Migrating a Legacy WAN to TCP/IP Infrastructure

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Introduction

TCP/IP has become a ubiquitous network architecture in both the LAN and WAN environments of many organizations. Coupled with the availability of small, low-cost embedded computer systems, TCP/IP networks provide those organizations with an opportunity to significantly reduce costs. Most legacy WANs use synchronous communications for their wide-area links. This white paper discusses the various types of legacy networks in use today, reasons for converting to TCP/IP networking, considerations for migration to TCP/IP and the use of a new device family - SyncServer - to permit cost-efficient migration to a TCP/IP infrastructure.

Legacy Networks

The meaning of the term "legacy network" and the devices and networks to which it applies varies with individual opinion and industry. Generally it is taken to refer to networks, designs and devices which are today difficult to source because they are no longer produced or difficult to maintain because of inherent complexity or lack of design and maintenance expertise. Many older/legacy host computers or data collection devices only implement particular network protocols. Consequently, to meet their communication requirements, those specific protocols are used. Some examples of legacy protocols are SNA, X.25, AX.25 (airline X.25), BX.25 (telephone X.25), HDLC-LAPB, SDLC, Frame Relay, BiSync, and raw synchronous.

Companies today are faced with the challenges of controlling equipment and operating costs, protecting their current investments and having the ability to deploy new applications cost-effectively. The Software Group provides cost-effective TCP/IP enabling solutions that permit the conversion from legacy networks to TCP/IP infrastructure without major changes to network endpoints or application design.

X.25 Networking

X.25 is one of the most predominant legacy networks, especially in international applications. The protocol was developed to provide reliable data communications on public data networks. X.25 users are typically large organizations with widely dispersed and communications-intensive applications. X.25 provides very robust error checking. It works well in many older networks that are susceptible to physical interference.

LAPB (Link Access Procedure, Balanced)

LAPB is the data link layer protocol in the X.25 protocol stack. LAPB is a bit-oriented protocol derived from HDLC.

HDLC (High-level Data Link Control)

HDLC is a general-purpose data link control protocol defined by ISO for use on both point-to-point and multipoint (multidrop) data links. HDLC supports full-duplex, transparent-mode operation. It is used extensively in both multipoint and computer networks. Some manufacturers and other standards bodies still use their own acronyms for the protocol, e.g., IBM's SDLC.

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SNA (Systems Network Architecture)

SNA is IBM's proprietary high level networking protocol standard. SNA is used by IBM and IBM-compatible mainframes for user/host as well as host/host (APPC) interactions.

Frame Relay

Frame Relay is a successor packet-switching technology to X.25. It uses a fast packet-switching technology that does not provide end-to-end error checking.

TCP/IP Networking

As corporations become more reliant on Internet protocols, either as Intranet components or interfacing directly with the Internet for corporate communications, they will become more reliant on worldwide IP (Internet Protocol) services. IP will become far more important and ultimately will become the predominant data networking protocol. Managing one type of network based on the most commonly used network protocol (IP) is simpler and less costly than managing many different types of network protocols and devices.

Reasons for Converting to TCP/IP Networks

Most organizations have several network protocols/infrastructures operating simultaneously, as their network needs and applications have evolved over time. What is cost-effective and efficient to deploy at one time is often not cost-effective even two years later. However, because network applications represent significant investments on the organization's part (staff training, business processes, even organizational design), network replacement cycles do not keep pace with technological evolution. As a result, organizations are often required to maintain rather expensive and varied network infrastructures, simply because the cost of rebuilding an application to take advantage of more modern techniques is too high.

Whether or not there is resistance to convert from legacy networks to IP networking varies by organization. Many legacy networks have been in place for more than ten years with few or no updates to the hardware or software. The legacy system works and it is reliable – so why change it? There is resistance to converting to anything different if it involves a redesign of the network or installation and setup of new hardware or software.

On the other hand, TCP/IP networking has become ubiquitous inside corporations through their LANs. TCP/IP networking has also become ubiquitous because of the business potential of the Internet. Maintaining an internal TCP/IP network (Intranet), a network for Internet connectivity and a network for communication with legacy devices involves considerable management and familiarity with different networking systems and protocols. TCP/IP provides for “any-to-any “ connectivity, as opposed to most legacy protocols, many of which are either implemented for proprietary systems, or are open systems co-opted to proprietary infrastructures.

