IBM Software Group
Enterprise Networking and Transformation Solutions (ENTS)

A Structured Approach to Modernizing the SNA Environment from a System z Perspective

Getting the SNA Environment Ready for SOA

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October 2006

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Abbreviations

Acronym	Explanation
AHHC	APPN Host-to-Host Channel
ADS	Application Data Structure
ANNC	APPN Node-to-Node Communication
ANR	Automatic Network Routing
APPC	Advanced Program-to-Program Communication
APPN	Advanced Peer-to-Peer Networking
BMS	Basic Mapping Support (CICS component)
BN	Border Node
BTT	Branch Transformation Toolkit
BX	Branch eXtender node
CCL	Communication Controller for Linux (IBM 3745 software emulator)
CDLC	Channel Data Link Control (mainframe channel protocol)
CDS	Central Directory Server
CICS	Customer Information Control System (a transaction manager)
CMC	Communications Management Configuration
CNN	Composite Network Node (an APPN NN composed of a VTAM and one or more NCPs)
COS	Class of Service
CP	Control Point
CPI-C	Common Programming Interface for Communications (LU6.2 programming interface)
CSL	Communications Server for Linux
CTG	CICS Transaction Gateway
CWS	CICS Web Support
DLC	Data Link Control
DLSw	Data Link Switching (SNA subarea and APPN/ISR encapsulation over TCP conenctions)
DRDA	Distributed Relational Data Access
EBN	Extended Border Node (gateway between two APPN networks - APPN equivelant of SNI)
EE	Enterprise Extender (also known as HPR over IP)
EJB	Enterprise Java Bean
EN	End Node
GR	Generic Resources
HATS	Host Access Transformation Services (SNA 3270/HTML transformation)

Acronym	Explanation
HPR	High Performance Routing
HTML	Hyper Text Markup Language (tag language for Web pages)
HTTP	Hyper Text Transfer Protocol (application protocol between Web browser and Web server)
ICN	Interchange Node (SNA node that routes between APPN and SNA subarea)
ILU	Independent Logical Unit
IMS	Information Management System (z/OS transaction and database manager)
INN	Intermediate Network Node
IP-TG	Internet Protocol Transmission Group (NCP INN/SNI encapsulation over an IP network between two CCL NCPs)
IP	Internet Protocol
ISR	Intermediate Session Routing
J2C	J2EE Connector Architecture
LLC2	Logical Link Control type 2 (SNA traffic on a LAN)
MAE	Multi-Access Enclosure
MDH	Migration Data Host (a combined SNA subarea node and APPN EN)
MFS	Message Formatting Services (IMS component)
MID	Message Input Descriptor (IMS MFS input ADS)
MNPS	Multi-Node-Persistence Sessions
MOD	Message Output Descriptor (IMS MFS output ADS)
MPC	Multipath Channel (mainframe channel protocol)
MPC+	HPDT Multipath Channel (mainframe channel protocol)
MPP	Message Processing Program (transaction program in IMS)
MPR	Message Processing Region
NCP	Network Control Program
NN	Network Node
NNP	(950) Network Node Processor
NNS	Network Node Server
NPSI	NCP Packet Switching Interface (X,25 connectivity support for an NCP)
OTMA	Open Transaction Manager Access
RTP	Rapid Transport Protocol (the transport protocol layer in HPR)

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Abbreviations (continued)

Acronym	Explanation
RUI	Request Unit Interface (an SNA programming interface)
RYO	Roll Your Own (home-written solution)
SDP	Software Development Platform
SFF	Service Flow Feature (CICS Web services infrastructure)
SNA	Systems Network Architecture
SNI	SNA Network Interconnect (SNA subarea-based business partner communication)
SOA	Services Oriented Architecture
SOAP	Simple Object Access Method
SSCP	System Services Control Point (PU Type 5 in an SNA subarea network)
TG	Transmission Group
VTAM	Virtual Telecommunications Access Method
WAS	WebSphere Application Server
WMQ	WebSphere Message Queuing
WSADIE	WebSphere Application Developer Integration Edition
WTS	Windows Terminal Services (split GUI technology)
XML	Extensible Markup Language
XOT	X.25 Over TCP/IP (encapsulate X.25 packets over a TCP connection)

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Agenda

1. **An introduction to SNA modernization**
2. **SNA Network Infrastructure Modernization**
   a. **Modernizing an SNA Subarea Environment**
   b. **Modernizing an SNA APPN Infrastructure**
3. **Modernizing SNA Application Access**
   a. **SNA Network Infrastructure Simplification - Preserving Existing SNA Clients**
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6. **Appendix B - Reference Material**
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An Introduction to SNA Modernization

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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.

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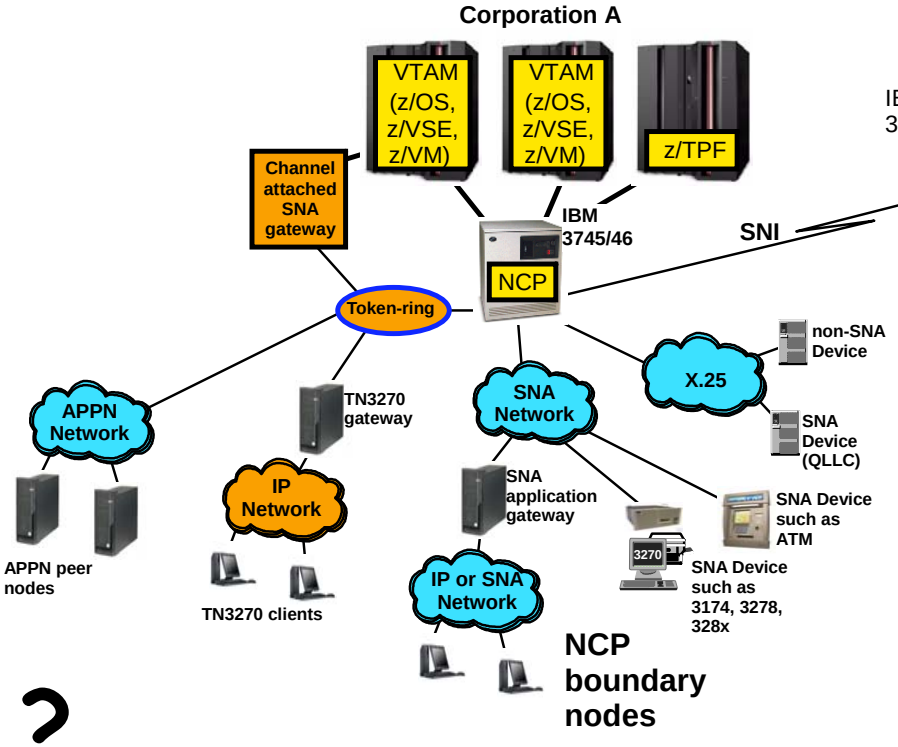
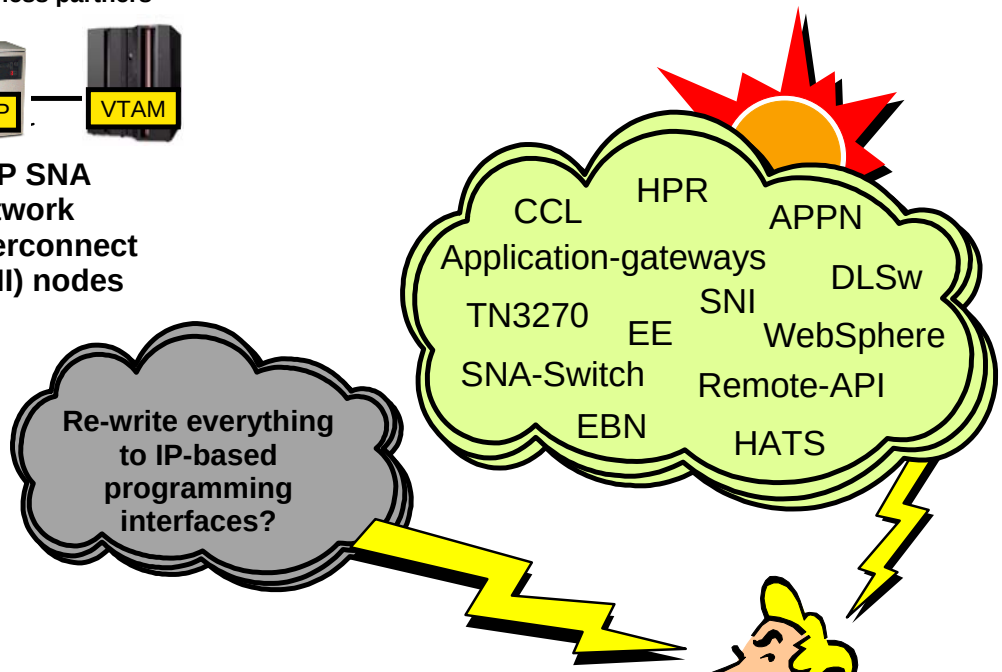
SNA networks and SNA applications in 2006 and beyond - what are the questions that need to be addressed?



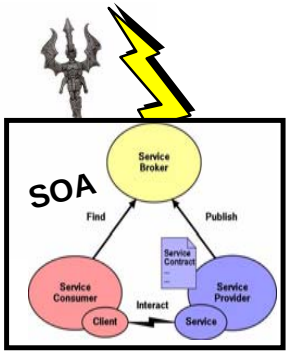


How do I modernize my SNA environment and maintain reliable and cost-efficient access to mainframe core SNA business applications and business partners with an aging SNA networking infrastructure?

- IBM 3705, 3720, 3725, and 3745/46 Communication Controller
- Token-ring technology in general
- ESCON channel-attached SNA controllers from various vendors (including Cisco CIP and CPA)
- IBM 2210, 2216, and 2217 Nways Multi-protocol Routers
- AnyNet
- OS/2 and its CS/2 communications component

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)?

- Transforming SNA application data stream to HTTP(S)/HTML to integrate use of SNA mainframe applications in browser-based client environments?
- Exposing SNA applications as Web services, tranforming the SNA application data stream to SOAP/XML and integrating these SNA applications into new business processes composed of Web service elements?



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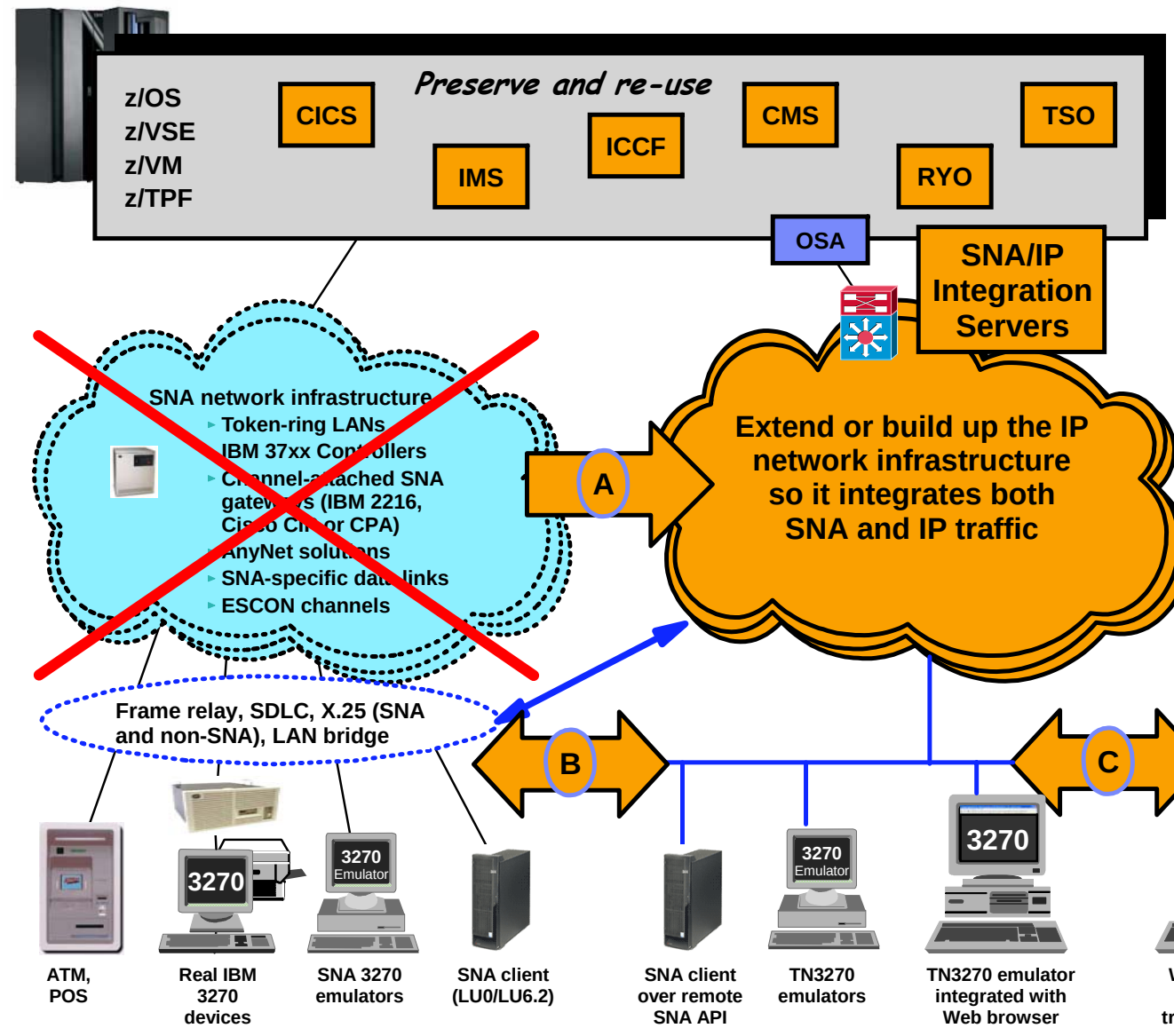
What are the next steps for SNA? - SNA modernization strategy



A. Modernize the SNA network infrastructure

- APPN w. EE/SNA Switch
- CCL with NCP and NPSI
- IP-TG, XOT, DLSw

B. Simplify the SNA node topology

- TN3270
- Remote SNA APIs
- Remote desktop

C. Enable new client technologies

- HTML transformation
- Web services integration

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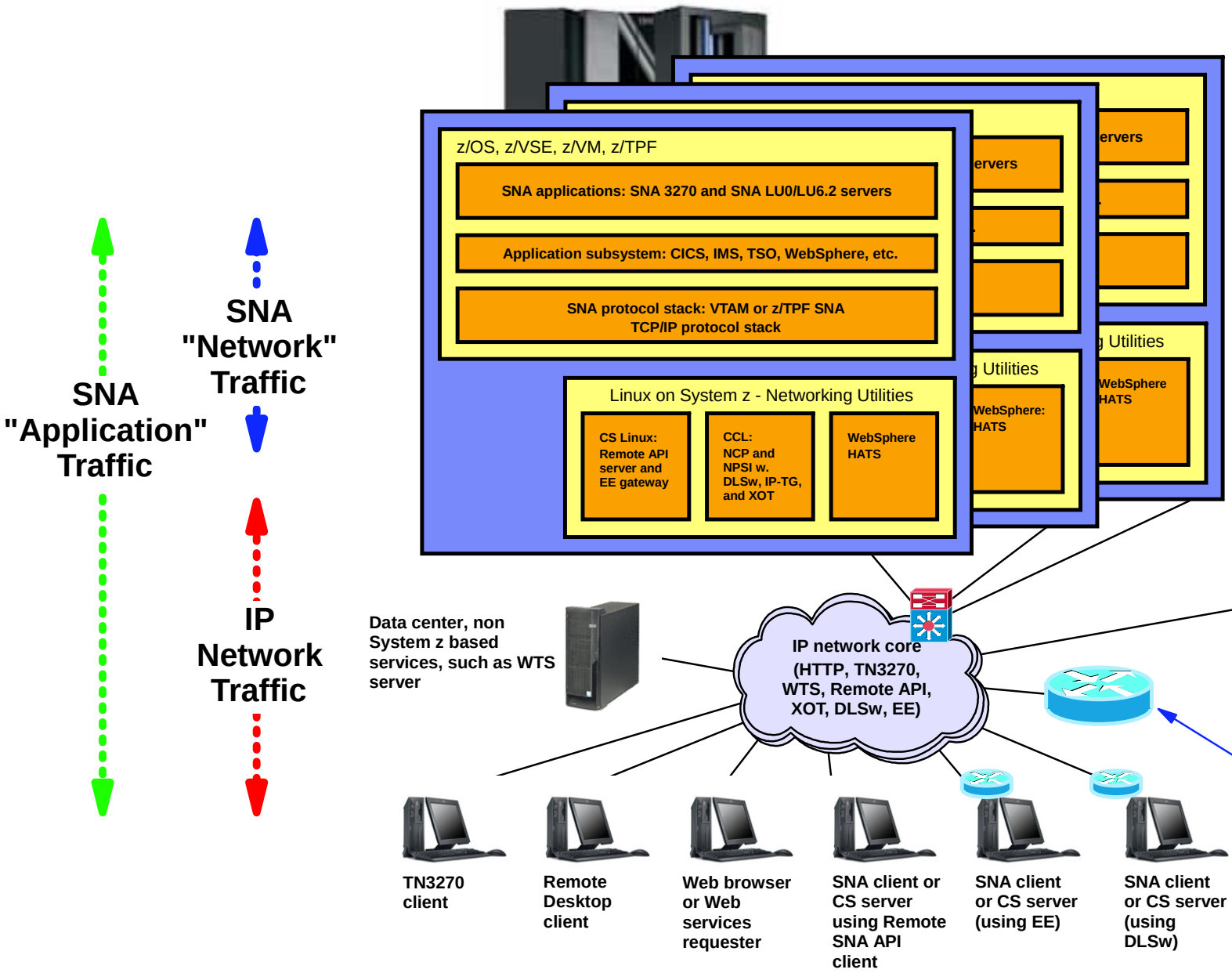
SNA without an SNA wide area network



- **SNA application traffic across the IP-based enterprise network infrastructure.**
- **SNA network traffic consolidated into the data center on a few SNA-specific link types, such as MPC+ channels, XCF messaging, or the data center LAN environment.**

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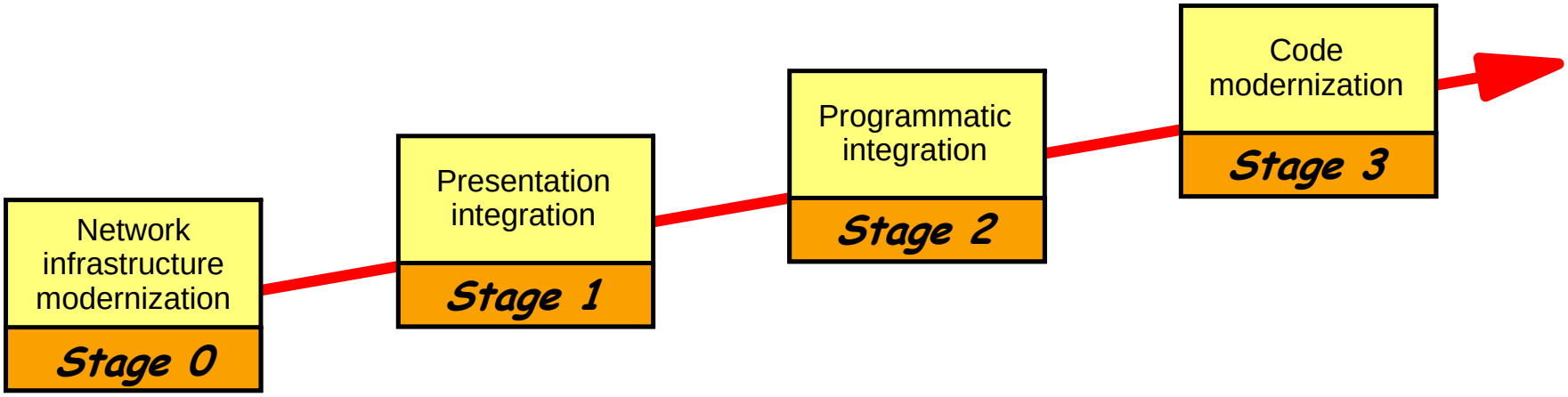
How do we get there? - through enterprise transformation stages

Enterprise transformation is about taking existing applications, which in many cases are SNA applications, and programmer skills, and cost-effectively and efficiently integrating them into the new world of e-business on demand.



