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Animal, Vegetable, or Mineral: The 3172 Interconnect Controller

As networked personal computers and workstations gain equal footing with traditional terminal-to-host computing, one challenge for IBM systems managers is negotiating connectivity between these LAN-based devices and host computers. Finding a cost-effective solution for LAN-to-mainframe communications is emerging as a very significant issue.

To address this requirement for LAN-to-mainframe communications, IBM announced the 3172 Interconnect Controller in October 1989. Because the 3172 is a new product category for IBM, there is some confusion over what it is and what it does. This article attempts to demystify the 3172 by addressing some of the basic issues surrounding it, in particular:

- What the 3172 does and doesn't do
- What the differences are between the three models
- Whether (and how well) the 3172 can be managed
- Hidden costs and confusion
- How the 3172 compares to similar offerings from other vendors
- What the future holds for this product category

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Integrating TCP/IP into SNA Part III: Implementations

This article is the third installment in a series intended to assist users facing the challenge of integrating TCP/IP into traditional subarea SNA networks. Part I focused on transport and network connectivity. Part II discussed application-level issues surrounding this integration and looked at several approaches to and aspects of TCP/IP and SNA integration. Primarily, this third installment is a composite case study of companies that have introduced TCP/IP into an SNA environment—the decision processes, implementation experience, benefits derived, and plans, if any, for further integration. This article also briefly reviews TCP/IP products for IBM's AIX (Unix-based) systems as well as the offerings on SAA systems, especially the newly-announced TCP/IP Version 2 Release 2 for MVS.

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The 3172: What It's Got and What It's Not

The 3172 Interconnect Controller is a product line that facilitates LAN-to-mainframe and, to a lesser extent, remote VTAM channel-to-channel communications via a rack-mounted, Intel microprocessor-based, microchannel architecture-based controller. (The 8232 LAN Channel Station, which the 3172 replaced, also handled LAN-to-mainframe communications but supported only TCP/IP.)

SNA Perspective believes that, in order to fully grasp what the 3172 is, it's important to first understand what it's not.

- The 3172 is not a communication controller (37xx) or a cluster controller (3174). While communication controllers and cluster controllers can directly identify themselves to other devices and establish sessions, the 3172 cannot (see Table 1).
- Along the same lines, the 3172 is not an SNA network addressable unit and does not have logical units (LUs) or physical units (PUs) that identify it to the network.
- The 3172 is not a bridge. The 3172 does move traffic, but it does not directly connect LANs (see Figure 5 in *SNA Perspective*, May 1992). While the technology that underlies the 3172 is admittedly capable of being developed to handle bridging, IBM has not exploited this potential and *SNA Perspective* does not believe that it will in the near future.
- The 3172 is not a router—it does not directly connect LANs and, at this point, does only limited protocol processing. There is an exception—the TCP/IP Offload feature enables basic IP routing between different LANs.
- The 3172 is not, strictly speaking, a gateway. *SNA Perspective* subscribes to a rigid industry definition that a gateway processes level four and up in the protocol stack. Because the 3172 serves largely as a transparent data pass-through it does not qualify as a gateway, even though IBM often refers to it as a LAN-to-mainframe gateway.

3172 Is Not a 3745, a 3174, or a 6611

IBM Product	LUs	PUs	Sessions	Bridging	Routing
3172 Interconnect Controller	No	No[1]	No	No	No
3745 Communication Controller	No	Yes	Yes	No	Yes[2]
3174 Cluster Controller	Yes	Yes	Yes	No	No
6611 Bridge/Router	No	Yes[3]	No	Yes	Yes[3]

[1] The 3172 ICP has a PU 2 that is used for network management only.
[2] The 3745 routes SNA and, with NCP version 6, also routes IP.
[3] The 6611 is a multiprotocol router that routes, or will route, several protocols including APPN (PU 2.1) but not subarea SNA.

Table 1

What the 3172 Does

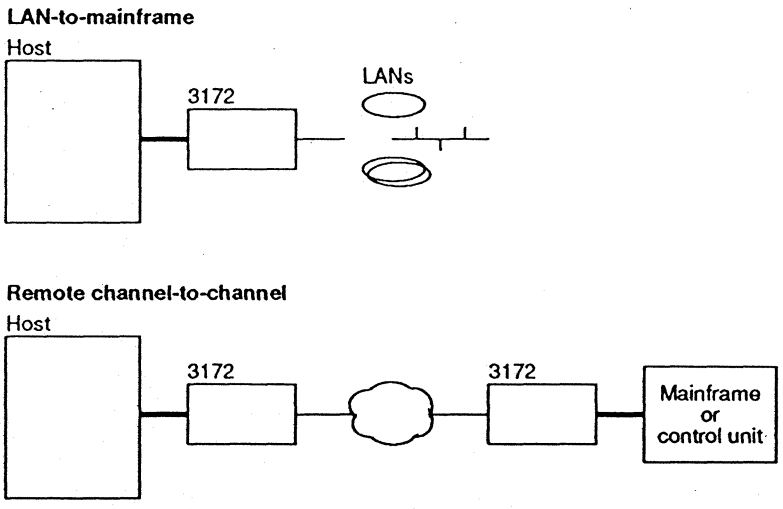

Figure 1

That said, what is a 3172? It's an interface for LAN-to-channel communications—a simple concept that has been prone to considerable

misunderstanding, mainly because of the number of LAN types and LAN protocols that exist. Although the 3172 is also capable of remote mainframe-to-mainframe and mainframe-to-control unit communications, these appear to be less strategic to IBM at this time (see Figure 1 on page 2).

The 3172 Family

Families, whether people or products, are sometimes difficult to figure out at first glance, but *SNA Perspective* believes that a little background can help. For the 3172, life began in parallel at two different IBM divisions in Kingston, New York and Research Triangle Park, North Carolina. IBM's Enterprise Systems (that is, mainframe) group in Kingston focused on developing a product for wide area channel-to-channel communications. The Networking System group in Research Triangle Park leaned more toward LAN-to-mainframe connectivity. Both groups decided to co-develop a single product based on a microchannel PS/2 that incorporated wide area channel-to-channel and LAN-to-mainframe connectivity.

Research Triangle Park has since taken full responsibility for the 3172, and the product has taken on its LAN-to-mainframe connectivity preference. IBM's recent announcements indicate that the product will continue to develop in that direction.

IBM announced the 3172 model 1 in October 1989. Since then, the product family has grown to three members, the most recent one, model 3, announced in June of this year. Each member of the family is based on IBM's Intel microprocessor/ microchannel architecture, similar to the PS/2, and can run the Interconnect Controller Program (ICP) software.

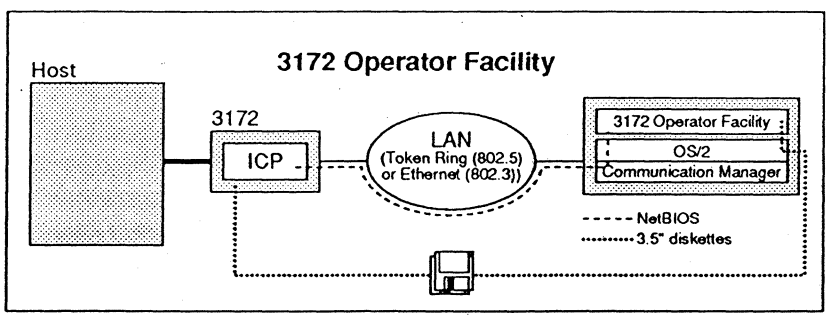

Figure 2

The 3172 and ICP are configured and controlled by the companion 3172 Operator Facility software. The Operator Facility runs on a PS/2 with OS/2, and configurations can be transfered using 3.5-inch diskettes or over a LAN (using OS/2 Communications Manager) with limited NetBIOS (see Figure 2). Although this indicates that IBM could support LAN access to the mainframe via NetBIOS, *SNA Perspective* does not expect IBM to develop this functionality. The 3172 must be configured with at least one channel adapter and a maximum of two. The 3172 Interconnect Enhancement feature must be purchased in addition to ICP to enable SNA traffic to flow through the 3172 to the host. As with any family, it's instructive to examine and evaluate each member individually.

Model 1

The model 1 is the most versatile, albeit the slowest, member of the 3172 family. It uses an Intel 386 processor and 8 MB of RAM to support LAN-to-mainframe communications. It supports a broader selection of LANs and protocols than either of its siblings. The Remote Channel-to-Channel feature supports Enterprise System Connection (ESCON) and parallel channels and remote communications of up to four high-speed links (T1, CEPT (E1), or HSDS (J1)).

The model 1 can be configured for LAN-to-mainframe *or* channel-to-channel communications, but not for both. LAN and protocol support for the model 1 are given in Table 2 on page 4.

Model 1 supports up to two parallel or two ESCON channel connections. The parallel channel (also called bus and tag) is a block multiplexer channel that supports data-streaming rates of up to 4.5 megabytes per second (MBps), or in LAN terms, about 36 megabits per second (Mbps). ESCON is a fiber-optic, point-to-point, serial connection supporting data rates up to 10 MBps, or about 80 Mbps. ESCON can be used only for channel-to-channel configurations of the 3172.

