

**MAINFRAME**

Brocade Solutions for Deploying Systems Network Architecture (SNA) in IP-based Environments

SNA over IP solutions have evolved over the last decade and a half to provide a variety of solution options. The optimal solution depends upon the application environment and the evolution of legacy equipment in those environments.

Typically, customers modernize their networks and then deploy technology that allows them to transport the SNA application traffic over the new IP network. This paper describes Brocade Ethernet Solution products and their application into the evolution of Systems SNA networks in IP-based environments. It describes the modernization use case and the tools needed to migrate from legacy SNA network structures to IP-based solutions.

This migration involves replacing traditional 3270 terminals with emulation programs (TN3270) for SNA LU Type 2 applications and providing transport emulation (Enterprise Extender) that replaces SNA infrastructure components to support SNA Advanced Peer-to-Peer Networking (APPN) applications (LU Type 6.2) and specialty devices (LU Type 0). The resulting solution leverages the advanced functionality and reliability of Brocade Ethernet Solutions with these “tried-and-true” IBM software solutions for a simplified and effective SNA over IP solution.

OVERVIEW

One of the key characteristics dating back to the inception of the IBM mainframe is investment protection, specifically for investments made in application software. Many System z customers have considerable investments in Systems Network Architecture (SNA)-based applications. Modernizing SNA reduces maintenance and operating costs of an aging SNA infrastructure while preserving the investment made in SNA applications. This is accomplished by making changes that enable reuse of SNA applications in an IP-based network infrastructure. The modernization of corporate network infrastructures has seen a shift in the last decade from SNA networks and applications to TCP/IP and Internet technologies. In many cases, applications have changed and processes have been reengineered to use TCP/IP rather than SNA. In other cases, SNA application traffic has been adapted to run over IP-based networks using technologies, such as TN3270, Data Link Switching (DLSw), SNA Switching (SNASw), or Enterprise Extender. Consequently, corporations have seen the traffic that traverses communications controllers, such as the IBM 3745/46, decline to the point where such technologies can be eliminated entirely from their networking environments.

The ultimate goal of SNA modernization is the preservation and enhancement of SNA applications on the System z and in the branch environment for as long as the SNA applications remain a valuable business asset to the organization. Simultaneously, wide area SNA application level traffic will be transported over an IP wide area network, and SNA network level traffic will be consolidated to the data center, or even to the System z platform itself.

Organizations typically update their SNA environment by modernizing their SNA Network infrastructure or SNA application access. This paper discusses how Brocade Ethernet Solution products are uniquely positioned to provide the ultimate modernization solution for an SNA network infrastructure. A subsequent paper will discuss modernization solutions for the SNA application process.

BACKGROUND

The IBM System z mainframe is the dominant Online Transaction Processing (OLTP) server platform on the market today. System z-based OLTP applications, such as DB2 and VSAM, are used to facilitate and manage transactions in a number of industries, such as banking, airline reservations, mail order services, retail, and manufacturing. The most widely installed OLTP product in the world, both historically and today, is IBM's Customer Information Control System (CICS). Well known examples of mainframe-based online systems are bank ATM networks, government tax processing systems, travel industry reservation systems, retail credit/debit card payment systems, and retail point of sale terminals.

Systems Network Architecture (SNA) is a proprietary network architecture developed by IBM. In the early 1970s, IBM discovered that large customers were reluctant to trust unreliable communications networks to properly automate important transactions. In response, IBM developed Systems Network Architecture (SNA). SNA is a set of protocols and services enabling communications between host computers (IBM Mainframes) and peripheral nodes, such as IBM's dedicated hardware boxes, the 3174 controller for 3270 type displays and printers, controllers for the retail and finance industry, and more. The mainframe subsystem that implements SNA was named Virtual Telecommunications Access Method (VTAM). Platforms that implement SNA in addition to mainframes are IBM's Communications Server on Windows, AIX, and Linux, Microsoft's Host Integration Server (HIS) for Windows, and many more. In the 1980s, SNA was widely implemented by large (Fortune 1000) corporations because it allowed their IT organizations to extend central computing capabilities worldwide with reasonable response times and reliability.

