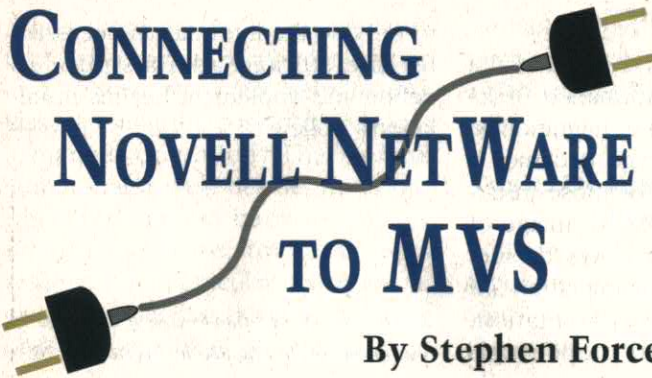


CONNECTING NOVELL NETWARE TO MVS



By Stephen Force

Local Area Networks (LANs) are not new to most enterprises. Terminal emulation from a LAN-based client is also not new. What is new is the certainty that distributed workstations and personal computers (PCs) will become far more strategic than ever before.

It is time for MVS-based enterprises to realize that a LAN is not a fad or of limited use. LANs are a viable, cost-effective, powerful alternative to the classical master-slave situation that makes up SNA (prior to APPN).

Several of us mainframe-types have been involved with PCs from the start and have seen how they have evolved from 4KB "monitors" up through 32-bit, multitasking, multiprocessing operating systems (i.e., OS/2 Version 2.1, Windows NT and UNIX). These systems have the potential to surpass MVS because MVS is only a 31-bit operating system (addressable memory).

Systems programmers have seen LANs develop from a simple printer and file-sharing medium to powerful client/server, multi-protocol supported networks.

The prudent systems programmer understands that things change and have always changed, and therefore realizes the inevitability of the LAN-client/server evolution and changes accordingly.

Probably the largest, most well-established installed LAN is Novell NetWare. Gartner Group, a market research firm in Stamford, Conn., estimates the worldwide installed base of networks based on the number of "nodes," or client computers connected. They estimate the installed base of Novell products represents 67 percent of the world market. The most current release of Novell NetWare is 4.0.

This article will show how an enterprise can connect NetWare LANs to MVS and will examine what applications are available once connected.

Why Connect a Novell Network to MVS?

There are several excellent reasons for an enterprise to connect their NetWare LANs to MVS. Some major reasons include:

- *By using NetWare as the SNA gateway, a client needs just one communications card vs. several for specific functions (i.e., IBM 3270 terminal emulation to MVS, LAN connection, etc.).*

As LANs became more widely used and PCs became

more versatile, it became inevitable that these PCs would need connectivity to either the LAN, the mainframe, another network topology or all of these. One solution was to have a communications card for each function. But each one of these cards is expensive, requires deep MS-DOS knowledge to "trick" in, and the supporting software took most of the available RAM and sometimes caused the PC to lock up.

Selecting a communications card that supported either Token-Ring or Ethernet and then standardizing on one, made the job of network implementation, administration and operations much easier.

Most cards and corresponding drivers support several network topologies simultaneously, thus reducing the need to have several cards installed. This allows users to use their PC LAN, terminal emulation, TCP/IP and other topologies simply by installing one card. However, this is a PC user's nightmare—using most available RAM and interrupts. It makes more sense to standardize on a network LAN and then install a SNA gateway on the LAN server to handle MVS access.

NetWare LAN users can use a NetWare server as the SNA gateway. Then, a LAN user needs just one communications card rather than several by using the client/server functionality built into NetWare.