- SNA over TCP/IP
- Terminals -> TN Servers -> Emulation

- Access via HTTP(S)
- Web enablement

- Wrap business logic/data with open standards access (such as Web Services, J2EE)
- Integrate with new application architectures and applications

- Move to open standards
- Refactor/rewrite portions of or entire application

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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 and an overall application infrastructure that is based on a Services Oriented Architecture**
  - Using a Web browser as the client - transforming SNA data stream to HTTP(S)/HTML
  - Exposing and accessing SNA applications as Web services - transforming SNA data stream to SOAP/XML
- **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**

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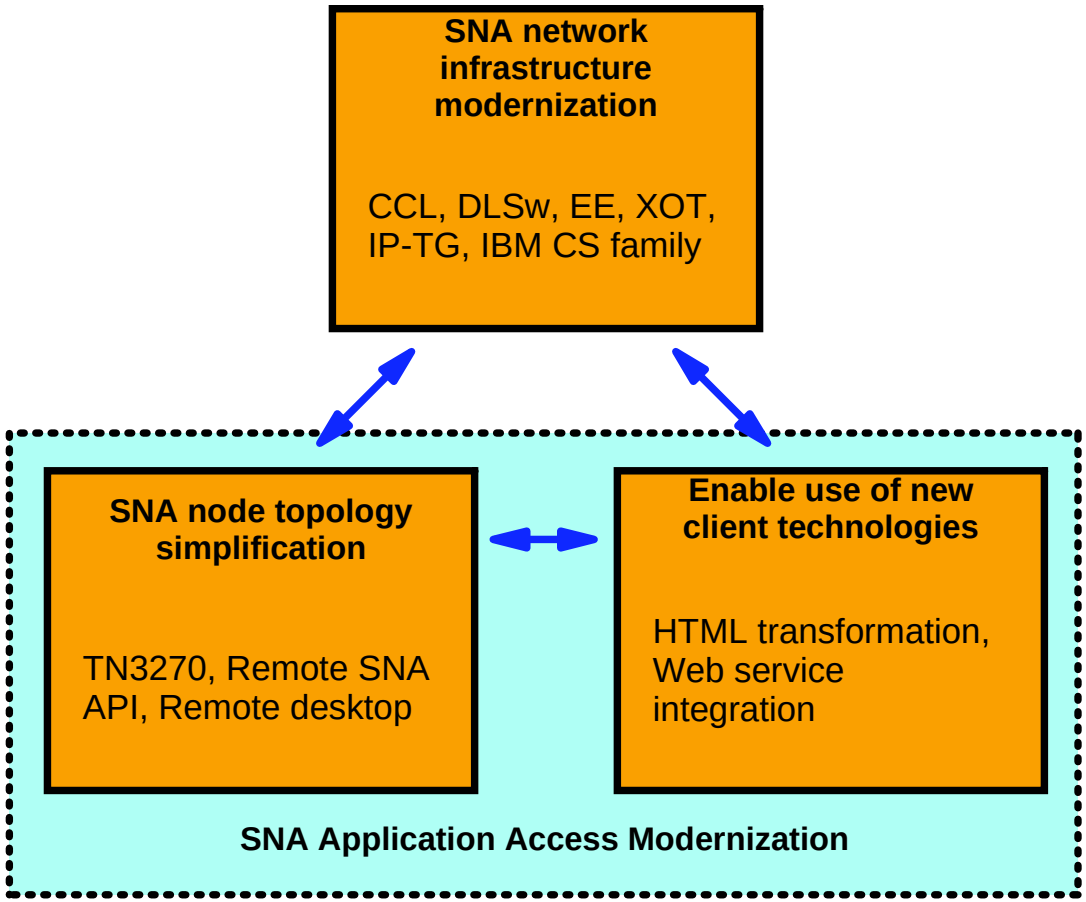
Structuring SNA modernization activities

- **The three groups of SNA modernization activities are distinct groups of activities, yet very much related:**



- **SNA network infrastructure modernization**
  - Updating the SNA network infrastructure to remove dependence on outdated SNA-specific hardware technologies - instead using a state-of-the art network technology that is based on a shared high-speed, secure, reliable, and highly available IP-based network topology for transporting both SNA and IP application traffic end-to-end.
- **SNA application access modernization**
  - Enabling continued use of both SNA client and server applications in their current form over a modernized network infrastructure, while at the same time allowing access to SNA-based server applications to be integrated into new client environments such as a Web browser, and into modern application environments, such as those based on a Services Oriented Architecture (SOA).
- **Do remember that by starting with SNA application access modernization, one implicitly reduces the amount of SNA infrastructure to modernize, but the overall modernization project will involve more people and may take significantly longer time.**

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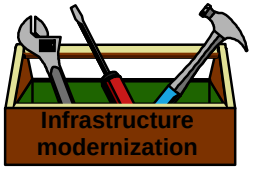
SNA modernization technology introduction

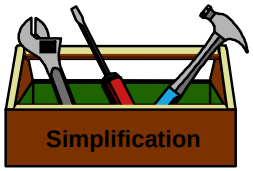
SNA network infrastructure modernization

- Primary objective is to remove dependency on old SNA-specific hardware, merge SNA and IP traffic over a common IP-based network, while preserving the existing full-function SNA end-user interfaces/functions and SNA node infrastructure in the branch and the data center.
- Technologies of primary interest:
  - APPN with High Performance Routing over IP (Enterprise Extender (EE))
  - Next-generation communication controller (Communication Controller for Linux (CCL))
  - Data Link Switching (DLSw)
  - IP Transmission Group (IP-TG)
  - X.25 over TCP/IP (XOT)



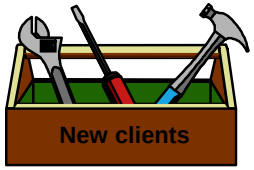
SNA node topology simplification

- Preserve existing SNA end-user interfaces and SNA client functions while at the same time providing means to remove SNA protocol stacks on workstations and branch servers, consolidating SNA protocol stacks into the data center.
- Technologies of primary interest:
  - Telnet 5250 and 3270 (TN5250 and TN3270)
  - Remote SNA API for desktop or remote server applications (split stack)
  - X-Windows or Windows Remote Desktop and Terminal Services (split GUI)



Enable use of existing SNA applications from new client technologies

- Provide ways for re-using existing SNA server applications from new client environments, such as a Web browser or a Web service requester.
- Technologies of primary interest:
  - SNA data stream to HTTP(S)/HTML transformation for use from a Web browser
  - Expose SNA applications as Web services and transform SNA data stream to SOAP/XML for use from a Web service requester and for integration into new business process workflows



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SNA Network Infrastructure Modernization

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SNA network infrastructure modernization - quick reference

Objectives		Modernization technologies				
		SNA subarea				APPN
		DLSw	XOT	CCL	IP-TG	EE
Enterprise Transformation Stage		0	0	0	0	0
Retain traditional 3270 screen on WS				(✓)		(✓)
Retain SNA client on WS				(✓)		(✓)
Access SNA 3270 applications from a Web browser with a web look and feel						
Enable as a Web service	SNA 3270 server application					
	SNA LU0 or LU6.2 server application					
Remove dependency on outdated hardware technologies	Token-ring			✓		(✓)
	IBM 3745/46			✓		(✓)
	Channel-attached SNA gateways			✓		(✓)
Share IP network for SNA and IP		✓	✓	(✓)	✓	✓
Consolidate SNA stacks into the data center						
Remove need for SNA						
Comments						

SNA Modernization Objectives

SNA Modernization Technologies

√ Primary objective

(√) Impacts, but not primary objective

There are two main aspects of modernizing an SNA network infrastructure:

1. SNA architecture ranging from SNA subarea through APPN/ISR to APPN/HPR including HPR over IP (EE) where such support exists.

2. Network consolidation and simplification consisting of two sub-dimensions:

   a. Consolidating the transport of SNA data end to end with transport of IP data over a common shared enterprise-wide IP network infrastructure.

   b. Consolidating SNA infrastructure functions and ultimately SNA protocol stacks into the data center.

You can meet most of the SNA modernization objectives with both an SNA subarea environment and an APPN environment, but the technologies you will choose, especially for network infrastructure modernization, will vary somewhat based on which SNA architecture level you decide to move forward with.

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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, and XOT technologies 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

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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 and is considered to provide an adequate level of service, a migration to APPN/HPR may not be necessary or may require skills that are not readily available.

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Modernizing an SNA Subarea Environment

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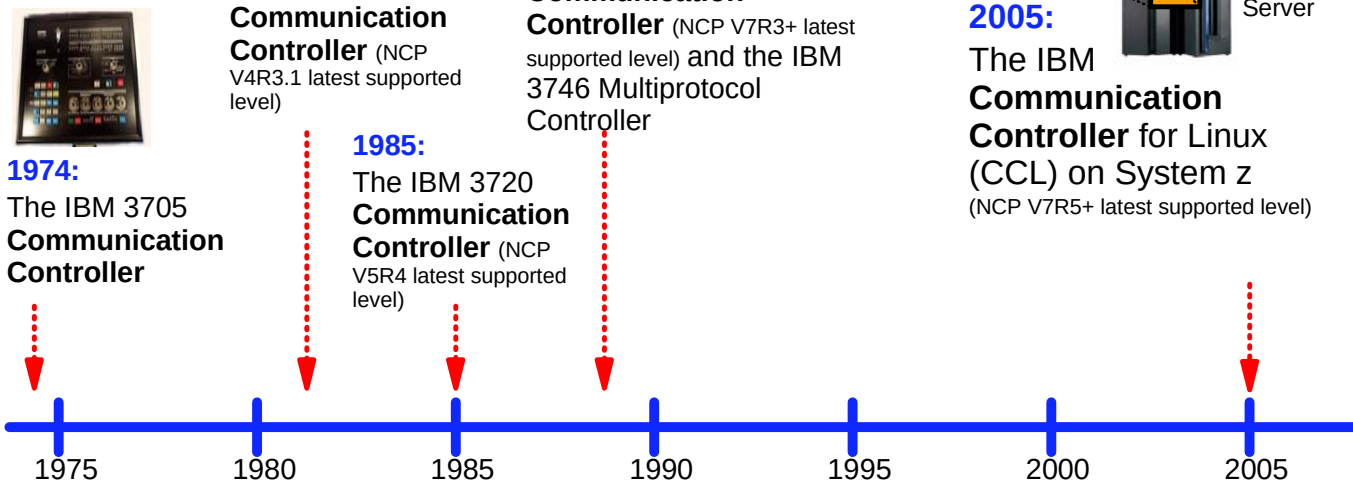
IBM Communication Controllers - the foundation of SNA application access to the IBM mainframe since 1974

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*



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

- **March 2005: CCL V1R1**
- **November 2005: CCL V1R2**
- **May 2006: CCL V1.2.1**

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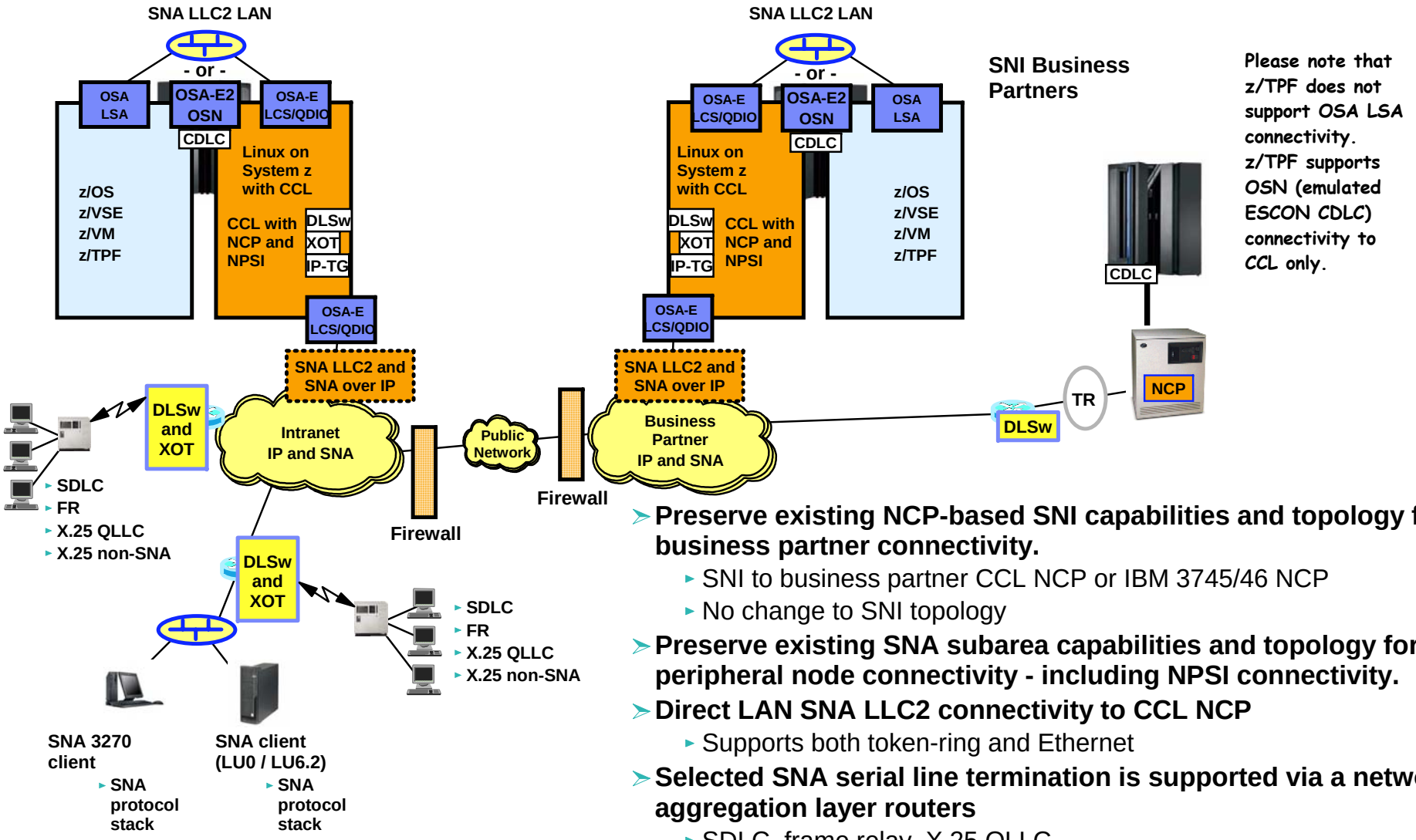
CCL V1.2.1 - topology and connectivity overview



- **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**

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CCL is not a complete replacement for the IBM 3745/46 Communication Controller

CCL Functional Overview Matrix	CCL V1.2.1 supports	CCL V1.2.1 support of serial lines via an aggregation layer router	CCL V1.2.1 does not support
Software	NCP (V7R5 and above) and compatible levels of NRF SSP, NTuneMON, NetView, and NPM continue to work as they have in the past NCP Packet Switching Interface (NPSI)		Other IBM 3745 software products: XI/NSF, EP, NTO, NSI, MERVA, and TPNS Functions provided by the IBM 3746 MAE or NNP (most of these functions can be migrated to CS Linux on System z) NCP-based IP routing (migrate to standard Linux-based IP routing)
Physical network interfaces	SNA LLC2 (LAN) access to OSA token-ring and Ethernet LAN NCP TIC2 or TIC3 LAN interfaces via OSA LCS or OSA QETH (QDIO layer-2) CDLC channel connectivity through shared OSA-E2 on System z9 IP-TG for direct IP connectivity between two CCL NCPs XOT for x.25 connectivity DLSw for DLSw termination in Linux for System z	SDLC, frame relay, X.25 QLLC, and ISDN serial line interfaces are not supported directly by CCL, but are supported via an aggregation layer router X.25 circuits are not supported directly by CCL, but are via an aggregation layer router that uses the XOT protocol to transport the X.25 packets to/from NPSI running in CCL	BSC, ALC, Start/Stop

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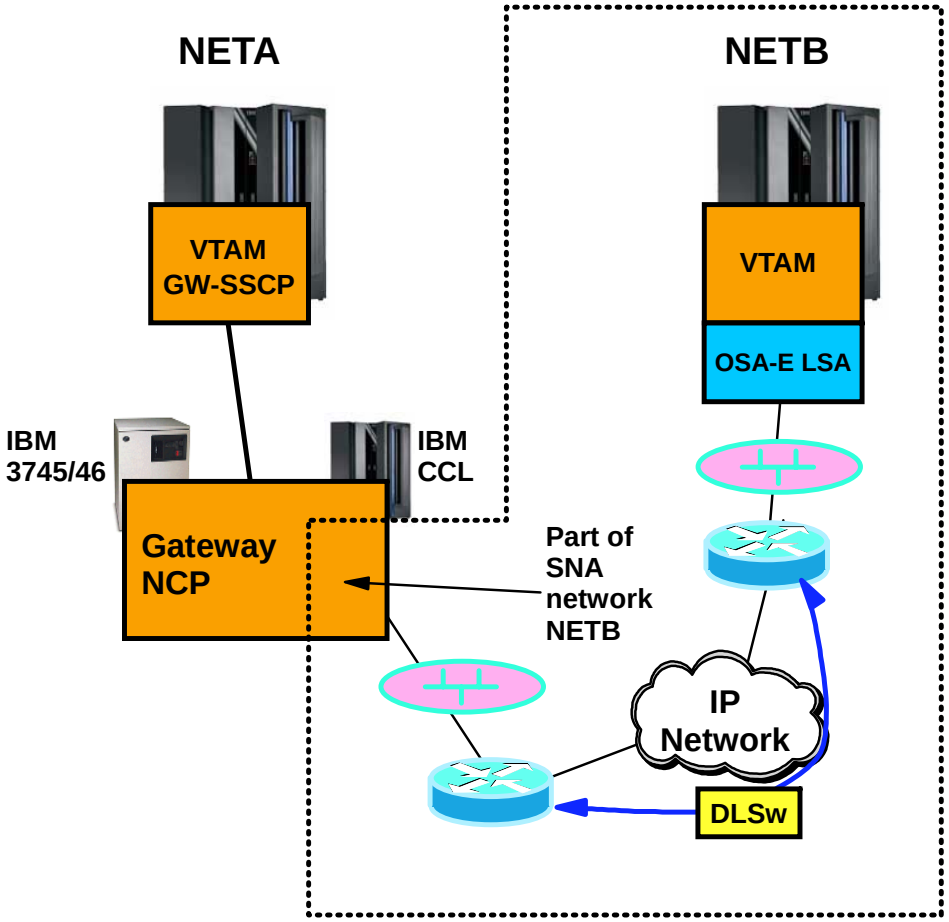
Are there any SNA subarea alternatives to an NCP for SNI connectivity?