Managing the performance of a single, TCP/IP-based Wide Area Network (WAN) is much simpler than attempting to manage an institutional WAN based on different protocols, facilities, and terminal devices. However, when an existing network functions adequately, there have to be either business or technical reasons to drive the migration to TCP/IP networks.

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Business Reasons for Conversion to an IP Infrastructure

Cost control is the key business reason driving migration to IP infrastructure, albeit in a number of different areas. The most obvious item is the cost of the communications facilities interconnecting the organization's sites. For a large organization with hundreds, if not thousands, of locations, this is considerable, and direct savings are available by eliminating legacy leased lines which run parallel to existing IP infrastructure, and carrying legacy traffic on the IP network.

In addition to these directly measurable cost reductions, an organization implementing a completely IP-based infrastructure also has the ability to capture savings in the following areas:

Human Resources

Fewer technical specialists are required to operate a single large TCP/IP-based network than a number of disparate synchronous data networks.

Network Support Equipment

Large synchronous data networks often require special diagnostic and troubleshooting tools. These devices are expensive, and infrequently used (but availability is critical when a failure occurs). With a TCP-based infrastructure, there is no requirement for such equipment.

Technical Reasons to Convert

Although cost control is often a key reason for consolidating data traffic to an IP infrastructure, other technical benefits result from such a change. Both reliability and network performance increase with a shift from collections of legacy infrastructures to a single IP-based network. TCP/IP was designed by DARPA, the United States Defence Advanced Research Projects Agency. One of the criteria for the design was resilience and reliability; a properly designed TCP/IP network can tolerate trunk and node failures by automatically routing traffic around the failure. Legacy networks can be designed to handle failures, but often at great cost (redundant equipment) and effort (legacy networks do not usually have resilience built in; it needs to be added during deployment).

Overall network performance, or an increase in cost-effectiveness, can result from migrating a network from groups of (relatively low-speed) trunk interconnections to a single high-speed trunk. For typical commercial traffic loads, consolidating several low-speed links into a single link with the same speed as the sum of the bandwidth of the low-speed links improves response times and throughput. Alternately, if the organization chooses to go ahead with a slightly lower-speed link, some ability to capture operational savings is available.

Planning for Conversion

When an organization’s network has evolved over time and the legacy portion of that network has been in place for some time, careful planning is required to ensure smooth infrastructure migration. The current network must be reviewed for placement of SyncServers to result in the maximum financial savings and minimum operational disruption.

Migration to a TCP/IP infrastructure can take place at different levels. Synchronous frame switching, which operates at the lowest level, can be implemented with minimal disruption of

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existing applications. However, it requires the highest level of performance from the IP infrastructure and new equipment on both sides of the network. While application-level changes to operate using a different protocol interface API representthe lowest-cost alternative from the point of view of equipment deployment and IP network performance, they can be costly in time and effort and risk. . Reprogramming of applications is unnecessary when SyncServer is used in a switching configuration. A full migration process is not transparent to applications. Both the network and applications it supports need to be taken into consideration when migrating to TCP/IP.

Network Considerations

In preparing to deploy SyncServers within the network, The Software Group conducts a detailed analysis of the current infrastructure, documents all findings, considers management's administrative policies and procedures, and plans network strategies to migrate to TCP/IP, thereby reducing complexity and operational costs.

An analysis of current infrastructure involves identifying the following:

- Existing physical and virtual legacy connections (number, speed, geographic location)
- Existing legacy devices for collection of data and hub consolidation of data (number, maximum speed, geographic location)
- Existing applications and server communications protocols
- Current use of TCP/IP connectivity (purpose, geographic deployment, future considerations)
- Existing LAN infrastructure
- Existing legacy technology suppliers and future availability of products and services

Supplied as a synchronous switch, SyncServer migrates any point-to-point synchronous traffic over a TCP-IP Intranet. It handles X.25, SDLC batch traffic, Frame Relay, and other HDLC-based protocols, with no requirement for change in host or terminal systems.