- *NetWare supports all popular network topologies, including:*
 - Ethernet;
 - Arcnet;
 - Token-Ring; and
 - FDDI.
- *NetWare inherently supports most popular protocols simultaneously. These include:*
 - Internetwork Packet eXchange Protocol (IPX) – Novell's protocol that allows the exchange of message packets on an internetwork.
 - Sequenced Packet eXchange Protocol (SPX) – Novell's connection-oriented packet delivery protocol that enhances the IPX protocol by providing reliable delivery. The NetWare SNA Gateway is an SPX implementation.
 - TCP/IP
 - SNA
 - Open Systems Interconnection (OSI) reference model
 - Digital Network Architecture (DNA) and
 - AppleTalk
- *Tunneling NetWare IPX/SPX through Internet Protocol (IP) Internet allows a NetWare LAN to ship encapsulated IPX/SPX packets over a TCP/IP network to another NetWare LAN on the internet. For enterprises that have invested heavily in TCP/IP, this prevents them from having to implement parallel technologies to implement NetWare.*
- *Connecting a Novell network to MVS provides the ability to store LAN data on MVS for wider availability and more reliability.*

There is no better data repository than MVS. LAN data must be stored in such a way that the data is safe, but yet quickly retrievable. This subject will be discussed in more detail.

- *Connecting a Novell network to MVS provides the ability to store data on MVS.*

There are several products available that enable MVS to function as a data server. The article, "Let MVS Be the Data Server," (*Technical Support*, April 1993) addressed this topic in more depth.

Here are two of several possibilities:

- IBM's LAN Resource Extension and Services/MVS (LANRES/MVS) Release 2.0 (IBM product 5695-123) establishes a server environment on the MVS to allow NetWare clients transparent access to mainframe resources (such as DASD and printers). A key feature of LANRES/MVS is the transparent manner in which it provides functions to end users who are accustomed to receiving services

from NetWare LAN servers. End users on a variety of programmable workstation platforms interact with NetWare in their usual manner and are virtually unaffected by the LANRES/MVS software running on the NetWare server and MVS. For more information on LANRES/MVS, refer to the article "Let MVS Be the Data Server" (*Technical Support*, April 1993).

- APTNet, from Automated Programming Technologies, Inc. (Bingham Farms, Mich.), provides, along with other powerful inherent features, an enterprise "virtual disk" capability. A LAN user must simply map to MVS using a user-specified standard drive. Running as a MVS VTAM application, APTNet stores original format data in a BDAM file format.

- *Connecting a Novell network to MVS allows LAN-based applications more access to MVS resources, such as data base connectivity, E-Mail, document*

exchange and MVS JES controlled printers.

Data Base Connectivity:

- SQL Gateway for NetWare Systems (APPC edition) from Gupta (Menlo Park, Calif.) enables NetWare-networked PC applications access to MVS DB2 data bases. Using the NetWare for SAA NLM (NetWare Loadable Module) and IBM's APPC/LU6.2 protocol, the Gupta NLM running on the NetWare server communicates directly to the MVS-based partner software application, SQLhost. The DB2 calls are then by SQLhost, which passes the results back to the SQL Gateway. The SQL Gateway routes these results to the requesting LAN client.

- Enterprise Data Access/SQL (EDA/SQL) from Information Builders, Inc. (New York) is a combination of client/server products that enables an enterprise LAN access to virtually any relational or non-relational data structure. The

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MVS-based EDA server obtains the desired MVS data; EDA/SQL handles the rest.

- Select* from Computer Corporation of America (CCA), Cambridge, Mass.) uses client/server technology so Microsoft Windows applications (such as Excel or WordPerfect) can obtain data from the MVS-based CCA Horizon Model 204 data base system. An enterprise can either use the Windows Dynamic Data Exchange (DDE) or, if desired, a "C" Applications Programming Interface (API) to interface.

- SQL Server from Microsoft provides Sybase data base server functions for PC networks. Although not specifically developed for NetWare, the Microsoft SQL Server operates effectively over a Novell LAN. This server provides PC LAN users the power of Sybase, SQL, CASE tools and multi-vendor integration such as Rdb, Oracle, Ingres, Informix, DB2 and CICS.

