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SNA Perspective

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SNA in Perspective: 1992

SNA was much in the news in 1992, with router vendors supporting SNA, LAN gateway vendors supporting APPC, and significant controversy over APPN. The major SNA networking themes in 1992 were:

- APPN
- LAN/WAN integration
- Multiprotocol participation
- Network management

APPN is finally on all IBM platforms. The company invited other vendors to participate. The feedback was a requirement for more openness, and IBM has been responding. On the LAN/WAN front, we found SNA on routers, Ethernet, and frame relay as well as enhanced LAN-mainframe support on all of IBM's controllers. In the multiprotocol arena, we find TCP/IP also on all IBM platforms and extensive TCP/IP and SNA interaction. IBM's networking blueprint is a vision for interoperability between applications, APIs, transports, and subnetworks of differing environments--a far cry from the monolithic seven-layer protocol towers of yesterday. SNMP network management made large strides with the AIX NetView/6000 and LANfocus Management/2, but NetView made little progress in subarea SNA or APPN support.

(continued on page 2)

SNA Directions: 1993 and Beyond

In this article, we discuss *SNA Perspective*'s projection of SNA network evolution during 1993 *and beyond*. Note the emphasis on beyond. Some of the networking directions we see IBM taking are clear now; others will evolve as 1993 unfolds and will probably take clearer shape in 1994.

We see several areas in which IBM will take significant steps in 1993 and beyond. Four of them carry forward our major themes of 1992. The last theme is an increasing trend toward alliances with other corporations and the industry in general. We touch on three: Novell, the CPI-C Implementor's Workshop, and APPI.

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Perhaps the most important word in the SNA vocabulary in 1992 was, ironically, TCP/IP. TCP/IP is showing up in a number of ways in "SNA" networks: TCP/IP is increasingly coresident on mainframes with VTAM. TCP/IP sockets applications will be running over APPC/APPN and CPI-C applications will be running over TCP/IP. SNA can be tunnelled in several ways through TCP/IP networks, and TCP/IP can also be carried across SNA backbones. TCP/IP is discussed below under TCP/IP Pervasiveness.

The second most important word for SNA was APPN. We rate it second only because it involved mostly announcements and statements of direction rather than shipped products. But these were significant announcements and IBM made several moves to open APPN, as discussed below.

The third word was multiprotocol integration, listed third for editorial reasons—it connects the first two words and many more. The monolithic seven-layer networking towers seemed to split into three mix-and-match sets: a few standard APIs and session protocols, a few standard transport/network sets, a few standard LANs and WANs. The most thorough example of this trend was the networking blueprint, IBM's strongest and clearest statement to date of its commitment to multivendor environments (and, some would say, commitment to reality). These issues, and multiprotocol implementations on IBM products and other vendor's routers, are discussed below under Multiprotocol Participation and under LAN/WAN Integration.

Network management is number one on many SNA users' list of concerns. Most of the action in 1992 was, again, in announcements and statements of direction rather than shipped products—but they were wide-ranging. IBM network management products included new release of NetView, a fully featured Simple Network Management Protocol (SNMP) manager on the RS/6000—AIX NetView/6000, a distributed version partner for it—Systems Monitor/6000, an OS/2-based LAN network management family—LANfocus Management/2, and enhanced LAN Network Manager.

APPN

During 1992, Advanced Peer-to-Peer Networking (APPN) topped the news in SNA. There were two major trends: platform pervasiveness and openness. APPN network node and/or end node was finally announced for every major IBM platform. IBM also made several dramatic moves toward opening APPN to increase its acceptance in the multivendor networking community. Many statements of direction were made for APPN network management support, but little was officially announced in products. APPN has been positioned squarely as IBM's pivotal networking integration architecture through the 1990s and beyond.

Platform Pervasiveness

The addition of full APPN nodes to VTAM has finally completed IBM's strategic transition to support peer-to-peer networking across all IBM's SAA and AIX platforms, ten years after it was first discussed and six years after it was first announced for the System/36. IBM announced in March that it would add APPN network node and end node to the mainframe. APPN will be part of VTAM 4.1, which will ship in the first half of 1993.

Also announced in March 1992 was APPN support for:

- 6611 multiprotocol router—statement of direction for network node
- RS/6000—statement of direction for end node and network node in AIX SNA Services/6000
- DOS and Windows—Networking Services/DOS as LEN node only, with APPC as well

APPN is already on many of IBM's other platforms: AS/400, OS/2 Communications Manager, 3174, and DPPX/370 (see Figure 1 on page 3).

VTAM 4.1. ACF/VTAM Version 4 was shipped for testing to selected customers by the end of 1992. General availability is expected about the middle of 1993.

VTAM APPN support includes APPN end node and network node on VTAM Version 4 for MVS and a

statement of direction for VM. With its NCPs, a VTAM can be configured as a composite network node. A composite network node provides to the APPN network the appearance that a given VTAM and all its associated NCPs (at release 6.2) are one node. A VTAM APPN network node need not own NCPs, however; it is a configuration option. A VTAM APPN end node never includes NCPs, although it can attach to NCPs owned by another VTAM network node. An NCP can only be part of composite network node, never an APPN node by itself.

Viable dependent LU support over APPN is provided in VTAM 4.1, which will support LUs in nodes logically adjacent to their boundary function nodes. A future release will implement the dependent LU requester/server model and support dependent LUs arbitrarily connected to an APPN network, as discussed in the SNA Directions article in this issue.

Openness

IBM originally envisioned APPN as its own protocol for IBM systems, with OSI and TCP/IP to serve for interconnection between systems from IBM and other vendors. IBM felt this position would be successful since it will be easier to migrate from subarea SNA to APPN rather than to TCP/IP and APPN offers several technical advantages over TCP/IP.

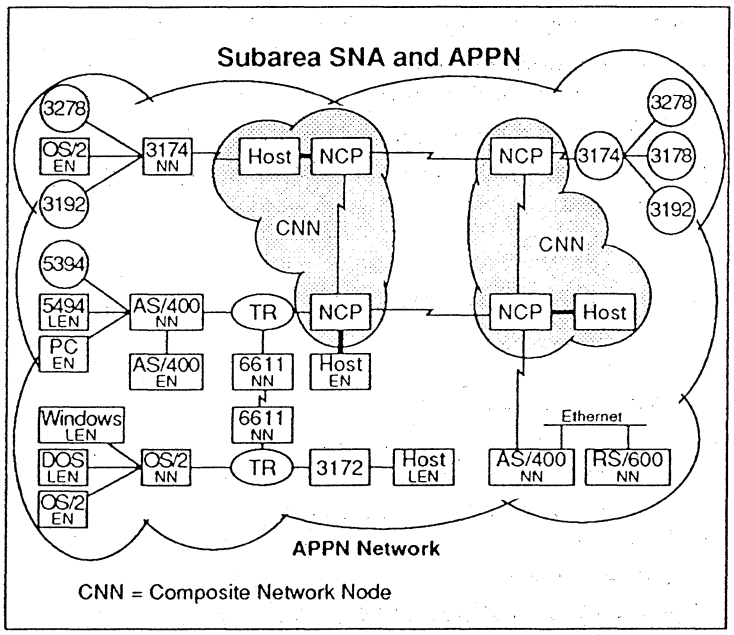


Figure 1

However, many of its customers are insisting on multivendor standards across the board and would still choose TCP/IP if APPN is not available from several vendors. These vendors, in turn, indicate a reluctance to implement APPN since TCP/IP is relatively inexpensive, pervasive, publicly developed, and in the public domain. Feedback from these users and vendors convinced IBM to increasingly open APPN during 1992.