Performance Testing

End users will expect performance of application functions to be as good as and probably better than the performance of the legacy network prior to migration. The migration should include performance testing that will verify performance criteria. Generally, TCP/IP is faster than many legacy networks. However, improper consideration of factors affecting conversion of data packets on legacy networks to TCP/IP packets can result in slower performance that will require network troubleshooting to resolve.

Concerns About IP Networking via Internet can be Addressed with Available Products

IP networking is generally associated with the Internet. As such, the two major concerns about IP networking are security and bandwidth availability. Many organizations have a private IP infrastructure and therefore no concern about security or bandwidth optimization. The data lines are private and bandwidth is known because it has been purchased. But today, even if the Internet is used as the IP network, concerns about security and bandwidth available can be

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addressed through network design and the availability of many products designed specifically for these purposes.

Security Considerations

If a new TCP/IP network is deployed in part or in whole to permit migration from legacy networks to TCP/IP networks, network security design must be incorporated as part of the overall network rollout. For an internal TCP/IP network, security concerns may be lessened somewhat. However, use of the Internet as the TCP/IP network will require the use of virtual private networking (VPN) and firewalls, and may require intrusion detection systems and data encryption.

Bandwidth Considerations

If there is an existing internal TCP/IP network, adding data traffic that was formerly on a legacy network will require analysis of total bandwidth requirements, priority and fluctuations in bandwidth requirements for peak periods.

Example Migrations

Synchronous Frame Switching Over IP

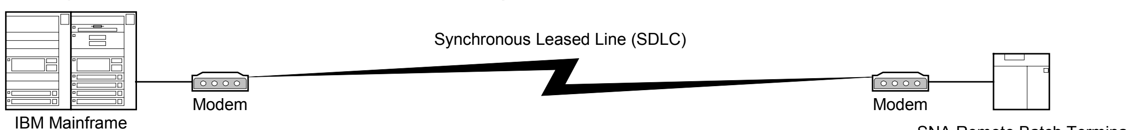

Figure 1: File Exchange over a synchronous leased line

Figure 1 illustrates a point-to-point network connection for file exchange with IBM mainframes. A synchronous frame-switching approach is the easiest migration for this type of connection, since the software for terminal devices and host applications is usually not amenable to change. In a frame-switching environment, the IP interface/switching devices have no knowledge of the protocol running over the synchronous leased line illustrated in the diagram.

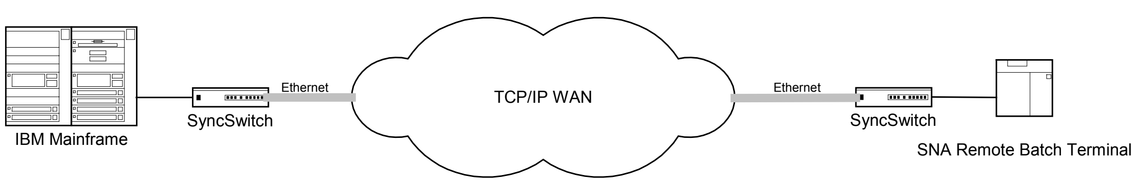

Figure 2: SyncSwitches deployed to provide frame switching for file exchange

Figure 2 illustrates SyncSwitches deployed to provide frame-switching services. This deployment has a unit at each side of the network. The SyncSwitch and TCP/IP WAN replace the modem/dataset and leased line shown in Figure 1 above. The SyncSwitches interface to the legacy gear using a standard synchronous serial electrical interface (RS-232 or V.35, for example). Synchronous traffic received is forwarded to the remote SyncSwitch over the SyncSwitch's Ethernet interface, using the organization's TCP/IP infrastructure to reach the remote device. Each SyncSwitch has its own IP address, and the system administrator matches

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the IP addresses of cooperating SyncSwitch devices to achieve a virtual leased line across the IP network.

At the host, where there are likely to be many physical connections from different sites terminating, further economies are available by using multiple port SyncSwitches to multiplex traffic from more than one link; SyncSwitch is available as a two-, eight-, or sixteen-port device. As the SyncSwitch has no protocol knowledge, successful implementation of a SyncSwitch migration depends on adequate IP network performance, as measured by end-to-end response time and TCP/IP throughput.

