SNA Strategy and Migration Considerations

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Session 12845

Agenda

Subarea

HPR

EE

APPN

❑ SNA: Dead or Alive?

❑ SNA: A Little History

❑ Modernizing SNA

❑ SNA Architecture

❑ SNA Modernization Techniques

❑ State of SNA

❑ References

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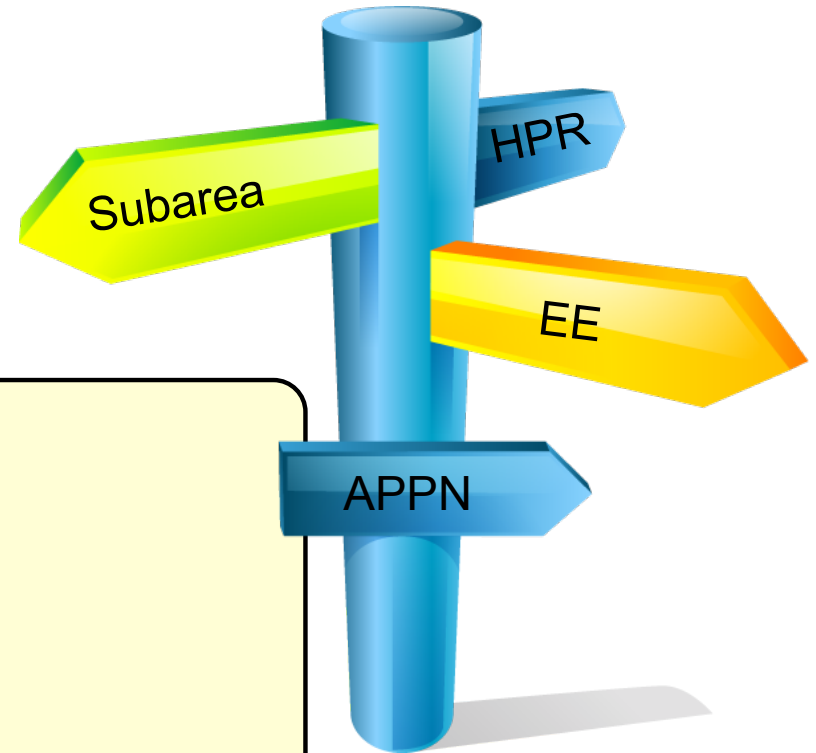
SNA: Dead or Alive?

> "This report of my death was an exaggeration."
> Mark Twain, 1897
> SNA, 2013

- SNA Applications: Over a trillion lines of customer written application code based on CICS, IMS, and DB2

- A large percentage (a majority?) of all business data is still accessed via SNA applications

- Numerous market factors including the continued convergence of enterprise networks onto IP technologies, and the withdrawal of the venerable 3745 from marketing, have led to a very rapid adoption of Enterprise Extender as a key component of SNA application access strategy amongst the IBM customer set.

- EE user experience presentations at SHARE conferences, by organizations such as Bank of America, iT-Austria, State Farm, and the Social Security Administration

- At this SHARE conference:

  - Session 12857 "Roadmap to Securing Enterprise Extender Traffic Over an APPN Global Connection Network" - Heinz Kleumper (Finanz Informatik) - Thursday, 11:00

SNA: A Little History

- SNA developed and distributed by IBM
  - Specifications have also been provided so that a large number of other vendors also provide products that implement SNA
- 1974 - SNA Announced
  - Systems Network Architecture
  - SNA is an architecture defining protocols such as:
    - Link Protocols
    - Node Intercommunication Protocols
    - Application Protocols
- VTAM is the mainframe and NCP is the front-end SNA product
  - Run with three main operating systems
    - MVS, VM, VSE

SNA: A Little History ...

- VTAM (Virtual Telecommunications Access Method) has been available as mainframe software since 1974

  - Has been continuously enhanced

- VTAM and TCP/IP for MVS were combined into a single product (Communications Server) in 1996

  - Has been continuously enhanced

- NCP (Network Control Program) originally ran on a hardware front-end controller, such as the 3745. It can also run on a 37xx-emulator known as the Communications Controller for Linux (CCL)

SNA History: The Road to Enterprise Extender

- In the beginning, there was hierarchical SNA: VTAM, NCP, subareas, SSCPs, VRs, ERs, SNI...

- In the late 1980's, Advanced Peer-to-Peer Networking (APPN) began to emerge, first appearing on the System 36 and AS/400, and by the early 90's on PCs via NS/2 (later CM/2).

- APPN first appeared on the mainframe with VTAM V4R1 in 1993, although LEN ("APPN without a brain") was supported in V3R4 of VTAM.

- The first support for High Performance Routing (HPR) was introduced in VTAM V4R3 in 1995. Support followed for the 22xx router, the Nways 950, PCs via CS/2, and Cisco routers via the SNASw feature. Other platforms would follow over time.

- Enterprise Extender was first shipped on the mainframe with OS/390 V2R7 in early 1999 (and was simultaneously made available on V2R6 via PTF).

- OS/390 V2R10 fixed a long standing problem with HPR support in interchange nodes, paving the way for EE migrations.

- Enterprise Extender has now been implemented by numerous customers, and continues to evolve, with enhancements in each z/OS release, including V2R1 planned for later this year.
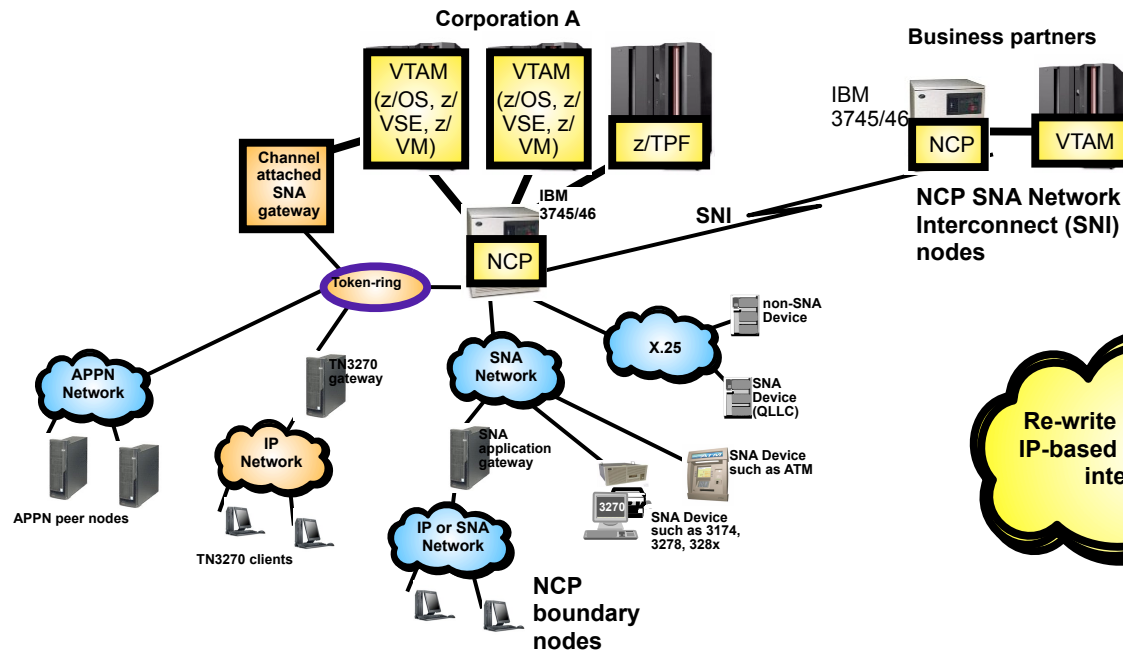
Modernizing SNA

SNA modernization is about preserving SNA applications, not replacing them

- Analysts estimate that 200 billion lines of COBOL code exist today
  - 5 billion lines are added each year
  - Similar inventory of PL/I code
- The typical mainframe customer has:
  - 30M lines of COBOL code
  - Worth $600M
  - Automating 100,000 business processes
- Any mainframe customer
  - Banking, Insurance, Government, Manufacturing, Travel and Transportation, Distribution and Retail, Media and Utilities, Healthcare Industries
- A majority (70-80% according to some studies) of these existing applications are terminal-access based

Consultants estimate it costs 5 times more to rewrite a business function than to re-use existing code

Modernizing SNA is not about re-writing or throwing away SNA applications. It is about preserving core SNA business applications in an IP-based network infrastructure and it is about enabling re-use of those applications in new end-user environments in an application-transparent manner.