E-Mail and Document Exchange Connectivity:

- Novell NetWare's Messaging CONNECT provides a connection between MVS electronic mail and messaging systems and NetWare Message Handling Service (MHS). CONNECT consists of two components: CONNECT/LAN for DOS-based, MHS-compatible NetWare applications and CONNECT/MVS, an MVS application. MVS-based compatible applications include: Office-Vision/MVS, Personal Services/CICS, DISOSS and PROFS.

For users who desire MVS batch program reports routed to a LAN destination, CONNECT/MVS provides a JES subsystem interface to extract these reports from the JES spool and then routes it to the proper MHS user.

- SNA Distribution Services (SNADS) for NetWare Global MHS from Novell enables products that implement SNA Distribution Services (such as DISOSS) connectivity with

the NetWare Global MHS running on the LAN. This product extends IBM office document and messaging functions seamlessly to the NetWare LAN users.

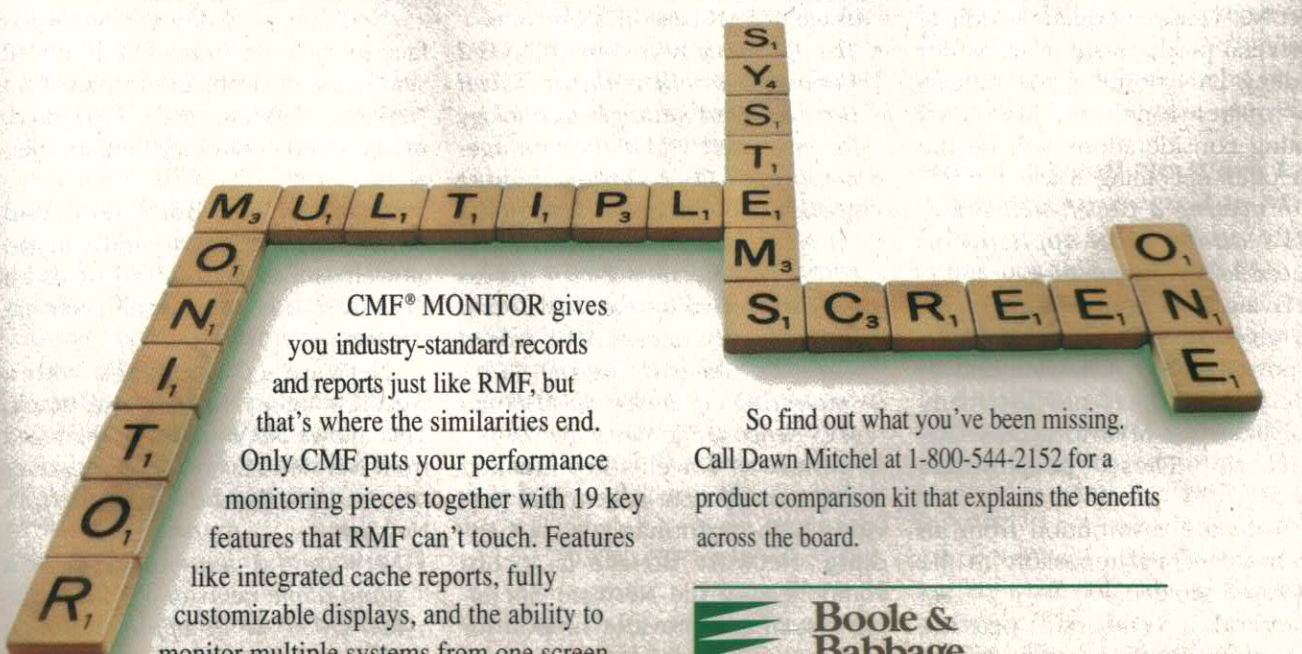
SNA Distribution Services (SNADS) for NetWare Global MHS requires both NetWare for SAA and NetWare Global MHS (along with NetWare) to run.