In 2010, organizations still have a heavy investment in SNA-based transaction programs and applications on their mainframes. According to IBM, as of 2009, over twenty trillion dollars have been invested in SNA-based applications in over 40,000 organizations worldwide on the mainframe and other server platforms. Over 1 trillion lines of customer written application code is mainframe-based CICS, DB2, and IMS. IBM surveys indicate that SNA-based applications account for 61% of Wide Area Network (WAN) traffic and 66% of WAN budgets.

Modern Use of SNA

There are five primary factors contributing to the use of SNA-based applications in 2010:

- SNA is stable, trusted, and relied upon for mission-critical business applications worldwide
- 70% of the world's corporate data is handled on the mainframe and SNA applications utilize large amounts of data
- SNA is connection-oriented with many timers and control mechanisms that ensure reliable delivery of data
- Rewriting stable, well tuned business applications, to change from SNA program interfaces to TCP/IP sockets, can be costly and time consuming
- Many businesses are choosing Web-enabling technologies to make centralized data available to the TCP/IP-based Web environment while maintaining SNA APIs.

SNA as a networking protocol is rapidly approaching its end of life, but this does not lessen the importance or viability of these SNA applications or the SNA application programming interfaces (APIs) to which they are written. IP technology is well-suited for reliable, high-speed communications lines. Indeed, IP network technology is ubiquitous and steadily improving through contributions from the open source community. IBM, like other vendors, focused on IP as its network transport. Does this mean SNA is dead? On the contrary, SNA applications are still thriving, but they can now exploit a network transport appropriate for today's communications technology—one that will grow as that technology grows. IBM's Communications Server's Enterprise Extender (EE) support provides the function necessary to transport SNA application flows over IP networks in a highly efficient and effective way. Enterprise Extender enables a customer's SNA applications to fully exploit the latest IP technology transport.

Transitioning to SNA over IP (SNA/IP)

During the 20 year period when SNA was the primary networking method, many CICS and IMS application programs were developed and implemented. The application programming interface (API) of these application programs is heavily dependent on the underlying protocol, SNA. A transaction oriented program is dependent on the underlying protocol it uses. Every protocol provides an API (i.e. the API is different if one uses SNA or TCP/IP as the transport in the network). TCP/IP's API is called socket programming and SNA has its own API. Migrating a networking application from one protocol to another (from SNA to TCP/IP) requires replacing the calls to the API. Changing a transaction oriented program from one protocol to another protocol often requires a re-design of the communication part in the program, for example, replacing the code that handles error recovery, exception processing, and other tasks.

In the past 35 years, businesses have invested a tremendous amount of labor and money in developing SNA applications. IBM estimates that the investment made in CICA and IMS applications during this time is in the range of \$20 trillion. Due to this large investment made in SNA applications, these programs will be used for many years to come. To recode these applications as TCP socket applications is often impractical and cost-prohibitive.

How can we enable IP applications and preserve SNA-application and endpoint investment, while converging on a single network protocol? IBM introduced new technologies to help businesses preserve the investment in SNA and use IP as the protocol for connecting SNA computers. This technology is known as SNA over IP (SNA/IP). The two endpoints (the SNA application in the mainframe and the SNA application in the remote location) remain unchanged. This preserves the investment made in SNA applications while providing the advantages of IP transport. SNA over IP solutions have evolved over the last 15 years to provide a variety of solution options. The optimal solution depends on the application environment and the evolution of legacy equipment in those environments. Typically, customers modernize the networks and then deploy technology that allows them to transport the SNA application traffic over the new IP network.

SNA over IP Networks

SNA over IP solutions are designed to connect enterprise applications built on top of the SNA architecture over a wide area. The SNA over IP translation points are either supported in the IP router, on servers at end of the IP network, or mixed (that is, router solution in the branch and server solution in the data center).