Several of these vendors, in fact, formed the Advanced Peer-to-Peer Internetworking (APPI) Forum in August with the goal of developing specifications to support APPN end nodes and LEN nodes over TCP/IP not using APPN directory services or routing and topology protocols. (See "APPI: The Product and the Protest," *SNA Perspective*, December 1992.)

There are several degrees of openness: published interfaces, source code licensing, published specifications, free/nominal fee patent rights, published development plans, open industry development/participation, and open ownership. IBM has turned up the heat on openness many degrees in 1992:

- Published several APPN-related interfaces and protocols. It published APPN end node
- Proposed multiprotocol transport networking (MPTN) to X/Open
- Decided to propose several APPN interfaces to the Internet Engineering Task Force (IETF)
- Is licensing APPN network node source code (to be shipped in first quarter 1993
- Agreed to publish network node specifications by first quarter 1993, though it has not announced patent right fees
- Held APPC/APPN conferences for platform and application developers

These are all significant steps toward making APPN more open and available in a multivendor environment. However, to counter the market momentum of TCP/IP, IBM may need to make further moves to foster APPN acceptance, as we discuss in the SNA Directions article in this issue.

For more details on these APPN issues, see the following *SNA Perspective* articles "APPN Strategy Today" (January), "Enterprise Network Management Part II: SNA Peer-to-Peer" (February), "APPN: Key in IBM's Networking Blueprint" (April), "APPN Insights and Design Clues" (April), "Users Plan for New Technologies: SNA over Routers and APPN" (October), "Old Apps, New Nets—Dependent LUs Across APPN" (November), and "APPI: The Product and the Protest" (December).

LAN/WAN Integration

IBM announced its networking blueprint in March (see "Blueprint to Integrate the Architectures," *SNA Perspective*, August 1992). One of its major objectives is to integrate LAN, WAN, network, transport, transaction processing, and API technologies to enable applications running in diverse processing platforms and operating environments to interconnect and share resources coherently. This should happen regardless of underlying differences in application session services, network transport and routing algorithms, and network connectivity interfaces.

Major developments in 1992 in LAN/WAN integration in SNA were:

- SNA support on multiprotocol routers, including the IBM 6611 announced in January and shipped in September and the IBM RouteXpander/2 announced in September
- SNA support over emerging subnetwork technologies such as SMDS, ISDN, and, particularly, frame relay
- Increased IBM support for Ethernet, including shipment of Ethernet for the 3745, statement of direction for Ethernet on the 3174, and general purpose Ethernet adapters for the PS/2.
- ESCON channel and enhanced token ring support for the 3745 communication controller
- Mixed-media multilink transmission groups
- Enhanced support for token ring, Ethernet, and FDDI integration including the IBM 8250

SNA Support on Multiprotocol Routers

Since early 1991, multiprotocol router vendors began announcing support for SNA over TCP/IP networks. Figure 2 (see page 5) shows several approaches that have evolved for supporting SNA, including source route bridging, SDLC passthrough, SDLC conversion, and SDLC and LLC2 local termination.

6611. The long-awaited IBM 6611 multiprotocol bridge/router was announced in January and, after a few delays, shipped in September. With routable support for IP, XNS, IPX, DECnet, and AppleTalk, plus source route bridging, the product made a respectable entry into this market. But significant holes exist—no SNA routing (tunnels but no routes), limited Ethernet/802.3 support, weak SNMP MIB support, weak X.25 support, and weak bridging function. The 6611 has many features targeted at existing SNA networks that can be grouped under the term data link switching

RouteXpander/2, announced in September, is low-end OS/2 based device driver software that supports frame relay, source route bridging, and multiprotocol routing. It supports up to 200 frame relay logical links over a single physical link. RouteXpander/2 is a relatively simple product but it is valuable because it takes advantage of existing communication protocols on the PS/2, such as IP, APPN, peripheral or subarea SNA, NetBIOS, and IPX; they do not have to be changed since connections appear to be bridged over token ring when they are actually routed through a WAN via frame relay. *SNA Perspective* believes that RouteXpander/2 is an intriguing product and that its capabilities will be added to other products.

Ethernet

Considerable activity was seen from IBM in the Ethernet arena in 1992.

3745. In August, IBM finally shipped NCP 6.1 and the Ethernet adapters that it supports. The 3745 Ethernet adapters support only TCP/IP traffic, though, and not SNA traffic. SNAlink was ported to the 3745 from the host, so 3745s with Ethernet adapters can tunnel TCP/IP traffic across the SNA backbone without routing it through a host.

3174. Several 3270 controller vendors have offered Ethernet adapters for some time. Since IBM added TCP/IP support on the 3174 in 1991, it was not surprising when IBM made a statement of direction in 1992 to add Ethernet to it as well.

PC Adapters. In September, IBM unveiled its own line of general-purpose PC adapters for Ethernet, which underscore its involvement in TCP/IP.

Frame Relay and Other Emerging Subnetworks

Several technologies are emerging to support the future need for high-speed LANs and WANs. IBM has kept a low profile on the switched multimegabit data service (SMDS), probably because it is a public service, while frame relay can be implemented in both public and private networks, which means IBM could still control the backbone. Broadband integrated services digital network (ISDN) and the asynchronous transfer mode (ATM) which will support it are longer-term emerging technologies.

Frame relay represents a new packet-switching focus to provide higher speed technology for information systems that are increasingly time sensitive. Frame relay is a logical step for IBM in light of the past connection between IBM equipment and X.25, a technology that frame relay seeks to replace. A significant benefit of frame relay is that, unlike

