manager's particular application, a form to prompt for ID password can be set up to appear on a terminal screen upon user log-on. Screen ID and passwords are forwarded to the SL-10 for final confirmation. The ability to protect the network from unauthorized access was cited as a critical feature in this user's application.

In summation, the user noted that by implementing a packet network, his company saved thousands of dollars over employing leased lines to transfer data traffic.

SITE TWO: The second user we interviewed was a communications manager with a large midwestern academic institution. The network included 448 PAD ports, some hosts with direct X.25 interfaces, three VAX computers, two Harris machines, a Digitial Equipment Corporation PDP-11, a Honeywell GCOS, and several IBM computers. The IBM hosts accessed the network PADs via IBM's 7171 protocol converters. The user noted that while many of the PADs in his network were from Dynapac Multi-PAD X.25s, others had been purchased from Micom Systems and ComDesign. All of these units were interchanged with one another with few problems.

The manager cited the advantage of fostering vendor competition to achieve economic advantages as the reason for using equipment from several manufacturers. During the initial bidding process for the network (about 2½ years ago), Dynapac offered the best price and functionality; however, during the last two years many competitors have entered the market for X.25 equipment, and many now offer higher performance at a price that is similar to Dynapac's. Dynapac PADs incorporate a single Z-80 microprocessor that, in this manager's opinion, limited the amount of aggregate data handled by the unit. Other manufacturers, he noted, now incorporate a multiprocessor design and a faster processor to achieve greater aggregate throughput. But in rating Dynapac's PADs for overall performance, this user said that the units were "functionally robust."

When asked to cite the chief advantages of Dynapac PADs, the manager noted their mnemonic addressing capability, ▷

▶ Front-panel LEDs include the following:

- 16-port LEDs—monitor status of individual lines connected to the PAD.

- Power—indicates that power is supplied to the unit.

- Error—illuminates when software is in error state.

- Trunk—illuminates when level 2 of X.25 is initialized.

Proto-PAD X.25: Configured and monitored via an asynchronous terminal connected to the PAD's diagnostic port; series of menu-driven routines available for selecting device operating parameters; X.25 trunk default values and baud rate clock on BSC and configuration port set via switches on printed circuit board (PCB).

Front-panel LEDs include the following:

- Power—indicates that power is supplied to unit.

- Error—illuminates when software is in error state.

- Trunk—illuminates when level 2 of X.25 is initialized.

- Interface leads—RXD, TXD, RTS, CTS, DCD, DTR, TXC, RXC.

DEVICE OPERATION

Multi-PAD X.25: Each unit supports 18 different X.3 parameters through which the Multi-PAD provides services. The Multi-PAD can operate transparently or be configured to take over many support functions from the computer, thus reducing overhead and freeing up the computer's time to handle more essential functions.

Terminals connected to the PAD operate in data transfer and command mode. In data transfer mode, characters typed into terminals are delivered to the destination; in command mode, characters typed in are interpreted as commands to the local Multi-PAD. Unless autoconnect is used, terminal sessions begin in command mode. Once a destination accepts a connection, however, the terminal shifts to data transfer mode. Each Multi-PAD can be configured to stay in data transfer mode until the destination device ends the connection. Escape to command mode is via depression of the Break key or through a special character, e.g., Control-P. Also offered is escape to command mode "Return-@-Return," which matches what Telenet equipment uses to complete this function. The Telenet CONT command is used to return to data transfer mode.

Depression of a Break key is used to control problems of data flow that can occur on a busy packet network. In response to the depression of the key, the Multi-PAD can send out an Interrupt packet that is reconstituted at the destination as a Break signal, send out a reset packet, cause an escape to command mode, flush incoming data and notify the destination that a Break key has been depressed, or take no action at all. According to Dynapac, the two most common Break key configurations are for sending an Interrupt packet and flushing incoming data. The Interrupt packet notifies the destination that the Break key has been depressed; flushing causes the immediate stoppage of output. There are two ways to enable the continuation of output. If a Break Cancels Flow Control Command is enabled, pressing the Break key will also cancel the "output stopped" (flow control) condition. Or, upon receipt of an Indication of Break notification, the properly configured destination automatically responds with an X.29 packet that sets parameter eight back to zero to allow output to resume. (This packet ▶

Dynapac Multi-PAD X.25 and Proto-PAD X.25

▷ the ability to assign different controls to RS-232-C leads for special applications, outstanding functionality and reliability, and comprehensive support for X.3 parameters. He noted that Mean Time Between Failures for his Multi-PADs was excellent: in 2½ years, his organization had to return only one bad PAD for service. (The university's service center stocks at least one backup PAD at all times; if a PAD goes down, it is immediately replaced by in-house service personnel, and the defective PAD is returned to the company for service or replacement.) He rated Dynapac's service and response to problems excellent. However, the user did note that it was sometimes necessary to "go through several levels of personnel to get to the right person to solve the problem."

Disadvantages noted included a problem with cooling fans that went out more frequently than they should have and an AC power glitch. If the PADs experienced a minor and short (less than one second) power outage, they would have to be reset manually. However, automatic switchover to backup power always occurred during a major power failure. The user also noted that every PAD had to undergo software changes to accommodate slight differences in X.25 implementation from product to product. Dynapac was extremely responsive in this regard and tailored software specifically for the university's applications. As a side note, the user added that one needed a solid background in X.25 networking in order to install Dynapac PADs. "They are not a plug in and run sort of device," he told us.

