



Overview of Cisco SNA Internetworking

The *Cisco IOS Bridging and IBM Networking Configuration Guide* discusses software components used to internetwork mainframe-based Systems Network Architecture (SNA) networks with router-based TCP/IP networks. This overview chapter provides a description of Cisco SNA internetworking. For technology overview and configuration information, refer to the appropriate chapter in this publication. This chapter contains the following sections:

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Background and Overview

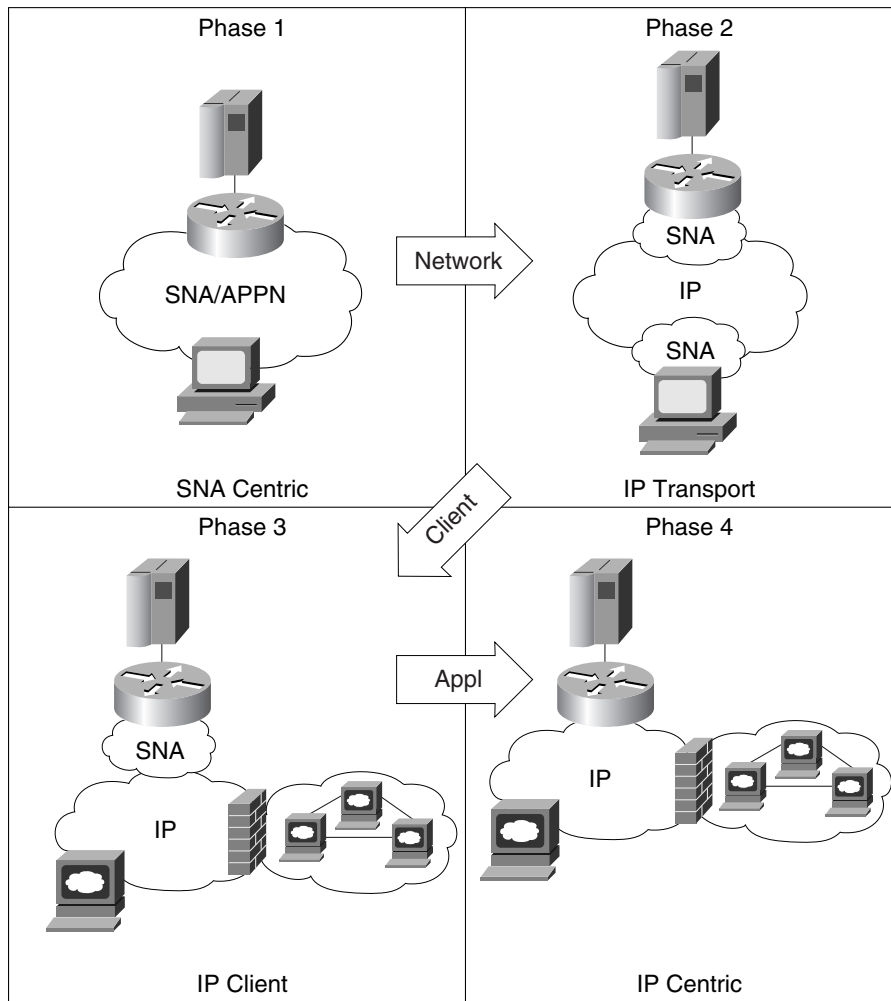
IBM mainframes and SNA traditionally have formed the foundation of enterprise networks. In the 1980's, Cisco routers and TCP/IP emerged as the technologies for the future of enterprise networks. By the early 1990s, many large commercial, government, and educational organizations began to integrate TCP/IP products and technologies into their SNA networks. Today, the common denominator for electronic communication from one organization to another or from a consumer to a company is TCP/IP. Adopting a TCP/IP infrastructure is the first logical step to creating a multiservice network that seamlessly accommodates data, voice, and video.

Enterprise organizations are heavily invested in mainframes and SNA and mainframes are still a vital part of enterprise data centers. The goal for these enterprise organizations is to integrate the TCP/IP-based environment with the SNA-based environment. Cisco's bridging and IBM networking technologies enable the delivery of SNA data over routers supporting TCP/IP.

Cisco's Four-Phase Model for SNA-to-IP Integration

Cisco has developed a high-level, four-phase model illustrating a typical integration path to incorporate TCP/IP into an SNA-based network. Figure 1 illustrates the four-phase integration path. The model helps to describe some common phases in SNA-to-IP integration. A single phase in this integration path might represent the network of some organizations, while two or more phases might represent the network implementation of other organizations in various sectors of their network.

Figure 1 Cisco's Four-Phase SNA-to-IP Integration Model



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The phases can be differentiated by the protocol that runs in each of three key elements in the network: the mainframe/midrange computer, the network backbone, and the desktop. The characteristics of each of the phases are described here along with the problems solved, types of products and technologies implemented, and challenges.