Protocol Switching Over IP: X.25 DTEs

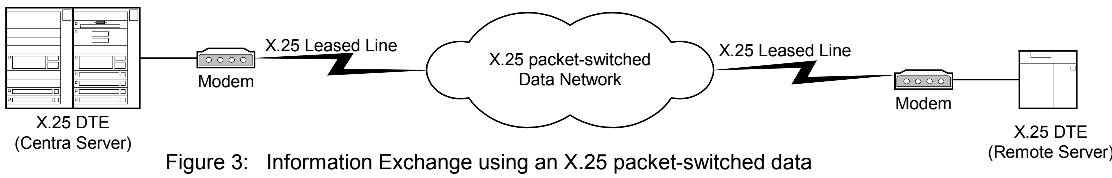

Figure 3: Information Exchange using an X.25 packet-switched data network

Although Figure 3 shows a point-to-point connection very similar to that of the first example, it also illustrates that a connection is achieved using a packet-switched data network rather than a leased line. Packet-switched connection replacement benefits from a different approach to migration from the first example to provide full functionality to end users. X.25 links, like Ethernet connections carrying TCP/IP, can carry multiple conversations to different endpoints on the same physical piece of wire. Although this example only shows two entities exchanging data, this is a limitation of the drawing, not of the capabilities of the X.25 networking protocol. As with the first example, the SyncSwitch hardware replaces leased line datasets/modems as well as the packet-switched data network. However, the SyncSwitch at each end analyzes the X.25 protocol information it receives, mapping X.25 connection requests to TCP/IP session establishment to remote SyncSwitches. As before, each SyncSwitch has its own unique IP address. In this case, the system administrator configures X.25 packet level address information to map to IP addresses, allowing the SyncSwitches participating in the network to establish connections to appropriate remote locations upon request.

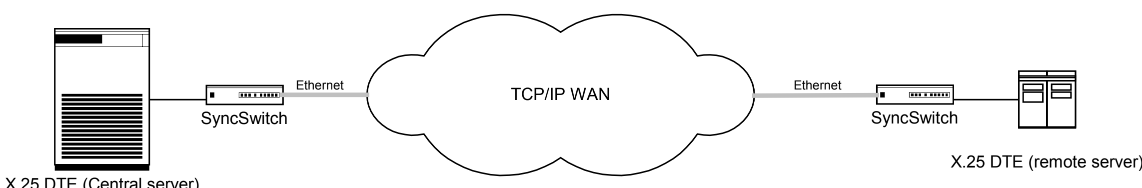

Figure 4: SyncSwitch implementation for X.25 Information packet switching

This packet-switching approach allows designers to use the SyncSwitch and an IP infrastructure to replace both leased lines and the packet-switching network, as illustrated above in Figure 4. Although there are no performance benefits to the end devices, sensitivity to IP network performance is greatly reduced, as the SyncSwitch both buffers information and responds immediately to legacy device protocol sequences.

Protocol Switching Over IP: X.25 and X.3/28/29 Connections

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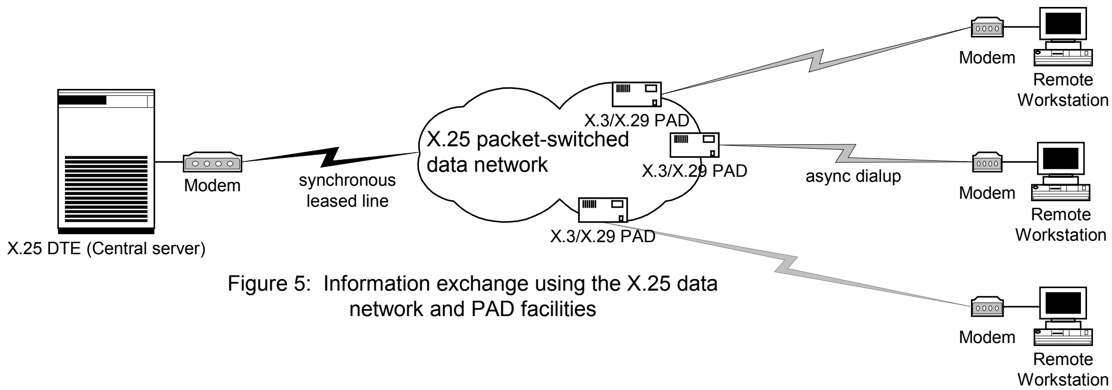