- SNI connectivity can be established to an SNA subarea business partner using only a single NCP connected to the business partner VTAM via an OSA LSA port.
- The business partner SNA NETID must in that case be made part of the gateway SNI NCP (in a single gateway SNI topology) - extending the business partner subarea SNA network topology into the gateway NCP. That may be acceptable to some business partners, but probably not to all.
- For maximum SNA network topology separation and isolation, the most widely used SNI topology is based on the use of back-to-back gateway NCPs, in which case both business partners need an NCP.

For SNI connectivity, at least one NCP is needed.

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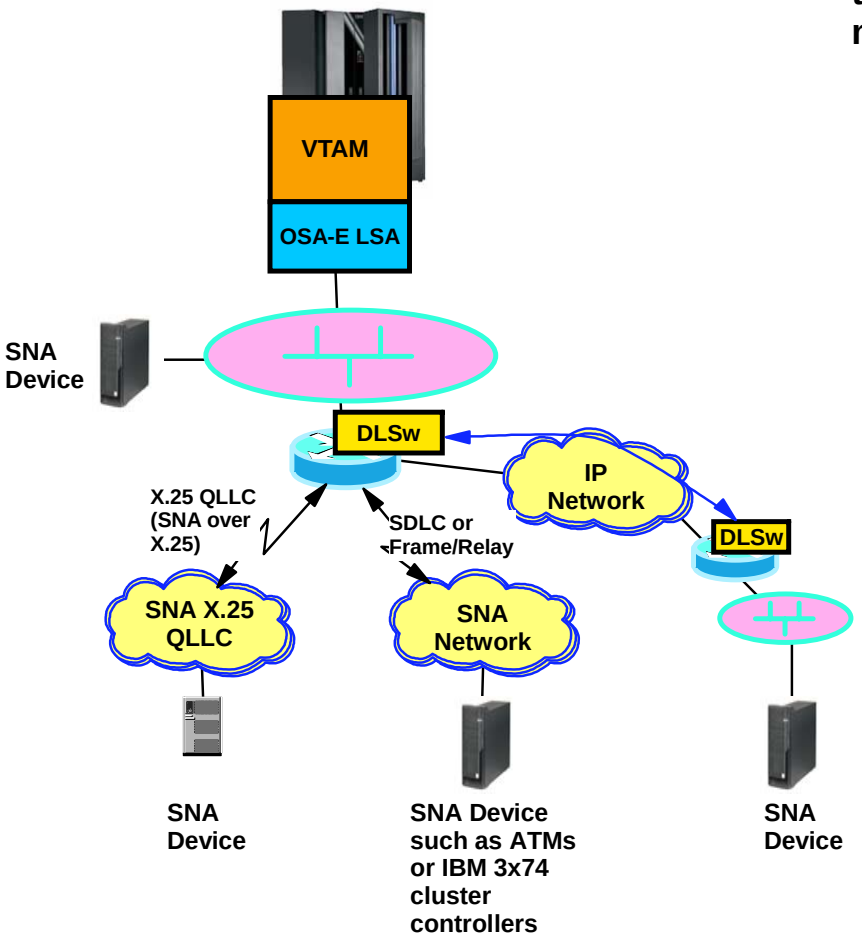
Are there any alternatives to an NCP for boundary functions in an SNA subarea environment?



- **VTAM can perform boundary functions for peripheral SNA nodes if they are connected to VTAM through an OSA port configured in LSA mode:**
  - VTAM will use low-order element addresses for the LUs it performs boundary functions for.
    - Limited to 64,000 - has become an issue in some scenarios
    - Use a D NET,STATS,TYPE=VTAM command to monitor
  - VTAM will use general mainframe CPU resources to perform the SNA boundary functions and to route SNA session data between the dependent LUs and primary LUs in the SNA network
  - If the boundary functions are being moved from an NCP environment, having VTAM perform boundary functions may also result in lower overall availability characteristics since there are no takeover functions or XRF available in that case
  - No non-SNA X.25 support (requires NPSI)
  - Not possible for VTAM to load/activate/own IBM 3745 NCP resources over an OSA LSA port
    - VTAM can communicate with an IBM 3745 NCP resource over an OSA LSA interface as long as some other VTAM is channel-attached to that NCP and owns it.
    - Please note that VTAM can activate and own IBM CCL NCP resources over an OSA LSA port

For a low number of dependent LUs, using VTAM to perform SNA boundary functions is a realistic alternative to an NCP. For large numbers of LUs, you need to watch out for running out of low order element addresses in VTAM and for the CPU resources VTAM will use to perform the boundary functions.

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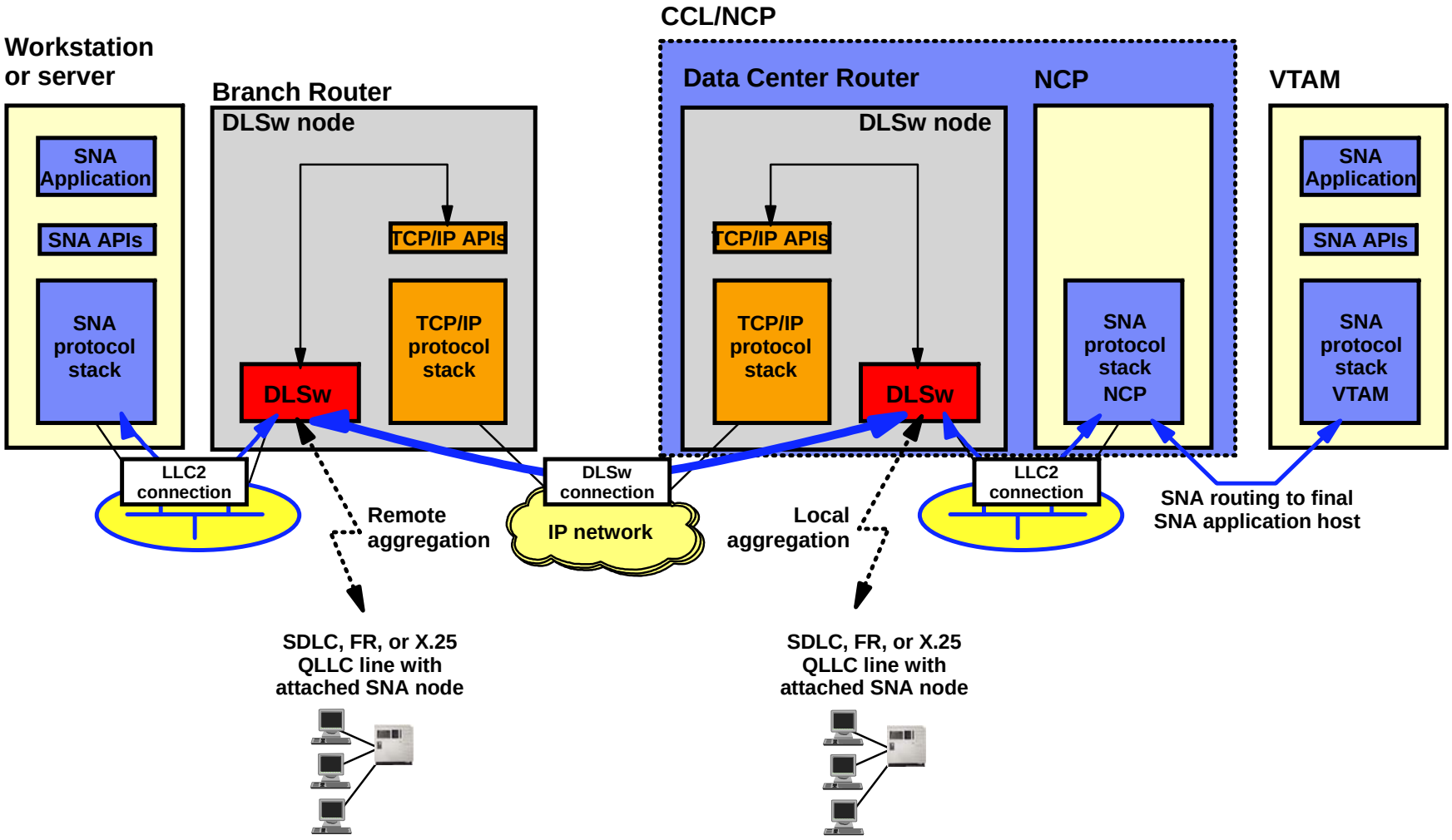
Transporting SNA subarea traffic over an IP network - Data Link Switching - DLSw



Note: No local aggregation by CCL DLSw (no direct serial line attachment to CCL)

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DLSw characteristics

- **DLSw is a technology that switches SNA link level frames over an IP network imbedded in TCP connections between two DLSw endpoints**
  - Each DLSw endpoint terminates the SNA LLC2 connections
    - To avoid wide area network latency and performance impact on local LLC2 timers
    - To avoid wasting wide area network resources on polling
- **DLSw uses one or two TCP connections between the two DLSw nodes when connecting over an IP network**
- **DLSw supports SNA subarea flows and APPN/ISR - but not APPN/HPR routing**
  - Some vendor-specific extensions do support HPR over DLSw (Cisco's DLSw+)
- **DLSw does not support SNA Class Of Service priorities over the IP network**
- **DLSw is incompatible with Multi Link Transmission Groups (MLTG) and does not support MLTG topologies between NCPs (INN or SNI)**
- **Typical use scenario is for remote SNA node access to data center and for serial line (SDLC) aggregation**
- **CCL V1.2.1 can be a DLSw endpoint - terminating DLSw connections inside CCL**
  - No local aggregation by CCL DLSw (no direct serial line attachment to CCL)

Relatively simple, widely used, and commonly known technology. DLSw isn't perfect, but it generally gets the job done in an SNA subarea environment.

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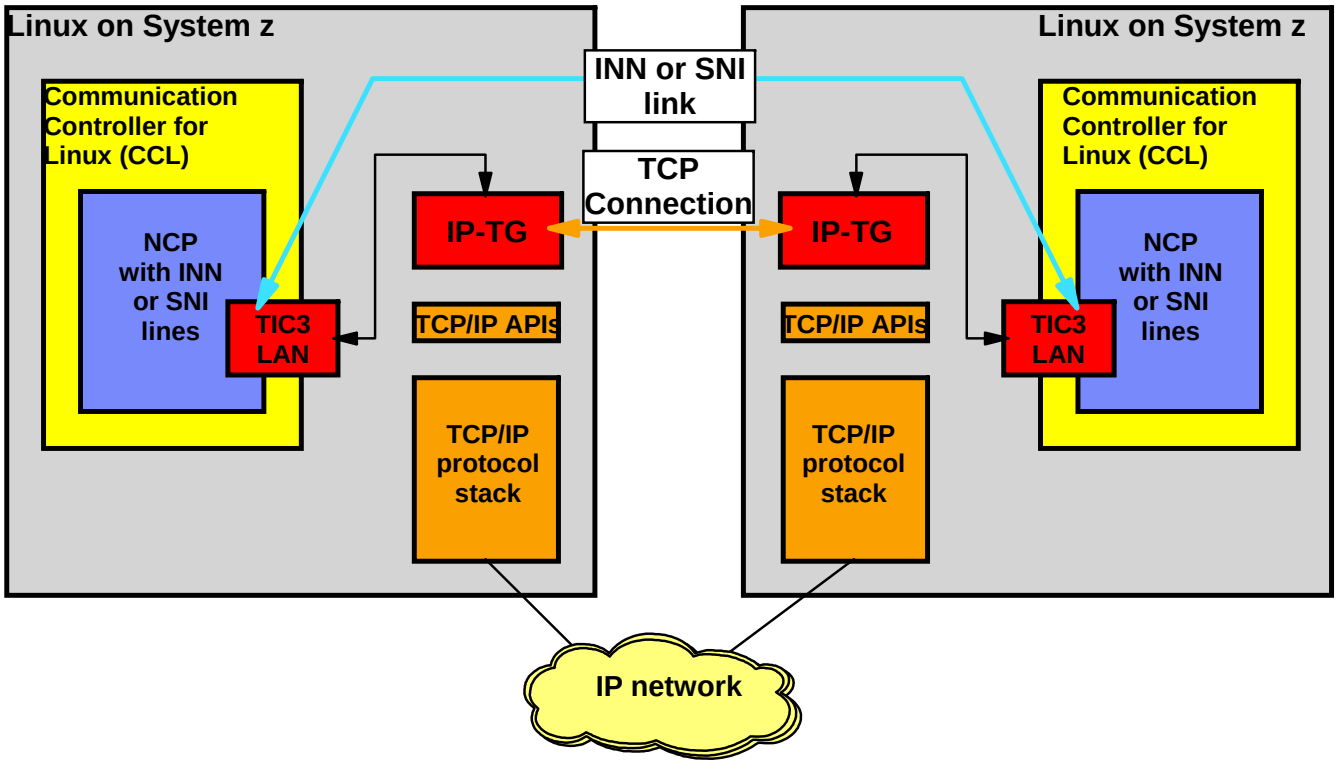
Transporting CCL/NCP to CCL/NCP (INN or SNI) traffic over an IP network - IP Transmission Group

- **CCL NCP to CCL NCP only - supports INN and SNI links**
- **Uses a single TCP connection per INN/SNI link**
- **Preconfigured TCP port number**
- **The TCP connection can be secured using STUNNEL (SSH) or IPSec**
- **IP-TG only support subarea flows - no APPN ISR/HPR flows**



- ✓ Simple IP end-to-end technology for SNI links
- ✓ Since TCP is used and TCP port number is pre-configured, firewall administration is easier than with EE
- ✓ Low-overhead technology that offers very high throughput rates

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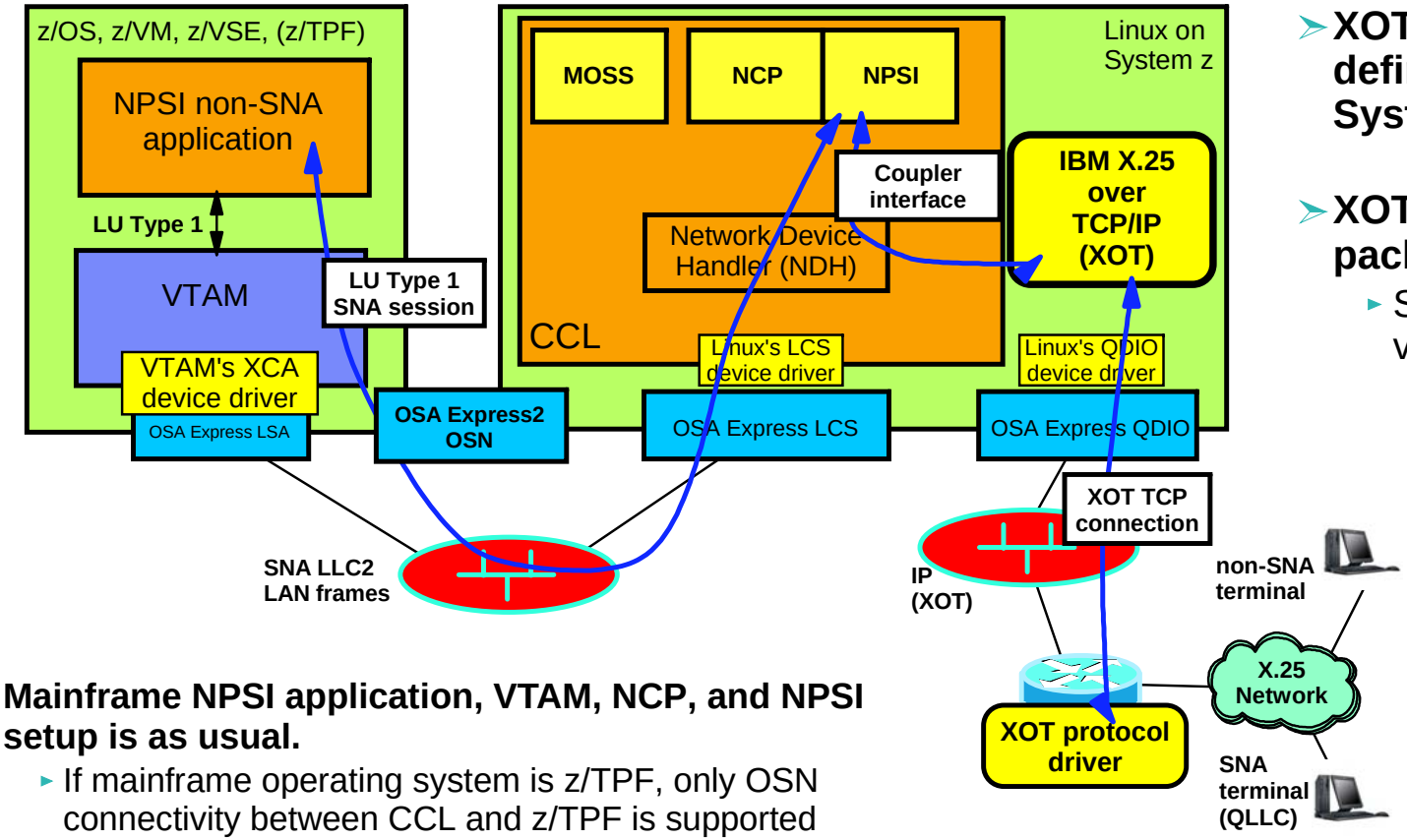
Transporting non-SNA X.25 access to CCL/NPSI over an IP Network - X.25 over TCP



- **XOT is an open standard and defined in RFC 1613 "Cisco Systems X.25 over TCP (XOT)".**
- **XOT is used to encapsulate X.25 packets over a TCP/IP network.**
  - Supported by various router vendors - including Cisco

XOT with CCL enables continued use of NPSI-based applications and X.25 connectvity to the System z platform via an XOT router.