SNA networks and SNA applications in 2013 and beyond - what are the questions that need to be asked?

Corporation A

VTAM (z/OS, z/VSE, z/VM)

VTAM (z/OS, z/VSE, z/VM)

z/TPF

Channel attached SNA gateway

IBM 3745/46

NCP

Token-ring

Business partners

IBM 3745/46

NCP

VTAM

NCP SNA Network Interconnect (SNI) nodes

SNI

non-SNA Device

X.25

SNA Device (QLLC)

APPN Network

TN3270 gateway

SNA Network

SNA application gateway

SNA Device such as ATM

3270

SNA Device such as 3174, 3278, 328x

APPN peer nodes

IP Network

TN3270 clients

IP or SNA Network

NCP boundary nodes

Re-write everything to IP-based programming interfaces?

CCL
HPR
APPN
Application-gateways
DLSw
TN3270
EE
SNI
WebSphere
SNA-Switch
Remote-API
EBN
HATS

?

How do I modernize my SNA environment and maintain reliable and cost-efficient access to mainframe core SNA business applications and business partners with an aging SNA networking infrastructure?

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?

How do I protect the investments made in core SNA business applications and re-use those applications from new and emerging end-user environments and integrate them into new application architectures, such as a services-oriented application architecture (SOA)?
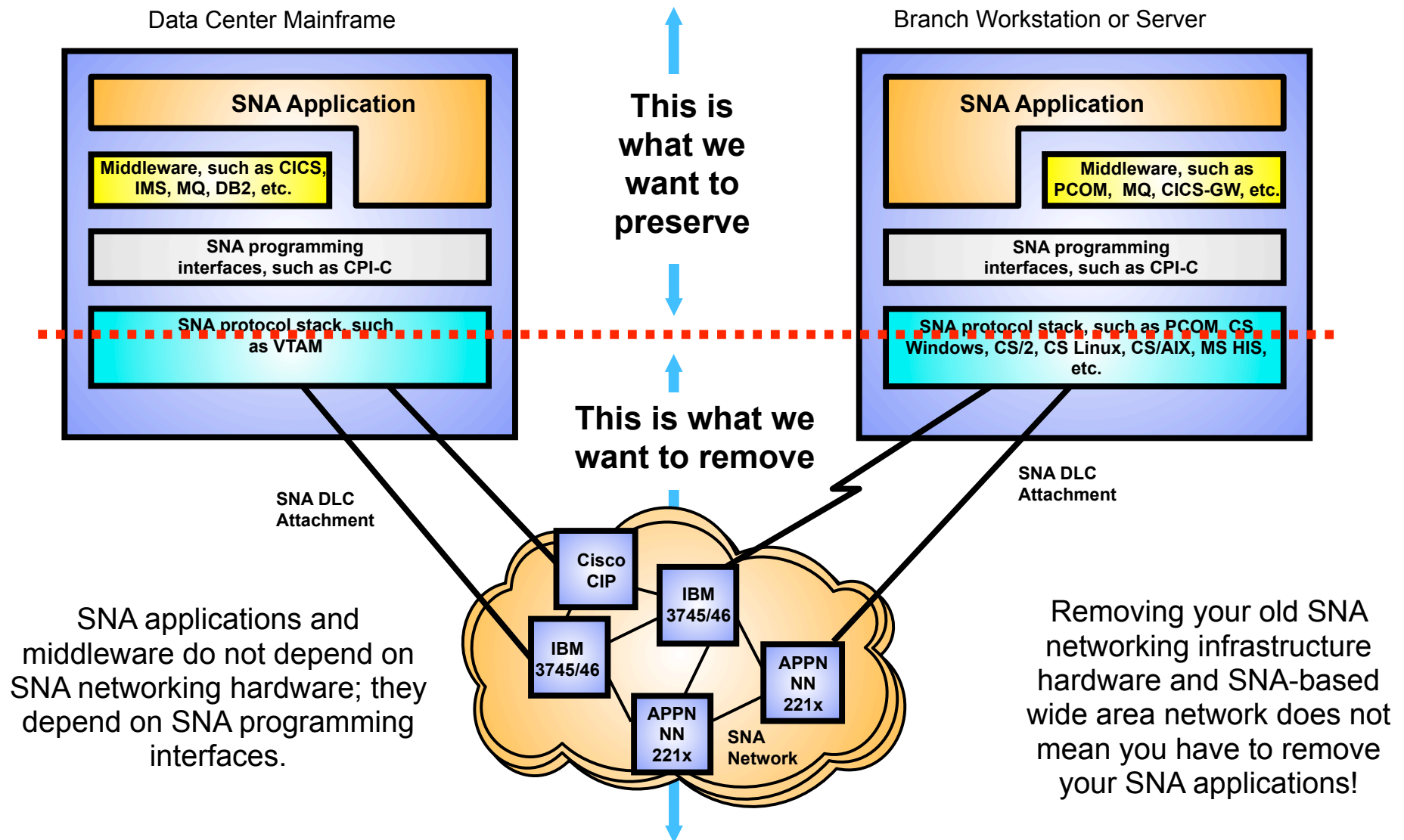
Overall SNA modernization objectives

- Continued use of SNA core business applications and the way these applications are accessed:
  - SNA 3270 applications - real 3270 devices and through various forms of 3270 emulation
  - SNA client/server applications - including user-written SNA LU0/LU6.2 client/server applications
- Provide opportunity for modernizing and simplifying the application portfolio by integrating access to SNA applications with a browser-based workstation technology
  - Using a Web browser as the client - transforming SNA data stream to HTTP(S)/HTML
- Help remove dependence on an outdated SNA networking infrastructure:
  - IBM 3705, 3720, 3725, and 3745/46 Communication Controller hardware
  - IBM 2210, 2216, and 2217 Nways Multi-protocol Routers
  - IBM AnyNet software technology in general
  - OEM ESCON channel-attached SNA gateways, such as Cisco CIP and Cisco CPA
  - Token-ring LAN technology in general
- Help reduce the overall cost of the enterprise networking environment by simplifying the enterprise networking infrastructure so both SNA-based and IP-based application services share a common high-capacity, scalable, reliable, and secure IP-based transport network that provides both enterprise-wide connectivity and inter-enterprise connectivity
- Assist in reducing the need for SNA skills requirements in the overall enterprise network

What do we want to remove and what do we want to preserve?

Data Center Mainframe

This is what we want to preserve

Branch Workstation or Server

SNA Application

Middleware, such as CICS, IMS, MQ, DB2, etc.

SNA Application

Middleware, such as PCOM, MQ, CICS-GW, etc.

SNA programming interfaces, such as CPI-C

SNA programming interfaces, such as CPI-C

SNA protocol stack, such as VTAM

SNA protocol stack, such as PCOM, CS Windows, CS/2, CS Linux, CS/AIX, MS HIS, etc.

This is what we want to remove

SNA DLC Attachment

SNA DLC Attachment

Cisco CIP

IBM 3745/46

IBM 3745/46

APPN NN 221x

APPN NN 221x

SNA Network

SNA applications and middleware do not depend on SNA networking hardware; they depend on SNA programming interfaces.

Removing your old SNA networking infrastructure hardware and SNA-based wide area network does not mean you have to remove your SNA applications!