Since the original announcement in 1989, IBM has changed its commitments for model 1 by discontinuing

support for token bus (IEEE 802.4), OSI/MMS, and MAP. In addition, IBM has not yet fulfilled its statement of direction for OSI/Communications System (OSI/CS) support except over Ethernet. Model 1 will not run the just-announced ICP version 3 or probably any future release, effectively limiting support to what is currently available in version 2. Support of higher-performance LANs is beyond the capability of the current model 1 anyway.

In sum, the capabilities unique to the 3172 model 1 are channel-to-channel functionality, support for TCP/IP over PC Network, and support for DECnet over Ethernet version 2 (in conjunction with Interlink host software). *SNA Perspective* believes that, except for these unique functions, user needs can be better met by the newly announced model 3.

Supported Protocols/LANs

Protocol	Ethernet version 2	IEEE 802.3	IEEE 802.5	PC Network	FDDI
Model 1					
TCP/IP	✔	✔	✔	✔	
SNA		✔	✔		
OSI		✔	SOD		
DECnet	✔[1]				
Model 2					
TCP/IP	✔	✔	✔		✔
SNA		✔	✔		✔
OSI		SOD	SOD		SOD
Model 3					
TCP/IP	✔	✔	✔		✔[3]
SNA		✔[2]	✔[2]		

[1] DECnet is supported only in conjunction with Interlink's SNS/SNA Gateway software on the host.
[2] SNA is not supported with TCP/IP Offload.
[3] TCP/IP over FDDI is supported only with TCP/IP Offload software; the ICP version 3 software does not support FDDI on model 3.
SOD = Statement of Direction

Table 2

Model 2

With model 2, IBM appears to have begun more actively shaping the 3172's market focus, with an emphasis on higher speed LAN-to-mainframe connectivity.

Physically, the model 2 is a higher performance unit than the model 1, using a 486 microprocessor. This faster chip, combined with the ability to handle larger form-factor (and higher performance) adapters and its greater power and cooling capacity, make the model 2 a faster, though more expensive box. The model 1's base unit price is $16,220, whereas the model 2's base unit price is over $50,000.

Model 2 also represents a major departure from VTAM channel-to-channel support. The standard 3172 model 2 is a LAN-to-mainframe product that does not allow channel-to-channel connectivity. To "fulfill" its statement of direction to provide channel-to-channel communications on model 2 (and, *SNA Perspective* speculates, perhaps to still the interdivisional waters between RTP and Kingston), IBM and AT&T Paradyne are jointly developing a solution based on the 3172 model 2, called the AT&T Paradyne XL/5000, which will provide remote T1/DS-3 SNA channel-to-channel functionality. The XL/5000 will provide mainframe-to-control unit functionality initially, and add mainframe-to-mainframe sometime in the future (see Figure 3 on page 5).

Although AT&T Paradyne is responsible for the XL/5000's sales and marketing, *SNA Perspective* believes that IBM will provide the enhanced ESCON and T1/DS-3 teleprocessing boards for the product. This joint product will be the only means by which model 2 supports remote channel-to-channel connections.

An important feature of model 2 is its support for the Fiber Data Distributed Interface (FDDI). The 3172 was IBM's first FDDI interface and, while IBM's investment acknowledges the importance of this emerging technology, it also implicitly indicates IBM's recognition that high-performance desktop computing—both on high-powered personal computers and engineering workstations—is here to stay.

Model 2's support of FDDI allows organizations to consolidate numerous LANs onto a single backbone without sacrificing host access (see Figure 4). It also supports LANs in engineering and scientific environments where increased bandwidth is required.

A restriction with the FDDI support is that only one FDDI adapter (plus two other low-speed LAN adapters) can be installed per 3172. A further and more significant restriction is that only one protocol, either TCP/IP or SNA, can be supported over that one $26,000 adapter. IBM recognizes that this is an expensive restriction for its customers, and is looking at possibly supporting multiple FDDI adapters in one 3172 or multiprotocol support over a single FDDI adapter in the future. Table 2 on page 4 shows model 2's LAN and protocol support.

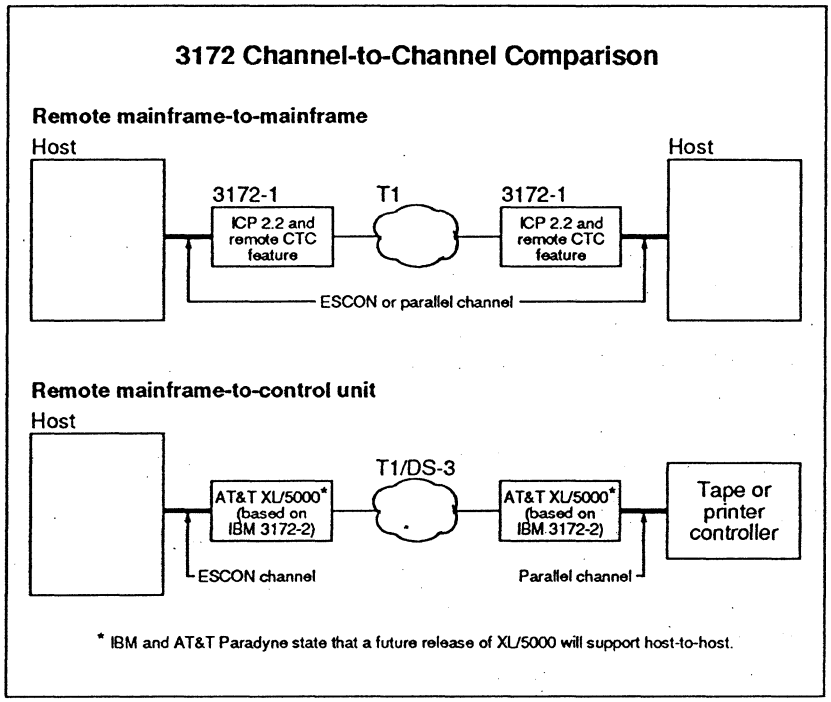

Figure 3

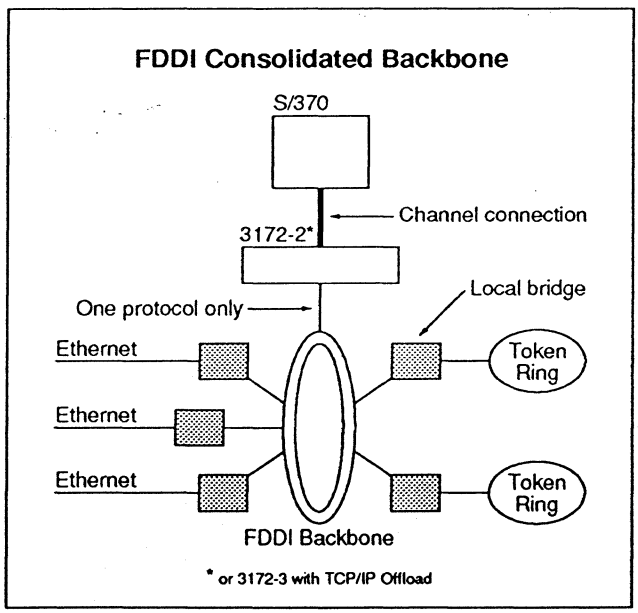

Figure 4

Model 3

The 3172 model 3, which was announced this June and is expected to ship at the end of September, is further evidence of IBM's commitment to LAN-to-mainframe connectivity.

Physically, model 3 uses a 486SX microprocessor and busmaster adapter cards. Busmaster adapters control the data transfer between the adapter and system memory or other adapters themselves, offloading this task from the system CPU. Because model 3's technology is both more advanced and less expensive from that used in model 1, model 3 effectively obsoletes model 1 for all but channel-to-channel, DECnet, and PC Network connections. IBM has told *SNA Perspective* that it does not intend to support channel-to-channel connectivity with the model 3.

Model 3 does support a reasonable offering of LANs and protocols (see Table 2 on page 4) but it has a few missing pieces. While the TCP/IP Offload software, discussed below, does support FDDI LANs, the ICP version 3 software used for all other protocol support does not support FDDI on model 3. We expect to see more extensive FDDI support in a future release.

TCP/IP Offload

Model 3 also has a new option for protocol support: customers can run either the standard ICP software or a new program called TCP/IP Offload. TCP/IP

Offload does what its name implies—it takes on some of the protocol processing formerly done by the host and saves CPU cycles (see Figure 5). This does not replace TCP/IP on the host; TCP/IP for MVS V2R2 is still required on the host.