- **Mainframe NPSI application, VTAM, NCP, and NPSI setup is as usual.**
  - If mainframe operating system is z/TPF, only OSN connectivity between CCL and z/TPF is supported
- **NPSI processing remains offloaded from the mainframe OS environment.**
- **Physical connectivity to X.25 network is via an aggregation layer router.**
  - Connectivity between aggregation layer router and NPSI is via an X.25 Over TCP/IP (XOT) TCP connection (IP network flows).
- **Interface between NPSI and local XOT protocol component is the same as NPSI uses today when communicating over X.25 adapters in an IBM 3746 unit - the Coupler interface.**
- **X.25 over TCP/IP for CCL is a separate IBM software product that is needed in conjunction with CCL for X.25 connectivity to NPSI**

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Modernizing an SNA APPN Infrastructure

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A select set of APPN-based technologies of special interest

- **Transport SNA over an IP network**
  - High Performance Routing over IP - Enterprise Extender
  - Some of the more common EE endpoints:
    - z/OS
    - Cisco SNA Switch
    - IBM Communications Server for Windows
    - IBM Communications Server for AIX
    - IBM Communications Server for Linux on Intel, Power, and System z
    - IBM's Personal Communication (PCOMM)
    - Microsoft Host Integration Server 2004
    - IBM i5/OS
- **Support for SNA boundary functions in an APPN network**
  - An NCP may still be used even if VTAM is defined as an APPN node
  - In VTAM if VTAM is attached to the network via an OSA LSA port
  - On any APPN node that supports being a Dependent LU Requester (DLUR) node
- **Control the size of the APPN network in terms of the number of APPN network nodes**
  - Branch Extender (BX, BEX, or BrNN) node technology
- **Control the amount of APPN transmission group definitions in an APPN network**
  - Connection network technology - Virtual Routing Node (VRN)
- **APPN-based business partner connectivity**
  - Extended Border Node (EBN) node technology
  - Physical connectivity may be IP if EE is used at both business partner locations

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Select set of APPN node capabilities

	z/OS VTAM	z/VSE VTAM	z/VM VTAM	z/TPF	NCP	CS Linux	CS AIX	PCOMM	i5/OS	CS Windows	Cisco SNA Switch
NN	y	y	y			y	y		y	y	
EN	y	y	y	y		y	y	y	y	y	
BX						y	y		y	y	y
MDH	y	y	y	(y)							
ICN	y	y	y								
EBN	y	y	y								
DLUR						y	y	y	y	y	y
DLUS	y	y	y								
CDS	y	y	y								
RTP end point	y			y		y	y	y	y	y	y
ANR router	y				y	y	y		y	y	y
HPR over IP (EE)	y					y	y	y	y	y	y

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APPN routing protocol review: ISR and HPR

- **Intermediate Session Routing (ISR) is the base APPN routing technology**
  - Each APPN node has awareness of all sessions that send data through the node
    - Storage requirements on the NNs on the session path
  - If a link fails, all sessions that use that link are terminated and the endpoints (the LUs) are notified of the broken session (UNBIND processing)

- **High Performance Routing (HPR) is an extension to the APPN architecture**
  - APPN/HPR nodes on the session path have no session awareness
  - If a link fails, HPR is able to re-route the data over another route - if one exists
    - This re-route (also known as path switch) is non-disruptive to sessions that use the failed route
  - The two endpoints of the HPR route are known as the Rapid Transport Protocol (RTP) endpoints or just the HPR pipe endpoints
    - Intermediate nodes between the two RTP endpoints perform Automatic Network Routing (ANR) forwarding of SNA session data without session awareness
  - HPR routing may be end-to-end if the endpoints support it
  - HPR may also be used on intermediate sections of the full end-to-end path
    - A session may start using ISR routing and then switch to an HPR "pipe" between two APPN nodes that are capable of HPR routing, and then switch back to ISR routing for the final part of the path

- **HPR routing may be used over**
  - A LAN
  - A mainframe channel (ESCON or FICON) operating in MPC+ mode
  - An XCF (Cross Coupling Facility) link between z/OS systems in a z/OS Sysplex
  - An IP network (Enterprise Extender)

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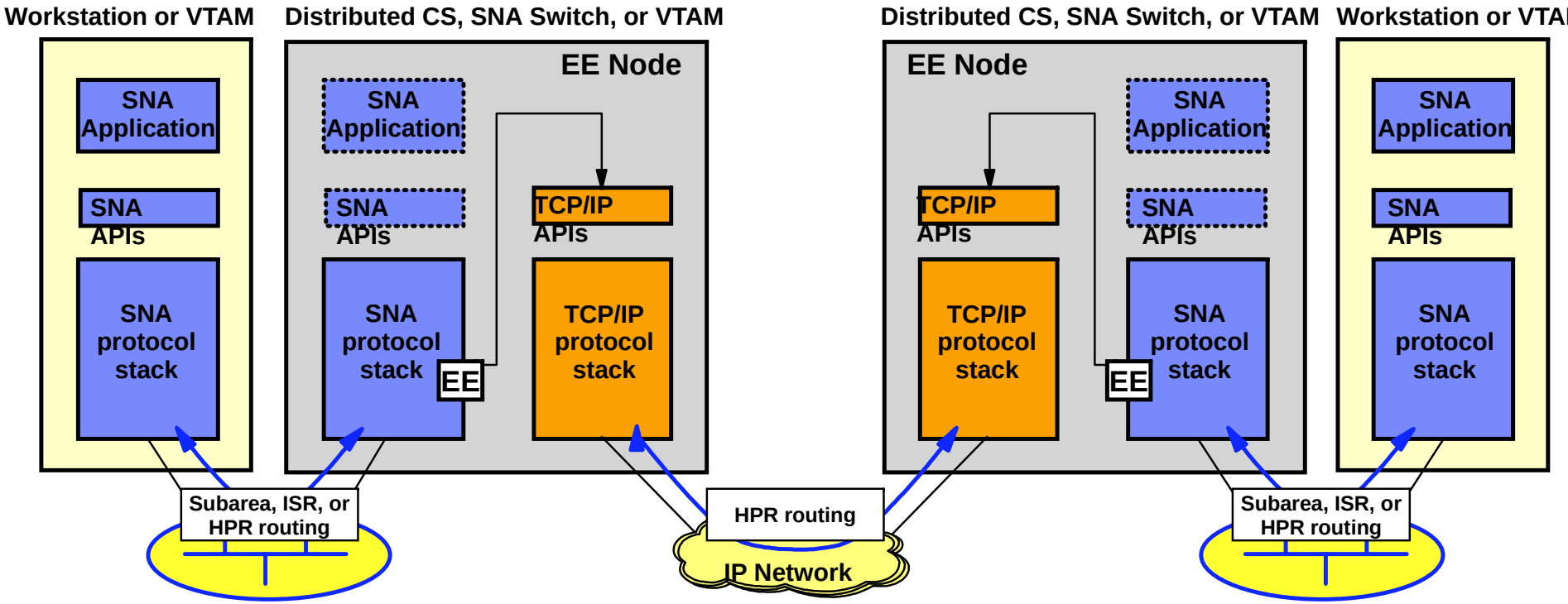
Transporting APPN/HPR data over an IP network: Enterprise Extender (EE)



- ✓ Uses latest SNA architecture enhancements
- ✓ True IP end-to-end technology
- ✓ Conceptually simple (HPR over IP using UDP transport protocols)
- ✓ Covers both branch access and business partner connectivity
- ✓ Be aware of IP firewalls

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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**
- **Main EE nodes are z/OS, CS/Linux, CS/AIX, CS/Windows, and Cisco SNA Switch**
  - Some EE nodes implement an EE-DLC connectivity function without being full APPN node capable - an example is Microsoft's Host Integration Server that cannot be a network node, and Cisco SNA Switch that can be a Branch Extender node only
  - i5/OS (iSeries) added EE support to i5/OS V5R4 in February 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**

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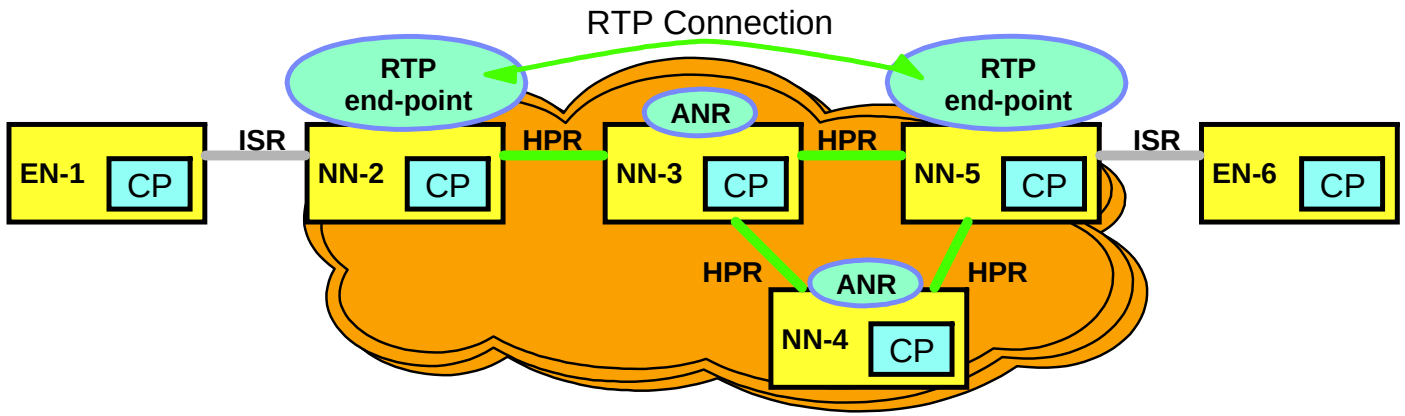
APPN routing protocol support overview

- **Do keep in mind that there are three levels of routing protocols for APPN nodes and that not all existing APPN implementations support all of these:**
  - **APPN/ISR routing**
    - All APPN nodes are supposed to support APPN/ISR routing over one or more physical link types
  - **APPN/HPR routing**
    - z/OS VTAM, z/TPF, CS Linux (System z, Intel, and Power), CS Windows, CS AIX, i5/OS, OS/400, Microsoft Host Integration Server (HIS) 2004, PCOMM, and Cisco SNA Switch
    - z/VM VTAM and z/VSE VTAM do not support HPR routing
  - **APPN/HPR over IP routing (EE)**
    - z/OS, CS Linux (System z, Intel, and Power), CS Windows, CS/AIX, i5/OS, Microsoft HIS 2004, PCOMM, and Cisco SNA Switch all support EE
    - z/VM VTAM, z/VSE VTAM, z/TPF, and OS/400 do not support EE
- **You can mix and match in an APPN network**



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High Performance Routing - general recommendation

If an APPN node supports HPR routing, then use HPR between the APPN nodes. In other words, if you have enabled APPN on your SNA node and the APPN technology on that node supports HPR routing, then you should enable HPR routing for the links that HPR may be used on.

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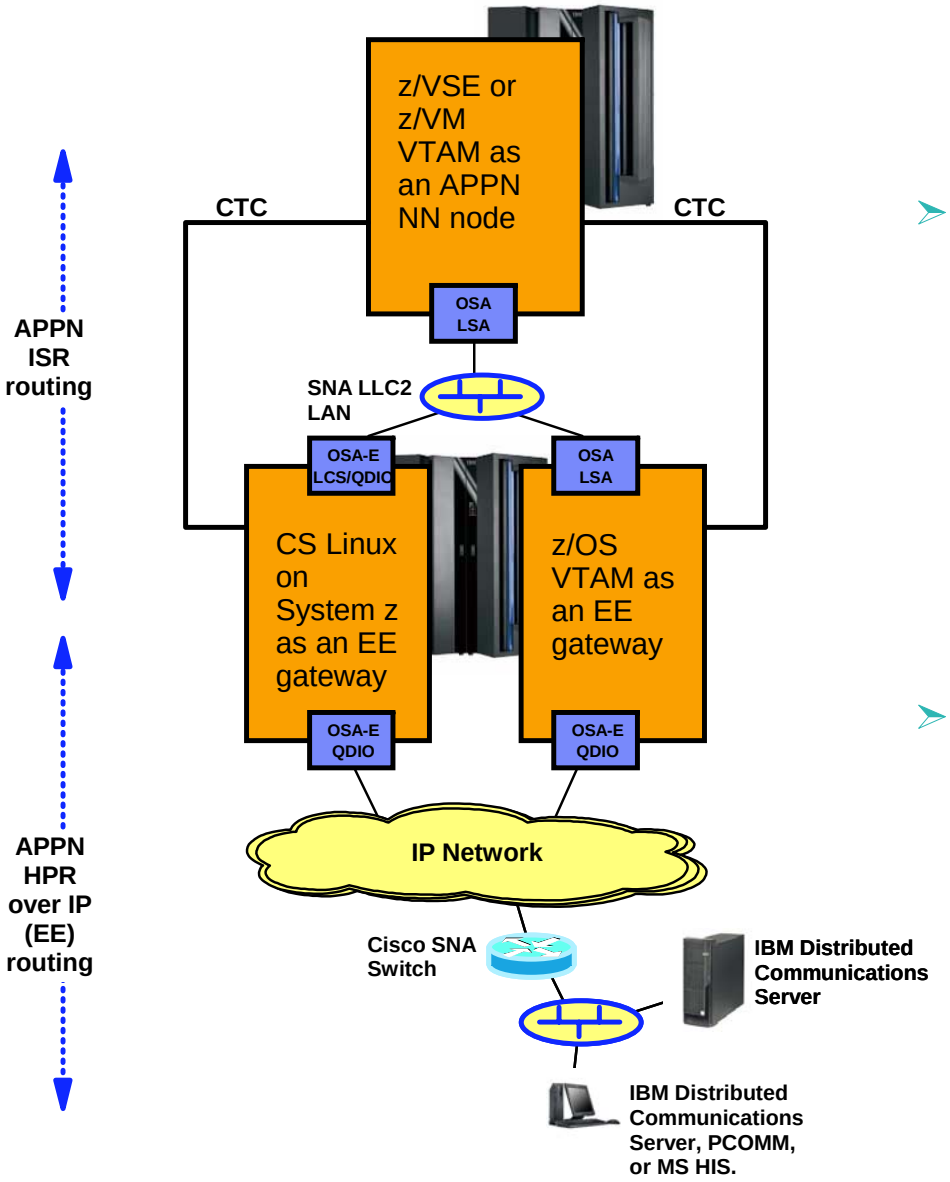
How can you use EE with z/VSE and z/VM VTAM?



- **VTAM on z/VSE and z/VM does support being configured as an APPN node**
  - VTAM on z/VSE and z/VM also supports APPN ISR routing, but not HPR routing.
- **If you need to connect z/VSE or z/VM as APPN nodes into an HPR or an HPR over IP (EE) infrastructure, you need an HPR/ISR gateway:**
  - Can be VTAM on z/OS
  - Can be IBM Communications Server for Linux on System z
    - Can also be IBM CS for Linux on a non-System z platform as long as there is SNA (APPN ISR routing) connectivity between that node and System z (could be via a shared LAN)
- **If CS Linux is used, then the following requirements need to be met:**
  - z/VSE and z/VM need to be in the same APPN NET ID as CS Linux
    - CS Linux cannot act as an APPN border node
    - z/OS can, in which case z/VSE and z/VM could be in a different SNA NET ID from z/OS
  - z/VSE and z/VM should be APPN network nodes
    - It is strongly recommended that VTAM end nodes use VTAM network node servers

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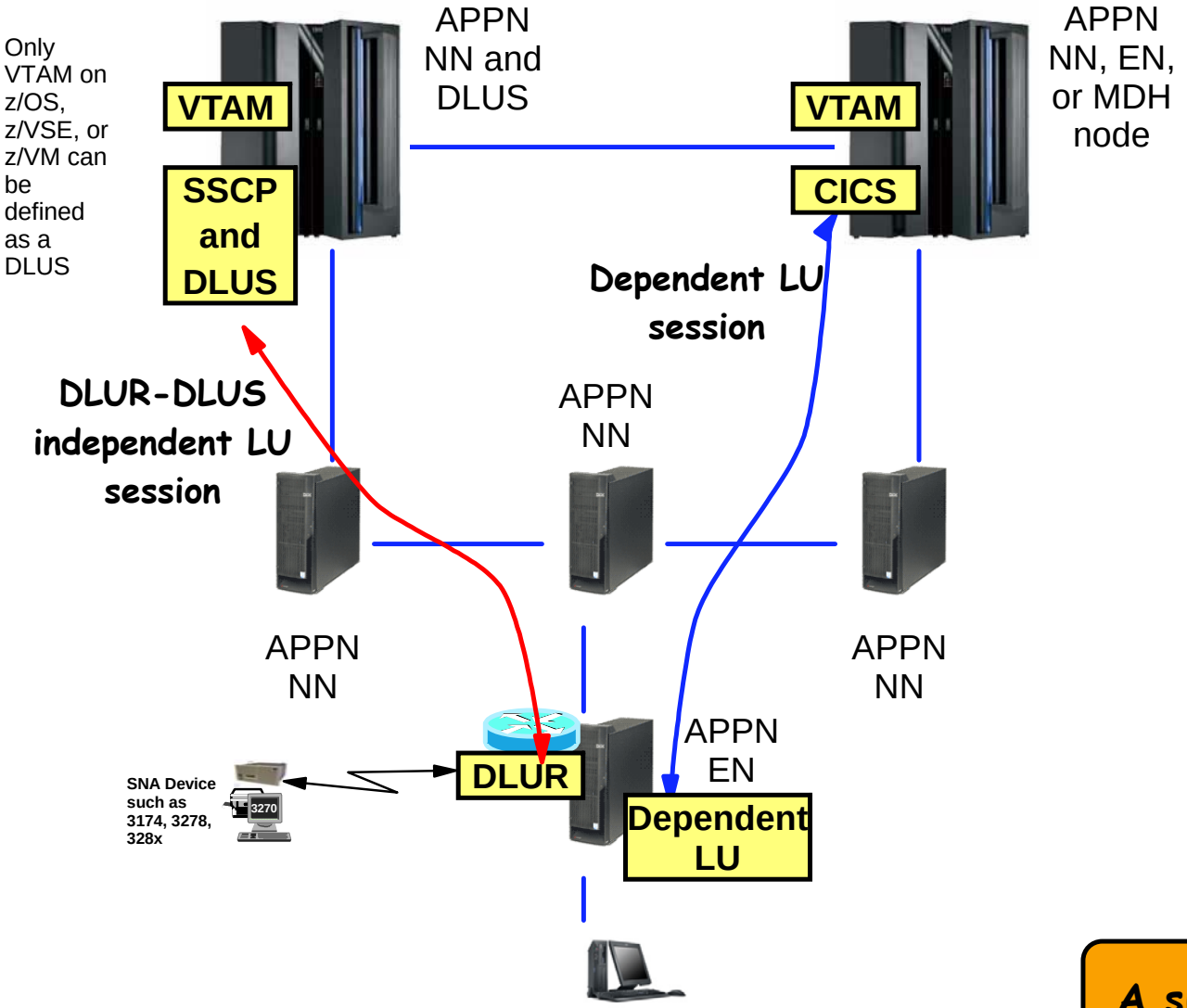
Dependent LU support via DLUR-DLUS in an APPN network