SNA Modernization Techniques

The SNA architecture level aspect of SNA modernization

- **The three SNA architecture levels:**

  - *Subarea SNA* (also sometimes referred to as traditional SNA or hierarchical SNA)
    - This is where you find an NCP along with the typical boundary functions and SNA network interconnect (SNI) functions to SNA business partners
  - *Advanced Peer to Peer Networking* (APPN) with the original Intermediate Session Routing (ISR) routing protocol
  - *APPN with High Performance Routing* (HPR)
    - HPR may use various types of network technologies, of which one is an entire IP network - known as HPR over IP or more commonly as Enterprise Extender

- **If your SNA mainframe environment today is SNA subarea**
  - You can keep that subarea environment including SNI business partner communication - modernizing the SNA subarea infrastructure using CCL, DLSw, IP-TG, XOT technologies or Communications Server Remote API for LU 0,1,2,3 and 6.2 to integrate SNA subarea traffic with your IP network
  - Or you can migrate from an SNA subarea environment to an APPN environment before you start looking at how to integrate your APPN traffic with your IP network

- **If your SNA mainframe environment today is APPN-enabled**
  - You can use HPR over IP to modernize the SNA APPN infrastructure and to integrate your APPN traffic with your IP network

- **Often it is both**
  - Even with APPN enabled and use of APPN connectivity to the bulk of your SNA nodes, you may still have some SNA subarea connectivity to handle also, such as SNI connections to business partners

If my SNA network is subarea today, should I migrate to APPN before integrating SNA traffic with my IP network?

- **APPN is much more advanced than SNA subarea and requires less administrative "maintenance":**
  - LUs can be found dynamically anywhere in the APPN network - Directory Services
  - Route selection is done dynamically and includes dynamic changes to the network topology - Topology and Routing Services (TRS)
  - Provides intermediate session routing (ISR) - Traffic between two nodes may pass through one or more intermediate APPN nodes
  - APPN with HPR provides non-disruptive path switch in case of link failures
  - Reduces system definitions - Logical units and control points need be defined only on owning node, and routes are dynamically determined at session setup time

- **An APPN migration is not overly complex, but does require some new SNA skills and planning:**
  - Skill development
  - Migration planning
  - Updating SNA network management software and procedures

- **If business partner SNI connectivity is to be replaced by EE/EBN:**
  - Business partner coordination of changes at both end points
  - If EE is to be used between business partners, firewall traversal needs to be addressed

- **APPN may use more resources than SNA subarea:**
  - For VTAM that may mean higher CPU and memory costs
 - For an SNA network, that may mean more bandwidth used for APPN control flows

> **APPN/HPR is the most functionally rich SNA architecture level and is the generally preferred level for SNA networks today. But if the existing SNA infrastructure is based on an SNA subarea architecture level, a migration to APPN/HPR may require a considerable effort.**

# IBM Communication Controller for Linux on System z

- *For SNA subarea connectivity, an NCP is a key component*
  - *For SNA boundary functions*
  - *For SNA business partner connectivity (SNI)*
  - *In combination with NPSI: for SNA and non-SNA X.25 access*

Move **selected NCP and NPSI functions** with no or minor changes to the definitions

Linux on System z

CCL

NCP and NPSI

System z Server

NCP and NPSI

1988:
The IBM 3745 **Communication Controller** (NCP V7R3+ latest supported level) and the IBM 3746 Multiprotocol Controller

1982:
The IBM 3725 **Communication Controller** (NCP V4R3.1 latest supported level)

2005:
The IBM **Communication Controller** for Linux (CCL) on System z
(NCP V7R5+ latest supported level)

1974:
The IBM 3705 **Communication Controller**

1985:
The IBM 3720 **Communication Controller** (NCP V5R4 latest supported level)