TCP/IP Offload runs on OS/2 version 1.3 with TCP/IP for OS/2 version 1.2.1, and does *not* use ICP software. This means that a 3172 model 3 running TCP/IP Offload can process only TCP/IP data; multiprotocol environments will need the ICP version 3 software. Configuration and control of the 3172 with TCP/IP Offload is much different from configuration and control with ICP—a keyboard and monitor must be attached (as part of the 3172 model 3 Offload Hardware Feature), and all configuration and control is done locally. With ICP, in contrast, configuration and control functions are done at a separate OS/2 workstation using the Operator Facility program, and up to sixteen controllers can be configured and controlled (one controller at a time) over the LAN, or configuration diskettes generated for many 3172s. The loss of operator functionality will be a concern to users, particularly those with other 3172s running ICP.

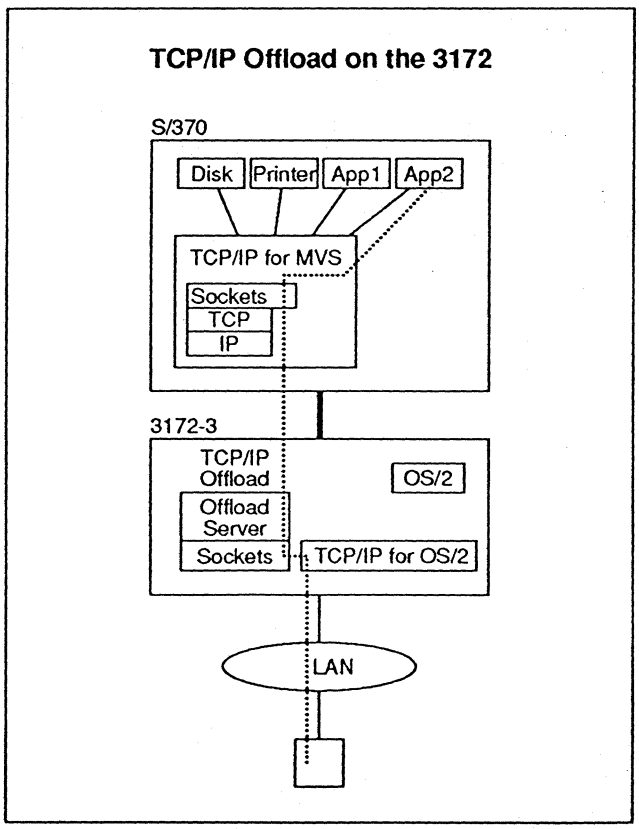

Figure 5

Also, the logistics of having a monitor and keyboard connected to a rack-mounted controller is rather awkward. But, if users are supporting TCP/IP on the host extensively and/or the mainframe is heavily loaded, TCP/IP Offload will prove valuable.

SNA Perspective sees TCP/IP Offload as a fortification of IBM's commitment to the TCP/IP market and does not expect IBM to develop offload programs to support any additional protocols. We believe this because IBM's greatest success with the 3172 has primarily been in TCP/IP environments, as an add-on sale to the purchase of host TCP/IP software.

Network Management

The 3172 can be managed with any (or a combination) of three network management utilities: the Operator Facility, NetView, or a Simple Network Management Protocol (SNMP) monitor. Each tool provides slightly different capabilities (see Figure 6 on page 7).

Operator Facility

The Operator Facility, which is used to install and configure the 3172, also provides local management for up to sixteen 3172s over the LANs. While the Operator Facility does not provide integrated network management, it can be used to view status and error logs, and directly manage changes such as software updates and configuration changes. The 3172 sends status updates to the Operator Facility which are shown on the status field.

The Operator Facility comes with the ICP software, the TCP/IP Offload software does not include an Operator Facility; therefore a model 3 running TCP/IP Offload cannot be managed with this utility.

NetView

To support NetView management on the 3172, a PU type 2 is implemented in the ICP software. Network management information flows between NetView and the 3172 across a separate subchannel (and SNA session) than the LAN-to-mainframe traffic. The 3172 Interconnect Enhancement feature, which is required to enable SNA traffic flow through the 3172 to the host, also enables the PU 2 in the ICP

for network management from NetView. Even if the 3172 is only carrying TCP/IP traffic from the LAN, the Interconnect Enhancement feature is required if the customer wants to manage the 3172 from NetView. The Remote Channel-to-Channel feature also supports the network management flows between NetView and the 3172.

NetView's Central Site Control Facility (CSCF) can be used to obtain configuration and statistical information and to view the 3172 system log. Unfortunately, IBM has not yet fulfilled its statement of direction made on September 5, 1990 to support NetView Distribution Manager (DM), because many of its functions are provided by Operator Facility. For IBM to realize its goal of central management through NetView, each networking component, particularly contemporary components such as the 3172, must be visible to NetView and support all the NetView functionality that is applicable, including Distribution Manager.

The 3172 model 3 running TCP/IP Offload cannot currently be managed by NetView.

SNMP

The 3172 can be managed using SNMP network management, although in a nonstandard way. IBM had to work around the fact that the 3172 with ICP is not an IP node, which is a requirement for SNMP manageability.

To overcome this limitation, IBM created an SNMP subagent for the 3172. The subagent resides in IBM's TCP/IP for VM or MVS (version 2 or later) and is a receptacle for 3172-related management information bases (MIBs). The 3172 ICP communicates with the host subagent via a proprietary data flow. Creating this subagent meant that IBM had to customize its host TCP/IP software. Because of this, users hoping to manage their 3172 can only run certain versions of IBM's TCP/IP and cannot use other vendors' host software. For example, many users have Interlink's TCP/IP software on their mainframe and will not be able manage their 3172 with SNMP. IBM's subagent customization includes SNMP GET and traps but does not implement the SNMP SET command, which means that SNMP can only be used to monitor the 3172 but cannot effect any changes. This proprietary subagent is not used with the TCP/IP Offload nor does it include its own SNMP agent. However, *SNA Perspective* hopes that IBM will add SNMP management capability to TCP/IP Offload by the time it ships in September.

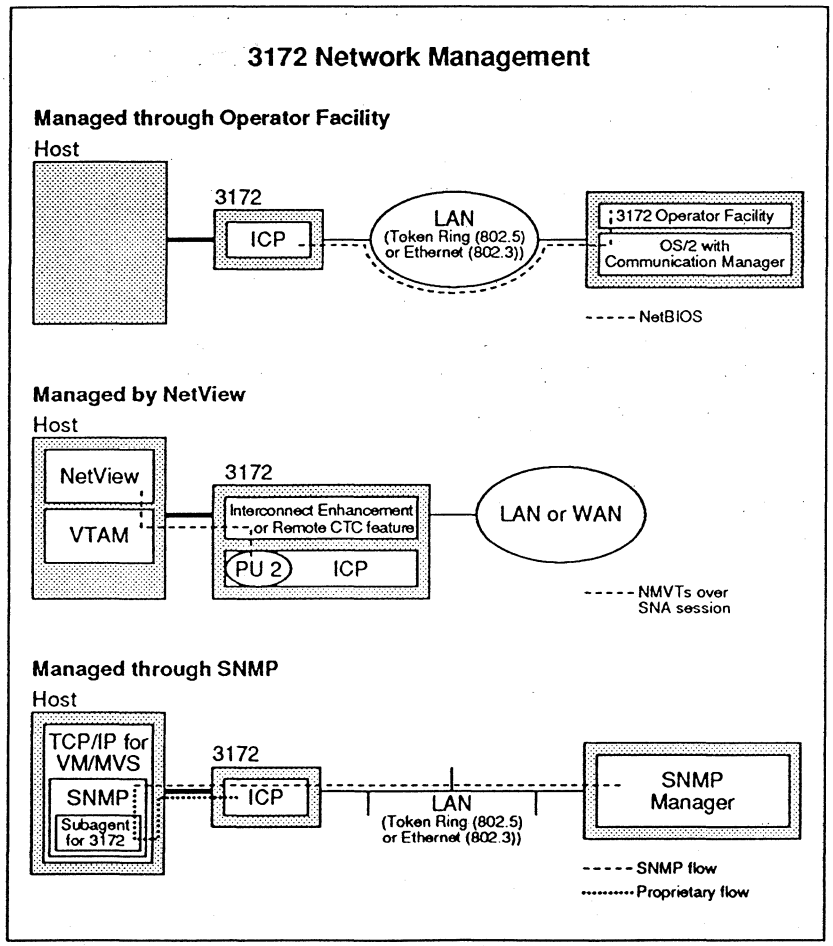

Figure 6

Performance

IBM has not published much performance benchmarking for the 3172. IBM provides the following statistics for token ring SNA LAN-to-channel performance:

- The 3172 model 1 throughput is comparable to the 3745 model 210
- The 3172 model 1 is twice as fast as the 3174

IBM reports that the performance of model 2 and model 3 is almost identical. Furthermore, they both are about 30 percent faster than model 1 with SNA traffic and 100 percent faster than model 1with TCP/IP traffic when ICP version 3 is used.

IBM has also conducted TCP/IP performance testing using TCP/IP Offload feature in a Model 3. This testing indicates that significant TCP/IP loading on the host is reduced by 30 percent. On the other hand, as expected, total 3172 model 3 throughput using TCP/IP Offload is significantly reduced compared to using ICP.