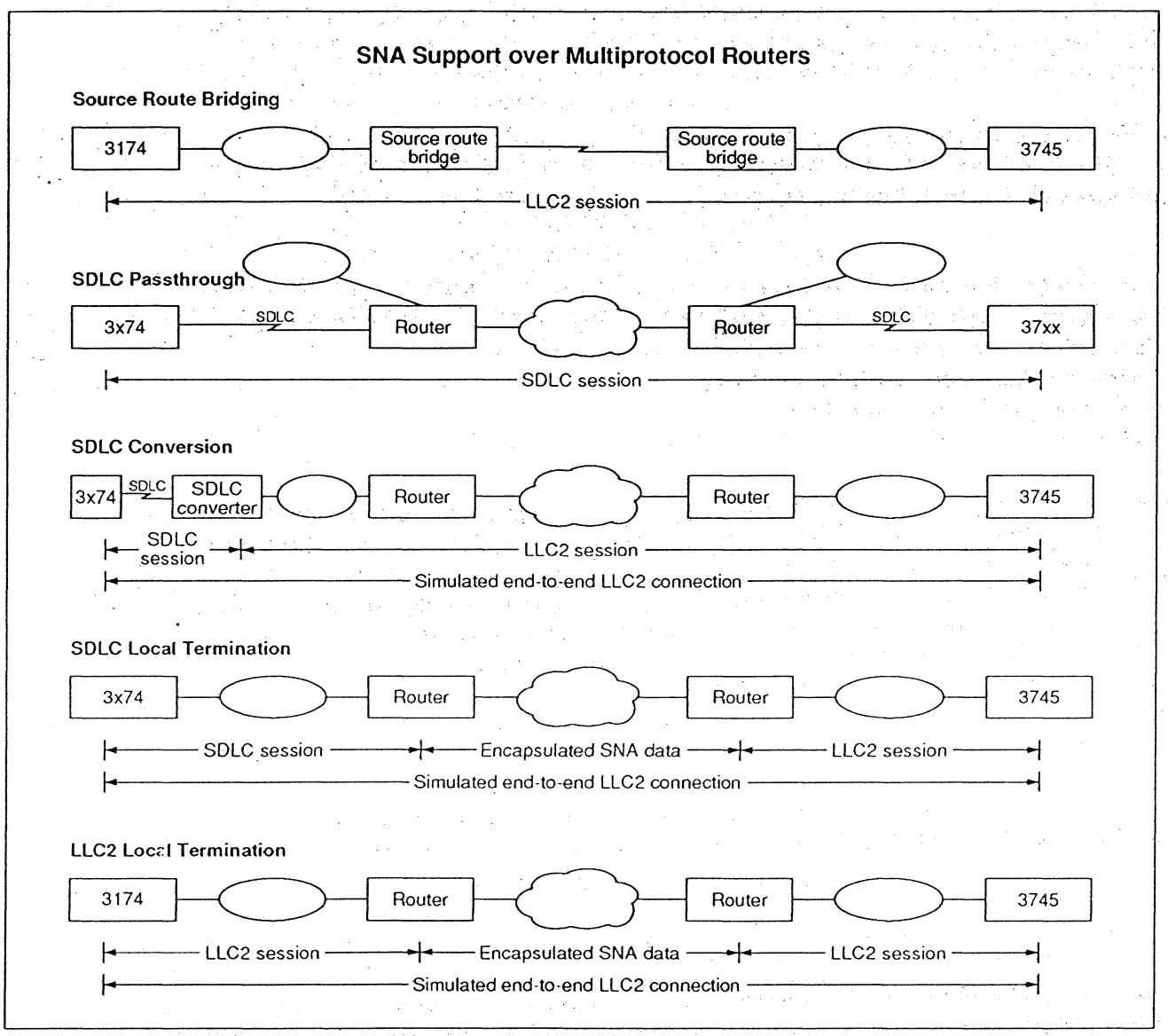


Figure 2

X.25, it can natively support any protocol, such as SNA, TCP/IP, and nonroutable protocols such as NetBIOS or Novell's IPX encapsulated in IP.

LAN-Mainframe Support

ESCON. In September, IBM announced several enhancements for the 3745. The most significant was the 3746-900 expansion frame for 3745 models 210, 310, 410, and 610, which adds ESCON channel and enhanced token ring support. IBM plans to support more ESCON and high-performance token ring adapters on the 3746-900 and to provide both the new ESCON and high-performance token ring adapters for the smaller 3745-170. The addition of ESCON to the communication controller increases speed and distance for LAN-mainframe connections and allows connection to up to eight hosts through one ESCON adapter and an ESCON director.

Token Ring. The enhanced token ring support on the 3746-900 offers increased performance and additional slots for a 3745 for token ring and Ethernet.

3172. The new 3172-3 offers increased performance at a lower price for host access through SNA and TCP/IP over Ethernet, token ring, and FDDI. The 3172 is being licensed by other vendors as well, such as Bus-Tech which is adapting the 3172 with software to support NetWare and IPX.

Mixed-media Multilink Transmission Groups

This new feature of NCP 6.2 provides a new means for defining transmission groups. Previously, multiple SDLC links between two 3745s could be associated as a single transmission group, providing a means of load balancing and back-up. However, a token ring network had to be defined in a separate transmission group from SDLC links, and token rings were limited to one network per transmission group. Frame relay networks were similarly limited. Now multiple SDLC, token ring, or frame relay networks can be associated in a single transmission group.

LAN Integration: The 8250 Multiprotocol Hub

Token ring, Ethernet, and FDDI emerged as the pervasive LAN technologies supporting SNA and other protocols, with frame relay and SMDS emerging as WAN subnetwork contenders.

IBM's entry into the multiprotocol intelligent hub market is the 8250. This backbone "LAN in a box" includes several multiport modules for Ethernet (in various media types including optical fiber), token ring, and FDDI, as well as modules that provide LAN management and SNMP for the system. Other modules permit interconnection via Ethernet bridging. IBM announced in July 1992 an agreement to work with Chipcom Corporation on future products and the 8250 is the first result of this cooperation between the two companies. A related hub management program runs on the RS/6000.

References

For more details on LAN/WAN integration, refer to the following *SNA Perspective* 1992 articles: "3174 Part II: Hard Hit by Gateways" (February), "LAN Network Manager Update" (June), "Animal, Vegetable, or Mineral: The 3172 Interconnect Controller" (July), "Data Link Switching on the IBM 6611" (August), "Optimizing SNA over Internetworks" (September), "SNA and the Future of X.25" (September), "The Rites of Autumn: IBM's September Announcements" (3745, frame relay, transmission groups, RouteXpander/2) (October), "Sprucing Up Your 3270 Controller" (December).

Multiprotocol Participation

Users increasingly need access to resources across multiple networks, and the applications they use need to share data. This creates the need for multiprotocol internetworking. The major thrusts for SNA multiprotocol participation we saw in 1992 are SNA on multiprotocol routers, IBM's networking blueprint, and TCP/IP pervasiveness.

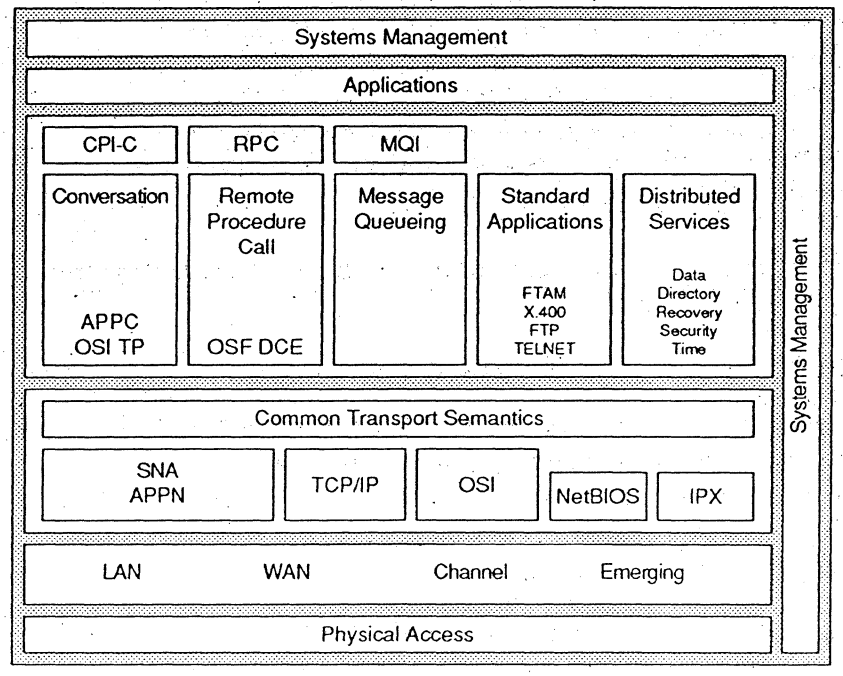
Networking Blueprint

The IBM networking blueprint was introduced in March 1992 as a strategy to support the coexistence of a wide range of application interfaces over a diverse set of networking architectures through a common set of transport semantics. It was designed to integrate diverse LAN, WAN, and transaction processing technologies, to support multiprotocol, multivendor, and multimedia elements, to enable users and their applications to interconnect across

diverse environments, to support client/server computing in a consistent way for end users, to exploit high-speed, high-bandwidth technology and services, and to provide comprehensive, architecture-independent management.