1975 1980 1985 1990 1995 2000 2005 2010

- **What is CCL?**
  - The next generation IBM Communication Controller for the majority of SNA workloads
    - Enhanced availability and performance
  - A mainframe software solution that provides a virtualized Communication Controller on the System z hardware platform
    - Utilizes IFL capacity
  - A platform for modernizing the traditional SNA environments
    - Replace token-ring and ESCON channel connectivity
    - Supporting DLSw to the mainframe
  - Supports existing NCP and NPSI software
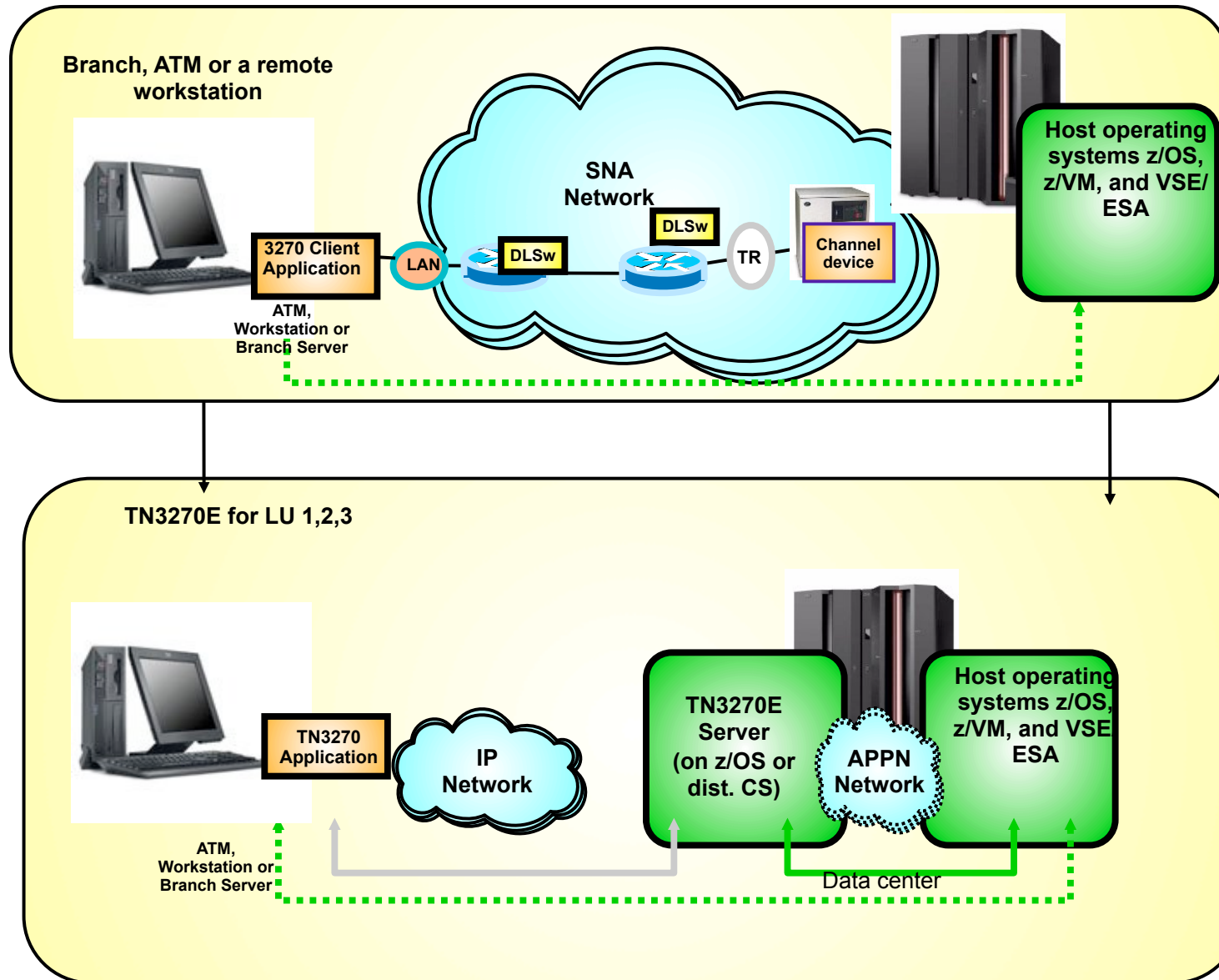   - Including existing SNA management software and procedures
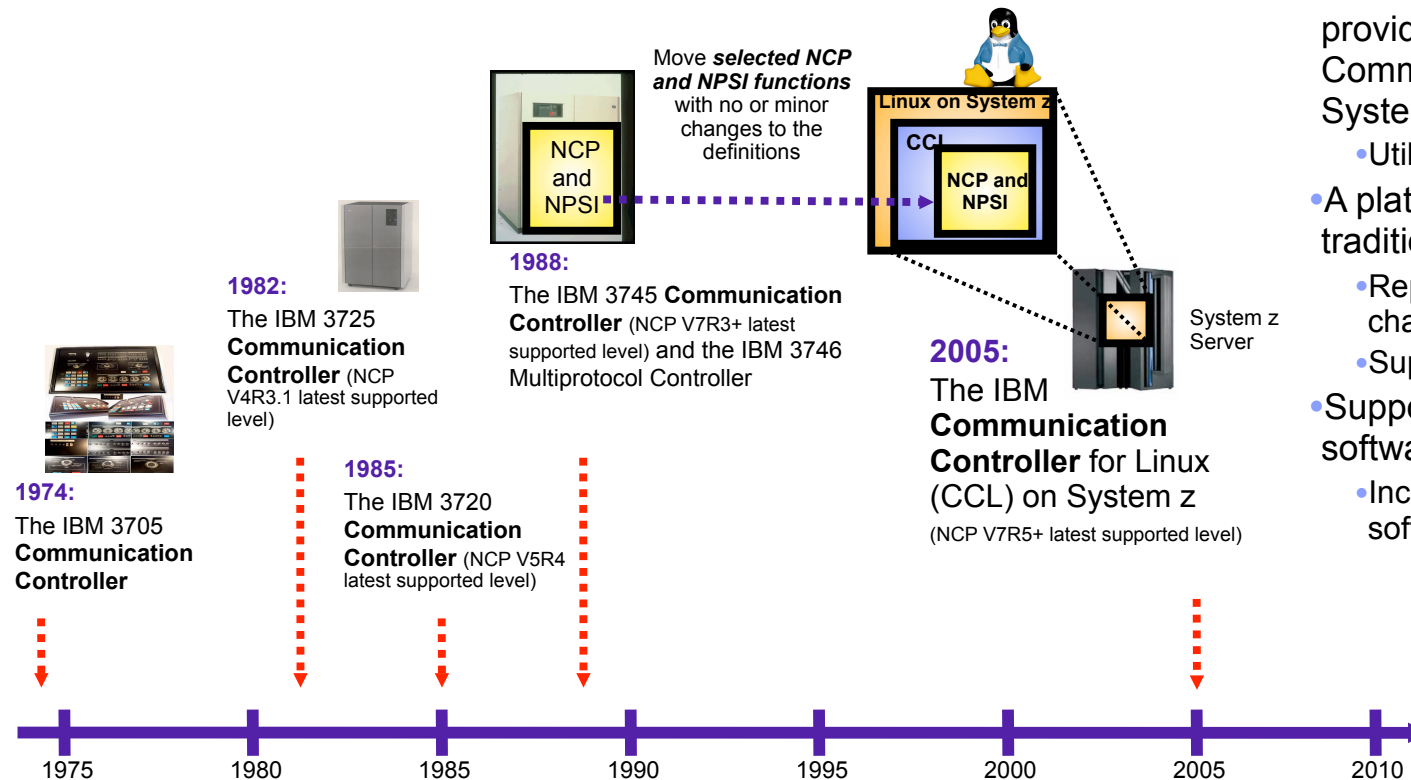
CCL - topology and connectivity overview
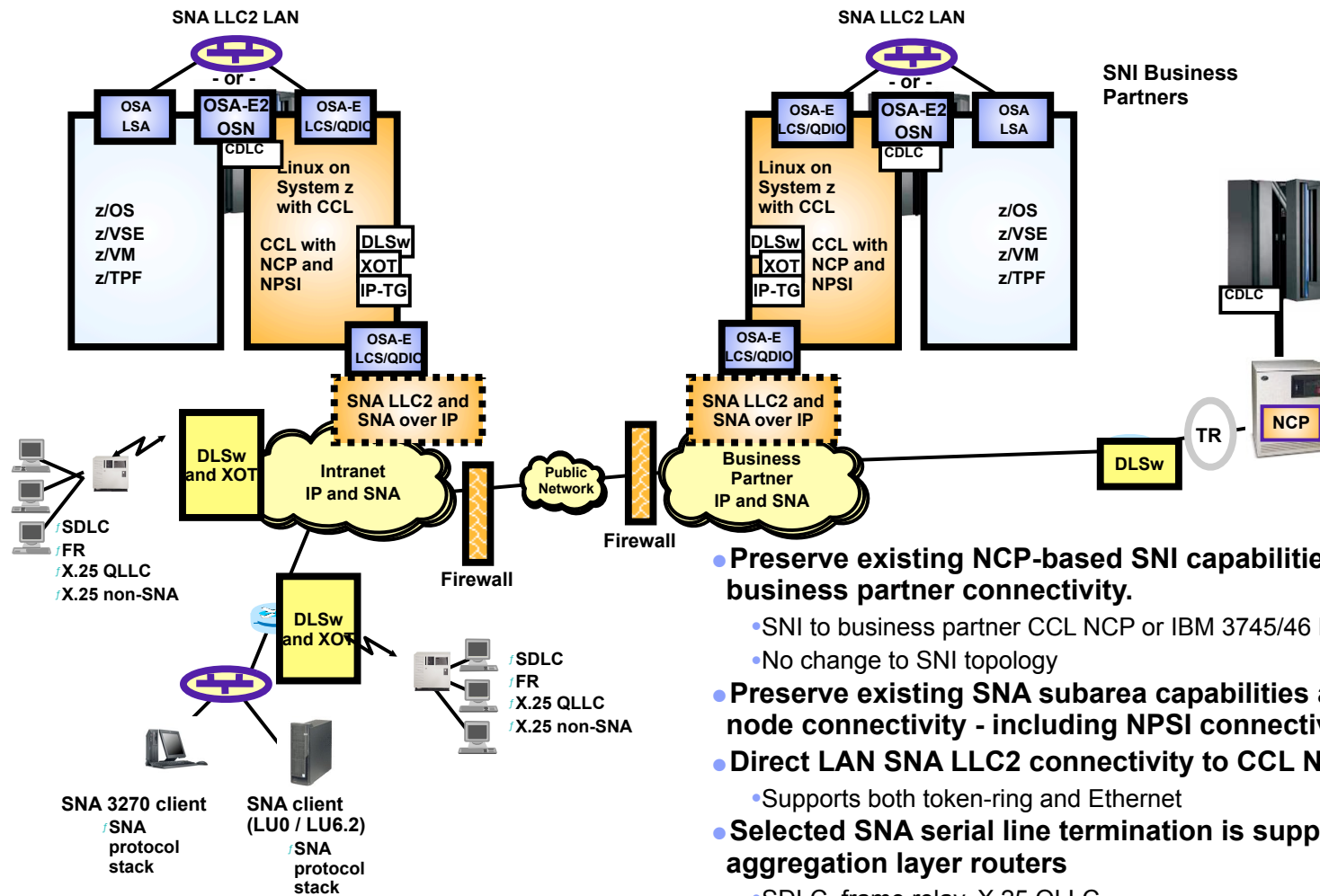
- **Preserve existing NCP-based SNI capabilities and topology for business partner connectivity.**
  - SNI to business partner CCL NCP or IBM 3745/46 NCP
  - No change to SNI topology
- **Preserve existing SNA subarea capabilities and topology for peripheral node connectivity - including NPSI connectivity.**
- **Direct LAN SNA LLC2 connectivity to CCL NCP**
  - Supports both token-ring and Ethernet
- **Selected SNA serial line termination is supported via a network aggregation layer routers**
  - SDLC, frame relay, X.25 QLLC
- **Simplify network infrastructure by supporting multiple SNA over IP technologies, such as imbedded DLSw, XOT, and IP-TG**
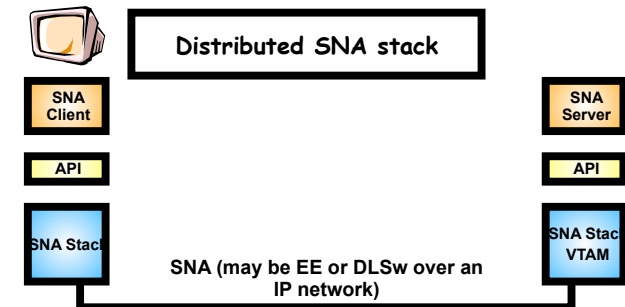- **Preserves existing network operations and management functions**