3172 Model Comparison

Base unit	Model 1	Model 2	Model 3
Base unit			
Architecture	Micro Channel 32 bit	Micro Channel 32 bit	Micro Channel 32 bit
Processor	80386DX (25 MHz)	80486DX (25 MHz)	80486SX (25 MHz)
RAM (MB)	8	8	8
Hard drive (MB)	30	80	80
Maximum connections			
LAN	4	4[1]	4[2]
Channel	2	2	2
Primary modes[3,4]			
LAN-to-host	✔	✔	✔
Remote channel-to-channel	✔(T1)	✔(T1, DS-3)	
Channel connections[5]			
Parallel	✔	✔	✔
ESCON	✔	[6]	
Controller software			
3172 software			
ICP[7]	V1 or V2	V2 or V3	V3[11]
TCP/IP Offload[8]	NA	NA	V1[12]
IBM host software for ICP			
VTAM[9]	3.4	3.4	3.4
TCP/IP for VM[10]	2.0	2.2	2.2
TCP/IP for MVS[10]	1.0	2.0	2.0
AIX/370[10]	1.2	1.2	1.2
AIX/ESA[10]	NA	2.1	2.1

1 Up to one FDDI LAN is permitted. When an FDDI connection is included, a maximum of two Ethernet and/or token ring adapters can also be installed.
2 Only when TCP/IP Offload software is used, up to one FDDI LAN is permitted. When an FDDI adapter is installed, a maximum of two Ethernet and/or token ring adapters can also be installed.
3 3172 cannot operate in LAN-to-host and channel-to-channel modes at the same time.
4 Model 2 channel-to-channel mode will be supported only by the AT&T Paradyne XL/5000.
5 For LAN-to-mainframe, model 1 supports only parallel channel.
6 ESCON support on model 2 will only be provided through the AT&T Paradyne XL/5000.
7 ICP software includes Operator Facility.
8 TCP/IP for MVS Version 2 Release 2 is required to run TCP/IP Offload.
9 Required only for SNA connectivity.
10 Only one of these is required for TCP/IP connectivity.
11 ICP 3 does not support FDDI on the model 3.
12 Model 3 can run TCP/IP Offload (on top of OS/2 version 1.3 and TCP/IP for OS/2 version 1.2.1) software instead of ICP.

Table 3

Pieces and Pricing

With a product like the 3172 there are a lot of good reasons to be confused. The product category is new and it takes time for the market to understand any new technology. Moreover, most potential customers don't have anything to which they can readily —and accurately—compare the 3172. See sidebar "A Chronology of Confusion" on page 11 for more on this issue.

Finally, figuring out all of the components necessary to operate the 3172—hardware, adapters, 3172 software, and host software—creates more confusion. The sections that follow attempt to sort out what is needed when stalking the elusive 3172. (See Table 3.)

Getting the Right Software

To run the 3172, you not only have to have the right software for the box itself, you also have to make sure you're running compatible host software.

On the 3172 side, the biggest issue is making sure that the version of ICP you're running supports the functionality that you require, a somewhat thorny issue for ICP version 3 in particular. For example, ICP version 3 supports Ethernet, token ring, and FDDI LANs on the model 2 but it does not support FDDI on model 3. To run FDDI on model 3, the box must be configured to run TCP/IP Offload software. To support SNA LAN traffic on any 3172, the Interconnect Enhancement feature must be purchased in addition to ICP.

On the host side, the required software varies depending on whether you're supporting SNA or TCP/IP. To support SNA traffic on the 3172, the host must be running VTAM version 3.4 or later—an expensive and time-consuming upgrade that many IBM users have not yet made. Similarly, to support TCP/IP traffic on the models 2 or 3, the host must be running TCP/IP for VM version 2.2 or TCP/IP for MVS version 2.0 or 2.2. MVS TCP/IP version 2.2 is required to use the model 3 with the TCP/IP Offload feature.

Pricing Scenarios

This article has focused primarily on the functional similarities and differences between the three models of the 3172. To further illustrate the differences between the models, we've created the pricing scenarios that follow in Table 4 on page 10. Although, of course, price is only one consideration when making a purchase of this type. In general, *SNA Perspective* believes you should consider model 1 for channel-to-channel connectivity, model 2 for SNA FDDI support, and model 3 for Ethernet and token ring LAN connectivity or for offloading of TCP/IP processing (with the option of FDDI). The majority of existing 3172 configurations installed are single channel, with one or two LAN adapter boards, usually Ethernet. And typically, if two LAN adapter boards are installed, they are of the same type.

What the Competition Offers

Several vendors make products that compete with the 3172. IBM's staunchest competitor in this area is McDATA of Broomfield, Colorado. McDATA's LinkMaster 6100 Network Gateway Server was the first sophisticated LAN-to-mainframe controller and it was announced even before the IBM 3172.

The Link Master 6100 can operate in several different modes, including VTAM channel-to-channel and as a TCP/IP server. The 6100 can also operate as a 3172 system-compatible product supporting a similar set of protocols and LANs. Configured as a TCP/IP server, it provides 3270 emulation for Telnet clients on Ethernet, tn3270, FTP, and SNMP and NetView manageability. The TCP/IP server offloads the TCP function from the mainframe, reducing CPU cycles. VTAM CTC provides support for parallel channels, links up to T1 in speed and, as with all McDATA products, a high degree of NetView manageability.

BusTech, Inc. (BTI) of Burlington, Massachusetts, is another manufacturer of 3172-like products, although it sources to other vendors rather than marketing directly. Interlink Computer Sciences, Inc. of Fremont, California, is one of these vendors and announced its 3762 Network Controller in March. While BTI boxes have received praise for their performance and price, their functionality is proportionally less than IBM's or McDATA's. Other companies such as Digital Equipment Corporation and Sun Microsystems have products for LAN-to-mainframe connectivity, although these products are, again, mostly limited to TCP/IP over Ethernet or DECnet over Ethernet. Both vendors OEM their channel adapters.

NCR Comten of St. Paul, Minnesota, a long-time contender in the 37xx communication controller market, is expected to announce a product competitive to the 3172 in late 1992. The product is expected to be based on the Intel microprocessor/microchannel architecture like the 3172 and will be 3172 compatible, but will probably support more LAN connections than IBM. *SNA Perspective* expects NCR Comten to offer TCP/IP networking applications such as Telnet, and 3270 emulation in addition to network-based routing and WAN interfaces on its controller, similar to what it offers on its 56xx communication controller family.

Competition not only exists from other vendors, but from IBM itself. For example, the IBM RS/6000 with a channel adapter and TCP/IP can act as a TCP/IP gateway. A host software driver for VM will support this configuration, and MVS support is expected soon. IBM may even port TCP/IP Offload to the RS/6000.

Conclusions

SNA Perspective believes that, while IBM's approach to the 3172 has been confusing because of an inconsistent focus and changing packaging of the product, it is responding to a very real market need. User surveys and studies have shown a huge interest in LAN-to-mainframe connectivity. Research done by International Data Corporation of Framingham, Massachusetts, shows that vendors of this type of product are seeing a 50 percent increase in orders. The market is expected to grow from $42 million last year to $125 million by 1996.

While the 3172 (and products like it) target a large, unserved market, it is a new product with a long sales cycle, so its shipments to date haven't been raising heads. Sales were further complicated because the 3172 was initially seen as a threat to IBM's communication controller. Since it began shipping in September 1990, *SNA Perspective* estimates IBM has shipped fewer than 1,250 units—very few of which are model 2 units.

The 3172 has primarily been a "piggyback" sale wherever TCP/IP on VM or MVS is sold, usually providing Ethernet connectivity. We expect this to continue, although the availability of the Ethernet adapter on the 3745 in September will affect this somewhat. The same will be true when FDDI becomes available on the 3745. But, with a fifth to fourth of IBM mainframes expected to be running TCP/IP by the end of 1993 and at least half of all IBM mainframe administrators considering it, the future is clearly bright for this product line or for other products that support LAN-to-mainframe TCP/IP support.

From a price/performance/functionality standpoint, the new model 3 is a strong candidate for LAN-to-mainframe communications, but it has serious deficiencies in the FDDI support area. IBM is now looking at how to solve these deficiencies and we encourage it to do so, especially as more competitive FDDI devices are becoming available. Certainly, from a performance and configuration standpoint, the 3172 model 3 should replace the channel-attached 3174 with the token ring gateway as an SNA token ring interface to the host.

The statement of direction for OSI remains unfulfilled, except for OSI/CS over 802.3. OSI protocol stacks exist for the host, but how will users access them from the LAN? Much has been said about the slow OSI sales, but unless connectivity and other key components exist, users will not buy the host software.

Packaging of the 3172 has unfortunately gone the way of the 3174 (both are managed by Network Systems group in RTP), where each component is a separate and chargeable item, making it very difficult for the person ordering this product for the first time. IBM would do itself and all its customers a favor by integrating some of the components and simplifying the process.