This section contains the following topics:

- Phase One: SNA Centric
- Phase Two: IP Transport
- Phase Three: IP Client
- Phase Four: IP Centric
- Summary of Four-Phase Model

Phase One: SNA Centric

An SNA-centric network has SNA, Advanced Peer-to-Peer Networking (APPN), or APPN/High Performance Routing (HPR) protocols running on one or more mainframe/midrange systems, in the network backbone, and at the desktop. Subarea networks that were widely implemented in the 1980s were built upon ACF/VTAM in the mainframe, ACF/Network Control Point (NCP) in communication processors (that is, front-end processors [FEPs] and remote concentrator processors [RCPs]), and cluster controllers with terminals attached via coaxial cable. The communication lines utilized were predominantly leased Synchronous Data Link Control (SDLC) and public or private X.25 lines.

In the late 1980s and early 1990s, traditional SNA networks evolved to meet the new demands for client/server computing and LANs. PCs running terminal emulation software replaced many of the fixed-function terminals. Token Ring LANs were widely deployed to bring higher speeds and support client/server computing. RCPs were often replaced by a new generation of remote SNA devices—LAN gateways, bridge/routers, and Frame Relay access devices (FRADs).

Today's SNA-centric network is a very high-speed and dynamic network when compared to the traditional SNA network of the past. ACF/VTAM on the mainframe includes APPN/HPR protocols to support dynamic rerouting around failures and high-speed switching in the network. The mainframe complex, which now comprises multiple complementary metal-oxide semiconductor (CMOS) processors, implements Parallel Sysplex to provide the ultimate in redundancy and session persistence.

The FEP has often been replaced by a high-performance, channel-connected router such as the Channel Interface Processor (CIP) or the Channel Port Adapter (CPA). The network backbone comprises high-speed switches (ATM, Ethernet/Fast Ethernet/Gigabit Ethernet, or Token Ring) and routers running APPN/HPR. Shared Token Ring LANs are being replaced with Token Ring or Ethernet switching to the desktop, offering a dedicated LAN segment and bandwidth to each end user. Most desktops have PCs running advanced SNA client emulation software such as TN3270 Server. Routers provide support, via features such as Dependent Logical Unit Requester (DLUR) and downstream physical unit (DSPU) concentration, to transport the traffic from the remaining traditional SNA terminals and controllers.

Phase Two: IP Transport

Beginning in the 1980s, large organizations began building TCP/IP-based networks to support client/server applications and systems. UNIX, a dominant operating system for client/server applications, natively supports TCP/IP. As the growth of TCP/IP-based systems continued, organizations often found that they had built parallel networks, one running SNA and one running TCP/IP. This setup is expensive because of the duplication of line costs, equipment, and personnel. To eliminate the duplication, organizations had a choice—run the TCP/IP traffic over the SNA backbone, or run the SNA traffic over the TCP/IP backbone.

Running TCP/IP over an SNA backbone was not a feasible choice because of the lack of redundancy and openness of SNA. Routers, which formed the core of the TCP/IP network, began to support the encapsulation of SNA in TCP/IP for transport across the TCP/IP network using technologies such as remote source-route bridging (RSRB) and data-link switching plus (DLSw+).

This encapsulation brings many benefits. First and foremost, while it is encapsulated in TCP/IP, the SNA traffic is dynamically routed around network failures, a benefit that only recently has been added to SNA networks with APPN/HPR. The encapsulation schemes also provide more flexible configurations for SNA devices and reduced polling traffic across the backbone. Cisco offered the first such encapsulation scheme with RSRB. Since then, the industry has adopted a standard, data-link switching (DLSw), that has been very widely accepted and implemented. Routers also provide features such as serial tunnel (STUN) and Block Serial Tunneling (BSTUN) to encapsulate other types of traffic (asynchronous, bisynchronous, and some proprietary protocols) in addition to SNA.

In this second phase of integration, many organizations find that the same end users who are running advanced SNA client emulators to access mainframe and midrange systems are also accessing TCP/IP systems. This means that each PC must run two different protocol stacks—SNA and TCP/IP—for access to host systems.

Phase Three: IP Client

In the third phase of SNA-to-IP integration, organizations eliminate the dual protocol stacks at end-user PCs by implementing emulation software that supports TCP/IP. The same rich functionality that end users rely on in their emulation software remains the same, only it now runs over a TCP/IP stack. Cisco Transaction Connection (CTRC) provides TCP/IP end-users and servers with direct access to Customer Information Control System (CICS) and IBM DB2 databases. Organizations achieve protocol independence between end-users and hosts, enabling applications to communicate directly to DB2 or CICS without upgrades.