TN3270: Modernize for 3270 access in APPN environment

Branch, ATM or a remote workstation

SNA Network

DLSw

DLSw

TR

3270 Client Application

LAN

Channel device

Host operating systems z/OS, z/VM, and VSE/ESA

ATM, Workstation or Branch Server

TN3270E for LU 1,2,3

TN3270 Application

IP Network

TN3270E Server (on z/OS or dist. CS)

APPN Network

Host operating systems z/OS, z/VM, and VSE/ESA

ATM, Workstation or Branch Server

Data center

What about SNA LU0, 1, 2, 3 or LU6.2 clients on workstations or branch servers? TN3270 does not address all of these!

- **Preserve the SNA protocol stack and SNA client application on the workstation or distributed server - transport SNA traffic over an IP network using EE or DLSw**
  - Retain existing SNA node topology, but address modernization through SNA network infrastructure modernization
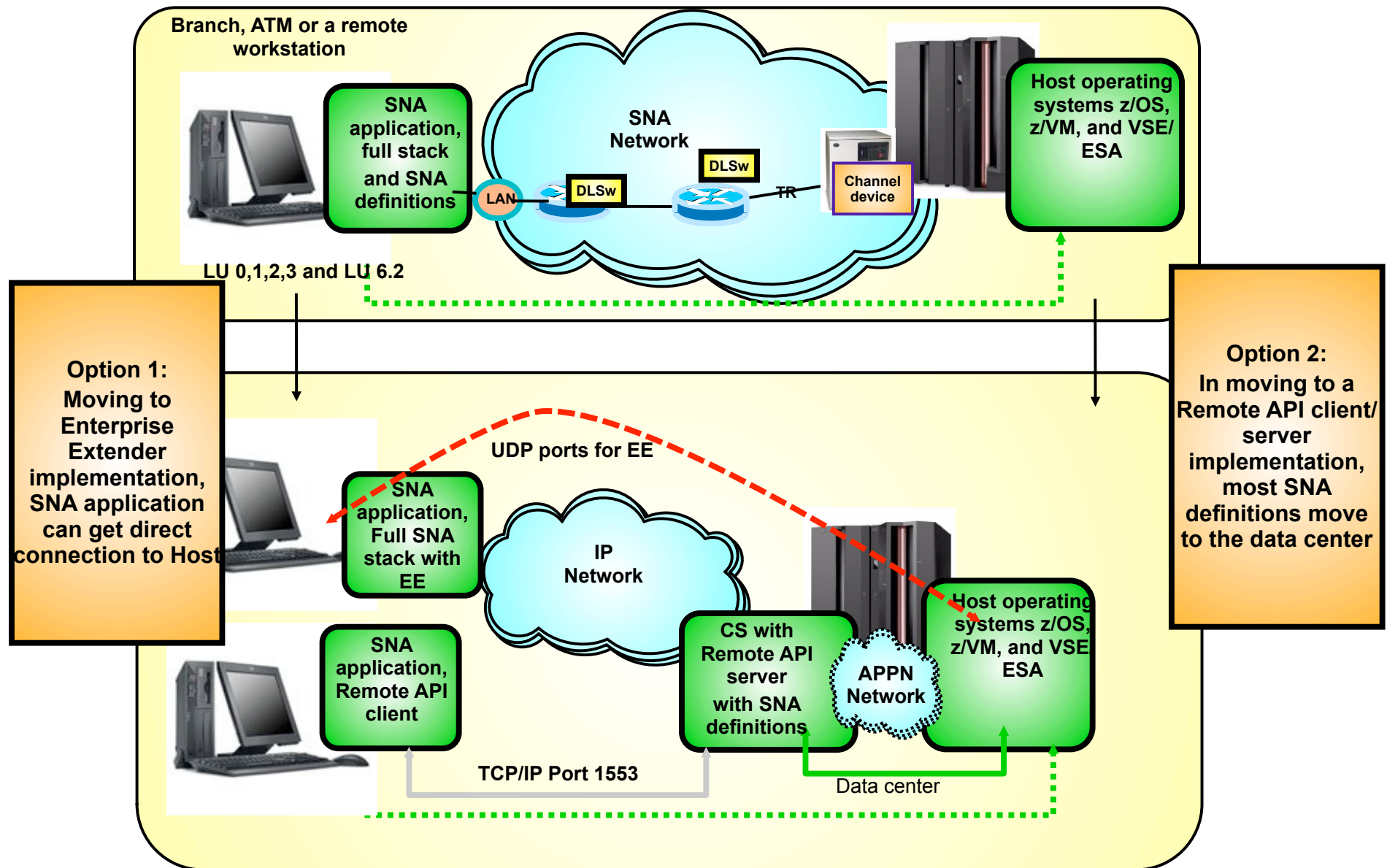
Distributed SNA stack

SNA Client | SNA Server
API | API
SNA Stack | SNA Stack VTAM

SNA (may be EE or DLSw over an IP network)

- **Preserve the SNA client application on the workstation or distributed server, but collapse the SNA protocol stack into the data center using IBM's remote SNA API technology (also known as "split stack")**
  - Remove SNA protocol stack on SNA client node, consolidating SNA protocol stacks onto servers and/or into the data center
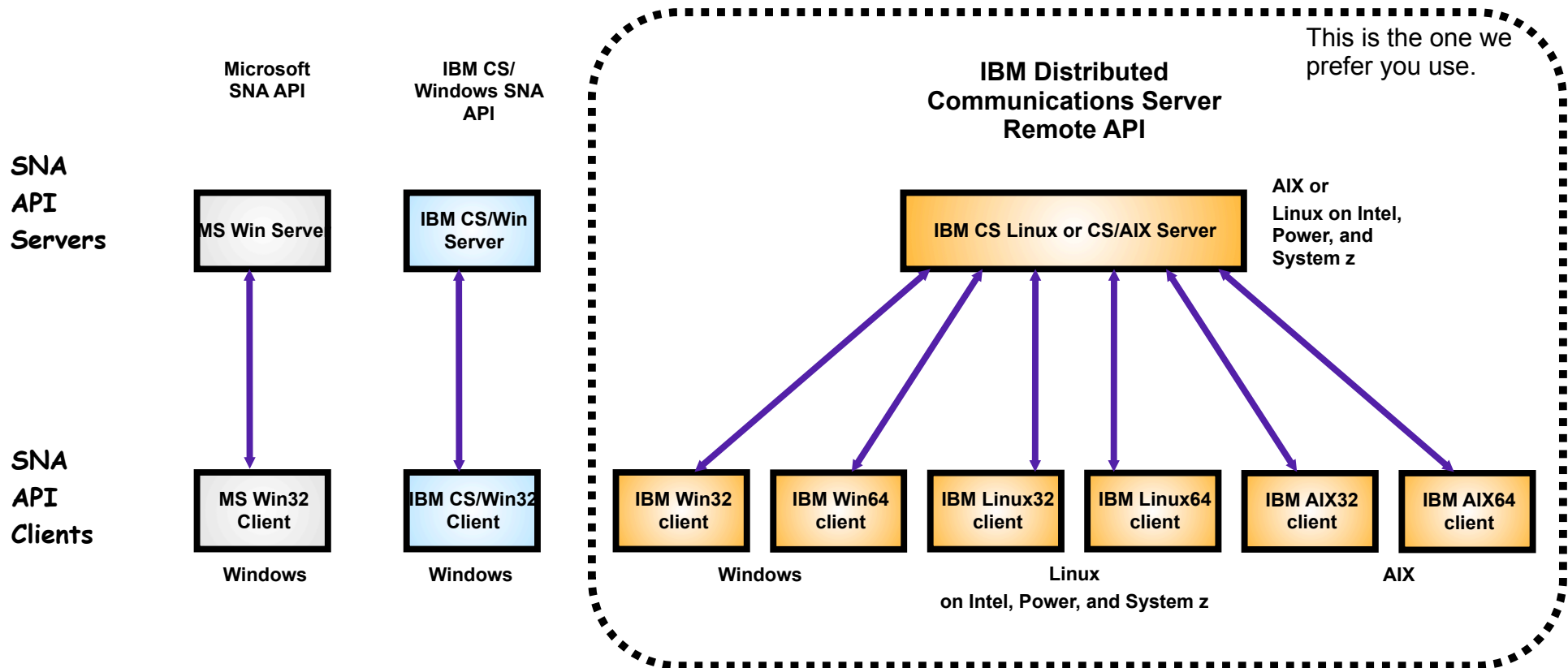
Split SNA stack