SNA Perspective expects to see new models (and versions of ICP) still based on the Intel microprocessor/microchannel architecture in the future. This also serves to protect users investments in the current products. Although IBM recognizes the performance that results from using a RISC processor, it believes the Intel microprocessor will continue to provide sufficient performance, particularly in light of busmaster adapters that offload the main CPU, continued development by Intel on this microprocessor family, and investment in controller software. ■

3172 Pricing Scenarios

LAN-to-Host with TCP/IP Traffic

For LAN-to-mainframe connections supporting TCP/IP traffic, you can choose between the three models but, unless PC Network, DECnet, or FDDI is also required, *SNA Perspective* recommends model 3.

Typical model 1 configuration (one channel connection, two LANs)

Model 1 base unit	16,220
Interconnect Control Program, version 2	5,775
Parallel channel adapter	8,430
Ethernet adapter	786
PC Network broadband adapter	669
	31,880

Typical model 3 configuration (one channel connection, two LANs)

Model 3 base unit	9,680
Interconnect Control Program, version 3	6,350
Parallel channel adapter	5,100
Ethernet adapter	786
Enhanced token ring 16/4 adapter	1,030
	22,946

FDDI LAN-to-Host with TCP/IP Traffic

Typical model 2 configuration (one channel connection, two LANs)

Model 2 base unit	50,920
Interconnect Control Program, version 3	6,350
Parallel channel adapter	5,100
Ethernet adapter	786
FDDI adapter	26,250
	89,406

Typical model 3 configuration (one channel connection, two LANs)

Note: Currently, FDDI LANs are supported on model 3 only with TCP/IP Offload. No other protocols are supported if TCP/IP Offload is used.

Model 3 base unit	9,680
Offload Hardware feature	2,780
OS/2 version 1.3	200
TCP/IP for OS/2 version 1.2.1	200
TCP/IP Offload software	3,000
Parallel channel adapter	5,100
Ethernet adapter	786
FDDI adapter (needs computer room environment)	5,990
	27,736

LAN-to-Host with SNA Traffic

For LAN-to-mainframe connections supporting SNA traffic, you can choose between the three models. However, *SNA Perspective* recommends model 3 unless FDDI is required.

Typical model 1 configuration (one channel connection, two LANs)

Model 1 base unit	16,220
Interconnect Control Program, version 2	5,775
Interconnect Enhancement feature	2,885
Parallel channel adapter	8,430
Two token ring adapters	1,790
	35,100

Typical model 2 with FDDI configuration (one channel connection, two LANs)

Model 2 base unit	50,920
Interconnect Control Program, version 2	5,775
Interconnect Enhancement feature	2,885
Parallel channel adapter	5,100
Enhanced token ring adapter	1,030
FDDI adapter	26,250
	91,960

Typical model 3 configuration (one channel connection, two LANs)

Model 3 base unit	9,680
Interconnect Control Program, version 3	6,350
Interconnect Enhancement feature	3,175
Parallel channel adapter	5,100
Two enhanced token ring adapters	2,060
	26,365

Channel–to–Channel with SNA Traffic

For channel-to-channel connectivity, the 3172 family offers two options—model 1, or model 2 with the AT&T Paradyne XL/5000 solution.

Model 1 minimum configuration (one parallel channel connection, one T1)

Note: As this article went to print, pricing for the XL/5000 was not available.

Model 1 base unit	16,220
Interconnect Control Program, version 2.2	5,775
Remote Channel-to-Channel feature	21,000
ESCON channel adapter	12,070
T1 teleprocessing adapter	3,205
	58,270

Table 4

A Chronology of Confusion

It is not surprising that many users are confused about the 3172. IBM has positioned the 3172 in three ways in less than three years. Even those who understood from the SNA side that it was not a 3174 or 3745 or from the non-SNA side that it was not a bridge or a router had to contend with changes in the product configuration itself.

First, it was a non-SNA LAN-to-channel box. Then in September 1990, it was touted as a many-protocols-over-many-LANs-to-channel box as well as remote channel-to-channel box. Now with this June's announcements, it seems to be positioned as a flexible box with four distinct flavors: low-cost TCP/IP-and-SNA over Ethernet-and-Token Ring LAN-to-channel, TCP/IP or SNA over FDDI LAN-to-channel, TCP/IP offload LAN-to-channel, or remote SNA channel-to-channel.

MAP Confusion Initially, support for Manufacturing Automation Protocol (MAP), a factory environment protocol standard based on OSI, and the related 802.4 token bus (carrierband and broadband) LAN and host-based OSI manufacturing messaging system (OSI/MMS) software were important components of the 3172. IBM has completely discontinued all 3172 support for these products.

LAN Confusion On the LAN side, the 3172 first supported Ethernet version 2, Ethernet 802.3, token bus 802.4, and token ring 802.5. In 1990, IBM added PC Network and FDDI. Now, IBM has discontinued 802.4, and supports PC Network on model 1 only. There are two FDDI options—users can combine 3172 model 3 and TCP/IP Offload and a low-cost FDDI adapter (that needs a class A computer room environment) or 3172 model 2 and ICP and a $26,000 FDDI board.

Channel Confusion When the 3172 was first announced, the parallel or bus-and-tag channel was the only channel interface and was included in the base unit price. In 1990, when the new ESCON channel was announced, the 3172 channel interface became an optional feature, which appeared to reduce the 3172 model 1 base unit price by about a third. This confused many users and obsoleted sales force configuration models. This confusion seemed unnecessary because the 3172 model 1 ESCON adapter was only available for channel-to-channel configurations. IBM hinted in 1990 at an enhanced ESCON adapter for the 3172 model 2, but this will now be available only as part of the AT&T Paradyne XL/5000.

Protocol Confusion Part I The 3172 began by supporting two non-SNA protocols but IBM has added, deleted, promised, and not discussed several others. At first, the 3172 supported TCP/IP and MAP. IBM added SNA support in 1990, though it costs extra. In addition, the 3172 model 1 can support DECnet traffic (if the user has Interlink's SNA/DECnet host software). Also in 1990, IBM said in a statement of direction that OSI/CS would be supported over 802.3, 802.4, 802.5, and FDDI. However, MAP support was withdrawn this June, and OSI/CS is only available, to date, on model 1 across 802.3. Further, the 3172 does not support two very popular LAN protocols: NetBIOS and Novell's IPX.

Protocol Confusion Part II Some users mistakenly believe that the 3172 provides multiple protocols. It actually only *enables* these protocols, if they're installed on the mainframe, to communicate across the 3172 to systems with those protocols on a LAN. In addition to the $30,000 for the box, users must spend around $50,000 for TCP/IP, and/or $100,000 for DECnet, and/or $200,000 for OSI/CS on the mainframe.

Protocol/LAN Combination Confusion Part I Many users mistakenly expect that any protocol supported by the 3172 can run over any LAN that can attach to the 3172. Unfortunately, it's not that simple, and we provide three examples: DECnet is only supported from Ethernet version 2 nodes, SNA is *not* supported from Ethernet version 2 nodes, and the PC Network adapter only supports TCP/IP.

Protocols/LAN Combination Confusion Part II IBM is pleased to say that most 3172 LAN adapters can support SNA or TCP/IP traffic. However, many users don't know that a given adapter in a 3172 can only be configured to support one protocol. This means, for example, that if both SNA and TCP/IP traffic will be sent from the same Ethernet LAN, the 3172 would need to have two Ethernet adapters attached to the same LAN. Although this is a source of confusion, we don't see this as a major inconvenience for Ethernet and token ring. However, the same constraint holds for FDDI and we believe this is a big problem. IBM says the 3172 model 2 with FDDI is intended for FDDI backbone support from multiple token ring and Ethernet LANs, but the $26,000 FDDI adapter can only support one protocol from all of these LANs to the host. ■

(continued from page 1)

IBM's TCP/IP

IBM has one of the richest sets of TCP/IP offerings, which is surprising to many. These products are provided across its diverse operating environments (see Table 5), ranging from native TCP/IP implementations in AIX and feature-rich offerings for its MVS, VM, and OS/2 environments to basic-function products for operating systems such as OS/400 and DOS. Users of these latter operating systems are less likely to purchase TCP/IP for these systems and, if they did, would probably not need as extensive set of TCP/IP features. It should be noted that several of IBM's TCP/IP products are packaged as modules, so not all of the features shown are provided in the base product and may need to be purchased separately.

AIX TCP/IP

As discussed in more detail in part I of this series, TCP/IP has for many years been bundled with Unix releases from Berkeley and has since become an increasingly pervasive element of any Unix offering. The TCP/IP planning and development for all AIX products are not done in IBM's Networking Systems but rather in Austin, Texas, which also manages the RS/6000.