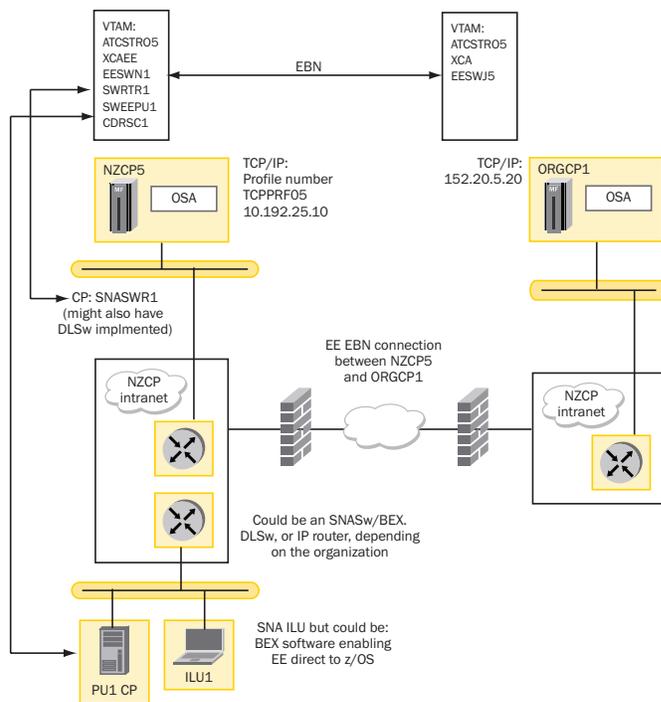


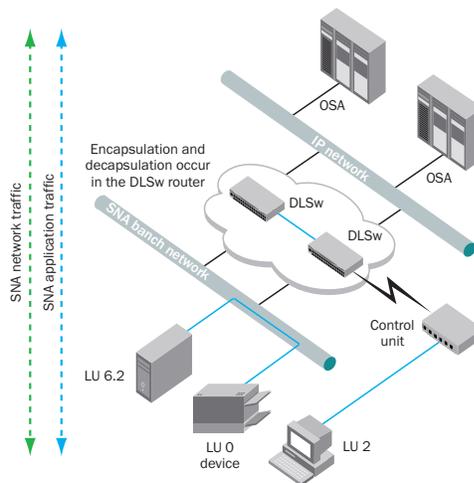
Figure 1.
SNA over IP
configuration
options.

The router solution provides flexible options, which allow the IP router to act as a concentrator at the branch (using DLSw) and as an End Node (EN) in the data center. In addition, the IP router can provide Enterprise Extender capabilities allowing the branch router to drive the SNA traffic all the way to the host (that is, no need for an EN in the data center). However, this solution requires specialized router software (the Cisco SNASw feature), which includes customized extensions to completely support the SNA requirements.

If, however, you want to get the most out of your IP network, then Brocade Ethernet Solution products paired with the TN3270 emulation software or Enterprise Extender software is the most robust, flexible, and cost-effective solution for your enterprise. The Enterprise Extender solution, more formally known as SNA Advanced Peer-to-Peer Networking (APPN) with High Performance Routing over IP (HPR over IP), is embedded in z/OS for the data center and is available on servers attached to the IP network at the branch. Enterprise Extender uses an IP network as the SNA HPR link. From the APPN viewpoint, the IP network appears like any other HPR link in a normal APPN HPR topology. From the IP perspective, HPR over IP looks like any other UDP-based application. HPR over IP allows the end user to implement IP connectivity from the branch based workstation right into the data center, even to z/OS itself for System z (in other words, end-to-end), without depending on any traditional SNA network infrastructure components.

From the topology perspective of APPN, Enterprise Extender (EE) looks upon the entire IP network as a single-hop HPR link. For customers who have enabled APPN with HPR, transport of the SNA HPR data over an IP network is quite simple. Define the HPR EE link and configure the local TCP/IP environment to support five UDP port numbers used by EE (12000-12004). These five UDP ports include one UDP port per SNA Class of Service (COS). What this does is provide the IP network routers with IP packet priority information based on the original SNA network priorities. By using a separate port number for each of the five SNA classes of service, it is possible to maintain the SNA prioritization in the IP network by assigning differentiated services (DS) settings (previously known as type of service or TOS) per UDP port that will match the relative priorities of the SNA class of service definitions.