- **The DLUR function may reside on one of IBM's distributed Communications Servers**
  - CS Windows
  - CS Linux for Intel, Power, and System z
  - CS/AIX
  - PCOMM
- **Or on other vendors' APPN-capable nodes**
  - Cisco SNA Switch as an example
- **Some platforms support serial line termination, which in combination with DLUR allows for support of downstream, serial-line attacted SNA peripheral nodes with dependent LUs in an APPN network**
  - Cisco routers
  - IBM CS Windows, AIX, and Linux on Intel
    - SDLC and X.25 QLLC

A simple way to integrate dependent LUs in an APPN topology

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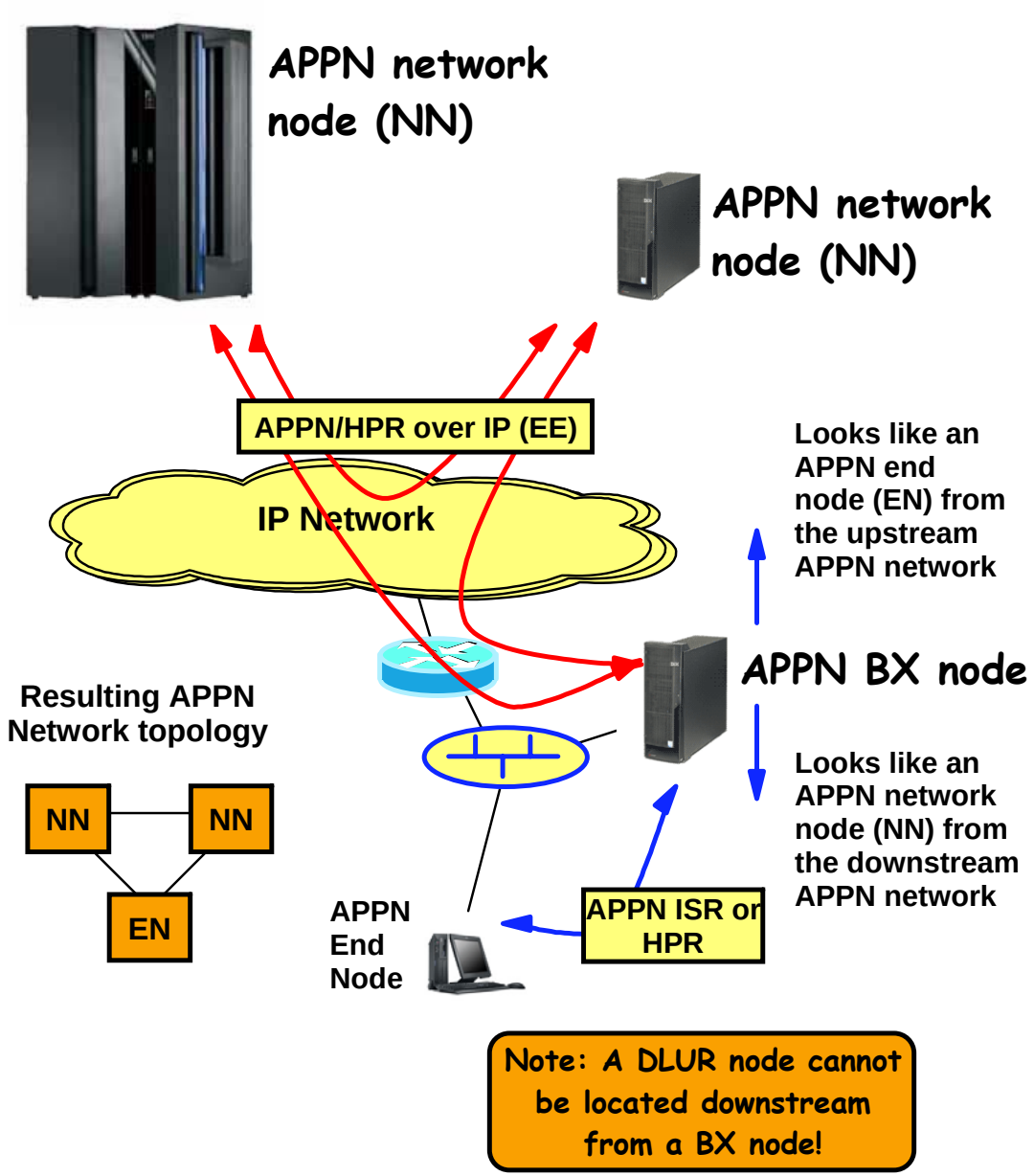
Branch Extender - simplifying APPN network node topology in large APPN networks



- **You generally want to keep the number of APPN network nodes under control**
  - Broadcast searches are sent to all NNs in an APPN network and can become an issue if NNs are connected over slow/low-capacity network links
  - Network topology updates are exchanged between all NNs
- **Branch Extender nodes connected to the data center over EE, allow you to consolidate APPN NNs into the data center**
- **Most commonly used nodes that support being a Branch Extender**
  - IBM CS Linux (Intel, Power, and System z)
  - IBM CS Windows
  - IBM CS AIX
  - i5/OS
  - Cisco SNA Switch

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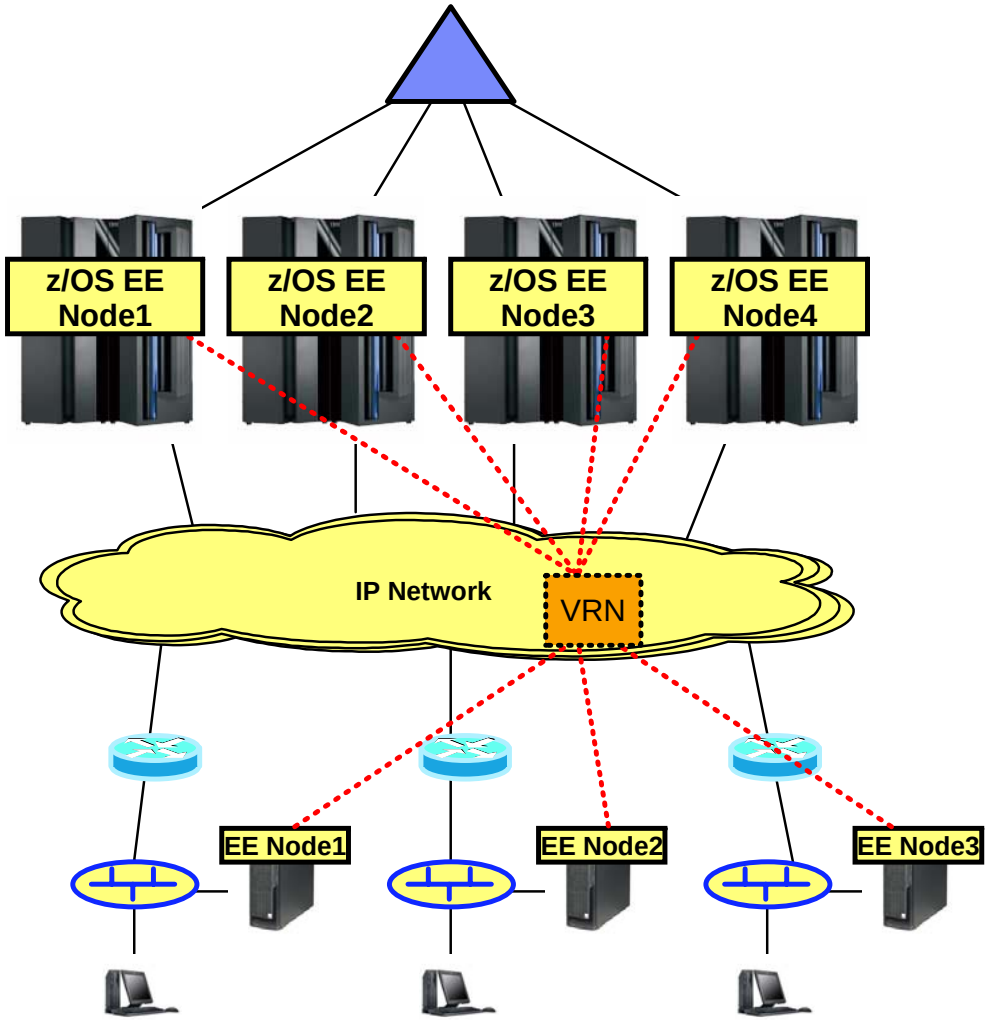
Simplifying link definitions in large EE networks - APPN connection network technology works over IP networks



- **Local connection network:**
  - Does not cross network boundaries
- **Global connection network**
  - May cross network boundaries

- **A connection network is an APPN technology that reduces the need for predefining APPN links between nodes that are connected to a shared access transport facility (SATF), of which a LAN is the most typical example.**
- **Connection networks can also be used with EE, where the full IP network can be viewed as a single SATF network.**
- **In this example topology, all EE nodes can send EE packets directly to each other without defining links to all the other nodes.**
  - Please note that in a connection network topology, each node still needs some pre-defined links for selected CP-CP sessions.
- **Generally the combination of EE with connection network technology is recommended with the objective of reducing the amount of link definitions that are required and to allow EE endpoint to endpoint communication to flow directly between the associated IP endpoints.**

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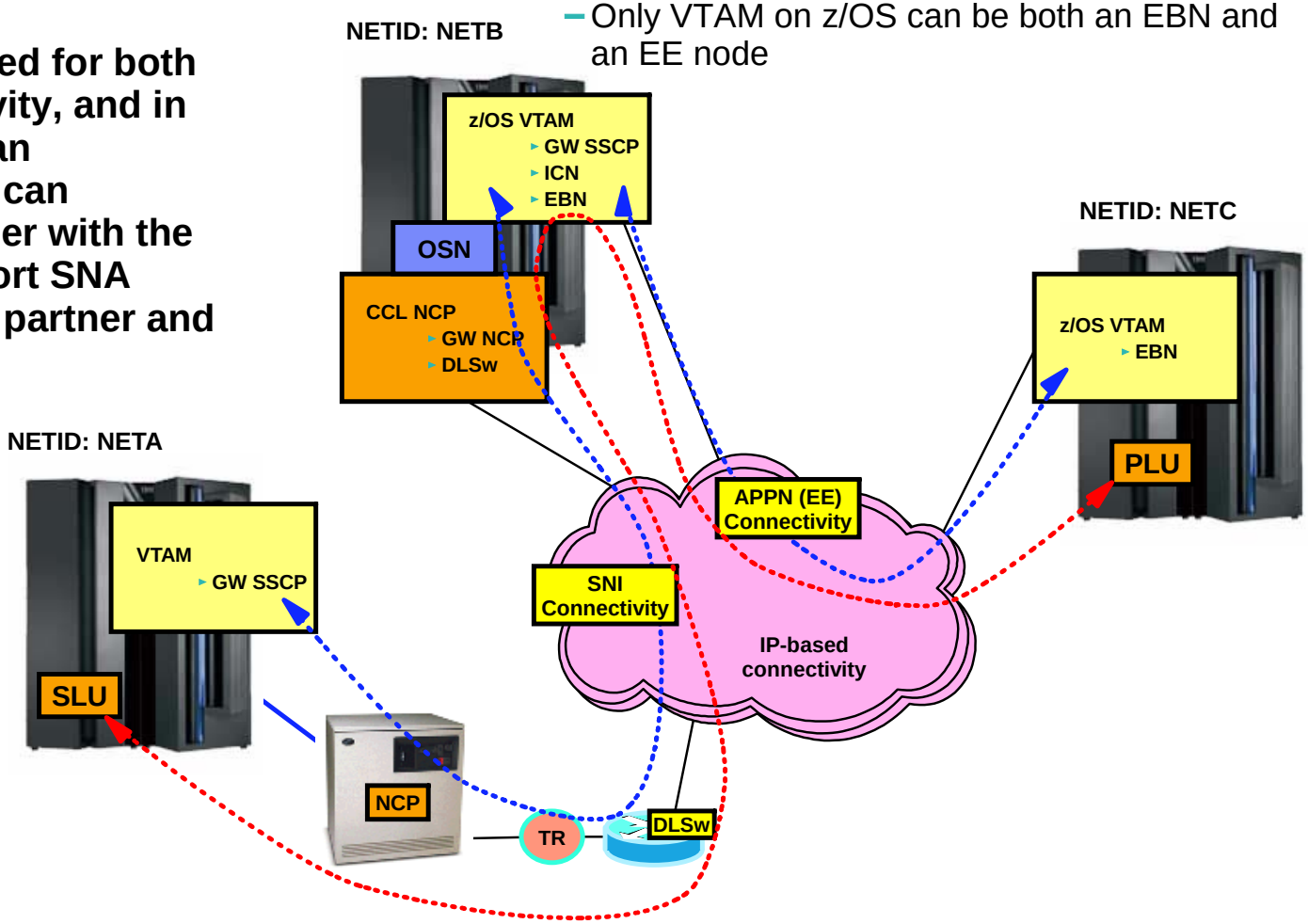
SNI and APPN multiple network connectivity (EBN connectivity)

- **An SNI gateway must connect to another SNA subarea node.**
- **An EE/EBN endpoint must connect to another APPN node.**
- **If a z/OS VTAM is configured for both EE/EBN and SNI connectivity, and in addition is configured as an Interchange Node (ICN), it can interconnect the SNI partner with the EE/EBN partner and support SNA sessions between the SNI partner and the EE/EBN partner**
  - NETA LUs can establish sessions with NETC LUs via NETB
- **APPN multiple network connectivity**
  - APPN's alternative to SNI for SNA connectivity between different APPN NET IDs
  - Implemented via Extended Border Node (EBN)
    - VTAM on z/OS, z/VSE and z/VM can be EBNs
    - Only VTAM on z/OS can be both an EBN and an EE node



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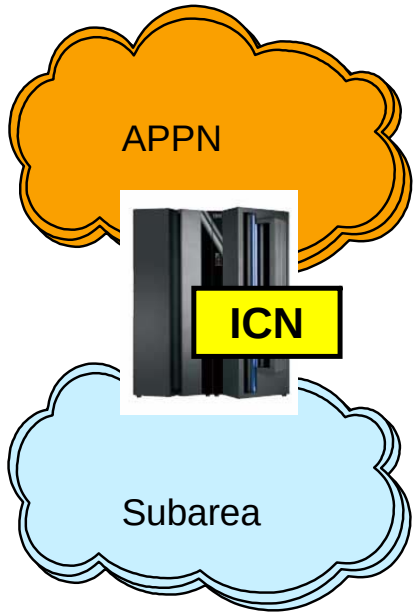
Mixed subarea and APPN networks on z/OS

- **VTAM has two distinct search algorithms: Subarea and APPN**
  - Understanding details of either is difficult
  - Understanding details of both is very difficult
  - Understanding how they interact is almost impossible!
- **Tuning for performance may require some work**
  - Especially when parallel APPN and subarea paths exist
    - Trade-off: dynamics versus predefinition
  - Complexity is significantly reduced when network is completely APPN
- **SORDER= on ADJSSCP tables makes tuning much easier!**
- **Which search algorithm is used?**
  - Depends on origin of search (subarea or APPN)
  - Searching switches between subarea and APPN as needed



During a subarea to APPN migration period, you will need to study the details of searching and adjust your ADJSSCP tables as you move forward.