IBM TCP/IP Networking Capabilities

Functions \ Platforms:	VM	MVS	OS/2	DOS	OS/400	AIX/370	AIX PS/2	AIX/6000
CONNECTIVITY								
Token ring	AV	AV	AV	AV	AV	AV	AV	AV
Ethernet	AV	AV	AV	AV	AV	AV	AV	AV
PC Network	AV	AV	AV	AV	—	—	—	—
X.25	AV	AV	AV	—	AV	AV	AV	AV
IEEE 802.3	AV	AV	AV	AV	AV	AV	AV	AV
FDDI	AV	AV	Future	—	—	Future	—	AV
SNAlink	AV	AV	Future	—	—	—	—	—
HYPERchannel	AV	AV	—	—	—	—	—	—
APPLICATION PROTOCOLS								
FTP C/S	AV	AV	AV	AV	AV	AV	AV	AV
TELNET Client	AV	AV	AV	AV	AV	AV	AV	AV
TELNET Server	AV	AV	AV	—	AV	AV	AV	AV
Kerberos C/S	AV	Future	AV	—	—	—	—	—
Name Server	AV	AV	—	—	—	—	—	AV
RPC	AV	AV	AV	AV	—	AV	AV	AV
NCS	AV	Future	AV	—	—	—	—	AV
LPR Client	AV	Future	AV	AV	—	—	—	AV
LP Daemon	AV	Future	AV	—	—	—	—	AV
Dynamic Routing	AV	AV	AV	AV	—	—	—	AV
SMTP Client	AV	AV	AV	AV	AV	AV	AV	AV
SMTP Server	AV	AV	AV	—	AV	AV	AV	AV
NFS Client	—	—	AV	AV	—	AV	AV	AV
NFS Server	AV	AV	AV	—	Future	AV	AV	AV
X-Windows Client	AV	AV	Future	—	Future	AV	AV	AV
X-Windows Server	—	—	AV	—	—	—	AV	AV
SNMP Monitor	AV	AV	AV	—	—	—	—	AV
SNMP Agent	AV	AV	AV	Future	Future	—	—	AV
REXEC Client	AV	AV	AV	AV	—	AV	AV	AV
REXEC Daemon	AV	—	AV	—	—	AV	AV	AV
APPLICATION TOOLKIT								
OSF/Motif	AV	AV	Future	—	Future	—	AV	AV

Note: Many third-party companies offer complementary products.

Table 5

In examining the three platforms for AIX, it is important to understand the different philosophies behind each of the implementations which are based on the strategic nature of the underlying hardware platform.

AIX/370

AIX/370, for example, is not a predominant operating system for IBM's mainframe environment. Similarly, AIX for the PS/2 is not the main operating system of choice for that platform either. In contrast, AIX is the dominant operating environment for the RS/6000.

Ironically, IBM provides a smaller set of TCP/IP applications for AIX/370 than for its other mainframe implementations under MVS and VM. For example, AIX/370 does not currently support SNMP, Kerberos, domain name server, or line printer requester/daemon (LPR/LPD).

Many users have installed Unix, from IBM or one of several other vendors, on the mainframe. But, in many cases, these users primarily wanted access from TCP/IP to mainframe resources rather than the ability to run Unix applications on the mainframe. This primary need dovetails nicely with IBM's preference for customers to use VM or MVS as mainframe operating systems and helps to focus its development effort on these. Providing sockets support, such as the new CICS-sockets interface, further serves these users.

AIX for PS/2

On PS/2 platforms, IBM's AIX offers about the same TCP/IP functionality as in AIX/370. However, since the PS/2 is a workstation, it also supports X Windows server and the OSF/Motif graphical user interface.

The reason for IBM not checking off all possible TCP/IP boxes for PS/2 AIX is probably because of the small market—AIX or Unix is rarely the operating system of choice for the PS/2 (more likely to be DOS, Windows, or OS/2), many customers who want Unix on their PS/2 usually buy it from other vendors, and users who want an IBM Unix workstation are more likely to invest in an RS/6000.

AIX 3 for RS/6000

Not surprisingly, the RS/6000 has the most feature-rich implementation of TCP/IP for AIX. TCP/IP is the premier networking environment for Unix workstations and the RS/6000 is IBM's mainline product for this market. IBM needs a strong implementation to compete against Sun Microsystems, Digital Equipment, HP/Apollo, and others.

TCP/IP for DOS

IBM's TCP/IP for DOS V2 provides a basic networking functionality to what was originally designed as a basic, standalone operating system. Although average DOS users today have more processing capability than they usually need, the limitations of the DOS operating system, such as the lack of true multitasking, can limit its TCP/IP support as well.

Take, for a start, X Windows, which IBM's current implementation of TCP/IP under DOS does not provide. IBM announced in January that it would provide X Windows server support through a third party, Hummingbird. *SNA Perspective* expects that

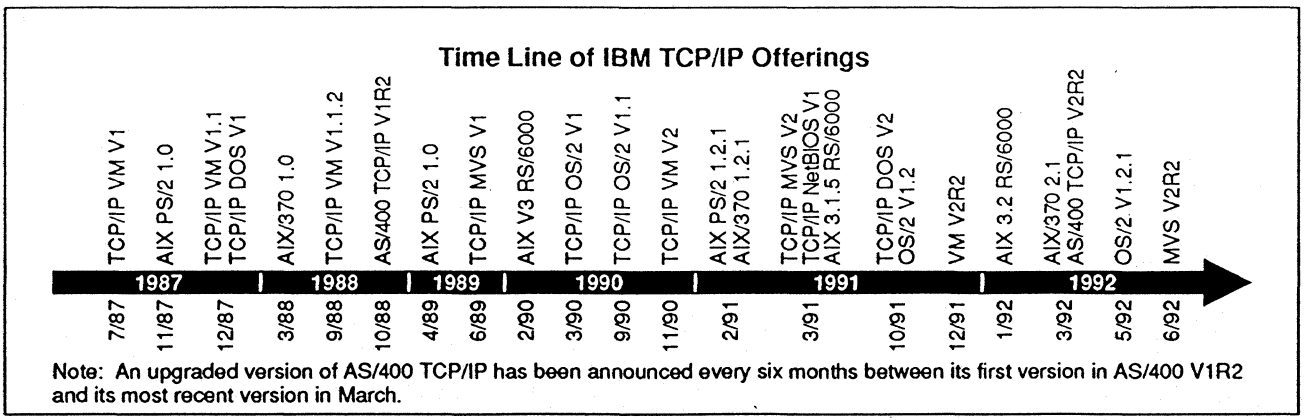

Figure 7

its performance may be weak. This, it should be stressed, would not be a fault with the implementation but with DOS itself.

Version 2 of TCP/IP for DOS included FTP client and server, which allows it to be part of a peer workstation network. However, TCP/IP for DOS can act as a client but not as a server for NFS. It would be a rare customer, though, who would want its DOS systems to be NFS servers.

IBM has stated that a future release will include an SNMP agent and is also indicating that a future release of TCP/IP for DOS will provide full Microsoft Windows compatibility.

TCP/IP for OS/2

IBM's TCP/IP for OS/2, currently at version 1.2.1, provides more TCP/IP functionality for the PS/2 than AIX PS/2 or TCP/IP for DOS. In fact, it provides almost as much as the VM and MVS implementations.

TCP/IP for OS/2 is actually several separate modules. In addition to the base kit, the user can buy the NFS kit, the X Windows Server kit, the programmer's tool kit (sockets), and a module for routing IP over X.25. *SNA Perspective* believes that IBM will probably repackage its mainframe TCP/IP packages into modules. This will lower the purchase price and memory and storage requirements for those who want basic functionality. The NFS component for TCP/IP for VM and MVS is already a separate cost optional component.

TCP/IP for the AS/400

IBM's implementation of TCP/IP for OS/400 is the least featured IBM TCP/IP offering so far. Of course, the AS/400 is primarily used either in a distributed environment off a centralized mainframe, which usually involves SNA, or as a small business system where there is little or no other computing or networking. Planning and development for TCP/IP for OS/400 is done in Rochester, Minnesota, with all other AS/400 and OS/400 work, and not through IBM Networking Systems.

The application functions provided for TCP/IP for OS/400 system are the basics: client and server for FTP, Telnet, and SMTP. This is not surprising since, traditionally, the AS/400 relies more heavily on support through third parties. IBM references several third party packages for additional AS/400 TCP/IP features. IBM has announced plans to implement SNMP agent, NFS server, and X Windows client functions for OS/400.

TCP/IP for VM and MVS

As discussed in parts I and II of this series, some form of access to the mainframe via TCP/IP has been available for some time. However, the popularity of a host-based TCP/IP has been a relatively recent phenomenon. Users have usually made do with products that allowed their terminals to appear like 3270 terminals or used specialized products that gave them access to a limited range of applications or functions.

The current release of TCP/IP for VM is Version 2 Release 2, announced by IBM in December 1991. This product provides a feature-rich implementation of TCP/IP and related features, including Kerberos, LPR/LPD, and domain name server. In June, IBM announced TCP/IP Version 2 Release 2 for MVS, bringing the capabilities of both systems to an equal level. In this release, IBM also included the capability for TCP/IP processing to be offloaded from an MVS mainframe to another device. Currently, the only device supporting this offload server is the 3172 (see the other article in this issue). However, *SNA Perspective* expects that the offload server will be ported to the RS/6000 and perhaps to other channel-attached platforms as well.