Common transport semantics, as shown in Figure 3, is an interface that rides on top of layer 4 of the OSI reference model. MPTN is a significant part of IBM's plan for the common transport semantics component in the networking blueprint. MPTN is IBM's proposed extension to the X/Open Transport Interface (XTI). XTI, in turn, is an X/Open specification for mapping between TCP/IP and OSI, and MPTN is designed to extend this mapping and compensation to APPN SNA and NetBIOS. The significance of MPTN is that it provides an "any-to-any" connection.

However, individual implementations based on MPTN will probably be single elements (e.g., one API over one transport network) rather than a single, massive protocol interface. MPTN may be implemented either on an end system as a server (so that a single application can run, unmodified, and be accessed from systems over several transports) or as a gateway in a separate node on the network. End users and their applications are unaware of the protocol or collection of protocols selected to transport their data across the network.



CPI-C = Common Programming Interface-Communications
LU 6.2 = Logical Unit Type 6.2
OSI = Open Systems Interconnection
TP = Transaction Processing
RPC = Remote Procedure Call
OSF = Open Software Foundation
DCE = Distributed Computing Environment
MQI = Message Queueing Interface
FTAM = File Transfer Access & Management
FTP = File Transfer Protocol
SNA = Systems Network Architecture
APPN = Advanced Peer-to-Peer Networking
TCP/IP = Transmission Control Protocol/Internet Protocol

Figure 3

IBM has discussed three products that will be implemented as part of common transport semantics: TCP/IP sockets applications over APPC/APPN (informally referred to as SNAckets), CPI-C applications over TCP/IP, and NetBIOS applications over APPN SNA (informally called SNAbeui).

Another integration product introduced in 1992 (which is not part of common transport semantics) is the IBM CICS-sockets interface. An application on a TCP/IP network can access a Customer Information Control System (CICS) application completely through TCP/IP with no VTAM involvement at all.

TCP/IP Pervasiveness

Although only a few years ago, IBM thought of TCP/IP as a transition step to OSI, the company now considers SNA, OSI, and TCP/IP all to be strategic architectures and is moving fast to integrate its TCP/IP products with SNA, as well as with network management—continuing its coordination of NetView and

SNMP. IBM is betting heavily on APPN, but it is not missing out on the popularity of TCP/IP.

IBM is finding some user confusion and resistance, however. Although IBM has offered TCP/IP on VM and the PS/2 since 1987, users are not yet used to IBM and TCP/IP in the same sentence. For example, a study by Infonetics Research of San Jose, California, indicates that users are reluctant to purchase a multiprotocol router from IBM. On the other hand, users of IBM TCP/IP on the host that we have talked to indicate that they are pleased with the products in spite of some overhead and performance issues.

TCP/IP on all platforms. IBM offers TCP/IP on all its strategic platforms: VM, MVS, AS/400, and OS/2, as well as for DOS and Windows and as a native element of its AIX products: AIX/370, AIX for RS/6000 and AIX for the PS/2. In fact, IBM has a broader range of TCP/IP offerings than any other vendor and the feature set is quite extensive. New versions or releases of most of these were announced in 1992. Many other vendors also offer TCP/IP on most of these platforms or as outboard gateways between TCP/IP networks and an SNA host.

TCP/IP over SNA. Most readers know that IBM and other vendors offer several products for supporting SNA over TCP/IP (discussed above). However, IBM also supports TCP/IP over an SNA backbone with SNAlink, which runs on the host and was added in 1992 to the 3745.

3172 TCP/IP offload. During 1992, IBM added TCP/IP Offload to the 3172. TCP/IP Offload is an alternative to the native interconnect controller program and runs under OS/2. With TCP/IP Offload, the TCP/IP processing can be handled outside the mainframe, which frees it up for applications and is also more efficient.

References

For more details on multiprotocol participation, see the following *SNA Perspective* articles: "IBM's Leading Communication APIs Face Off: CPI-C and APPC" (March) "IBM Makes Partners of SNA and OSI" (March), "Integrating TCP/IP into SNA" (Part I: May, Part II: June, Part III: July), "CPI-C Part II: IBM's Strategic API" (May), "Blueprint to Integrate the Architectures" (August), "Optimizing SNA over Internetworks" (September), "Users Plan for New Technologies: SNA over Routers and APPN" (October), "APPI: The Product and the Protest" (December).

Network Management

The beginnings of true integrated network management were seen in 1992 from IBM. NetView 2.2 can manage SNA, TCP/IP, and OSI networks. AIX NetView/6000 manages SNMP and CMIP networks and systems, can communicate with NetView through the AIX NetView Service Point and can convert SNMP traps into NetView alerts. Systems Monitor/6000 can distribute several functions of NetView/6000. (We would like to see a similar "skinny NetView" for the SNA arena.) LANfocus Management/2 can manage SNMP and CMIP LAN networks and can also coordinate with NetView. LAN Network Manager will have SNMP agent as well as CMIP support.

IBM network management product announcements in 1992 included:

- A new release of NetView
- A fully featured Simple Network Management Protocol (SNMP) manager on the RS/6000—AIX NetView/6000
- A distributed version partner for it—Systems Monitor/6000
- An OS/2-based LAN network management family—LANfocus Management/2
- An enhanced LAN Network Manager

AIX NetView/6000

IBM AIX NetView/6000, an SNMP manager based on Hewlett-Packard's OpenView, replaced AIX Network Manager/6000 in early 1992. It provides network management for TCP/IP devices with SNMP agents including the 6611 router. These agents are found extensively in environments such as Unix and LANs. AIX NetView/6000 also monitors all IP addressable devices.

Significant features included its OSF/Motif-based graphical user interface, a dynamic network discovery and mapping capability, and SNMP fault, performance, and configuration management features. As shown in Figure 4, AIX NetView/6000 can communicate with host-based NetView through the AIX NetView Service Point.

A new version of NetView/6000 was announced in 1992 which included even more functionality, with several new features and functional responsibilities. NetView/6000 Version 2 Release 1 offers a new graphical user interface based on X Windows and Motif. The product can now manage OSI as well as SNMP, and supports three industry-standard application programming interfaces (APIs)—X/Open Management Protocol, the Carnegie-Mellon SNMP API, and the End User Interface API from Hewlett-Packard—as well as an IBM API.

AIX Systems Monitor/6000

Distribution of the management function will also be improved with the announcement of a program called Systems Monitor/6000. In essence, this program runs on distributed RS/6000s in association with one RS/6000 running NetView/6000. Systems Monitor/6000 collects a range of user-definable data on its RS/6000 and the LAN segment to which it is attached and provides that information selectively, through user-definable filters and thresholds, to AIX NetView/6000. The data gathered can range from the LAN to the application level. The program also allows for the automation of some management functions, responding automatically to a set of pre-established conditions.

With Systems Monitor/6000, the central management station is freed from the task of collecting all the data—only that data that the network manager will need/want will actually be provided. AIX NetView/6000 still has provides the status of the network and the graphical display of the network. It also serves to configure the Systems Monitor/6000s that report to it. But with Systems Monitor/6000, the AIX NetView/6000 node is significantly removed from handling information that is unneeded or unwanted.

LANfocus Management/2

LANfocus Management/2 is an OS/2-based, SystemView-compliant LAN distributed systems management family which was alluded to all year by IBM and finally announced in October. The LANfocus family consists of several elements: LANfocus Manage/2 is the basic component. LANfocus Monitor is for gathering statistics. LANfocus Fix/2 is for problem determination and handling. LANfocus Start/2 is for configuration. LANfocus NetView Tie/2 is for optional communication with host-based NetView. LANfocus View/2 is the graphical user interface. LANfocus Agents will reside in managed systems. Only a few of these elements were actually announced; the others are statements of direction.