Print Routing:

- Mainframe batch jobs can generate large volumes of printed output. If the LAN is expected to handle the printing chores, then an enterprise must take into consideration what impact (if any) the increased data traffic might have on the LAN.

- There are several possibilities to route print output from MVS to a NetWare LAN. Novell provides at least two options: IBM 3278 printer emulation in either a server or individual LAN workstations, or through the use of the HostPrint NLM. HostPrint provides IBM 3287-like

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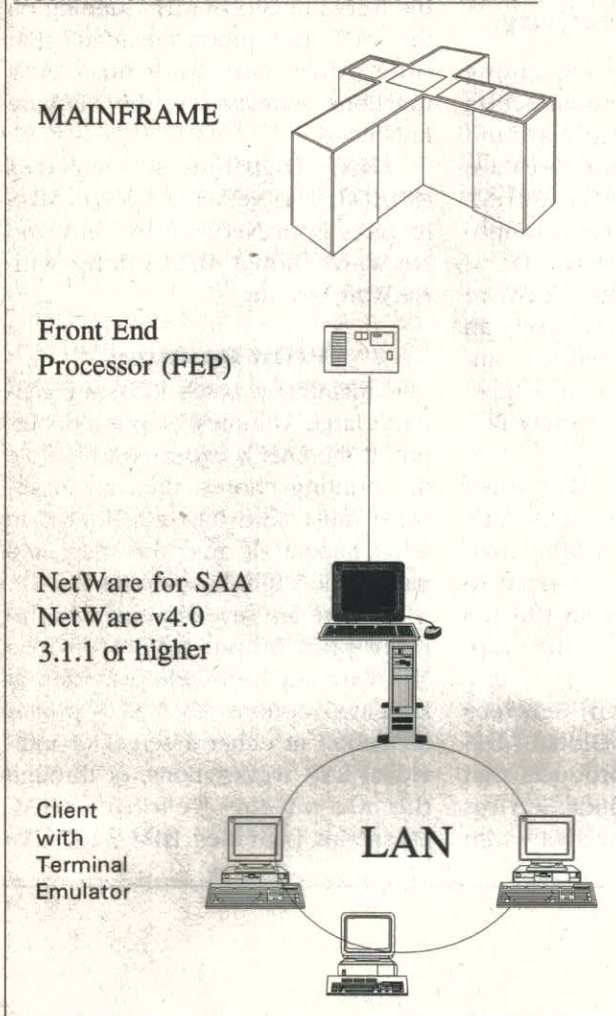
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FIGURE 1: A SIMPLE NETWORK LAN TO MVS CONNECTION



printer emulation sessions on a NetWare for SAA server, providing a direct NetWare print queue interface.

Several products are available for handling LAN printing, too numerous to mention here. MVS/LAN printing considerations will be the topic of an upcoming article.

- *Connecting a Novell network to MVS allows MVS applications access to LAN resources.*

Having MVS as a member of the LAN gives all LAN users access to the power of MVS. NetWare and its associated products provide many possibilities for MVS to access LAN resources. These possibilities include:

- Software distribution from an MVS-based central repository to the LAN-based servers.

Several vendors provide NetWare-compatible products that

on a LAN;

- usage of LAN printers; and
- usage of LAN-based FAX servers.

- *The upcoming release of CICS OS/2 Version 2.0 will contain Novell Btrieve record manager technology for emulated VSAM file management. CICS OS/2 Version 2 server applications can access data stored on Novell LANS using NetWare. CICS OS/2 Version 2 can access data anywhere on the LAN. It can also directly access MVS-stored data by several means (i.e., "mounting" a device on MVS via MVS Network File Server [NFS]).*

Btrieve is Novell's key-indexed record management system that provides high-performance data handling. NetWare Btrieve is a core component of the NetWare operating system and provides support for applications to obtain, use and

provide centralized software distribution from MVS to, depending on the product, strictly MS-DOS and/or to the other major platforms.