Users Choices for TCP/IP in an SNA World

SNA Perspective spoke to several users who have adopted TCP/IP for access to their IBM host systems.

We wanted to learn why TCP/IP was brought to their mainframe environment, the problems it had solved (or created), and the users' long-term view of the importance of TCP/IP in an otherwise SNA world.

Why TCP/IP?

In most cases, the decision to add TCP/IP was not because MIS wanted to open the resources of the mainframe to the TCP/IP users. Rather, it was a response to the needs of those users to access those resources. In most cases, TCP/IP had been installed on the mainframe for a year and a half to two years.

Data Download

In most cases, the largest single user demand is for data. The mainframe system is often the large single repository for data and users want to gain access.

The initial reason our respondents gave for bringing in TCP/IP was to give non-SNA users access to that data. How users gain access to mainframe data varies, but the most widely used approach is to use FTP or, less frequently, Telnet to download data from the mainframe to a local application.

Storage and Output

While some companies also want to better leverage mainframe resources such as storage and output devices, this is generally secondary to the need for data by the TCP/IP users.

Applications

Access to host applications was not as significant as access to data. But this seemed to be more a factor of lack of cooperative applications or application interfaces. Some companies we interviewed believed that, as cooperative processing allowed for better integration, access to host applications would become more important.

Backup

Although some companies expressed an interest in eventually making use of mainframe storage for backup over TCP/IP, few companies were actually doing this yet. Some companies felt that the relatively low cost of local disk or tape storage systems made backup a poor use of host resources. A common sentiment was expressed by one user who said, "Users need the mainframe's data. Using it as a big file server would be too expensive."

"Just Because"

Some companies had unusual reasons for bringing in TCP/IP. A large Eastern United States financial institution originally brought in TCP/IP "because it was there." The bank found the idea technically appealing and originally installed TCP/IP on a developmental system. Since then, the company has been adding many Unix-based workstations to its environment, so the appeal of using TCP/IP to access the host has grown substantially.

Not Dropping SNA

We did not find, in this survey, a stated corporate move away from SNA given as a reason for using TCP/IP. Instead, TCP/IP was seen as a good way to communicate with the non-IBM world, especially where there was a significant Unix user base.

However, several users said that TCP/IP was seen as an alternative means to access resources such as CICS applications, because TCP/IP was simpler to install and tune than VTAM. Some sites indicated that VTAM may eventually be relegated to a secondary role as TCP/IP takes hold and new applications or interfaces are developed. (In the course of other research, we have encountered cases of companies completely abandoning SNA.)

Electronic Mail

Integration of electronic mail was not stated as a significant reason, at first, to add TCP/IP, although some users saw it emerge as a side benefit. A large university in the United States said it was primarily using PROFS mail for mainframe users and had begun integration to allow its Unix users to communicate via the TCP/IP SMTP interface. A large Canadian utility saw "no need whatsoever for mail integration at present." The overall feeling was that while mail integration was not a significant reason to introduce TCP/IP, it did have some long-term significance as interfaces, such as SMTP-PROFS, were brought into the system.

Growing

Whatever the reasons for bringing TCP/IP into an environment, the protocol usage has generally expanded beyond the original vision of its implementers. "Users are coming up with new reasons [to use TCP/IP], more applications, and things we never thought of when we started," said one respondent.

Whose TCP/IP?

Users have also taken a number of approaches to bringing TCP/IP into mainframe SNA environments; in fact, we often found a combination of approaches in the same environment. *SNA Perspective* spoke to users of IBM's TCP/IP for MVS and VM, SNS/SNA Network Integration for MVS from Interlink of Fremont, California, and gateway solutions from companies such as Open Connect Systems (formerly Mitek) of Carrollton, Texas.

In most cases, few alternatives or competitive suppliers were considered in the purchase process. Most sites indicated that they had done little in the way of shopping around but rather found the first solution that addressed their initial needs and adopted it. A large university had begun many years ago with a developmental TCP/IP system from the University of Wisconsin (developed under a project funded by IBM and later refined and released by IBM as its TCP/IP for VM) and then moved to the commercial version.

In most cases, and especially in more recent installations, IBM's TCP/IP product was used, selected largely because of the IBM name. Users believed that IBM's offering would be better integrated with the host environment and would offer more long-term benefits. They also believe that IBM now has a firm commitment to making TCP/IP workable in their environments.

Pros

Nearly all users, regardless of whose product they adopted, said their original needs that led them to buy TCP/IP for mainframe access had been met by the solution they purchased. More importantly, most users also said there had been additional, unanticipated benefits, such as the ability to move more to client/server computing in a multivendor environment.

There was a lot of user excitement about the socket library from IBM. Users familiar with sockets felt this could be the basis for a great deal of application development, especially in environments with many Unix workstations. Sockets support was seen as one of the greatest and least-anticipated future benefits of TCP/IP software.

Cons

One financial institution expressed the need for more system security. It readily admitted that many of its concerns are not with any particular vendor's implementation but with limitations of TCP/IP itself. Because of security concerns, the company does not allow FTP for data transfer to the mainframe, only from it. To ensure security, the company has purchased source code to implement its own security encryption algorithm.

Another area of discontent was NFS. One user said the overall performance of IBM's NFS implementation was not good. This was a problem in the initial implementations of NFS from IBM and there was hope that subsequent implementations would abate this problem.

Users Optimistic

Despite these and some other problems with TCP/IP, most users felt that none of the problems were significant enough for them to consider their TCP/IP program disadvantageous. In fact, most users, regardless of which TCP/IP product they used, felt their significant issues would be addressed by future releases.

Directions

Most companies said they were seeking to expand their use of TCP/IP. One company stated that it had started using TCP/IP on a limited basis but now intended to install it on all mainframe systems. Its overriding concern was for data availability and interoperability throughout its network because TCP/IP allows it to accelerate the move to client/server computing.

In those few sites where TCP/IP was not expanding, the reason given was that there were no current plans to change the systems as a whole. However, if a system were to grow, TCP/IP would likely grow with it.

(continued on page 20)

Architect's Corner

Silver Lining in the SNA Internetworking Cloud

by Wayne Clark

Those of us who have been working for years in SNA software development are flabbergasted by all the current activity at the data link level. From an SNA perspective, the data link was quite simple—once written and debugged, the data link software and never needed to be touched.

The simplicity and stability of the data link layer caught the attention of internetworking vendors. Most vendors of multiprotocol routers have rushed to embrace SLDC and LLC2 in their "SNA" product offerings. The SNA is in quotes here since those conversant with the details of SNA architecture know that the link level is not actually specified in SNA. Therefore, accommodating SNA by transporting its most common link level protocols is like a postal carrier saying she understands everyone's mail just because she can deliver an envelope.

The result of these efforts by internetworking vendors is a potpourri of product offerings that perform SDLC tunneling, LLC2 tunneling, and SDLC-to-LLC2 conversion. Even IBM has joined the fray with data link switching (DLS) on its 6611 Network Processor. While most of these offerings satisfy a real market need, vendors don't make clear which connectivity options are really possible. Marketing literature makes it appear as if you can do an any-to-any mapping but this is definitely not the case. Even so, this is not a major problem, as we shall see.

Getting from Here to There

Figure 8 shows two mainframes with channel-attached 3745 communication controllers accessible through a multiprotocol network. The 3745 on the left is attached to a token ring while the one on the right is SDLC-accessible. On the remote side ("remote" from the perspective of the mainframe—host-centered mentality dies hard) are a token-ring-attached 3174 cluster controller and an SDLC-attached 3174 or 3274 cluster controller.

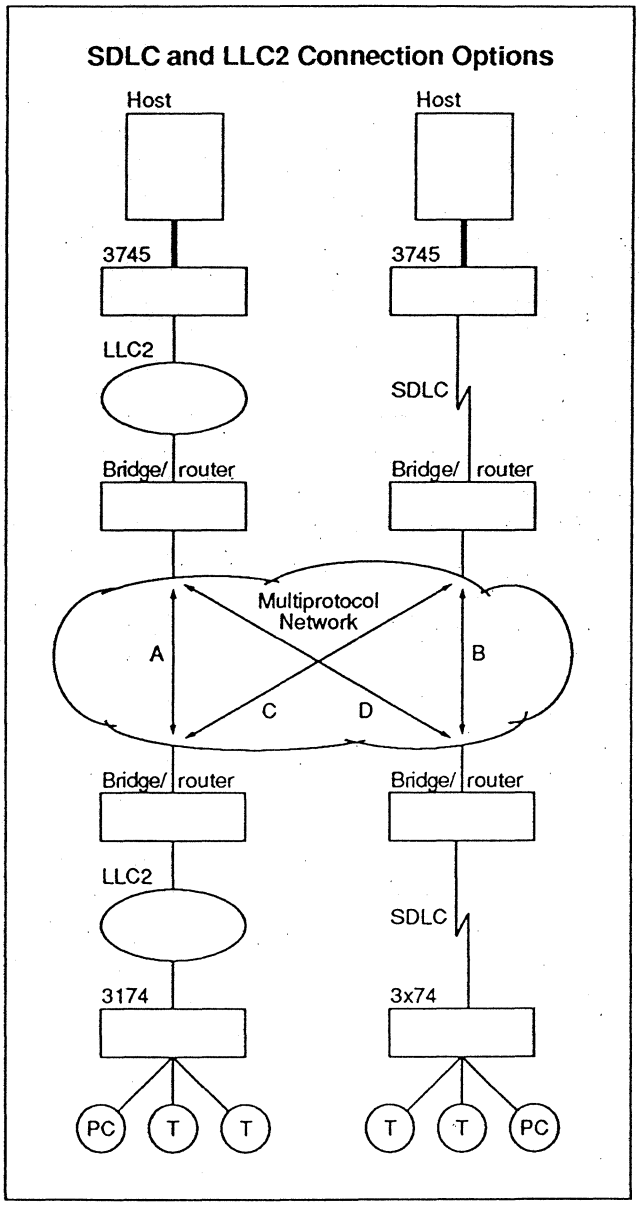

Figure 8

In the figure, lines A and B connect homogeneous data link types and are tunnels while C and D connect heterogeneous types and are therefore conversions. The tunnels in A and B can either be locally terminated or support passthrough.