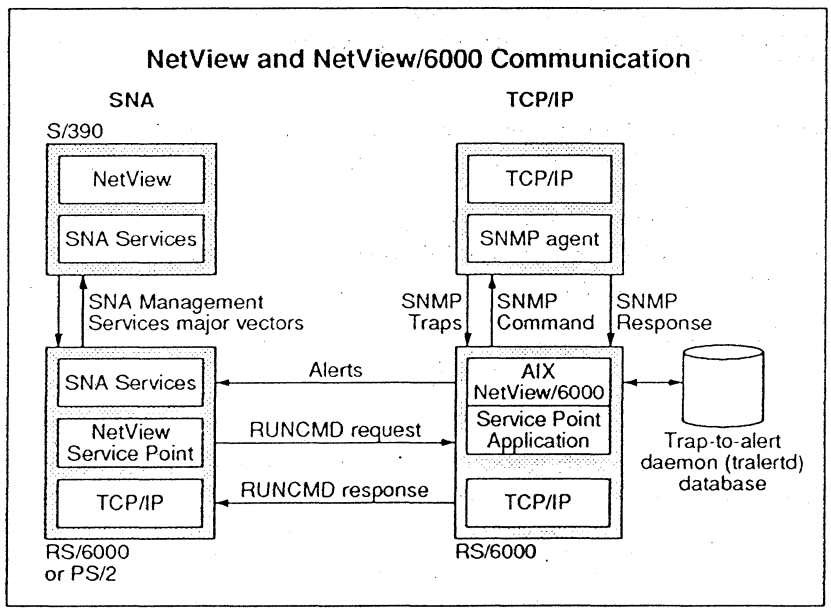


Figure 4

The first elements of LANfocus will ship in the second quarter of 1993 and several components will probably not ship until sometime in 1994.

IBM has not specifically discussed the relationship between the new LANfocus Management/2 and its LAN Network Manager or LAN Management Utilities (LMU). However, it appears that the latter two will act as an element manager for the former, managing selected elements.

How Did We Do In Forecasting 1992?

In the December 1991 issue of *SNA Perspective,* we made some predictions about directions we thought IBM networking would and should take in the coming year. Let's take a look at what actually happened.

Online Transaction Processing

- IBM will continue to enhance CICS to provide a wide range of online transaction processing solutions.

  Done. Major announcement in September.

- CICS API will be enhanced to run with AS/400 and AIX.

  Yes, and also to OS/2. CICS can run now on MVS, VM, VSE, AS/400, AIX, and OS/2.

- CICS data types will include:
  - A Resource Manager interface for non-IBM data.

    Done.

  - Support for compound document data types with multiple Object Content Architectures.

    Yes. a) continuing evolution of Modified Object: Document Content Architecture (MO:DCA) b) IBM and Apple joint companies, Telligent and Kaleida, defining products to support vendor independent multimedia document management.

  - Possible support for X/Open data types.

    Unclear.

- IBM must enhance remote unit of work for two-phase commits in a distributed, segmented relational database.

  Not yet. (Expected in 1993.)

- IBM will add distributed unit of work to SAA CPI.

  Not done. (Expected in 1993.)

- The networking interface for all affected applications will be based on CPI-C and LU 6.2.

  Yes. IBM made abundantly clear during 1992.

- CICS appears to be a strong candidate for development of an end-user API that would be transparent to the underlying IBM strategic SAA or AIX platform.

  Yes.

APPN Enhancements

- IBM should and likely will extend APPN network node logic to VTAM and to NCP in 1992.

  This was done in March for VTAM 4.1 and in September for NCP 6.2.

- Upon rollout of NCP Version 6, it will include APPN network node and end node.

  Instead of adding APPN to the already-announced NCP 6.1, it was added to NCP 6.2.

- IBM will announce ACF/VTAM Version 4 during 1992, which will include APPN.

  Yes. Announced in March.

- NetView must track APPN changes. IBM will incorporate APPN capability into NetView during 1992.

  Some, but not enough. Many statements of direction to be filled in 1993.

- IBM will publish an APPN network node format and protocol language document or perhaps publish under license.

  IBM said it was going to license it then said it was going to publish it. It will be published in the first quarter of 1993.

- APPN network node will be incorporated into SAA CCS Network Services.

  Announced during 1992.

How Did We Do In Forecasting 1992?

(continued)

- APPN will evolve into a high performance routing scheme to address requirements for OLTP and multigigabit LANs and metropolitan area networks (MANs).

  Long term, we still believe this will happen. IBM has started discussing high-performance routing (HPR), with a connectionless network protocol, that will be part of APPN+.

Multiprotocol APIs

- IBM will emphasize development of TCP/IP networked application solutions to the same extent as, if not greater than, their OSI solutions.

  Absolutely (described in the three-part series of articles in the May, June, and July issues of SNA Perspective*).*

- IBM will evolve a meta-architecture wherein applications and users will have access to applications via a high-level, platform-independent API which makes transparent the underlying SNA, OSI, or TCP/IP application and network services.

  The meta-architecture is the networking blueprint.

- IBM will architect additional SAA/OSI APIs for transaction processing, messaging, file processing, database processing, device streams, distributed processing, graphical design, systems/network management, object-document interchange, and job processing.

  IBM did add message queueing and RPC as part of the networking blueprint.

- SAA/OSI APIs will likely be extended during 1992 and beyond to incorporate TCP/IP.

  This is essentially what the networking blueprint did.

Multiprotocol Routers

- The announcement of the multiprotocol router is now likely in January 1992.

  Yes. Announced in January.

- The first version will ship early in 1992.

  Yes. It shipped in September.

- APPN will be added later in 1992.

  APPN will be added in first quarter 1993. ■

LAN Network Manager

LAN Network Manager 1.1 finally shipped in December. This version includes a graphical representation of IBM's 8230 token ring hub and 8250 multiprotocol hub, a new event filter, and support for Heterogeneous LAN Management, IBM's LAN management standard for token ring and Ethernet which was developed in conjunction with 3Com. (See "LAN Network Manager Update" in *SNA Perspective*, June 1992.)

In September, IBM announced LAN Network Manager 1.2, which also shipped in December. It is not really an enhanced release but is an alternative to LAN Network Manager 1.1 for different graphics environments.

According to a September statement of direction, IBM will add an SNMP agent to a future release of LAN Network Manager permitting it to communicate with NetView/6000 and any other SNMP monitor.

NetView Service Point and Performance Monitor

A new release of AIX NetView Service Point adds LU 6.2 communication to NetView. A new release of NetView Performance Monitor includes frame relay, Ethernet, and LAN segment support.

References

For more details on SNA network management products, issues, and trends, refer to the following 1992 *SNA Perspective* articles: "Enterprise Network Management Part I: The SNA Subarea" (January), "Enterprise Network Management Part II: SNA Peer-to-Peer" (February), "LAN Network Manager Update" (June), and "The Rites of Autumn: IBM's September Announcements" (October).

Miniaturization

SNA Perspective also noted a mini-trend for in 1992—miniaturization. IBM has provided SNA support for laptop PCs—through adapters and asynchronous SNA (SNA-A). In September, IBM announced credit-card–sized adapters, conforming to the personal computer memory card interface adapter (PCMCIA) industry standard, for token ring, Ethernet, and 3270.

During 1992, IBM released several products that implement SNA-A, which allows them to use the less expensive and more ubiquitous asynchronous modems rather than synchronous modems. This is particularly helpful for the portable PC user who has SNA traffic to send.

Summary

Despite all the controversy regarding APPN in 1992, it cannot be called the year of APPN. It could be called the year of APPN promise—a promise that must be fulfilled in 1993.