These products range from basic distribution functions to full-blown, sophisticated, multi-featured systems. Some offerings include:

- APTNet from Automated Programming Technologies, Inc. (Bingham Farms, Mich.);
- Network Navigator from Novell; and
- AM:PM from Tangram Systems, Corp. (Raleigh, N.C.) [This product is marketed by Systems Center, Inc., Reston, Va.]

Product characteristics include:

- access data stored

manipulate data. CICS OS/2 Version 2.0 will reportedly use this technology in its upcoming release.

- *Connecting a Novell network to MVS provides Advanced Program-to-Program Communications (APPC).*

NetWare, when used in conjunction with NetWare for SAA Version 1.3, provides full APPC (LU 6.2) support to servers and clients. Enterprises opting for, or that have already implemented APPC techniques, can easily continue even though the network is Novell rather than IBM SNA.

- *Connecting a Novell network to MVS provides Advanced Peer-to-Peer Networking (APPN) functionality.*

Novell and its third-party vendors are keenly aware of IBM's SNA successor, APPN, and have reacted accordingly. Enterprises desiring APPN functionality in a Novell NetWare environment can opt for the 3172-BT1 application gateway, which provides the LU 6.2 support necessary for APPN implementation. (LU 6.2 is a fundamental component in the APPN architecture.)

- *IBM's MVS-based NewView can monitor and control both TCP/IP and NetWare LANs via a NetWare agent.*

NetWare provides a clean interface to route LAN and TCP/IP SNMP statistics and problems to and from NetView. NetView can, if so desired, monitor and control all NetWare networks.

NetView can both send and receive commands to handle alerts, as well as load and unload NLMs on the server to handle certain event situations.

NetWare 4.0 is shipped with a NetView agent and an SNA stack. This allows NetWare to be managed from NetView. Every NetWare server on the LAN can be managed from NetView.

- *NetWare 4.0 can run either as a stand-alone network operating system (NOS) or as applications on OS/2 and UNIX, with NetWare for*

UNIX ported to non-UNIX platforms such as VMS, MPE, Unisys A-series and Windows/NT.

This is important for enterprises that have opted for UNIX or OS/2. These operating system platforms offer one advantage over NetWare NOSs; several NetWare servers can run on the same computer.

- *Connecting a Novell network to MVS provides terminal emulation capabilities.*

Terminal emulation is probably the main reason for connecting the LAN to MVS. There are several products available, all offering slightly differing features:

For the Apple Macintosh:

- MacMainFrame for NetWare for SAA from Digital Communications Associates, Inc. (IDCA) Alpharetta, Ga.) provides Apple Macintosh terminal emulation, SNA printer, as well as IND\$FILE file transfer support to MVS.
- IRMA WorkStation for Macintosh from Digital Communications Associates, Inc. (Alpharetta, Ga.) provides typical emulation functions as well as DISOSS and vector graphics support.
- NetWare 3270 LAN Workstation for Macintosh Version 1.1 from Novell, Inc. (Sunnyvale, Calif.) provides comprehensive access to IBM mainframes.

For UNIX systems:

- EXPRESS 3270 for NetWare from Systems Strategies, Inc. (New York) provides IBM 3270 terminal emulation, IBM 3287 printer emulation and IND\$FILE file transfer support for most UNIX systems.
- 3270LINKix for NetWare from CLEO Communications (Ann Arbor, Mich.) (similar to above).

For OS/2 systems:

- RUMBA for the Mainframe (OS/2 version) from Wall Data Inc. (Redmond, Wash.) provides typical emulation functions for the IBM OS/2 platform.
- OS/2 3270 Emulation products from IBM Corp.

Microsoft Windows 3270 emulation products include:

- LAN Workstation for Windows Version 1.1. products from Novell, Inc.
- RUMBA for NetWare Systems from Wall Data Inc.
- DynaComm/Elite Version 3.3. from Network Software Associates, Inc. (Laguna Hills, Calif.).
- SDX SAA from Dr. Materna GmbH (Dortmund, Germany).