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Some of the more recent APPN/EE enhancements on z/OS

- **z/OS V1R4**
  - Support of HPR-only virtual routing nodes (VRNs) for interchange nodes (ICNs)
    - Removing a topology restriction that an ICN node could not route between the subarea network and the APPN network if the ICN was connected to the APPN network over an EE network that used connection network technologies
  - Use enhanced addressing for both EE lines and Rapid Transport Protocol (RTP) PUs
    - Freeing up more VTAM element addresses below the 64,000 mark
  - Automatic re-dial of switched PUs
    - Remove the need for automation logic to re-dial switched PUs
- **z/OS V1R5**
  - EE support over IPv6 networks
  - Support of EE connections over a global connection network that includes IP network address translation (NAT) devices
    - By using host names in the control vectors instead of IP addresses
  - Support for more connection networks (multiple Virtual Routing Node (VRN) support)
    - z/OS V1R2 added support for one local and one global connection network, but not more than one of each
    - Multiple EE endpoints on z/OS by supporting multiple local static VIPAs
    - Each endpoint may belong to different connection networks
  - EE network management data through the CS z/OS network management interface (NMI)
  - Multiple concurrent APING commands
  - Various administration and operations enhancements
    - New D RTPS command
    - Improved APPN search diagnostics
    - EE model PUs

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Some of the more recent APPN/EE enhancements on z/OS (continued)

- **z/OS V1R6**
  - Vary update support for XCA major nodes
  - EE connection network reachbility awareness
  - EBN session awareness
  - EE packet trace (IP) formatting for improved diagnostics
  - EE performance improvements
    - Logical Data Link Control (LDLC) timer optimization for performance improvements in EE networks
    - RTP queuing optimization
- **z/OS V1R7**
  - VTAM XCF connectivity support in SNA subarea environments
    - Includes ability to use IP XCF connectivity without APPN-enabling VTAM
  - Model definitions of VTAM cross domain resources
  - Various administration and operations enhancements
    - Improved EE diagnostics through a new D EEDIAG command
    - HPRDIAG option on display command for RTP PUs
- **z/OS V1R8**
  - EE connectivity test command
    - A traceroute-like EE command to verify EE connectivity for all 5 UDP ports between two EE endpoints
  - Dynamic update of VTAM application major nodes
  - ICN selection function for DSME

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Modernizing SNA Application Access

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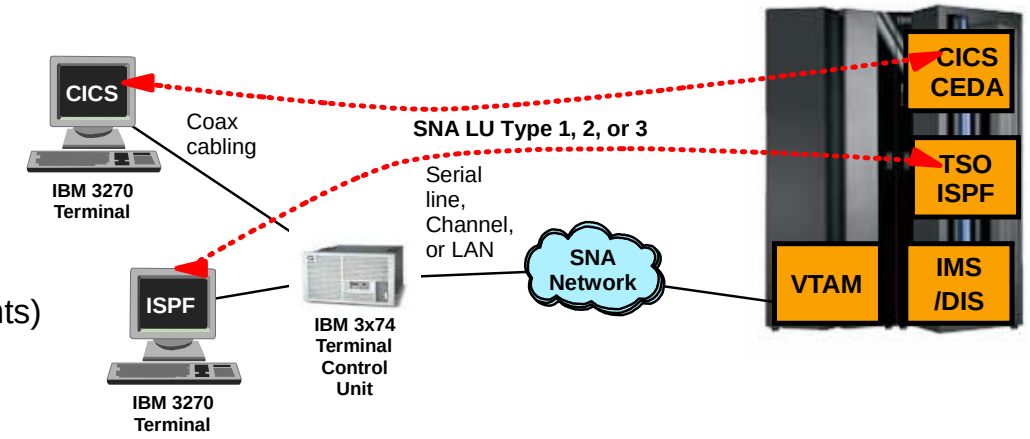
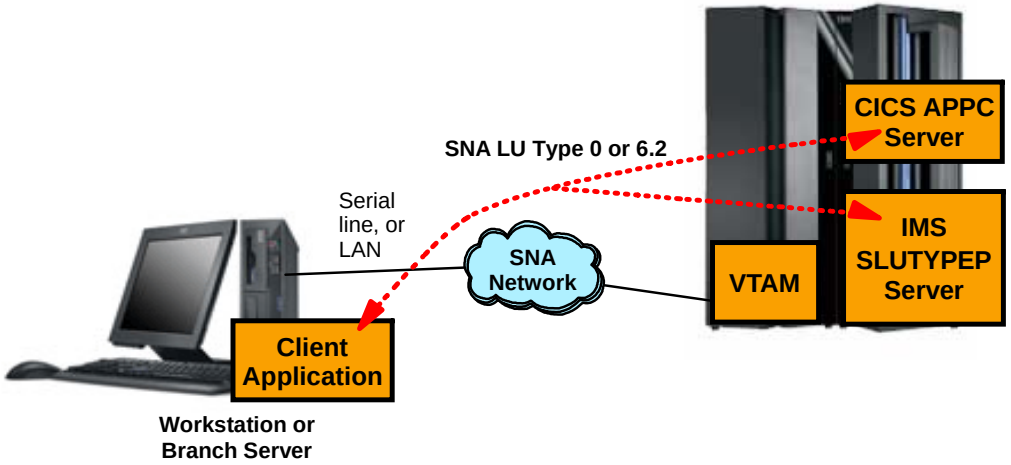
An SNA application view of SNA modernization

- **SNA 3270 applications**
  - It is the "server" part we need to preserve
    - CICS or IMS transactions (BMS/MFS)
    - TSO, NetView, etc.
  - Client environments
    - Traditional 3270 screen interface
      - SNA emulators or real IBM 3270 devices
        - ★ SNA network infrastructure modernization focus
      - TN3270 emulators (fat clients and on-demand clients)
        - ★ SNA node simplification focus
    - Web browser via HTTP(S)/HTML
    - Web services requester



- **SNA LU0/LU6.2 client/server applications**
  - The "server" part:
    - CICS or IMS transactions
    - APPC/MVS, etc.
  - Client environments
    - User-written client
      - Preserve SNA client where it runs
        - ★ SNA network infrastructure modernization focus
        - ★ SNA node simplification focus (Remote SNA API technology)
    - Web browser via HTTP(S)/HTML
      - New "presentation" logic in HTTP server
    - Web services requester
      - New "presentation" logic in Web service wrapper



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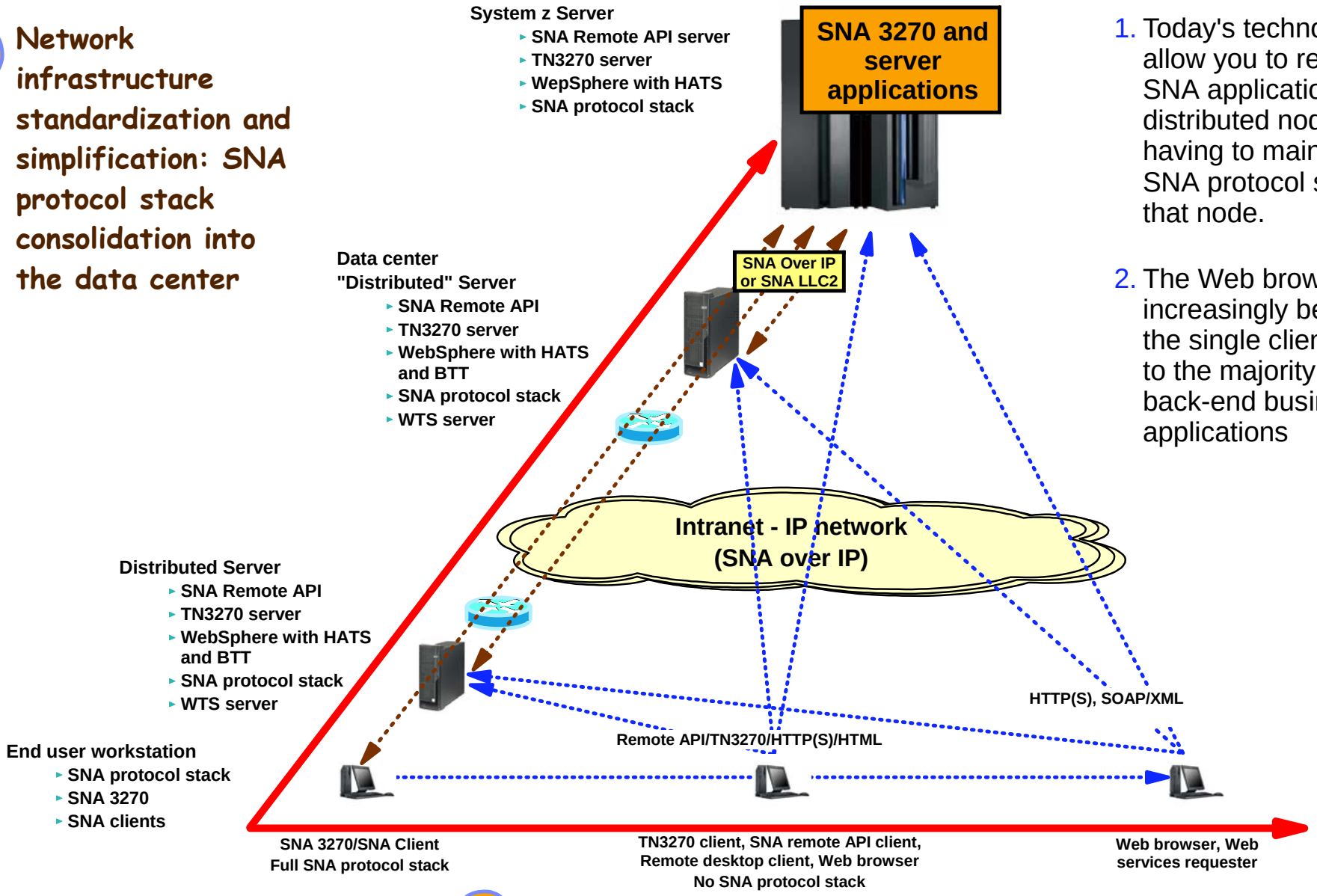
Two dimensions impacting SNA application access modernization

1 Network infrastructure standardization and simplification: SNA protocol stack consolidation into the data center



1. Today's technologies allow you to retain an SNA application on a distributed node, but not having to maintain a full SNA protocol stack on that node.
2. The Web browser is increasingly becoming the single client interface to the majority of back-end business applications

2 Client standardization and simplification

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Modernize application access - quick reference

Objectives		Modernization technologies								
		SNA 3270 applications			SNA Client/Server applications					Rewrite applications to TCP/IP APIs or as Web services
		TN3270 emula-tion (PCOMM and HOD)	User inter-face trans-forma-tion (HATS, IMS, CICS)	Web service and SOA integra-tion (HATS, IMS, CICS)	Remote API	Remote desktop	Web service and SOA integra-tion (BTT, IMS, CICS)	DRDA o. IP	MQ o. IP	
Enterprise Transformation Stage		0	1	2	0	0	1 and 2	0	0	3
Retain traditional 3270 screen on WS		✓				(✓)				
Retain SNA client on WS					✓	(✓)				
Access SNA 3270 applications from a Web browser with a web look and feel			✓							
Enable as a Web service	SNA 3270 server application			✓						
	SNA LU0 or LU6.2 server application						✓			
Remove dependency on outdated hardware technologies	Token-ring									
	IBM 3745/46									
	Channel-attached SNA gateways									
Share IP network for SNA and IP										
Consolidate SNA stacks into the data center		✓	✓	✓	✓	✓	✓			
Remove need for SNA				(✓)			(✓)	✓	✓	✓
Comments								For DRDA traffic	For MQ traffic	

- **The technologies in this area fall into two main groups:**
  - SNA 3270 applications
  - SNA client/server applications (LU0/LU6.2)
- **For each of those groups, there are in general three levels of modernization:**
  - Preserve existing user interface and/or SNA client functions
  - Replace the client with a Web browser and use some form of SNA to HTML transformation technology
  - Replace the client with a Web service requester and use some form of Web service interface enabling technology to wrap the existing SNA business application and enable use of that SNA application as a building block in a service oriented application architecture (SOA)

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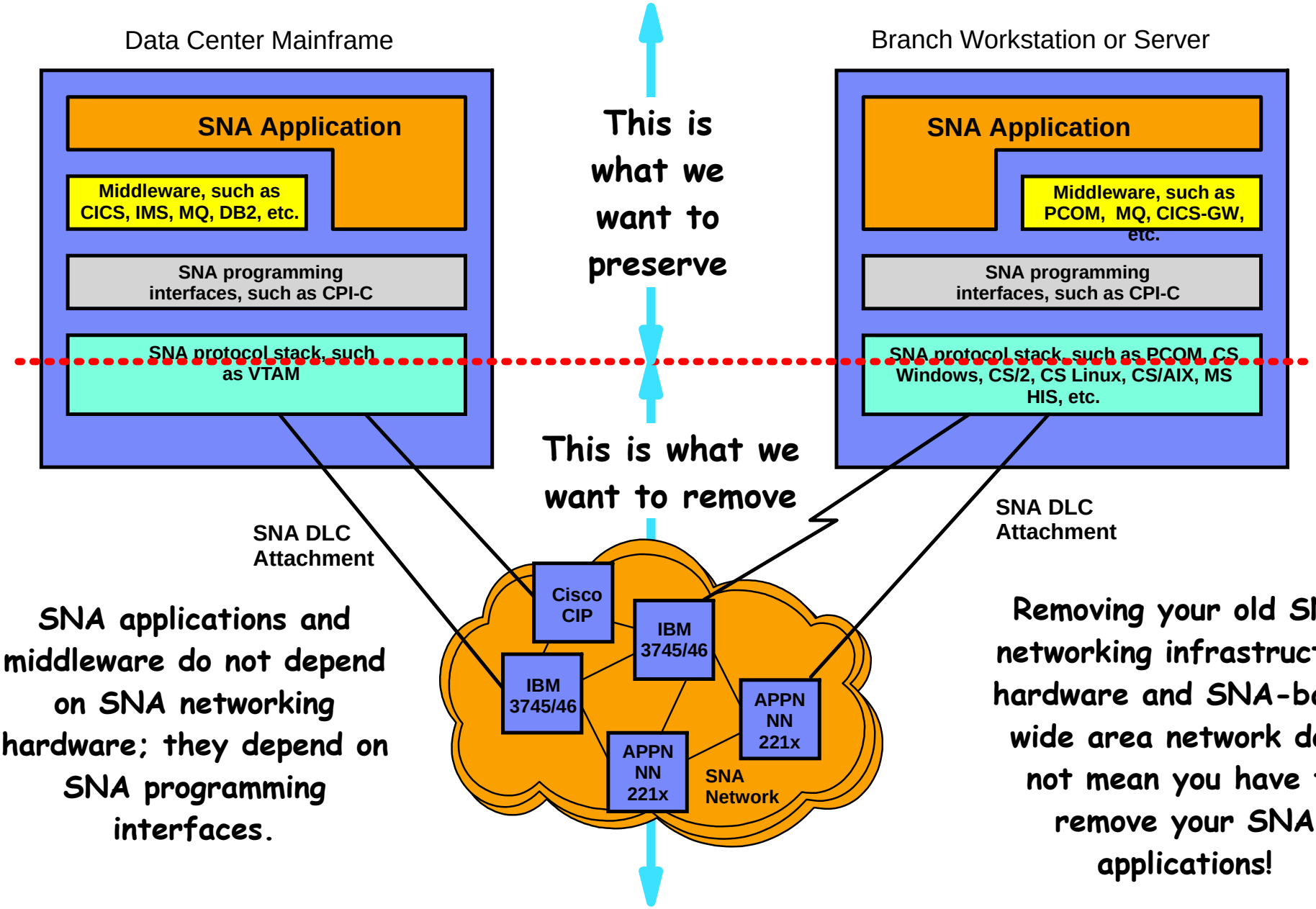
What do we want to remove and what do we want to preserve?



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SNA Node Topology Simplification - Preserving Existing SNA Client Interfaces

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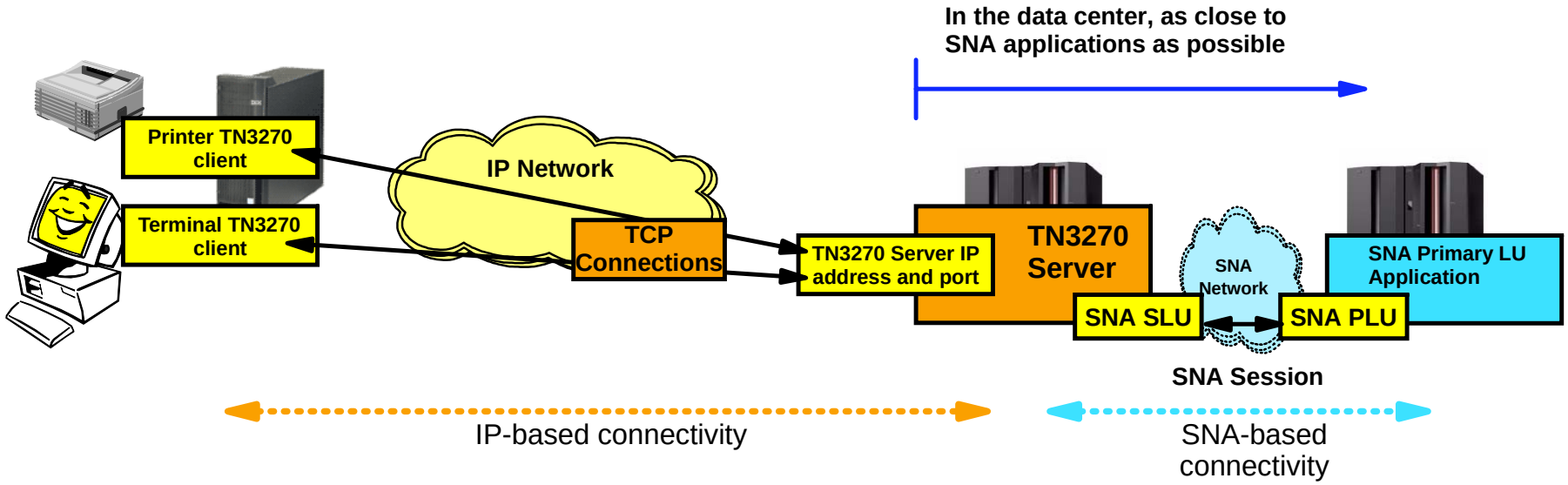
The basics of TN3270

- **Telnet 3270 (TN3270) is a standard application protocol - RFC2355 plus various additions**
  - Lots of TN3270 client software available - including IBM PCOMM and IBM HOD
  - Many TN3270 server solutions available, for example, CS z/OS and IBM CS Linux
- **Between the TN3270 emulator and the TN3270 server is a TCP connection over an IP network**
  - There is no SNA protocol stack on the node where the TN3270 emulator runs - that node only needs an IP protocol stack
- **Between the TN3270 server and the SNA application is an SNA session over an SNA network.**
- **The TN3270 protocol supports:**
  - Traditional IBM 3270 display terminals, such as IBM 3278 and IBM 3279 (LU Type 2)
  - Printer devices, such as IBM 3286 or IBM 3287 (LU Type 1 (SCS data streams) or LU Type 3 (3270 data streams))
  - The protocol does not impose limitations on the 3270 data stream - GDDM graphics is fully supported
    - Limitations may be imposed by the emulator - not all support GDDM graphics