LAN/WAN integration in 1992 was extensive in 1992, including SNA support on multiprotocol routers and frame relay, LAN-mainframe enhancements to the 3745, 3174, and 3172 for SNA and TCP/IP, mixed-media multilink transmission groups, and LAN integration in the 8250 hub.

Multiprotocol participation was the name of the game for many participant. IBM now tells its story as the networking blueprint and its common transport semantics. Although it was unveiled in March, no products based on the common transport semantics were announced in 1992. Based on the blueprint's strategic importance, we expect product announcements early in 1993.

The important trend the networking blueprint epitomizes is the collapse of the monolithic seven-layer architecture tower: SNA or TCP/IP or OSI from top to bottom. Instead, it will be like the children's books with multiple pages to mix and match for faces, torsos, legs, and feet. We could see "SNA applications" (e.g. CICS) with "TCP/IP APIs" (e.g., sockets) running over "OSI transport" (e.g., TP4 and CLNP) on an "SNA data link" (e.g., token ring). Not all the combinations will be implemented in a single massive meta-architectural implementation, but then not all nor even most of the combinations will be needed. But hopefully, in 1993 and beyond, the chosen combinations will be implemented with some degree of coordination and congruence.

The beginnings of true integrated network management were seen in 1992 with management of SNA, TCP/IP, and OSI networks and attached systems by NetView/390, AIX NetView/6000, AIX NetView Service Point, Systems Monitor/6000, LANfocus Management/2, LAN Network Manager, and LAN Management Utilities. It is not clear how these products will relate to each other, and it may never be.

IBM has made an impressive array of alliances and cooperative development agreements and, through them, has announced viable products in market areas that are not its traditional strength. Cooperative development is revolutionary for IBM and can assist the company in moving aggressively into new markets.

We consider 1992 the year of "SNA and...," that is, SNA as it relates to the world around it: SNA and TCP/IP, SNA and OSI, SNA and frame relay, SNA and multiprotocol routers, subarea SNA and APPN, SNA and Ethernet, SNA and NetBIOS, SNA and sockets, and even APPN SNA and openness. ■

(continued from page 1)

APPN

This year will be as full of APPN news as 1992 was. We have a somewhat clearer view of 1993 directions, though, because of the many statements of direction IBM has made about APPN, which are listed in Table 1 (see page 15).

Three Types of Routing

SNA Perspective believes that APPN will emerge in 1993 with three possibilities for communication.

Intermediate Session Routing (ISR). Existing APPN's routing protocol is ISR. It uses a connection-oriented network protocol and requires both layers 3 and 4 in each intermediate node. ISR does not support adaptive routing in case of congestion or link failure.

High-Performance Routing (HPR). IBM has begun to discuss some details about what has been called APPN+, a forthcoming version of APPN. APPN+ will include an alternative to ISR is called high-performance routing (HPR). APPN+ HPR will have separate layer 3 and 4 protocols. With HPR, the intermediate nodes can use only layer 3, similar to most protocol stacks such as TCP/IP. The network protocol in HPR will be connectionless. HPR will also support adaptive routing and will be implemented on several more link types. HPR will not be incompatible with existing APPN nodes using ISR; HPR nodes will also include the capability to appear as an ISR node. We expect that IBM will formally announce products with HPR in the first half of 1993 and HPR for VTAM after the first half.

Connection Networks. The third type of APPN routing is connection networks. Connection networks is a feature of APPN developed for LAN internetworks so end nodes can connect with just one APPN hop rather than using APPN hop-by-hop routing.

APPN connection network support allows an APPN end node to define its connection to a LAN as one virtual routing node rather than to define its connections to every other node on the LAN. A connection network can also be defined to include multiple bridged LANs and extend across WANs.

Two end nodes defined on the same connection network can be connected to each other by a network node server as just one APPN hop, with the underlying bridge/router network treated as a shared access transport facility, rather than using APPN hop-by-hop routing. To APPN, the connection appears as a single hop rather than multiple hops from end node to network node, from network node to however many intervening network nodes, and then from the final network node to end node. Thus connection networks can provide higher performance by avoiding APPN processing of each packet at every node.

Connection networks will be part of the 6611 APPN and of the initial licensed APPN network node code. VTAM 4.1 can support connection networks as a network node, but we will have to wait for a future release for a VTAM end node to be able to be part of a connection network.

Dependent LUs on APPN

IBM's strategic approach for supporting dependent LUs over APPN has two steps. The first step, implemented in VTAM 4.1, allows LU 0, 1, 2, and 3 traffic from all existing IBM and nonIBM peripheral SNA nodes to travel across an APPN network as long as the node remains logically adjacent to its boundary function (host or communication controller). VTAM 4.1 will ship in the first half of 1993.

dLS/R. The second step in IBM's strategic approach is called the dependent LU server/requester (dLS/R) model. A future release of VTAM will support dLS and a future release of 3174 code will support dLR. dLS/R eliminates the adjacent boundary function requirement in VTAM 4.1. Either the dependent LU can connect to an APPN network at any node with dLR or dLR can be added to the dependent LU node itself.

We expect dLS to be part of VTAM 4.2 which will probably be announced in 1993 and shipped in early 1994. We hope that IBM will make dLR specifications available to other vendors so that their controllers, routers, and gateways can have dLR support by the time VTAM with dLS ships.

Encapsulation. IBM and several third parties are also discussing the development of encapsulated support for dependent LUs over APPN. This could be done in several ways—tunneling, spoofing, or appc3270. Since these development efforts are in their early stages, *SNA Perspective* does not expect any encapsulation solutions to be available until the end of 1993.

dLS/R will scale up to larger networks, mixed subarea APPN networks, and very high-speed networks better than encapsulation, and will provide for more flexible and dynamic configurations for dependent LUs. However, dLS is VTAM dependent, requiring a future VTAM release at the dLS node as well as requiring VTAM 4.1 at most application nodes.

APPN: Make or Break

1993 is a make or break year for APPN. IBM must educate its subarea SNA customers on the ease of transition to APPN. The company must also deal with the significant TCP/IP momentum by making clear the benefits of APPN compared to TCP/IP. Finally, the company must deliver on products outlined in the networking blueprint which allow smooth support for applications to communicate over a range of transports. APPN might be the natural child of subarea SNA, but TCP/IP is also being "adopted" and stands to inherit a significant portion of the subarea SNA estate.

How open must APPN be? IBM is agonizing over the different levels of openness available: published interfaces, source code licensing, published specifications, free or nominal fee patent rights, published development plans, open industry development and participation, and open ownership.

IBM took several significant steps toward APPN openness in 1992. IBM has published the APPN end node specifications and several interfaces and has said it will publish the network node specifications. The company is also licensing source code and proposing several APPN elements to standards bodies.

However, as pointed out by the APPI Forum (see discussion on page 17), IBM still owns APPN. Implementors can be required to pay patent license fees up front or for each copy even if they develop their own code. IBM also controls the development—it will develop the features and products it believes it can sell to the most users and afterward will publish the specifications for these new features.

IBM is struggling to decide the appropriate price points and level of openness for APPN. This is a several billion dollar decision. We expect clear pricing and some additional movement on openness in 1993.

LAN/WAN Integration

Evolution of the Controllers

IBM's primary networking platforms are the 3745, 3174, and 3172 (though the 6611 and PS/2 serve in this role as well). There has been much speculation that these three product lines may be succeeded by some other networking direction or family of products. If this convergence of product lines into a new family is coming, it is unlikely to be announced until sometime in 1994.

In the meantime, IBM has stated strongly through the evolution of these machines that they remain valid components of its multiprotocol network strategy. Though network protocols have evolved into peer-to-peer architecture, these existing products participate in the evolution.