For MS-DOS systems:

- 3270 ElitePlus from Network Software Associates, Inc. (Laguna Hills, Calif.).
- LAN Workstation for DOS Version 3.0. from Novell, Inc. NetWare 3270.
- *Novell's optional LAN WorkPlace product provides TCP/IP functionality.*

Users desiring TCP/IP services need to install an additional Novell product that will provide NetWare client support for TELNET, FTP and remote printing. This product is Novell's LAN WorkPlace and is available for all supported operating systems.

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Users opting for Network File Server (NFS) support must obtain and install Novell's NetWare NFS product, which will allow NFS clients transparent NFS server access. NetWare NFS also provides support for the LPd (UNIX line printer daemon), allowing UNIX TCP/IP clients to directly place print jobs on the normal NetWare 4.0 print queues.

How a Novell NetWare LAN Can Be Connected to MVS

We now know some of the things possible once the LAN and MVS are connected. Now, let's look at how a Novell NetWare LAN is logically connected to MVS.

SERVER: Netware 4.0 and NetWare for SAA 1.3. Two Novell server software components are required to connect a NetWare LAN to MVS. These are either NetWare 4.0 or NetWare 4.0 runtime (depending on what other things the server computer is slated to do) and NetWare for SAA Version 1.3. The

NetWare component provides the LAN connectivity; the NetWare for SAA Version 1.3 provides the connectivity for MVS.

CLIENT: Two components are necessary to connect the client to the NetWare server: NetWare client support software (shipped standard in NetWare for DOS, OS/2 and Windows, as a feature for Macintosh and UNIX), which provides the network driver layer necessary to link a client to a LAN and terminal emulation software.

There are several products available to provide the IBM 3270 terminal emulation necessary to access MVS via NetWare. These products were previously mentioned under the "terminal emulation" sub-heading.

NetWare LANs can be connected to MVS in three different ways: channel-attached, SNA SDLC or X.25 packet switching.

- Channel-attached:

- Bus-Tech, Inc. IBM 3172-BT1, which is based on a standard IBM 3172 Model 3 Interconnect Controller. This product, developed by Bus-Tech, Inc. (Burlington, Mass.), is directly installed and maintained by IBM.

The IBM 3172-BT1 is a micro-channel-based PC running NetWare for SAA along with a Bus-Tech supplied NetWare Loadable Module (NLM). This controller is capable of data transfer rates up to 4.5MB/second and can contain up to four LAN cards and two channel adapter cards. By having two channel adapter cards, this machine can be either connected to two separate hosts for flexibility or to two different channels on a single host for reliability.

Also provided is inherent LU 6.2 capability. Because of this, full APPC and APPN-based applications are possible.

- Ethernet LAN Controller (ELC) for NetWare, a high performance block-multiplexor channel connection from an Ethernet LAN. Manufactured by Bus-Tech, Inc., it

provides the capability of attaching a Novell Server running NetWare for SAA directly to the mainframe channel via Ethernet. ELC for NetWare appears to the mainframe as up to 16 locally-attached IBM 3174s, with a data transfer reported to be 4.5MB/second (channel speed). It is done by pairing each subchannel to a NetWare for SAA NLM image. This means that ELC for NetWare can support up to 16 different NetWare for SAA servers.

- Memorex Telex 9430 Enterprise Gateway, an Intel x86-based, micro-channel architected computer offering either SDLC link or direct MVS block-multiplexor channel connection, allowing an enterprise to directly connect a NetWare LAN to MVS. Running as a NetWare for SAA server, this product supports (selectively) from 16 to 254 host sessions with a data transfer rate of up to 4.5MB/second.