Figure 2.
Sample SNA over
IP network.



One other key point about Enterprise Extender (EE) is that it uses the UDP transport layer. From the TCP/IP perspective, EE is just another UDP application. UDP is a connectionless, best-effort transport, non-reliable protocol. At first glance, UDP seems to be an odd choice for the reliability we typically associate with the mainframe and SNA networking. However, EE is an extension to HPR, and HPR uses the Rapid Transport Protocol (RTP) layer in the SNA protocol stack to achieve the levels of required reliability.

This solution can be as varied as software deployed on a per-terminal basis or concentrated on scalable servers from Windows to pSeries to zSeries Business Continuity (BC) solutions. EE offers the potential for true end-to-end SNA over IP transport between the branch and the data center. The range of flexible options associated with Enterprise Extender makes it the natural choice for modernizing your existing SNA network.

Solutions

Brocade Ethernet Solutions integrate SNA applications into modern networking infrastructures and provide you with the tools needed to support existing business operations and processes on strategic enterprise networks. Brocade's best-of-breed solutions help your enterprise or service provider build highly reliable broadband IP infrastructures, laying the foundation for next-generation applications. Brocade solutions build your competitive advantage in business, and ensure a network that scales with your business. These solutions now incorporate SNA over IP to provide you with a highly flexible option for modernizing your SNA networks and applications.

The technologies at the core of the Brocade SNA over IP solution are the Brocade Ethernet Solution products and IBM SNA support technologies (TN3270 and Enterprise Extender). Brocade Ethernet Solution products enable creation of highly available, scalable, and strategic IP infrastructures, which enhance the capabilities of TN3270 and Enterprise Extender to migrate SNA applications into corporate strategic LANs. These tools combine to create the most flexible solution for your SNA applications now and into the future.

METHODOLOGY

Basic SNA networks consist of the following four components:

- The mainframe hosting the applications and acting as the System Services Control Point (SSCP)
- The communications controller hosting the Network Control Program (NCP)
- The leased or dial-up lines connecting the data center to the remote locations
- The terminal control units connecting terminals and printer or branch computers hosting applications and/or connecting terminals and printers (see Figure 3)

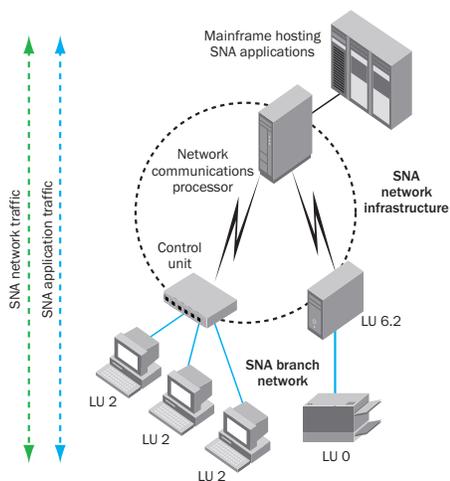


Figure 3.
Traditional
SNA network.

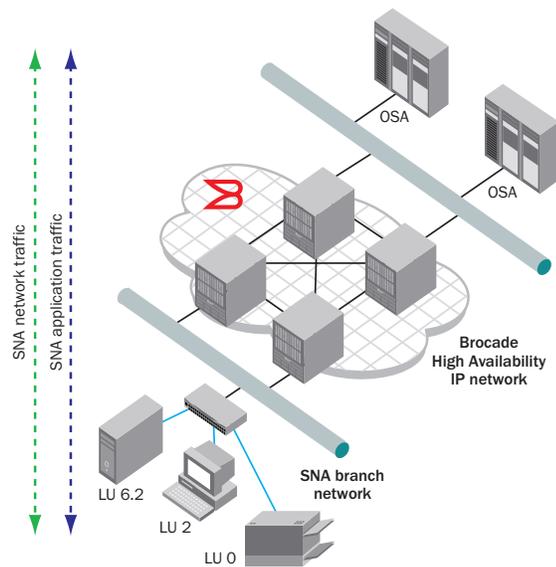
As you migrate from this hierarchical infrastructure to a peer-to-peer based infrastructure, the most logical component to modernize first is the network. IP networks provide a strategic transition for you and your enterprise and also provide the most common replacement technology for the SNA network components. Once an IP network is in place, replacement of the LU 2 components becomes cost-effective and manageable. By deploying the TN3270 terminal emulation on workstations or PCs, you can remove the legacy 3270 terminals and control units. In addition, APPN applications or LU 0 devices can be attached to local branch servers enabled with Enterprise Extender to complete the transition.