SNA Perspective believes that IBM will continue to support these platforms well into the future in the company's multiprotocol strategy for both LANs and WANs. All of these products play a role in the important LAN-mainframe market, which will be the subject of an upcoming *SNA Perspective* article.

3745. During 1993, we expect IBM to support the ESCON adapter and enhanced token ring adapter of the 3746-900 on the 3745-170.

3172. On the 3172, we expect support for multiple protocols on a single adapter, SNMP network management in TCP/IP Offload, additional OEM deals (in addition to AT&T and Bus-Tech), and ESCON support for LAN-channel configurations.

3174. For the 3174, we expect the Ethernet adapter and additional TCP/IP support to ship by the end of the year. In 1992, we began to anticipate Ethernet for the 3174 as its TCP/IP features increased. Where TCP/IP is growing, could Ethernet be far behind? In September 1992, IBM announced that it intends to make the 3174 capable of attachment to Ethernet networks, both as a downstream node and as an upstream gateway. Although this enhancement by IBM is overdue, it is nonetheless welcome.

Frame Relay

Especially for SNA traffic, we expect 1993 to be a significant year for frame relay at IBM. We expect peripheral, subarea, and APPN SNA traffic over frame relay will be supported on the RouteXpander/2, 6611, 3174, and 3745.

Multiprotocol Integration

TCP/IP has been growing at an incredible rate in corporations with large SNA networks. IBM has been investing heavily in TCP/IP—with a major acceleration since 1991. The result has been an increasing array of products, a shorter design-to-shipment cycle, better integration with SNA and network management, and continued enhancements and additional features on existing products.

The company will increasingly decouple applications from networking for each stack so that customers can select applications and networks independently. We believe that IBM will continue to focus on greater integration of TCP/IP features with host resources.

TCP/IP and SNA environments will increasingly coexist on networks and within systems and new applications will draw on the strengths of each. *SNA Perspective* expects increasing integration of SNA and TCP/IP, over wide area networks, metropolitan area networks, and local area networks during 1993.

APPN Statements of Direction

VTAM APPN border node in VTAM. Border node allows cross-network APPN connections.

APPN session routing over channel-to-channel links.

APPN session routing over SNA subarea routes. Currently, APPN can be routed only over type 2.1 links.

Dependent LU server/requester (dLS/R) in VTAM and 3174, respectively, for LU types 0, 1, 2, and 3 support across APPN.

APPN end node and network node as well as a CPI-C interface for AIX SNA Services/6000.

Network management through NetView for APPN. Support will include dynamic collection and display of APPN network topology, existing remote operator controls applied to APPN resources, and collection facility for APPC accounting data.

APPN on NetWare. A joint development by IBM and Novell will implement APPN in NetWare for SAA.

Mixed-media multilink APPN transmission groups. NCP 6.2 is expected to support these for APPN as well as subarea SNA links.

Connection networks in VTAM. Connection networks is an APPN feature which allows end nodes to define their connection to a LAN or internetworked LAN as a single virtual routing node and thus connect to each other over the entire LAN as a single APPN hop.

TCP/IP over APPC/APPN (SNAckets). IBM will offer support for applications written to sockets, which usually run over TCP/IP networks, to run instead over APPC/APPN.

6611 network node to VTAM/NCP composite network node through frame relay.

SNA peripheral device, such as 3174, to VTAM/NCP composite network node over frame relay for APPN or peripheral SNA traffic.

Table 1

Evolution of the Networking Blueprint

An important element of the networking blueprint is the common transport semantics, an interface that rides on top of the transport layer. Common transport semantics will be based in large part on IBM's multiprotocol transport networking (MPTN). IBM published MPTN in 1991 and has proposed it to X/Open for adoption as an industry specification. MPTN is a coordinated means of mapping, compensation, and address resolution between SNA, TCP/IP, OSI, and NetBIOS.

SNA Perspective expects that, starting in early 1993, IBM will develop several MPTN-based products, primarily for communication between SNA and TCP/IP networks. These would support dependent and independent LUs in APPC across TCP/IP and sockets applications across SNA.

The IBM networking blueprint extends to users beset by complex and costly networking choices the promise of enabling the coherent coexistence of compound solutions in a way that also reduces costs.

Network Management

APPN Network Management

SNA Perspective believes that the major issue with network management is that now, with APPN capability on workstations and midrange departmental processors, users have access to highly dynamic SNA network environments. The problem is that, although there is much APPN dynamism on the network, the host's network management is static.

However, IBM has already developed an SNA/APPN-specific successor to the network management vector transport (NMVT) called the multidomain support message unit (MDSMU). MDSMU provides network management functions in an APPN-only network where a network node can actually function as a focal point.

We believe that IBM's strategic solution to network management will not be based on SNA Management Services (SNA/MS). APPN network management and multiprotocol network management will likely be based on CMIP and SNMP even with the introduction of the MDSMU. CMIP is a more strategic, long-term direction for IBM, and it is integral to SystemView. APPN and multiprotocol network management will be able to be managed by NetView/390, which supports various architectures, including TCP/IP and SNMP, but the management will not be based on SNA/MS.

The first release of the APPN source code will include an SNMP Management Information Base (MIB) so it can be managed by SNMP.

Multiprotocol Network Management

IBM has been providing NetView-based functions for integrated SNA, TCP/IP, and OSI networks being managed with SNMP and CMIP as well as IBM's proprietary management protocols. We expect additional such features for NetView in 1993.

Standards-based network management allows for multiprotocol, multiplatform, multimedia network management. IBM customers want network management for all of their systems and networks. IBM will start shipping the LANfocus Management/2 family in 1993 and will continue to enhance AIX NetView/6000 for this purpose, as well as enhancing their interface with NetView/390.

The average time it takes to bring up a NetView/390 focal point in a host in the SNA environment, from scratch, is about 400 person hours. In contrast, the average time it takes to activate AIX NetView/6000 in the SNMP environment, from scratch to full functionality, is about fifteen minutes. This is an example of user benefits of a less complex system.

SNA Perspective expects that NetView focal point logic will be found outside the hub—i.e., outside the S/370/390 environment. In fact, it will probably be found right on LANs within the workstation platform. LANfocus Management/2 will evolve to be able to manage both SNA/MS focal point and NetView focal point.

Alliances

With the breadth and depth of the information and communications industry, IBM could not be all things to all people even at its largest. With its significance workforce reductions of the past several years, and with another 25,000 jobs to be cut in 1993, IBM cannot go it alone to provide the solutions its customers need. Over the past decade, IBM has increasingly taken on partners and alliances to fill out its offerings. Further, IBM has always been heavily involved in industry standards forums.

We only touch on three important relationships for 1993: Novell, the CPI-C Implementor's Workshop, and the APPI Forum.

Novell

The IBM-Novell relationship is actually a set of evolving relationships. Novell seems to be a much greater beneficiary of that relationship than IBM, particularly with IBM's offer of APPN network node. It appears that, since IBM is quite eager for APPN to be supported in NetWare but Novell has limited SNA expertise, the "joint development" of APPN on NetWare will probably be primarily an IBM development effort.

With IBM's recent announcements for OS/2 LAN Server, the set of new functions is somewhat comparable to NetWare for SAA.

NetWare is also appearing on the 3172. At Interop in October, IBM announced that Bus-Tech, a leading manufacturer of LAN-to-mainframe—particularly Ethernet to mainframe—devices, will be using the IBM 3172 and running Novell NetWare for SAA as the operating system. Bus-Tech has been a leading competitor for the 3172 even though its products have mostly been TPC/IP-over-Ethernet-to-mainframe rather than multiprotocol, multi-LAN-to-mainframe. This is another instance of IBM recognizing the importance of the NetWare installed base.