- SNA:

- SDLC to a Front-End Processor (FEP):

NetWare for SAA Synchronous Adapter from Microdyne Corp. (Alexandria, Va.) is a user-installable SDLC communications adapter for NetWare for SAA. At line speeds of up to 64KB/second, this adapter allows NetWare for SAA to appear to MVS as an IBM 3174 remote (SDLC) cluster controller. Up to two adapters can be installed per server, providing either single system redundancy or two-host connectivity.

Memorex Telex 9430 Enterprise Gateway (previously described).

- X.25:

- XCI X.25 Communications Interface from The Newport Systems Solutions, Inc. (Newport Beach, Calif.) is an interface card providing Netware for SAA X.25 packet switching network support for terminal emulation. For MVS enterprises that currently use X.25 packet switching, this is one way to provide remote LANs terminal emulation access.

Figure 1 is an example of a simple NetWare LAN to MVS connection.

Advanced Uses of a NetWare to MVS Link

Most advanced usages of a NetWare LAN involve internetworking or using another network as the LAN backbone. The following are examples of using the SNA network as a wide area network (WAN) backbone:

- NetWare SNA Links Version 1.0 from Novell is a NetWare Loadable Module (NLM) that works with NetWare for SAA to route IPX/SPX protocols over an existing SNA network. This software combination allows an enterprise to use the existing SNA network as the LAN backbone without adding software to the host.

- APTNet from Automated Programming Technologies, Inc. (Bingham Farms, Mich.) provides a LAN-to-LAN WAN solution over an existing SNA network. This product converts the IPX protocol into SNA and then ships the packet to the target LAN workstation. This reportedly is more efficient than Novell's IPX routing technology. A software component needs to run on MVS, but the product has other inherent features other than strictly routing (i.e., remote printing, file distribution/collection, mainframe "virtual disks" and taking control of a remote workstation).

- XAM/HUB from Syzgy Communications Inc. (Scotts Valley, Calif.) is an MVS or VM application, works with NetWare for SAA and NetWare SNA Links to route IPX/SPX data over SNA networks between NetWare LANs. The mainframe appears to the rest of the SNA Links internet as a NetWare server.

APPC

Since NetWare for SAA Version 1.3 supports LU6.2, APPC support is inherent in the product. Users desiring peer-to-peer connectivity can either use existing products or write their own applications.

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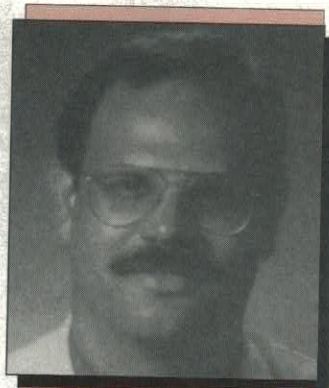
Writing TCP/IP sockets and/or RPCs should be relatively straightforward since the TCP/IP protocol is supported by NetWare.

Conclusion

There is a bewildering array of LAN possibilities available to an enterprise. Some LAN implementations handle a few functions particularly well but fail in other ways. As with operating systems, there is no one right way to do LAN-to-MVS connectivity.

We must provide our "clients"—our user community—with as many choices as possible. One good way to start is to pick a LAN network that is powerful enough to support all current and future needs, able to grow with the networking needs, yet able to support existing popular network implementations.

Because Novell's NetWare product line can do all of these remarkably well, it should be on every enterprise's LAN network selection "short list."



Stephen Force is a contributing editor to Information Technologies magazine and an independent consultant.

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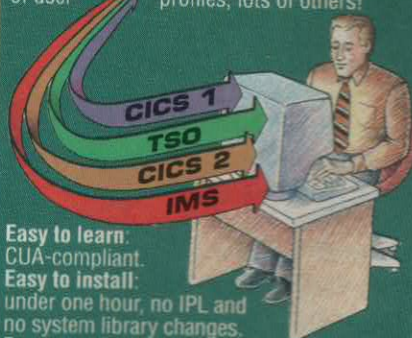
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