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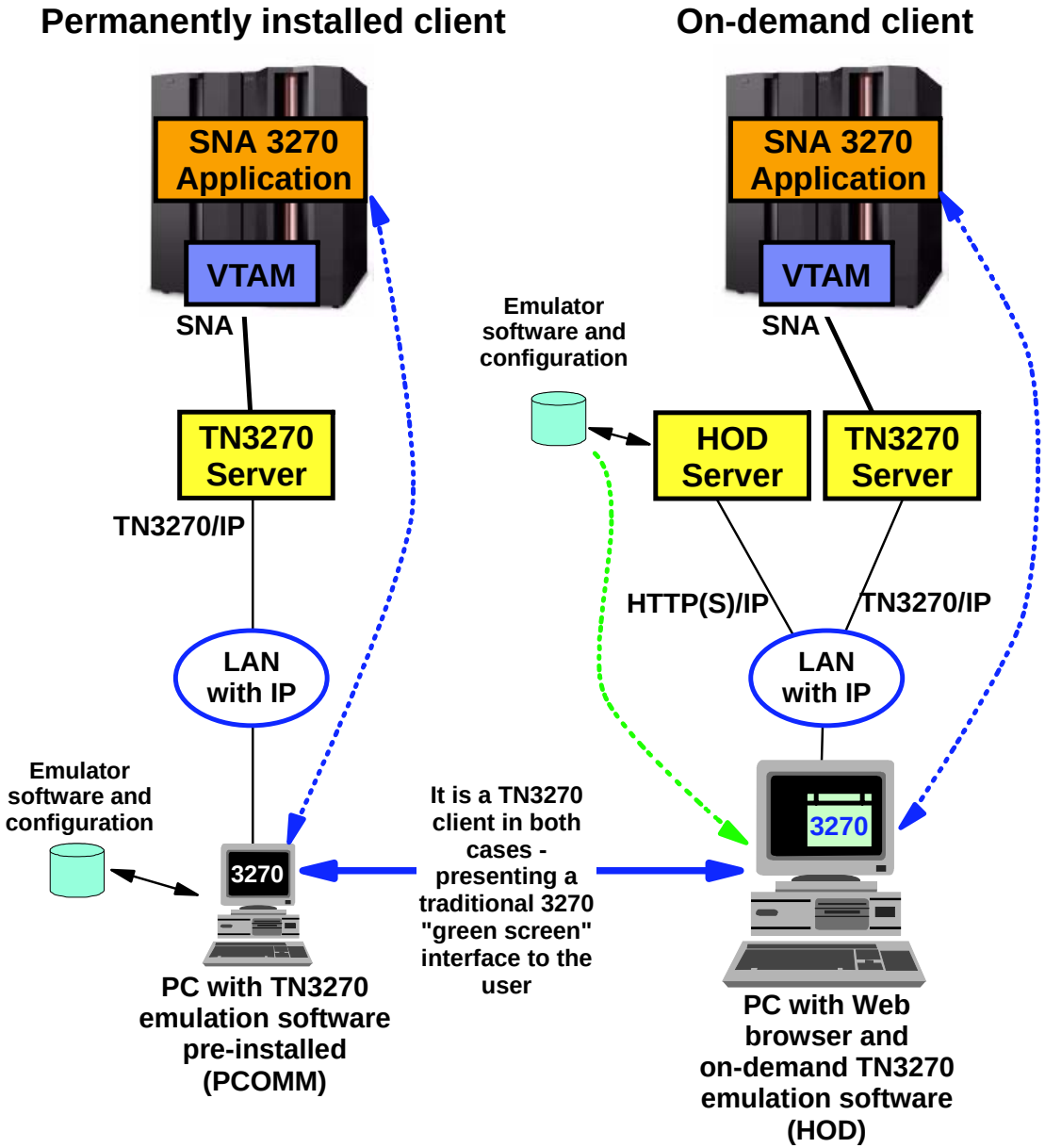
TN3270 client: Permanently installed or downloaded on demand



- **Permanently installed TN3270 client (also known as a "fat" client)**
  - Software installed locally on each user's workstation (or on a remote desktop/WTS server)
  - Emulator session configuration local on each user's workstation
  - Many alternative vendors and solutions in this category
  - Generally good functions and performance
  - Maintenance/administration concerns
- **On-demand TN3270 client**
  - Software installed on server and downloaded on-demand, when it is needed
  - Integrated into Web browser environment
  - Local caching is generally supported for users connected over slow transmission media
  - Emulator session configuration maintained by administrator on server
  - Generally same functions as the permanently installed TN3270 clients

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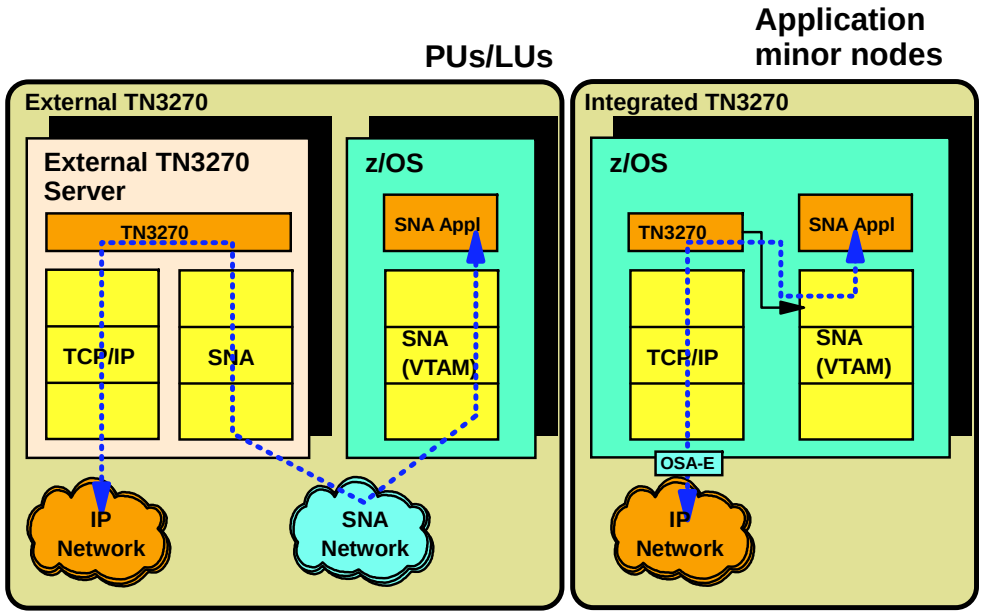
TN3270 server: Distributed or centralized

- **Between the TN3270 server and the SNA applications is an SNA network**
  - Can be SNA subarea through an NCP, APPN using DLUR/DLUS, or even Enterprise Extender connectivity
  - From an SNA infrastructure simplification perspective, the general objective is to make the "distance" between the TN3270 server and the SNA applications as short as possible
  - Often preferable to place the TN3270 server on the mainframe itself, or as a minimum, inside the data center in order to collapse the SNA network as much as possible

- **Things to consider when determining where to place your TN3270 server and how to design your TN3270 service environment:**
  - Continuous availability - this is an important business support function that requires 24x7 availability
  - Scalability - one or multiple load-balanced servers
  - Manageability - response time monitoring, accounting, configuration/administration efforts, etc.
  - Performance - predictable and consistent
  - Security - SSL/TLS support, user authentication, etc.
  - Will all TN3270 access be from intranet users, or are there external TN3270 users?
  - LU name assignment (also known as LU nailing) - can be complex if applications have dependencies on specific LU names (CICS terminal-based security as an example)
    - LU name pools with optional association between terminal and printer LU names
  - Do you need to support 328x printer technology through your TN3270 server?
    - TN3270-based print is fine for ad-hoc print requirements
    - For large-volume print, you are probably better off with a spool-based IP printing subsystem, such as IBM InfoPrint Server



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TN3270 summary

- **Switching from SNA to TN3270 will in most cases remove a considerable portion of your SNA wide area network traffic.**
  - Along with that, it will remove the need for maintaining (and modernizing) an SNA network infrastructure between the end-user locations and the TN3270 server location.
  - TN3270 also removes the need for a full SNA protocol stack on the workstations - helping to consolidate SNA to the data center
- **TN3270 is a well-proven and widespread technology that today is in use by a large number of enterprises and users.**
- **Switching from SNA to TN3270 connectivity preserves the end-user interface - it is transparent to the end user and it is transparent to the 3270-based mainframe subsystems and applications (TSO, CICS, IMS, etc.).**
  - With one potential exception: some EHLLAPI programs may have issues with the switch
- **A TN3270 server infrastructure is often the base for further SNA 3270 application access modernization steps:**
  - SNA 3270/HTML transformation and Web-services integration.
- **With the recent withdrawal from marketing of some of the frequently used non-System z TN3270 solutions, this may be a good time to reconsider the location of the TN3270 service.**

Given that the majority of SNA network traffic in most cases is IBM 3270 traffic, replacing SNA-based 3270 access with IP-based TN3270 access and placing the TN3270 server in the data center can make a big reduction in the amount of SNA-based wide area network traffic that still exists in an enterprise.

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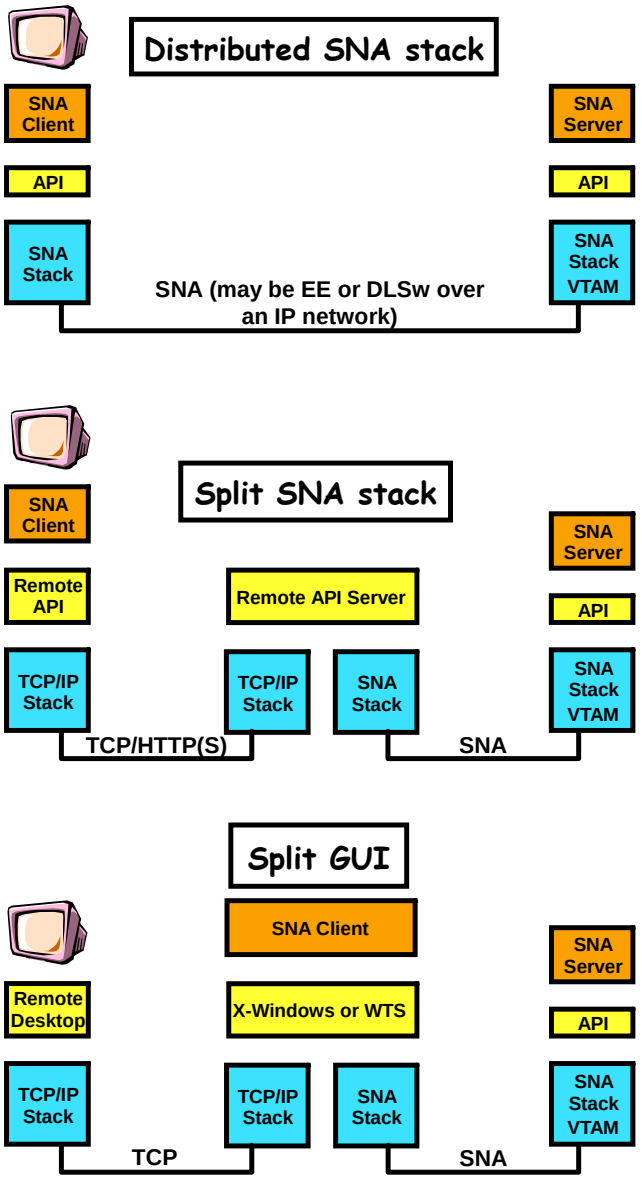
What about SNA LU0 or LU6.2 clients on workstations or branch servers? TN3270 does not address those!

- **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

- **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

- **Preserve the GUI interface on the workstation, but collapse the SNA application and the SNA protocol stack into the data center using Microsoft's Windows Terminal Services technology or an X-Windows technology (also known as "split GUI")**
  - Move SNA client to a server (remote or in the data center)
  - If the server is remote, then combine with split stack technology for further consolidation of SNA protocol stacks into data center SNA remote API servers



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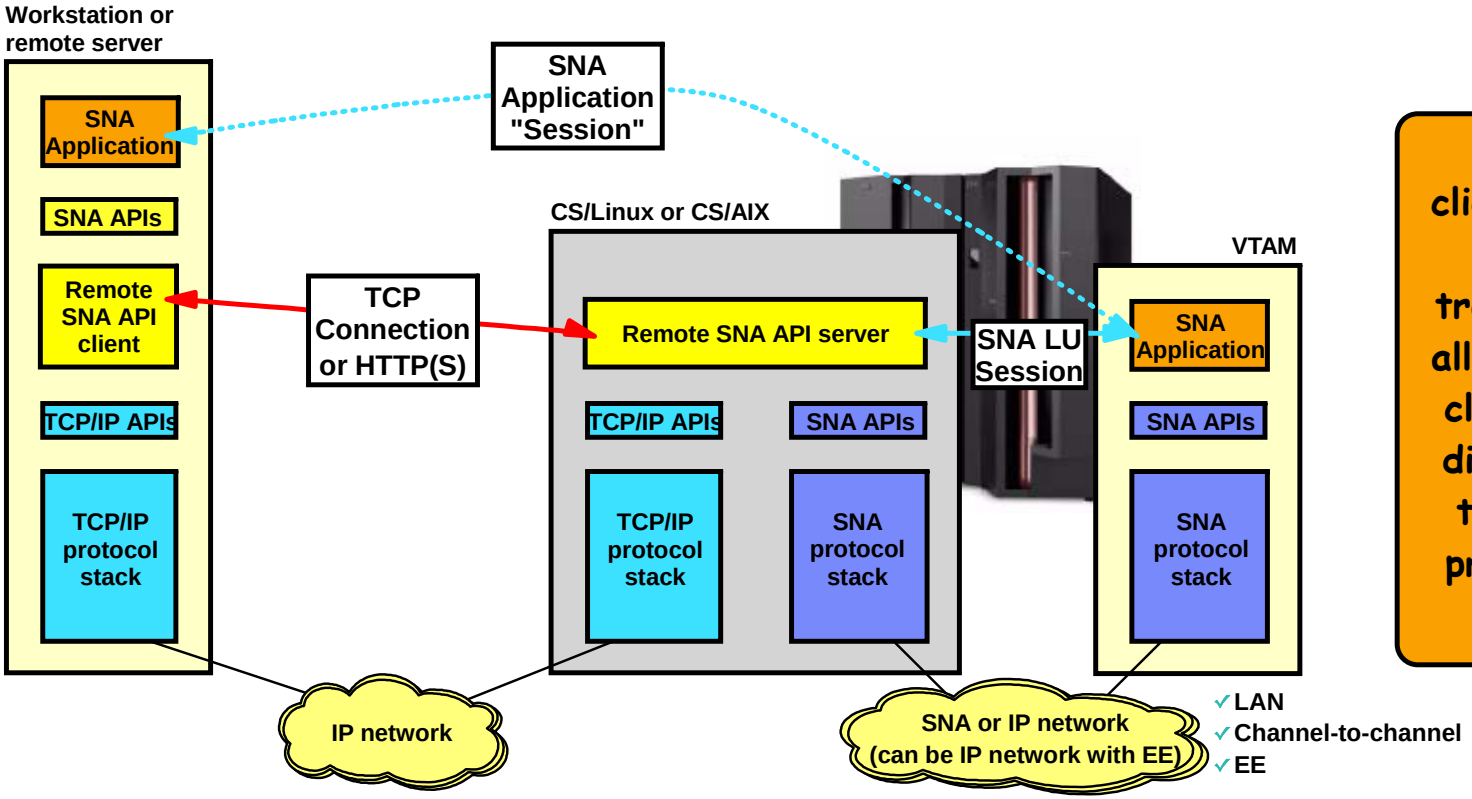
Remote SNA API overview

- **Supports both dependent and independent LUs**
  - For independent LUs that includes support for outbound attach requests
  - Might be used for SNA 3270 emulation, where a migration to TN3270 isn't possible due to EHLLAPI issues
  - IBM PCOMM can be configured to be an SNA 3270 emulator using the remote SNA API
- **Remote API servers can be configured in a server pool for load-balancing and availability**
- **Two transports between remote API client and remote API server:**
  - Plain TCP connection to remote API server-specific TCP port number
  - HTTP(S) as transport requires WebSphere Application Server on the Remote SNA API server node



The remote SNA API client/server technology is a simple, efficient, and transparent technology that allows continued use of SNA clients on workstations and distributed servers without the full footprint of SNA protocol software on those client nodes.

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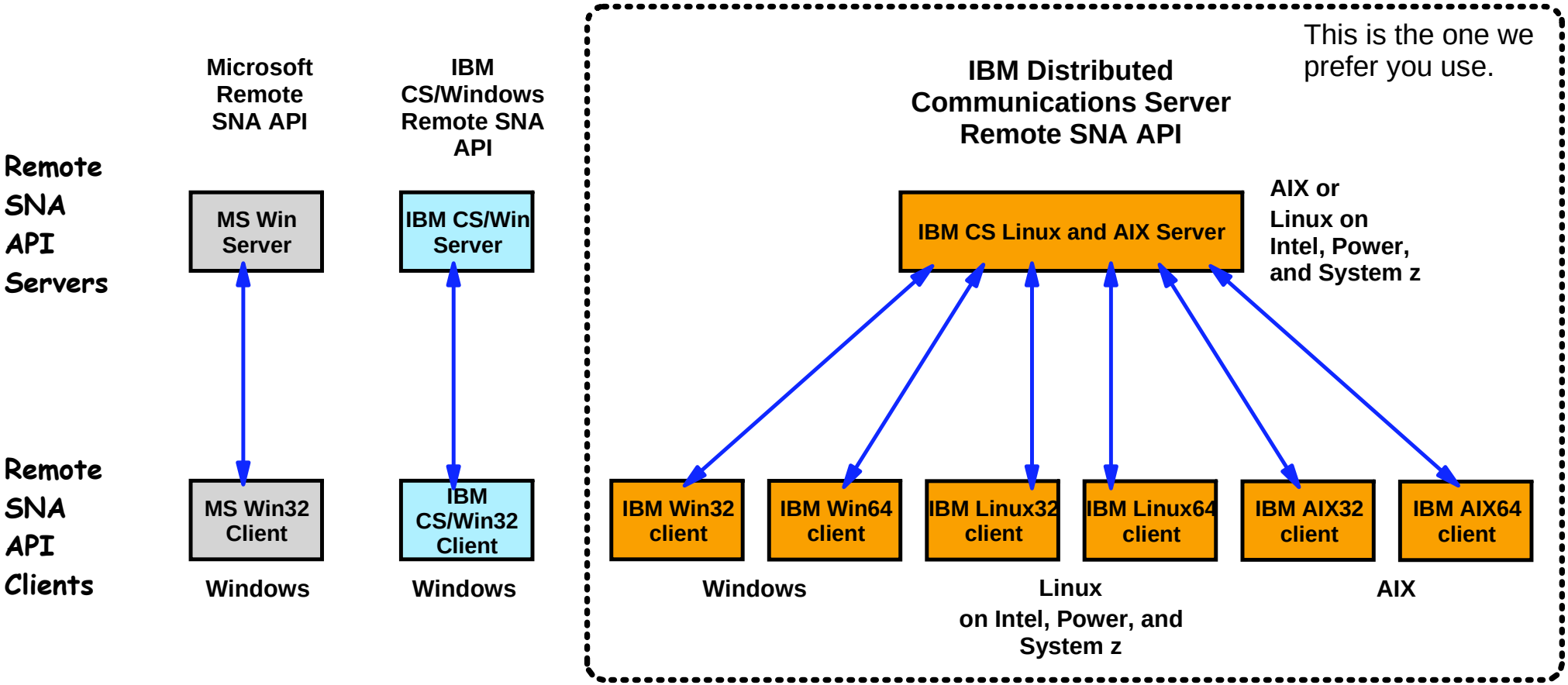
Three flavors of remote APIs