CPI-C Implementor's Workshop

IBM is opening CPI-C to development participation by other vendors, though in a workshop under its own auspices. The first meeting was held in December 1992 and further meetings will be held in 1993. IBM's ability to open CPI-C was enhanced because a version of CPI-C is already an X/Open specification and because LU 6.2/APPC and the OSI transaction processing protocol standard, which can both run under CPI-C, are quite similar.

CPI-C went through several changes in 1992, especially in the area of openness. In 1992, IBM eliminated any license charges for developers using CPI-C. IBM had proposed CPI-C to X/Open as an interface specification. It was accepted with several changes such as nonblocking, accept multiple, security, and data conversion. IBM will be incorporating these changes. To do so, IBM has started to number CPI-C levels. CPI-C 1.1 is the initial CPI-C with resource recovery. CPI-C with the X/Open extensions is referred to as X/Open CPI-C. CPI-C 1.2 is the integration of CPI-C 1.1 and X/Open CPI-C.

CPI-C level 2 will emerge in 1993, with Open Software Foundation Distributed Communication Environment extensions for directory services and Kerberos securtiy and additional multiprotocol support for OSI transaction processing, TCP/IP transport, and full duplex APPC.

We shall see in 1993 whether the industry participants will feel like equal players when the game is played in IBM's backyard.

The APPI Forum

As discussed in the "SNA in Perspective" article in this issue and in "APPI: the Product and the Protest" in December 1992, the APPI Forum was formed in August 1992 to support APPN end nodes and network nodes over TCP/IP, using routing and topology protocols and directory services based on TCP/IP instead of APPN. The Forum cites technical, price, openness, and pervasiveness advantages of TCP/IP over APPN as well as the benefits of a single backbone protocol instead of multiprotocol backbones or tunneling.

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Architect's Corner

Plumbing Paradigm is Obsolete

by Dr. John R. Pickens

Since the 1970s, the paradigm for networking has been plumbing. An infrastructure to transport data regardless of origin, destination, or type of data.

In that sense, 1993 is shaping up as a year of fulfillment—though with hints of change.

- U.S. political environment. A new presidential administration is on hand with a heavy emphasis to be placed on building a telecommunications infrastructure.
- User environment. A widespread rollout of multimedia is underway. My local electronics stores now have row upon row of multimedia kits stacked in the aisles for the holiday season—and reportedly they are selling well. Networked multimedia cannot be far behind. The relationship of networked multimedia to operating system services such as Windows Dynamic Data Exchange still requires definition.
- LAN environment. The triple standard is nearly pervasive—Ethernet 802.3, token ring 802.5, and FDDI.
- SNA environment. APPN has moved from the early beachheads of minicomputers (AS/400) and personal computers (PC) to the center of mainframes (VTAM) and routers (6611, third parties), with the integration of 3270 devices about to occur.
- High-speed networking environment. A new standard to the desktop is being proposed—100 megabit/sec Ethernet (802.3). Gigabit networking is on the horizon. The high speed requirement will impose change on the SNA protocols.

Problems With the Plumbing Paradigm

There are two problems with the plumbing paradigm.

First, all the pipes don't fit together. There are SNA pipes, IPX pipes, and TCP/IP pipes. There are even pipes that are generic but spring leaks in times of flood (i.e., bridges and multicasting).

Each of these independent pipe infrastructures has its own types of fittings and management methods. Various techniques have been proposed to carry pipes inside of pipes (tunneling) or incorporate special adaptation connectors (gateways). But each of these techniques results in reduced flow, loss of manageability, or other problems with loss of function.

Our Challenge

We just need to design one type of pipe that supports them all, right?

For integrated multiprotocol routing (i.e., a single plumbing infrastructure) throughout the 1990s, many standards will be offered and many standards will fall. This prediction has been based upon considerations of the overwhelming complexity and scale of the network plumbing problem and the immense diversity and number of inwardly focused and outwardly contentious standardization environments (vendor, de facto, ISO, IETF).

But there is a more serious problem. Plumbing is no longer the correct paradigm!

First case in point, NetBIOS. NetBIOS carries data—yes, plumbing. But it also contains a distributed name registration and discovery function. This function is used by operating system assisted functions—client server computing—a form of distributed process model (albeit a weak model, inasmuch as use of NetBIOS names by the operating system is really not mandated).

Second, IPX. IPX carries data—yes, plumbing. But it also contains a multicast-based service registration and discovery function—service access points (SAPs). SAPs are used by the operating system to enable client-server relationships between distributed processes—a stronger model than NetBIOS. In fact, one of the more difficult challanges for vendors routing IPX is maintaining currency with the evolving multicast-oriented SAP service required by the evolving NetWare operating system.

Third, APPC. APPC carries data—yes, plumbing. But it also contains an operating system–oriented function—flexible registration and discovery of LU names and transaction program names (current architecture needs a minor extension to support a generic TP name-to-LU name directory services function). Interestingly, the original architecture for LU 6.2 did not define the LU to be a "pipe." Rather it was defined as a resource manager—an element of the operating system.

Finally, gigabit networking research. Gigabit networks do carry data—yes, plumbing. But a growing contingent of the research community is proposing a very different model for gigabit networks. The network as a virtual memory store. The network handles page faults, locates memory segments, and even assists in the location and distribution of processes.

Advocates of this approach argue that it completely hides the communications (i.e., plumbing) abstraction from the user—APIs, elements of procedure, everything. It also allows over twenty years of research in virtual paging systems experience to be applied to networking.

> The network is behaving more like an operating system than a system of pipes.

Distributed naming servers, process mapping, page faults—this doesn't sound like plumbing. What is the new paradigm?

A New Paradigm—Exoskeletal Nervous Systems

How about exoskeletal nervous systems? The synapses, fiber, and pathways which knit together a functioning organism. (Alternate proposals for the new paradigm are welcomed...) Whatever the paradigm, the network is behaving more like an operating system than a system of pipes. Its services—process registration, memory mapping, data access—are supportive of, and ancillary to, operating systems. Operating systems also move data, so the plumbing paradigm is not incorrect, just insufficient.

By modeling the APPC LU as a resource manager, IBM's SNA architects got the new paradigm correct the first time. Members of the research community have seen this coming for some time. The vendor community, however, is still focused on design and delivery of the plumbing paradigm. A change of focus is needed on the role of the network as an extension to the operating system by vendors and standards communities alike. The plumbing paradigm is obsolete. ■

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We find that many of the APPI Forum's points have merit. However, *SNA Perspective* finds several concerns with the proposed APPI design. For example, because it does not communicate with APPN network nodes, it will not support hosts that connect to LANs through 3745s nor AS/400s running PC Support/400. We believe that the actual APPI specification, which is scheduled to be available by the middle of 1993, may differ significantly from its original concept, hopefully addressing these concerns.

At the time the APPI Forum was formed, IBM was not publicly planning to publish the APPN network node specifications but, rather, to make network node available only through licensing the source code. IBM was responsive to significant industry pressure—including pressure from the APPI Forum—and announced in October that it would publish the APPN specifications at the same time as the licensed code becomes available—in the first quarter of 1993.

Support for industry input into APPN development could be a next step in opening APPN. This could be accomplished if the focus of the APPI Forum could change or expand—though we do not see this as likely. Alternatively, the IBM APPC/APPN Platform Developer's Conference could be evolved to incorporate such participation, along the lines of the CPI-C Implementor's Workshop. ■