Figure 5: Information exchange using the X.25 data network and PAD facilities

As illustrated in Figure 5 above, public packet-switched data networks often provide conversion services that allow other devices and protocols seamless connection to the packet network. The asynchronous Triple-X (X.3, X.28 and X.29) PAD (Packet Assembler/Disassembler) is a typical example of such a conversion. In this scenario, a server with a few X.25 connections to the packet-switched network (only one is illustrated) uses those connections to handle connections with many remote asynchronous devices (hundreds, if not thousands). Each remote device has an asynchronous connection to the packet-switched data network, and uses an agreed-upon procedure (usually based on the X.3/28/29 protocols) to establish an X.25 connection with the server.

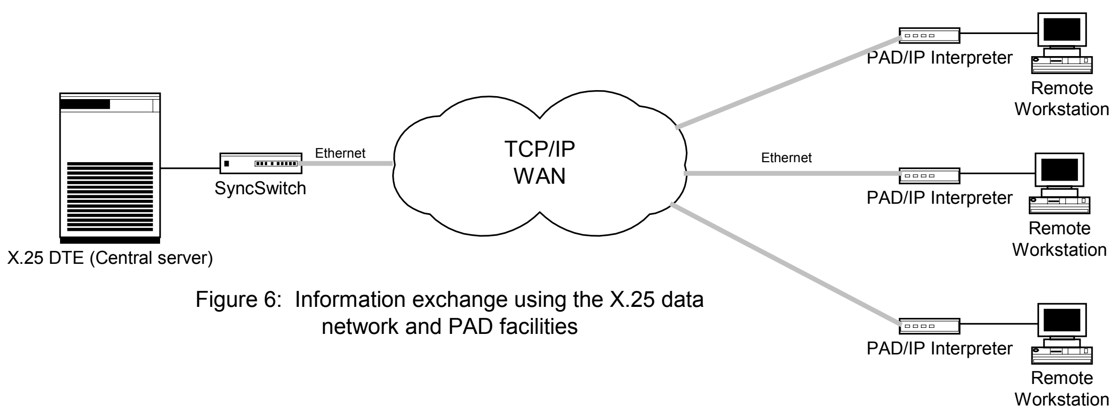

Figure 6: Information exchange using the X.25 data network and PAD facilities

This environment requires two types of device: a low-power, single port asynchronous device to handle individual terminal traffic, and a higher-power device with one or more synchronous ports for concentrating traffic from asynchronous remotes to X.25 datastreams at the central server. In the diagram below, the asynchronous modem is replaced with TSG's PAD emulator. It interprets the serial data stream from the remote device as a modem/PAD combination would, establishing a TCP/IP connection across the network to a SyncServer attached to the customer's host. As far as both the host and remote application are concerned, there is no change to the network; the only change is the reduction in the customer's cost of operating the network.

Application Migration

Although not transparent to applications and existing networking hardware like the switching examples described above, application migration holds the potential for the most significant cost

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savings over switching alternatives. Cost savings accrue directly, in that less equipment is required for a network implementation, and indirectly, in that synchronous protocol processing is offloaded to TSG-supplied SyncServer devices and applications become more portable. Further indirect cost savings are available in terms of the system's insensitivity to operating system and/or computer platform changes - since a SyncServer implementation does not involve adapters, device drivers, or protocol stack add-ons.