INFRASTRUCTURE

The role of data networks in our daily lives continues to expand. Emerging needs such as application convergence, non-stop operation, scalability, and IPv6-readiness place new demands on the network. Modern network solutions must be assessed across a wider set of attributes than earlier-generation equipment. In particular, the network must be evaluated on merits that include performance, reliability and scalability, quality of service, security, and Total Cost of Ownership (TCO).

The modernization of SNA networks begins with updating the networking infrastructure with highly reliable, strategic components. The Brocade Ethernet Solution products excel in all of these areas, enabling network designers to deploy an Ethernet infrastructure that addresses today's requirements with a scalable and future-ready architecture that will support network growth and evolution for years to come. Brocade Ethernet Solution products incorporate the latest advances in switch architecture, system resilience, quality of service, and switch security in a family of modular chassis, setting industry-leading benchmarks for price performance, scalability, and TCO.

Figure 4.
SNA over IP network
configured with a
Brocade IP solution.



Available in multiple chassis models, the Brocade Ethernet Solution products allow network designers to standardize on a single product family for aggregation and backbone switching. In addition to its enterprise role, Brocade Ethernet Solution products with their high-density and compact design are an ideal IP solution for data mining and high-performance computing environments and Internet Exchanges (IXPs) and Internet Service Providers (ISPs) in which non-blocking, high-density Ethernet switches are needed.

All Brocade Ethernet Solution products are designed for non-stop operation, supporting 1:1 management module redundancy, N+1 switch module redundancy, M+N power module redundancy, and N+1 fan redundancy. Additionally, Brocade Ethernet Solution products support hitless software upgrades and graceful restart routing for fast convergence in the event of a management module failure.

At the heart of the Brocade Ethernet solution products architecture is an adaptive self-routing Clos-based switch fabric with a Virtual Output Queue (VOQ) design. This non-blocking architecture is optimized for maximum throughput and low latency for all size packets. Scalable to over two billion packets per second, Brocade Ethernet Solution products are the most powerful Ethernet switch family in the industry. This advanced and scalable design ensures the reliable delivery of all IP-based voice, video, and data applications. Brocade Ethernet Solution products ship with field-proven IronWare networking software and IronShield security, embedded sFlow per port, advanced Ethernet switching, IPv4/IPv6 routing, and multilayer security services. Brocade Ethernet Solution products enable a user to deploy a reliable, secure, and scalable networking solution today, which is ready to accommodate tomorrow's applications and technologies.

Terminals

SNA LU Type 2 devices are the most common interface to SNA applications. Typically, these devices were connected to the SNA network by 3174 cluster controllers, which in turn connect to the 3745/46 communications controllers. As the SNA infrastructure becomes modernized, these devices have been replaced by emulators running on intelligent workstations or PCs. The most common deployment is the TN3270 emulation software running on a PC attached to the LAN. Using this methodology, the data stream is driven as standard IP traffic to the data center before bridging to the SNA network and applications. These TN3270 clients connect directly to the mainframe operating system TN3270 servers over the Brocade Ethernet Solution network through the OSA adapters on the mainframe.

TN3270 is a standard application protocol defined by the Internet Engineering Task Force (IETF) that allows a 3270 emulator to connect over an IP network to the TN3270 server running on the mainframe. It emulates SNA LUs (Type 1, 2, and 3) and establishes SNA sessions with the requested SNA application. In this configuration, the PC to TN3270 server connection is TCP/IP over the Brocade Ethernet Solution network and the server to SNA application connection is an SNA session over an SNA network. However, the local connection to the network is still just an IP protocol connection, which simplifies the deployment.