SNA Client | | SNA Server
Remote API | Remote API Server | API
TCP/IP Stack | TCP/IP Stack | SNA Stack | SNA Stack VTAM

TCP/HTTP(S) | SNA
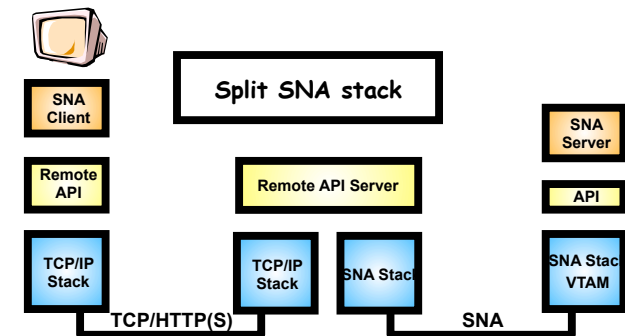
Modernizing remote access in IP network, 2 options

Three flavors of remote APIs

- **IBM Communications Server for Linux, Linux on System z or Communications Server on AIX support Remote API client/server.**
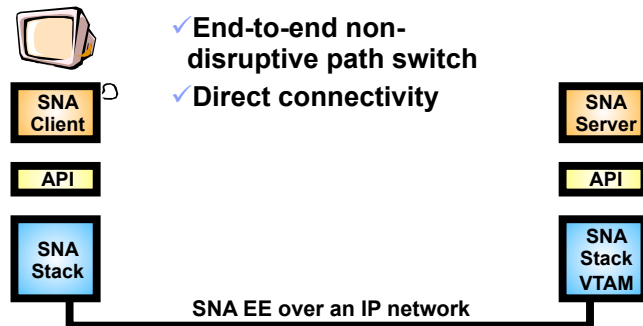 - Consolidation of the SNA protocol stacks all the way into System z is possible using CS Linux on System z
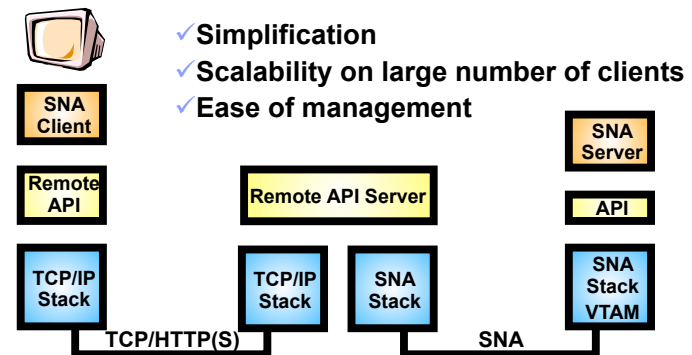
Microsoft SNA API

IBM CS/ Windows SNA API

IBM Distributed Communications Server Remote API

This is the one we prefer you use.

SNA API Servers

MS Win Server	IBM CS/Win Server	IBM CS Linux or CS/AIX Server

AIX or Linux on Intel, Power, and System z

SNA API Clients

MS Win32 Client	IBM CS/Win32 Client	IBM Win32 client	IBM Win64 client	IBM Linux32 client	IBM Linux64 client	IBM AIX32 client	IBM AIX64 client

Windows

Windows

Windows

Linux
on Intel, Power, and System z

AIX

Using SNA stack and EE connectivity - or consolidate SNA stack using Remote API?

Preserve SNA stack on client node

✓**End-to-end non-disruptive path switch**
✓**Direct connectivity**

SNA Client
API
SNA Stack

SNA Server
API
SNA Stack VTAM

SNA EE over an IP network

- **Location: In data center, EE is needed**
  - Performs better in high speed, low latency networks
  - Managed SNA resource in data center
- **With backup EE connections, EE allows non-disruptive path switch in case the EE partner goes down**
  - Note: the IP network infrastructure itself will deal with IP-link unavailability and dynamically re-route around such failed links
- **When EE is combined with Connection Network technology, EE allows a direct EE connection over an IP network between the remote EE node and the EE node where the SNA primary LU is located**
  - Much improved performance as compared to traversing multiple intermediate server node hops, as would normally be the case for non-HPR environments

Consolidate remote SNA stack into data center

✓**Simplification**
✓**Scalability on large number of clients**
✓**Ease of management**

SNA Client
Remote API
TCP/IP Stack

Remote API Server
TCP/IP Stack   SNA Stack

SNA Server
API
SNA Stack VTAM

TCP/HTTP(S)   SNA

- **Location: In remote location**
  - Performs the same as full stack connectivity
  - In general, run Remote API in remote environments
- **Remote API provides redundancy and load balancing**
  - "Domain" of servers provide multiple backup scenarios
  - Recovery is disruptive
- **Simplified remote API client configuration (less than 4 parameters to specify)**
  - There is no remote SNA protocol stack to configure with node characteristics, transmission groups, etc
- **Scalability impact on data center servers**
  - Remote API client/server use maximum 1 or 2 TCP/IP sessions per connection
  - EE uses a minimum of 3-4 RTP sessions per end node
- **All SNA data must be routed through the remote API server**
  - Eases administration, but can introduce latency

Enterprise Extender characteristics

- **EE is APPN HPR routing over an IP network**
  - To the IP network, EE looks like a UDP application
  - To the APPN network, EE looks like an HPR link

- **Dependent LU access via DLUR/DLUS services**
  - Subarea SNA traffic (dependent LUs) is based on the normal APPN DLUR/DLUS functions

- **The SNA traffic is sent as UDP datagrams over the IP network, each EE endpoint using 5 UDP port numbers**
  - Firewalls can be an issue, especially between business partners

- **EE can be implemented on the SNA application hosts, or on APPN nodes that act as EE gateways**

- **Complete APPN/EE nodes include z/OS, CS/Linux, CS/AIX, and CS/Windows**
  - Some EE nodes implement an EE-DLC connectivity function without being APPN network node capable - examples include Microsoft's Host Integration Server which can only be an end node, and Cisco SNA Switch which can only be a Branch Extender node
  - i5/OS (iSeries) added EE support to i5/OS V5R4 in 2006

- **Since EE is HPR over IP, EE traffic inherits all the APPN/HPR characteristics including non-disruptive path switch**

- **EE traffic can be secured using IPSec**
  - But not with SSL/TLS - SSL/TLS is TCP only