TN3270(E), TN5250, Distributed Relational Database Architecture (DRDA) and Inter-System Communications (ISC) protocol are widely implemented and widely accepted standards for achieving TCP/IP-based access to mainframes and AS/400s. The TN3270 Server technology on the router provides support for the TN3270(E) clients. CTRC on the router supports access to IBM DB2 databases from ODBC and JDBC drivers. CTRC also supports access to transaction programs managed by IBM's CICS. In addition to eliminating a second protocol from each desktop, organizations reap the following benefits by implementing low-cost, standards-based solutions such as TN3270(E), TN5250, and CTRC:

- Availability of high-performance servers. Very high-capacity and high-performance gateway servers are available that offload the protocol processing of TN3270(E) or TN5250 from the mainframe or midrange host. These servers replace the low-capacity PC gateways that are based on proprietary gateway protocols.
- Integration with corporate intranet. Because the desktop is based upon TCP/IP, all the advances taking place in corporate intranets can be brought to mainframe and midrange connections. For example, virtual private networks (VPNs) can be created for secure remote host access. Encryption and authentication can become a new level of security for host access.
- Access from a browser. A whole new market, the Web-to-host market, is emerging that allows end users to access host systems using the browser as the standard interface. This setup brings enormous benefits by reducing the software distribution and administration chores for emulation software and this sets the stage for a new, browser-style interface to older applications. Organizations can look to these mission-critical applications to extend new services to their customers, as in the case of home banking, citizen access to government records, and insurance company applications.

Phase Four: IP Centric

In the fourth and final stage of SNA-to-IP integration, the mainframe and midrange systems natively support TCP/IP. They share files with and transfer data to other, non-SNA systems. The corporate databases are securely accessed in a standard way from a variety of different end-user applications. The remaining applications that are based on traditional “green-on-black,” character-based terminals are accessed transparently through standard emulation screens or through intuitive, user-friendly Web pages. These TCP/IP-based mainframe and midrange systems offer advanced redundancy and high-availability features similar to those provided to SNA-based applications today. With the full, native support of TCP/IP, the mainframe and midrange systems can be fully participating members in the corporate intranet.

Summary of Four-Phase Model

The four-phase model of SNA-to-IP integration is based on Cisco's experience helping to integrate some of the world's largest and most complex SNA networks. In reality, very few organizations go through a stepwise, linear migration from SNA centric, to IP transport, to IP client, to IP centric. For example, many large organizations have run TCP/IP stacks on their mainframes for years, alongside ACF/VTAM, whether they have implemented TCP/IP in the enterprise backbone network or not. Indeed, most large organizations will find elements from all four phases represented somewhere in their network. The model, however, is useful to describe the various issues of SNA-to-IP integration, their common solutions, and the characteristics of the network at various points in the change.

Scenarios for SNA-to-IP Integration

There are common elements or scenarios for integrating TCP/IP with SNA networks. This section describes three elements or scenarios, the corresponding phase from Cisco's four-phase integration model, and the Cisco products and software features deployed in these scenarios. This section discusses the following scenarios:

- Line Consolidation
- FEP Replacement
- Desktop Consolidation

Line Consolidation

Line consolidation involves simplifying the network by providing a single network infrastructure, based on TCP/IP. This structure accommodates SNA and other traffic and allows the elimination of multiple single-protocol lines to each location.

Phase two of SNA-to-IP integration dictates the building of a single network backbone based upon TCP/IP. This setup often allows organizations to consolidate the number of communication lines in the network which simplifies the support and maintenance.

The primary product in a line consolidation project is a multiprotocol router that encapsulates and converts the traffic from the SNA lines. RSRB and DLSw+ are the Cisco IOS technologies used for this conversion. In addition, Cisco routers also support the tunneling of both bisynchronous and certain asynchronous protocols with Cisco IOS features such as STUN and BSTUN and the Airline Product Set (ALPS).

FEP Replacement

FEP replacement involves replacing FEPs (and possibly other special-purpose mainframe channel-attached equipment) with new channel-attached routers that offer high throughput, low costs, and flexible software functionality.

Throughout all phases of the SNA-to-IP integration, high-capacity throughput to the mainframe is a key requirement. Organizations are replacing FEPs with routers with direct channel attachments.

The primary product in a FEP replacement project is a channel-attached router. This router contains the mainframe channel connection hardware supporting either a bus-and-tag or ESCON interface (or multiple interfaces). It also runs the necessary channel protocol software and, in some cases, special software designed to offload communication processing from the mainframe. For example, the Cisco CIP and CPA both support TCP Offload, TCP Assist, CTRC, and TN3270 Server features to offload mainframe cycles.

Desktop Consolidation

In a desktop consolidation, desktops running multiple protocol stacks are simplified to utilize TCP/IP for access to all resources, including mainframes and AS/400s. This consolidation can be accomplished using traditional emulators that utilize TCP/IP instead of SNA for host communication, or it can be accomplished by leveraging new browser-based access approaches.

Phases three and four of the SNA-to-IP integration require end users to access host systems using TCP/IP.

The primary products in a desktop consolidation project are desktop devices, desktop software, and new gateway servers. Other products that may be considered for deployment are additional load-balancing domain name servers, firewalls, and other security devices. Terminal emulation is, by definition, a client/server implementation. That is, PCs running terminal emulation software communicate with gateway software (located on a PC server, a router, or the host) using either a proprietary or a standard protocol that is at a higher level than the TCP/IP transport. These gateways then communicate directly with the host applications using standard SNA protocols. Most terminal emulators offer multiple choices of gateway connectivity. The only standard TCP/IP-based protocols for communication to mainframe and midrange systems are TN3270(E) and TN5250, respectively. Many organizations are implementing TN3270 and TN5250 because they are standards and they set the stage for Web-to-host solutions.