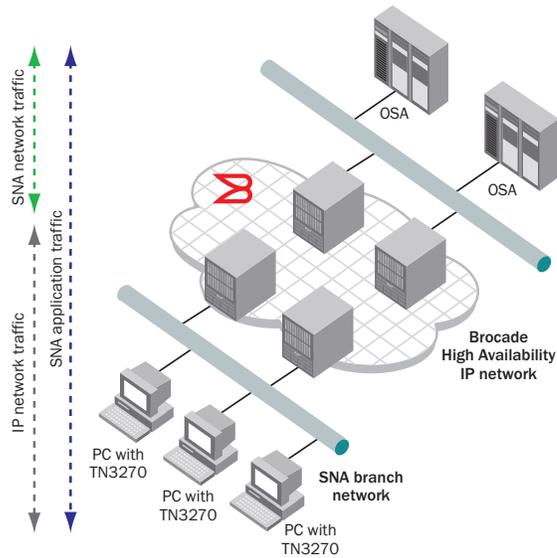


Figure 5.
SNA over IP network utilizing TN3270 with a Brocade IP solution.

Applications and Devices

The methodology used to adapt SNA LU Type 6.2 applications or LU Type 0 devices into the local IP network is to provide SNA bridge technology at the edge of the enterprise. The most effective technique is to exploit the functionality and flexibility of Enterprise Extender for this purpose.

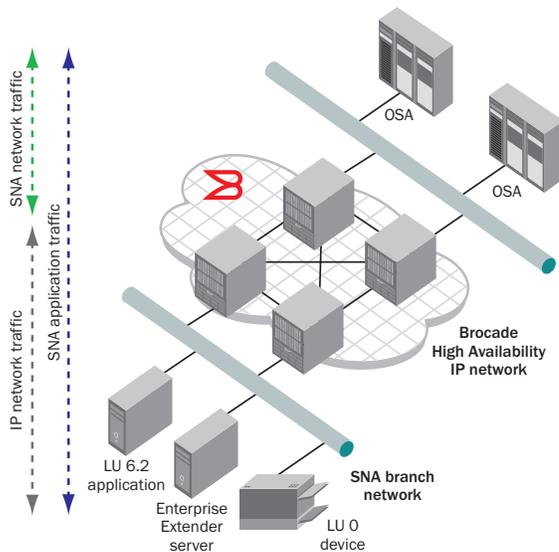


Figure 6.
SNA over IP network deploying Enterprise Extender with a Brocade IP solution.

The Enterprise Extender architecture carries SNA (HPR) traffic of any LU type over an IP infrastructure without requiring changes to that infrastructure. It essentially treats IP network as a particular type of SNA logical connection, in much the same way as an ATM or frame relay network is treated. In this manner, these SNA protocols act as transport protocols on top of IP, as does any other transport protocol such as TCP.

Enterprise Extender provides end-to-end SNA services because it can be deployed in hosts and intelligent workstations. Running at the edges of the IP network, it benefits from IP dynamic rerouting around failed network components without disrupting SNA sessions. In addition, these capabilities are performed without the need for specialized data center routers or network communications protocol concentrators.

Enterprise Extender integrates SNA APPN technology with modern IP infrastructures, and thereby allows the preservation of SNA transmission priorities across a QoS-enabled IP network. This capability coupled with support for High Performance Routing (HPR) provides for optimal SNA application performance and behavior.

CONCLUSION

SNA over IP environments have well-defined and mature solutions. TN3270 is a proven solution for LU 2 SNA connections and the components of Enterprise Extender are embedded in the z/OS operating system and are kept current with the available capabilities of z/OS. Leveraging this technology allows Brocade to develop solutions that not only meet the SNA requirements for existing applications, but also provide a consistent migration path that remains current with the expanding functionality of the System z environment. Brocade's partnership with IBM brings the power, intelligence, and stability of industry-leading solutions to your SNA over IP solutions.

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