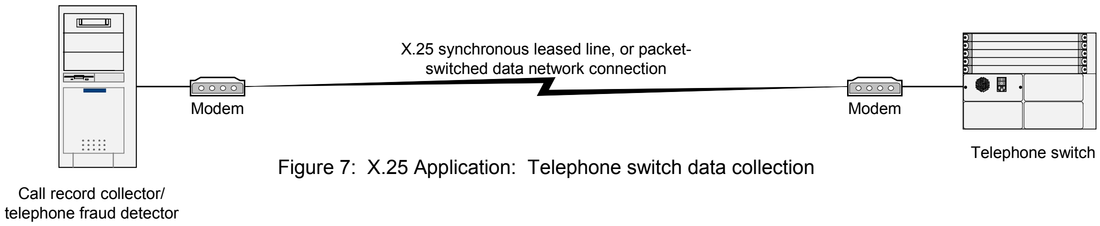

Figure 7: X.25 Application: Telephone switch data collection

In the scenario illustrated in Figure 7, a computer system collects billing data from one or more telephone switches (Figure 7 only illustrates one). The collector uses a synchronous serial leased line and X.25 protocol to connect to the switch and control the flow of data from it. To make the X.25 connections, the organization either implements a private synchronous leased-line based network (illustrated here), or rents leased line and X.25 packet-switching facilities from a public carrier. In the public packet-switched network case, the customer pays both for leased lines and use of the packet network (packet-switched data network charges are usually based on the amount of data transferred, but there may also be additional time-based charges).

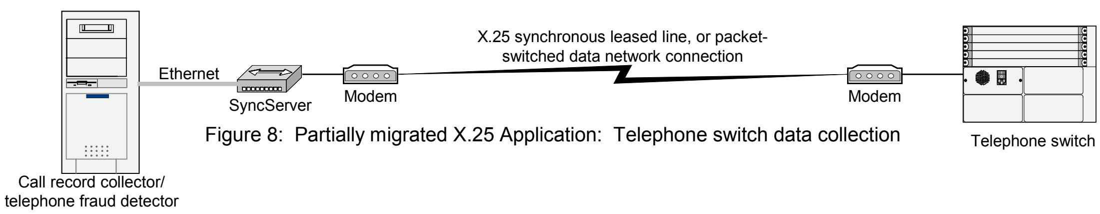

Figure 8: Partially migrated X.25 Application: Telephone switch data collection

To begin the migration, a SyncServer can be deployed to replace the collector computer's X.25 implementation and synchronous interface hardware, as illustrated above in Figure 8. The X.25 implementation runs on an outboard device (the SyncServer) and the collector application uses a socket-based API to communicate with it in order to exchange X.25 information with the telephone switch. Although this partial migration does not exploit the availability of a TCP/IP WAN infrastructure, it does have an important benefit for systems expected to have a long lifetime in the field: the X.25 implementation is not sensitive to the bus architecture of the collector computer, or what operating system version (or operating system) it is running. As the API operates in process space, and there are no drivers or protocol modules required in the collector, the application can be moved to another machine without having to worry about the availability of OS drivers or appropriate hardware to plug into the computer bus.

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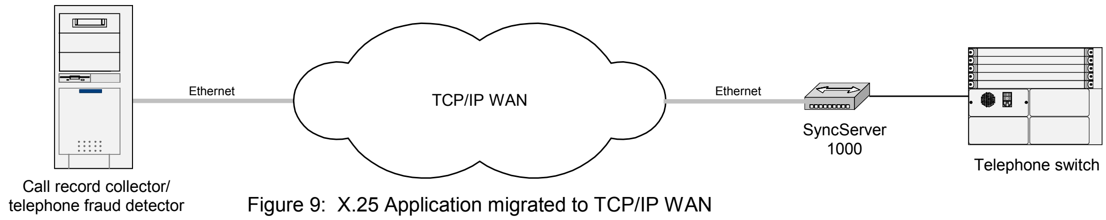

Figure 9: X.25 Application migrated to TCP/IP WAN

Figure 9 illustrates a complete migration to the SyncServer, which captures all of the potential benefits of this architecture. In this illustration, the collector computer becomes a client (a user of the remotely located X.25 services that SyncServer provides). It uses an Ethernet-based /IP connection to move X.25 information to the SyncServer, which operates the X.25 connection to the telephone switch. (Any medium which supports TCP/IP connectivity may be used; it need not be Ethernet-based.) Unlike the scenarios already described, this SyncServer approach eliminates both the synchronous hardware adapter in the collector and leased lines between the collector and telephone switch.

Conclusion

Many legacy networks are still in place today because they function adequately to suit production environments. Support for legacy protocols and the underlying physical network elements is decreasing. Making the transition from legacy networks to TCP/IP network can result in significant operational savings. The transition need not involve significant redesign, capital expenditure or application recoding if SyncServers are deployed. With consideration of objectives and careful network planning, the transition from legacy to TCP/IP network can be accomplished quickly and efficiently.

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