- **Business partner connectivity through EE/EBN (z/OS only)**

Subarea SNA to Enterprise Extender
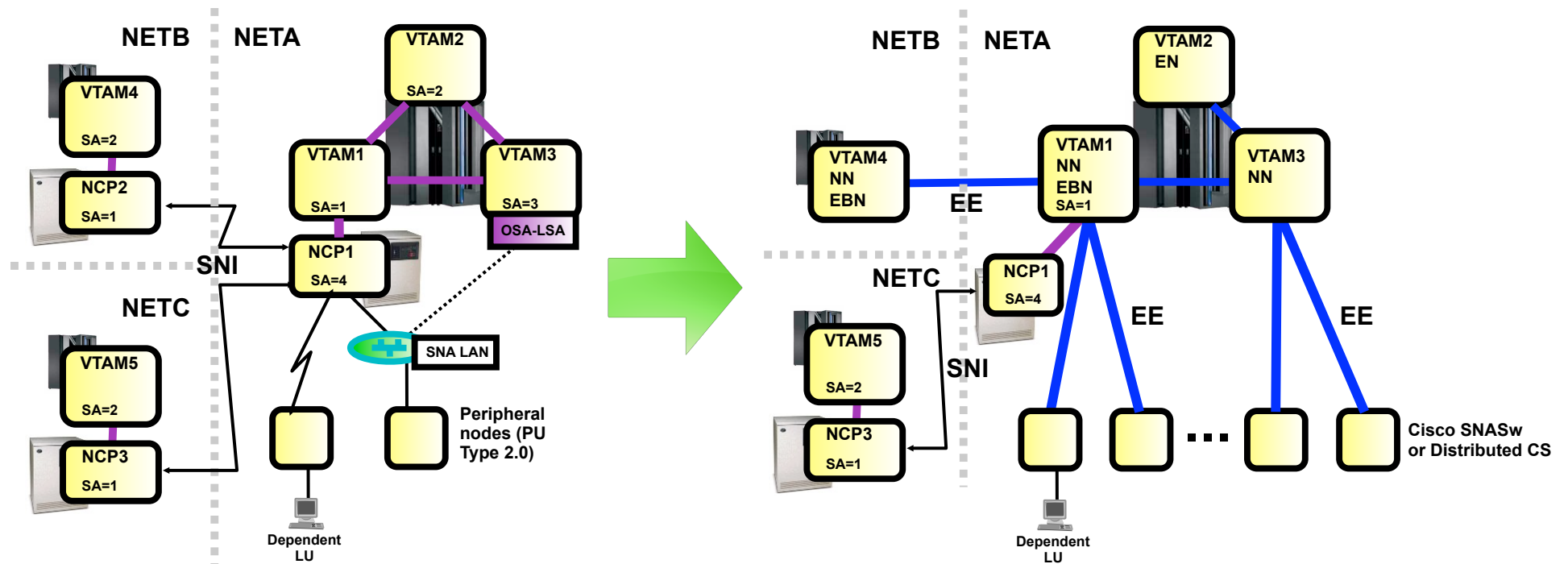
Subarea SNA

Enterprise Extender

Subarea (FID4) connections ▬▬▬
Enterprise Extender logical links ▬▬▬

SNA application simplification summary

- **TN3270**
  - Preserve 3270 "green screen" user interface
  - Replace SNA 3270 emulation
  - Transport 3270 data stream over a TCP connection
  - Remove remote SNA protocol stack on emulator workstation

- **Remote API**
  - Preserve SNA client placement
  - Remove remote SNA protocol stack for SNA clients
  - Transport SNA API calls over TCP or HTTP(S)
  - Provides less overhead costs for larger network implementation
  - Consolidates SNA resources into the data center

- **Enterprise Extender**
  - Preserve SNA client placement
  - Connects application directly to Host over UDP transport
  - Provides application session recovery in a non-disruptive manner

- **Enterprise Extender verse Remote API**
  - Depends on objectives, move SNA into data center or direct connectivity to Host resources
  - Location:
    - Data center use EE
    - Remote, consider either
  - How many nodes?
    - Fewer number, use EE
    - Larger number, use Remote API

Subarea SNA

Enterprise Extender

The State of SNA

The State of SNA - Challenges in Converting to IP

Subarea SNA

Enterprise Extender

- Economic challenges

  - Questionable cost/benefit ratio

  - Other projects more important

- Risk in altering long-established business processes

- Challenges when converting existing SNA applications to sockets applications.

  - Declining skills to participate in the conversion project

  - Typically not available to be purchased off-the-shelf

    - For applications that can be purchased, additional customization likely needed

  - Need to find good sockets programmers, which can be a challenge

- Once the applications are converted to sockets, there are additional challenges:

  - Change in monitoring/management when moving from an LU-basis to an IP address/ port basis

    - Affects tooling and processes

  - Affects overall process

- Often requires significant hardware changes

  - Still a fair amount of SNA legacy hardware out there - 3745s, 3174s, SDLC, etc

SNA to IP Conversion - Customer Anecdotes

Subarea SNA

- Company A (several years ago):

  - Conversion successful, but took seven years to complete

- Company B (ongoing):

  - Began conversion process 2-3 years ago - now about 80% SNA / 20% IP

- Company C (ongoing):

  - Started migration in late 2010 - first production branch was completed about three months ago - This branch is regarded as a trial branch. If continues to go well, conversion will continue across other branches
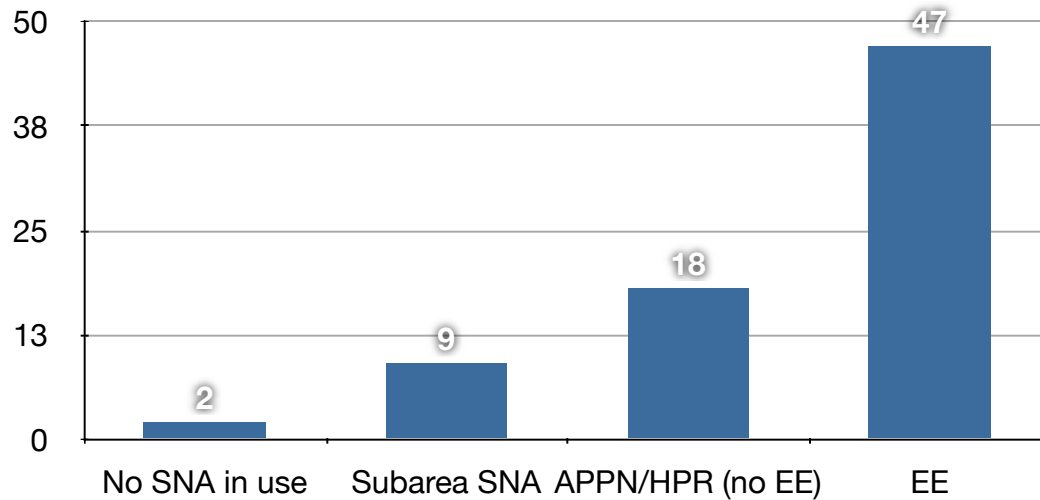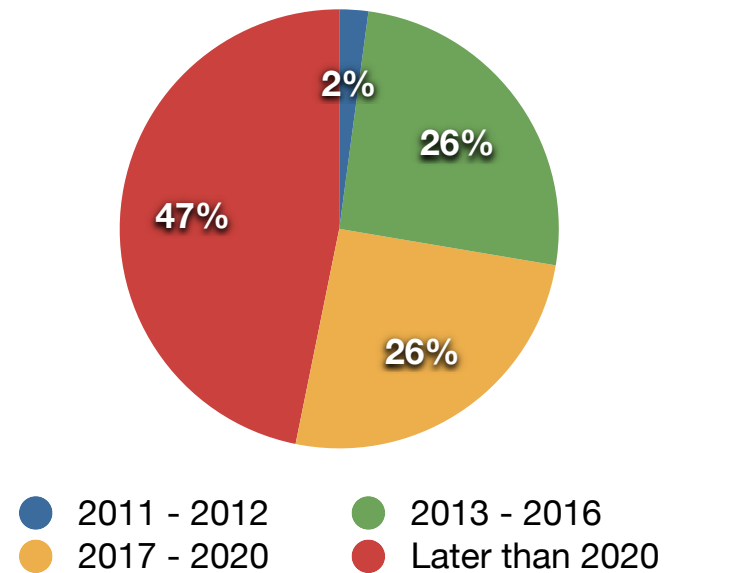
Enterprise Extender

2011 Customer Survey - SNA Questions/Responses

SNA Connectivity Used

Date SNA No Longer Needed

- ● 2011 - 2012
- ● 2013 - 2016
- ● 2017 - 2020
- ● Later than 2020

Five customers still had 37x5s, with one customer having 16, two having two each, and the other two having one each.