In the figure, A is LLC2 tunneling which, in the case of token ring, is also sometimes called remote source route bridging. This option is provided by IBM, Cisco Systems, CrossComm, Proteon, and others. B is SDLC tunneling and is implemented in products from Cisco Systems, CrossComm, Proteon, and Wellfleet. Ironically, IBM does *not* offer SDLC-to-SDLC tunneling under data link switching for the 6611. More will be said about this later.

Continuing on the connectivity options in the figure, C is conversion from LLC2 on the host side to SDLC on the remote side. This capability is implemented in multiprotocol routers by IBM and Cisco Systems and in standalone products from Sync Research, Netlink, and Ring Access. D is the inverse of C—conversion of SDLC on the host side to LLC2 on the remote side. Interestingly, the only device which can do this today is the IBM 3745 communications controller—no multiprotocol router handles this configuration.

Weaning the 3745 from SDLC

This limited SDLC support in the 6611 appears to be a deliberate move on IBM's part to wean 3745s from SDLC attachments while encouraging integration of existing remote SDLC devices with its one-way SDLC-to-LLC2 conversion option. However, this is not such a bad idea. Those familiar with the SDLC protocol will readily agree that it was designed for the networks of yesterday. It was meant to serve primarily as a point-to-point protocol over an unreliable medium with deterministic delays. From this perspective, SDLC does not internetwork well at all.

Whether the lack of SDLC-to-SDLC support in the 6611 will affect the success of IBM's router remains to be seen. The lack of a totally symmetrical SDLC-to-LLC2 conversion offering, however, will probably not hurt IBM. Most token rings in SNA environments, if only installed at one end, are at the host end which is the neck of the funnel and therefore requires the highest bandwidth medium. Choosing the conversion of host-side LLC2 to remote-side SDLC allows IBM to target a market six times larger than for local SDLC to remote LLC2. IBM's backing of this asymmetrical SDLC conversion reinforces the belief that SDLC-to-LLC2 conversion is a transition strategy meant to accommodate older SNA devices that have only SDLC as their data link protocol.

The lack of universal connectivity in these products actually serves a useful purpose. Since you can't connect to just any medium from any other medium using these facilities, network managers will have to carefully examine their networks and plan their upgrades according to what connectivity is needed and what options are available. Hopefully, this scrutiny will lead to better overall network design. ■

Our guest architect, Wayne Clark, is a frequent contributor to SNA Perspective. *His most recent article, on SDLC tunneling, was in the October 1991 issue and his first Architect's Corner column ran in February 1990. Formerly with CSI, the publisher of* SNA Perspective, *Wayne will give his third annual SNA interoperability tutorial at Interop this fall.*

(continued from page 17)

Conclusions

TCP/IP has arrived at the mainframe, at the department, and on the desktop. It will not go away and, in fact, is growing very quickly. *SNA Perspective* believes that half of all IBM mainframe sites in the United States are discussing TCP/IP access and that, by the end of 1993, twenty to twenty-five percent of all mainframes in the U.S. will be accessible from TCP/IP. This figure will be somewhat smaller outside the United States, but interest and installations are also growing much more rapidly than was expected even a year ago.

We do not believe that TCP/IP will replace SNA. Instead, the two environments will increasingly coexist and new applications will draw on the strengths of each.

IBM has moved from a position of "accepting" TCP/IP to making the protocol a major component of its overall communications offering. TCP/IP is now available, in some form, for just about every IBM operating environment. More important, IBM is providing additional functionality for TCP/IP, such as its CICS-sockets interface, to allow TCP/IP users greater access to applications and resources.

What users want, primarily, from TCP/IP on the mainframe is a means to access the data on the mainframe, as well as access to applications and resources that reside there. TCP/IP can also enable communication and access throughout the enterprise, from client/server computing using sockets to mail services carried via SMTP.

SNA users should carefully consider the direction in which their environments will be growing. The demand for TCP/IP has come from users outside the SNA world, but the problems of integrating TCP/IP into SNA environments must be solved by SNA professionals. Proactive solutions require consideration not only of what is in place today but where TCP/IP makes sense in the future. ■

In the July issue of *SNA Perspective*, there was an inconsistency between the text and Figure 8 in the "Architect's Corner" on page 18. Did you catch it? (The answer is below.)

Attached is a correct version of the drawing, ready to paste over the original. Peal off the backing on the replacement and affix atop the existing figure.

Also, while it is not exactly a mistake, to avoid confusion we would like to clarify a component named in Figure 2 and in the associated text on Page 3. The component, Communication Manager, is correct for OS/2 EE versions 1.3 and below. It is not correct for OS/2 version 2.0, since the components are bundled differently. The component required with OS/2 version 2.0 is the OS/2 LAN Requester that is part of the OS/2 LAN Server version 2.0 product.

The lines labeled C and D in the "Multiprotocol Network" cloud were switched. The line labeled C should be between the upper left and lower right of the cloud, while the line labeled D should be between the lower left and upper right of the cloud.

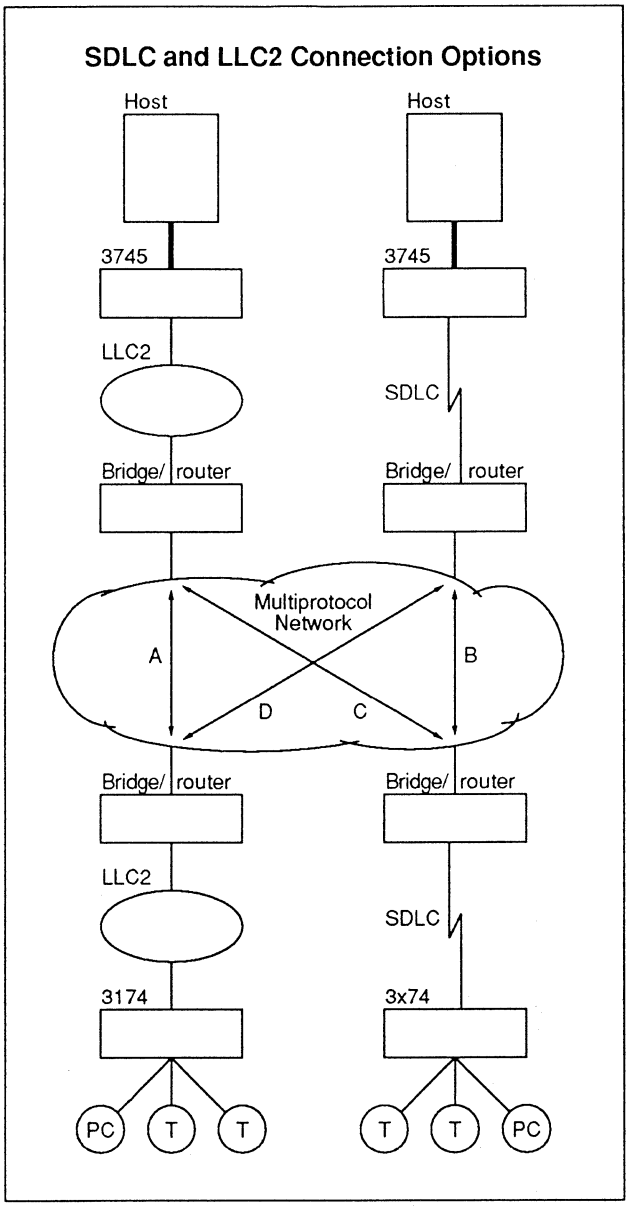
SDLC and LLC2 Connection Options
Host
Host
3745
3745
LLC2
SDLC
Bridge/ router
Bridge/ router
Multiprotocol Network
A
B
D
C
Bridge/ router
Bridge/ router
LLC2
SDLC
3174
3x74
PC
T
T
T
T
PC

Figure 8