Overall, this manager rated Dynapac's products and company very good. His institution plans to expand its network to include a backbone switch and more X.25 equipment. He looks forward to a continued good relationship with Dynapac. □

▶ travels behind unwanted data and allows output to resume when it is received.)

The Multi-PAD can be configured to operate as a host computer port concentrator, and in such setups the PAD often configures the X.3 parameters of a calling party because the host computer cannot perform that function. Parameter values are established via X.29 messages that are stored on a port-by-port basis on the host-attached PAD. The disconnection of calls occurs when the host computer drops its data set signals or when the host-attached Multi-PAD sends out a Clear Request packet or an X.29 Invitation to Clear message packet to the destination device.

For a summary of additional Multi-PAD functions, consult Table 1.

Proto-PAD X.25: Operates under four basic software releases. software Release 1.0, the basic package, supports IBM 3270 BSC protocol. Connection between the host emulator PAD and the cluster emulator PAD is via one logical channel onto which data from all connected devices is multiplexed. Software Release 1.1 offers all of the features available on Release 1.0; the main difference is that with Release 1.1, diagnostics, configuration, and calling are under the control of an IBM 327X device connected to a cluster controller. Software Release 2.2 supports IBM 3270 BSC protocol. Under this package, calls are set up and cleared from a host emulator Proto-PAD; cluster controllers multi-

dropped from the host emulator PAD use the same logical channel. A translation table allows the host to address remote clusters with the same poll address as if they were multidropped units.

Each Proto-PAD supports Manual Call and Autocall modes. In Manual mode, calls are set up via the menu on the diagnostic port or through mnemonics. Autocall mode allows calls to be automatically placed by pressing the Enter key on a terminal attached to a cluster controller and corresponding Proto-PAD. Clearing a call in either mode occurs when DCD (power off) is dropped. In Autocall mode, an inactivity timer clears a call if no data has been transferred for five minutes. In Manual mode, a call can be cleared via the configuration menu.

IBM 3270 text blocks are generally longer than the maximum X.25 size; therefore, a block is usually transferred in a sequence of two or more packets. An X.25 M-bit is put into all but the last packet of the block to signify that packets are part of the same entity. The Proto-PAD transmits a packet as soon as it is full, and it does not wait until an entire block has been received before transmitting more information. Sometimes a block of data is partially transmitted across the X.25 link before the PAD detects an error. When this occurs, a Level 4 Abort signal is transmitted to the receiving PAD, telling it to discard the corrupted data block.

PHYSICAL SPECIFICATIONS

Dimensions: *Multi-PAD X.25 Model 108*—3½ inches high, 17½ inches wide, 11 inches deep; *Multi-PAD X.25 Model 116*—5¼ inches high, 17½ inches deep, 11 inches deep; *Proto-PAD X.25*—3½ inches high, 16¾ inches wide, 10½ inches deep.

Power Requirements: *Multi-PAD X.25*—1 AMP at 110 volts; 0.5 AMP at 220 volts; operates at 50 or 60 Hz; *Proto-PAD X.25*—1 AMP at 110 volts; operates at 50 or 60 Hz.

Operating Temperature: 0° C to 50°C (all models).

Storage Temperature: -10°C to 70°C (all models).

PRICING

Prices for Dynapac's PADs vary according to options and number of ports selected. However, general prices for the units are as follows:

• Multi-PAD X.25 Model 108—$2,205 to $2,905.

• Multi-PAD X.25 Model 116—$3,415 to $5,500.

• Proto-PAD X.25—$2,700 (301); $4,200 (341); $5,200 (381).

• Mono-PAD X.25—$695 to $995.

Dynapac warrants its hardware products against defects in material and quality for 90 days after delivery. Software is warranted for one year. Extended warranty arrangements, including "spare-in-the-air" service, are available for an additional charge. The company offers a repair service for both in- and out-of-warranty products. On-site, 8 a.m. to 5 p.m. maintenance service is available within a 50-mile radius of Chicago, Dallas, Los Angeles, New York, San Francisco, and Washington, DC, Monday through Friday. Monthly charges for standard maintenance vary according to product; the service must be purchased before the end of an Extended Warranty period. ▶

Dynapac Multi-PAD X.25 and Proto-PAD X.25

Table 1. Summary of Multi-PAD X.25 Features*

Automatic trunk verification
Calling address
Clear Call to Overflow option
Character-by-character echoing
COM called and calling addresses
Data set signal handling
Datapac network support
Diagnostic port password protection
DROP dial-in option
Facilities and feature request disable
Hewlett-Packard ENQ-ACK support
IMMEDIATE host drop support
Incoming call herald
Incoming call password protection
Invitation to clear
Local calling
Local connect diagnostic port
Logical channel number range assignment
Logical group number assignments
MAI/Basic Four Echoing
M-bit support
Multiple rotary hunt feature
New line to carriage return conversion
Port-by-port accounting information
PVC-only operation
Refuse collect calls
Remote connect diagnostic port
Remote modem busyout
Remote password log-on

Table 1. (Continued)

Selectable PVC
Slave hard copying
Tandem T-pause flow control
Telenet network support
Transferring
Transpac network support
VT100 terminal support
Western Union Telegraph support
212 modem physical signal
  speed detection

Table 2. Summary of Proto-PAD X.25 Features

Abbreviated (mnemonic) addressing
Autocall via an Enter key
Cluster address assignment
  and translation
Printer support
Reverse charging
Subaddressing (for incoming calls)
T2 Timer for issuing clear packet
Variable X.25 parameters
3270 transparent mode support