Subarea SNA

Enterprise Extender

Subarea SNA

Enterprise Extender

IBM SNA Statements of Direction

2002:

It is IBM's intent to support VTAM in z/OS Communications Server for the foreseeable future. Customers have a substantial investment in 3270 and SNA applications. We continue to support and enhance VTAM's capabilities while integrating it with new technologies. IBM has no plans at this time to discontinue SNA support in z/OS Communications Server.

2004:

IBM's plans to support SNA workloads have not changed since the Statement of Direction made in 2002. As of June 2004, customers can -- for selected SNA workloads -- use Communications Server products for Linux®, Linux on IBM® zSeries®, Microsoft® Windows®, and AIX® to replace some of the old SNA infrastructure components, such as the IBM 3745/46 or other channel-attached SNA controllers. z/OS® Communications Server can replace some (SNA Network Interconnect) SNI workloads using Enterprise Extender and Extended Border Node functions.

It is IBM's intent to introduce an additional solution in 2005 that uses NCP software running within Linux on zSeries. The intent is to provide a migration path for customers who use traditional SNA (including SNA Network Interconnect (SNI)) to communicate with their Business Partners. This solution can allow them to continue using traditional SNA without a dependency on IBM 3745 and 3746 Communications Controller hardware.
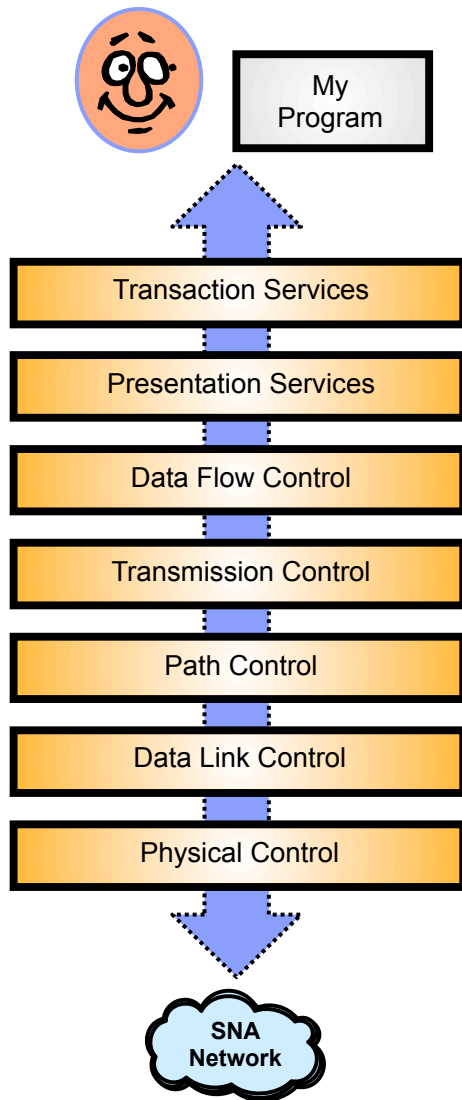
This statement represent current intentions of IBM. Any reliance on this statement of direction is at the relying party's sole risk and will not create any liability or obligation for IBM. All statements regarding IBM's plans, directions, and intent are subject to change or withdrawal without notice.

http://www-01.ibm.com/software/network/commserver/snasupport.html

These statements of direction are old, but still relevant!

Subarea SNA

Enterprise Extender

It is all thanks to a good architecture

My Program

Transaction Services

Presentation Services

Data Flow Control

Transmission Control

Path Control

Data Link Control

Physical Control

SNA Network

- **As long as the interface between two SNA architecture layers doesn't change, an underlying layer can be totally redesigned and re-implemented using new technologies and protocols for communication with its partner layer in another SNA node - without any impact to upper layers in the architecture, which ultimately includes the SNA applications.**

- Hardware components can be ripped out and replaced
  - IBM 37xx
  - Token-ring
  - ESCON channels
- New protocols can be deployed
  - Enterprise Extender
  - DLSw
  - XOT
  - IP-TG
  - Remote API client/server
- New clients can be introduced
  - TN3270
  - Web browsers

With minimal or no impact to the applications or, in many cases, the application subsystems

- **SNA was from the beginning built for change (almost 40 years ago!)**

- **Protecting the investments made in programming skills and applications**

References

Subarea SNA

Enterprise Extender

- Redbooks
  - SG24-5957-00 Migrating Subarea to an IP Infrastructure
  - SG24-7359-00 Enterprise Extender Implementation Guide
  - SG24-7334-00 A Structured Approach to Modernizing the SNA Environment

- Screencasts
  - APPN Configurations: Recommendations & Limitations:
    - http://www.youtube.com/zoscommserver#p/a/u/0/TC1gaiARPgM
  - APPN Logmodes and Class of Service:
    - http://www.youtube.com/zoscommserver#p/u/14/-rPxj2ImP-Y
  - Practical Guide to Optimizing APPN and Extended Border Node Searches:
    - http://ibm.co/mxWyE3
  - IBM Remote API Client:
    - http://www.youtube.com/watch?v=h9K057ujZBs

- SNA Sessions at SHARE in San Francisco
  - 12848: z/OS CS Enterprise Extender Hints and Tips (Tuesday, 9:30 AM)
  - 12856: The Journey Through the Layers of Enterprise Extender Continues - I Knew It Must Be The Firewall (Thursday, 8:00 AM)
  - 12857: Roadmap to Securing Enterprise Extender Traffic Over an APPN Global Connection Network (Thursday, 11:00 AM)

References ...

- Prior SHARE sessions

  - Searching in Mixed APPN/Subarea Networks
    - http://proceedings.share.org/client_files/SHARE_in_Austin/S3618JH145212.pdf

  - APPN Logmodes and Class of Service
    - Presentation: http://proceedings.share.org/client_files/SHARE_in_Austin/S3620JH145658.pdf
    - Script: http://proceedings.share.org/client_files/SHARE_in_Austin/S3620JH145712.pdf

  - APPN Configurations: Recommendations & Limitations
    - http://proceedings.share.org/client_files/SHARE_in_Austin/S3608JH144707.pdf

  - Searching and Security in APPN/HPR Border Node Networks (Parts 1 and 2)
    - http://proceedings.share.org/client_files/SHARE_in_Austin/S3615JH145455.pdf

  - Enterprise Extender: Implementing Connection Network
    - http://proceedings.share.org/client_files/SHARE_in_Austin/S3602SR224007.pdf

  - SNA Security Considerations
    - http://proceedings.share.org/client_files/SHARE_in_Austin/S3612RW083850.pdf

  - SNA 101: Basic VTAM, APPN, and EE Concepts:
    - http://proceedings.share.org/client_files/SHARE_in_San_Jose/S3431SR132942.pdf

  - Diagnosing Enterprise Extender Problems
    - http://proceedings.share.org/client_files/SHARE_in_San_Jose/S3611MB092402.pdf

  - It's Gr-EE-k to Me! What Do All those Enterprise Extender Messages Mean?
    - http://proceedings.share.org/client_files/SHARE_in_Orlando/S3618GD171929.pdf

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