- **None of the traditional mainframe operating systems have support for being the remote SNA API server.**
- **IBM Communications Server for Linux does include support for being the remote SNA API server.**
  - This includes Linux on System z - so a consolidation of the SNA protocol stacks all the way into System z is possible



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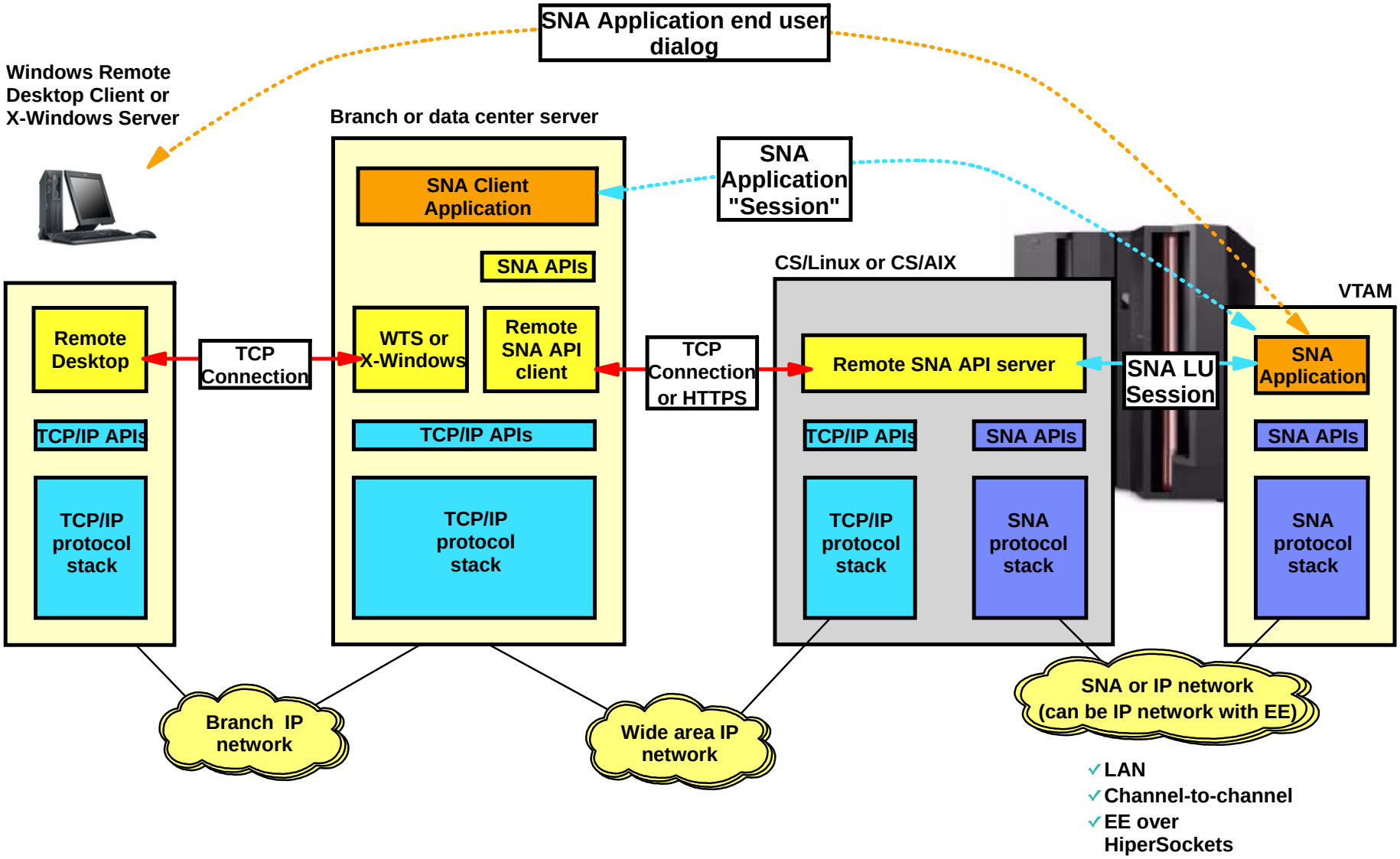
Split GUI technologies in combination with IBM Remote SNA API technology



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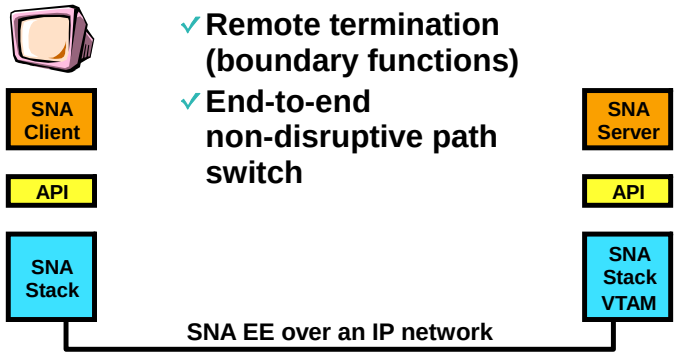
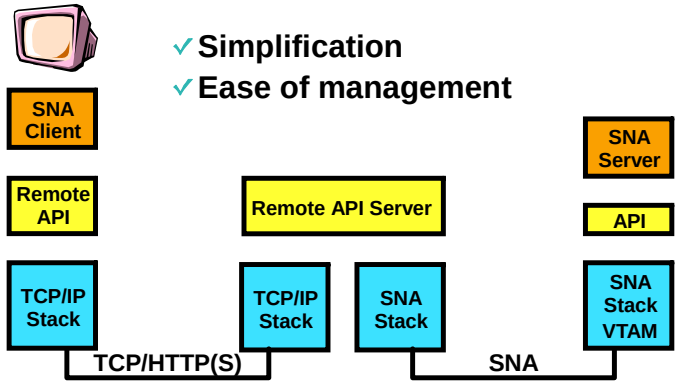
Using remote SNA stack and EE connectivity - or consolidate SNA stack using remote API?

Preserve remote SNA stack on client node



- **SNA stack may be needed remotely to perform boundary functions - for example, ATM or POS SNA devices**
  - Using DLUR/DLUS over the EE/APPN network
  - Could also be addressed using DLSw to data center boundary function in CCL/NCP, VTAM, or APPN node
- **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



- **Simplified remote API client configuration (less than 10 options)**
  - There is no remote SNA protocol stack to configure with node characteristics, transmission groups, etc.
- **Remote API server pooling for availability and load balancing**
  - Losing a TCP connection and re-connecting to another server instance is disruptive
  - You may have server affinity in case of specific LU requirements
- **All SNA data must be routed through the remote API server**
  - EE connection network advantages can be exploited for the connectivity between the remote API server and the EE nodes where the primary LUs reside

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Enabling Use of New Client Technologies

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Replacing the end-user interface with a Web browser or a Web service requester - transforming the SNA application data stream

- **Stage 1 - Presentation integration (enhancing the user experience):**
  - Enabling a Web browser to act as the client for existing SNA applications
    - Transforming the SNA data stream to an HTML data stream over an HTTP(S) connection from a Web browser.
  - For SNA 3270 applications, such transformation can often be done without writing new presentation logic.
    - The transformation can in most cases be rules-driven where the transformation rules are generated by a development toolkit based on the SNA 3270 data stream or, when the transformation is done in CICS or IMS, the unformatted application data structures (ADS).
  - For SNA server applications that are accessed from LU0 or LU6.2 client programs, the transformation normally requires development of some new presentation logic to transform whatever presentation the existing client program did to the new user interface.
- **Stage 2 - Programmatic integration (adapt for enhanced relationships):**
  - Enabling SNA applications as Web services
    - Providing a Web service development tooling and runtime technology that can be used to expose SNA application as Web services.
  - For SNA 3270 applications, exposing the SNA 3270 core business application as a Web service is an additional element of the transformation that was discussed above
    - The transformation is extended to also expose the SNA 3270 application as a Web service and transform the SNA 3270 data stream to/from SOAP/XML instead of HTML.
  - For SNA server applications, the transformation again normally requires development of a Web service wrapper component that is aware of the SNA client/server application protocol and knows how to transform the application data stream to/from SOAP/XML.

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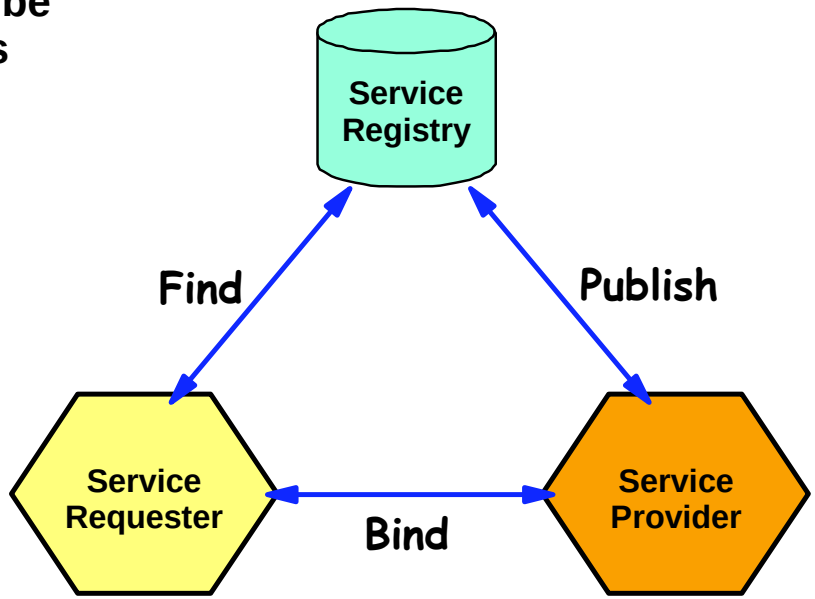
A very brief introduction to what a Web service is

- **A Web service is a function that is well-defined, self-contained, and does not depend on the context or state of other services.**
- **A service-oriented architecture is a collection of services.**
  - These services communicate with each other, for example, simple data passing or two or more services coordinating an activity.
- **SOA characteristics and principles:**
  - Loose coupling
  - Location transparency
  - Protocol independence
- **Web services are the application building blocks that can be used individually or orchestrated into business processes using business process modelling**

By providing a Web service interface (a Web service wrapper) to existing SNA core business applications, those SNA applications can be exposed as Web services and be included as reusable Web service elements in new business processes as these are implemented using today's business process modeling and business process runtime technologies from both IBM and other vendors that support the Web services-related standards



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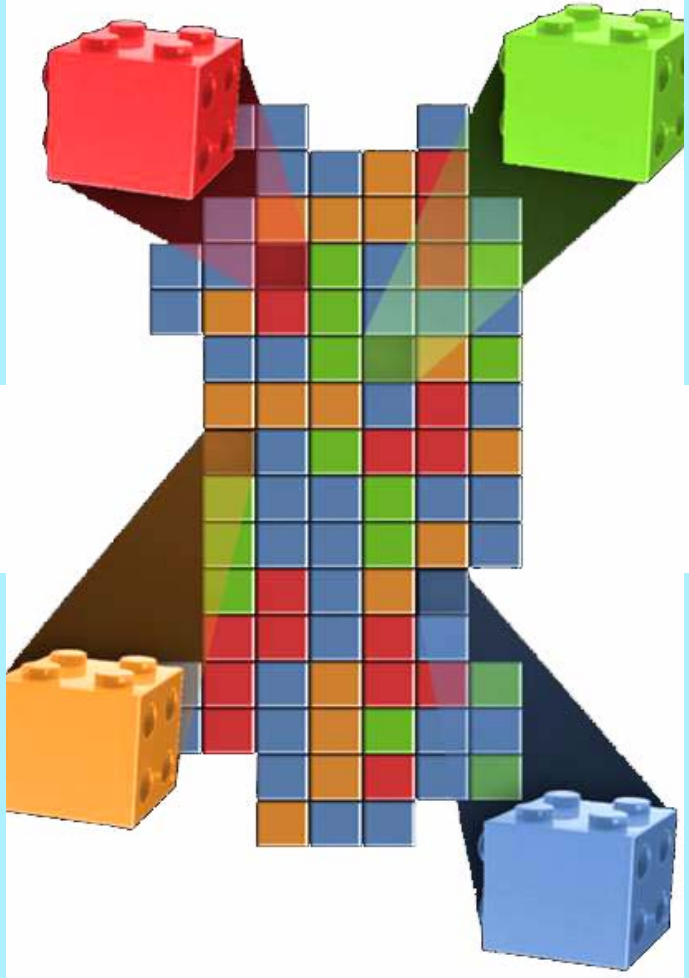
A few more definitions - what is ....?

...a service?

A **repeatable business task** - for example, check customer credit; open new account



...service orientation?

A way of integrating your **business as linked services** and the outcomes that they bring

...service-oriented architecture (SOA)?

An IT **architectural style** that supports service orientation

...a composite application?

A set of **related and integrated** services that support a business process built on an SOA

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SNA application access transformation IBM product overview

	SNA 3270 Application			SNA LU0 and SNA LU6.2 Application		
	Subsystem independent	**CICS specific**	**IMS specific**	**Subsystem independent**	**CICS specific**	**IMS specific**
Presentation integration - SNA data stream / HTML transformation	Host Access Transformation Services (HATS)	CICS Web Support and 3270 Web bridge, or CTG	IMS MFS Web Enablement	Branch Transformation Toolkit (BTT)	CICS Web support or CTG	IMS MFS Web support
Programmatic integration - Expose SNA core business applications as Web services	Host Access Transformation Services (HATS)	CICS Service Flow Feature and Link3270	IMS MFS Web Services	Branch Transformation Toolkit (BTT)	CICS Service Flow Feature	IMS MFS Web Services

When deciding if you are going to use a subsystem-independent solution or one or more subsystem-dependent solutions to Web-enable your SNA core business applications, you need to analyze much more than just the topology aspects of the two types of solutions. Each of them offers different levels of transformation capabilities, and a detailed analysis of what is required, compared to what is offered by these solutions, in combination with the network topology aspects, will determine which you will use.

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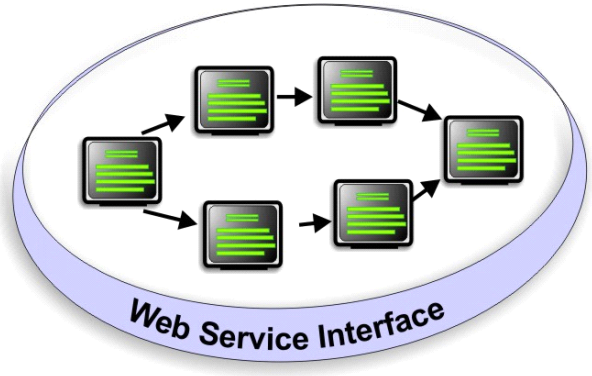
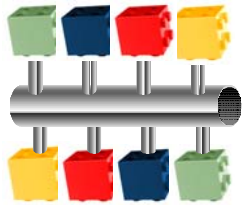
Introduction to IBM Host Access Transformation Services (HATS)

- **Transforms 3270 and 5250 traditional screen applications into HTML interfaces**
- **Combines data from multiple screens, applications and application environments (CICS, IMS, TSO, etc.)**
- **Screen transformation rules running on IBM WebSphere Application Server**
- **No software download to clients**
  - A Web browser is all that is needed on user workstations
- **Extends terminal applications as Web Services**
- **Low skills requirement**
- **Rules-based, highly customizable**
- **Iterative, Eclipse-based development environment**





3270 and 5250 Data stream

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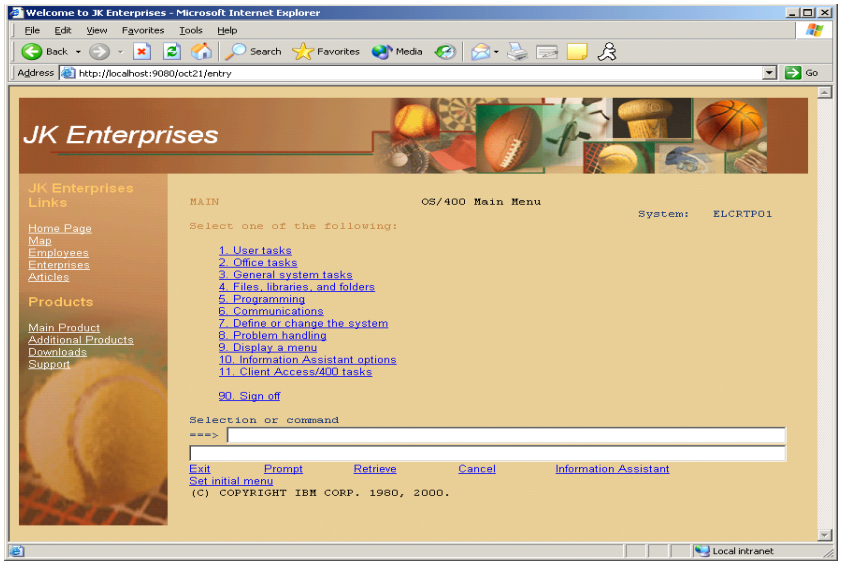
Transformation introduction

- **HATS offers a wide range of options for customizing the SNA 3270/HTML transformation, but from the perspective of just providing an "out of the box" transformation, HATS also offers what is known as default transformation rules where HATS can present a somewhat familiar SNA 3270 look-and-feel on the browser interface.**
  - The default transformation rules of HATS can be used with no or minimal customization of the HATS environment.

- **With relatively simple customization efforts, it is possible to completely transform the end-user experience. For example:**
  - Application navigation can be streamlined with the use of skip screen macros and using global variables to enter saved information on behalf of the end user.
  - Data from multiple 3270 screens or hosts can be combined onto a single HTML page.
  - 3270 menus and function keys can be transformed to use links, buttons, radio buttons, or drop downs.
  - The presentation of the application can be modernized to match your corporate Web site look and feel.
  - Tables of numeric data on the host screen can be transformed into bar or line graphs.



- **The above is a very limited list of the capabilities of HATS; please refer to the detailed HATS documentation for more information.**

- **HATS also provides 5250/HTML transformation**
  - 3270 and 5250 applications can be integrated into a single HTML page

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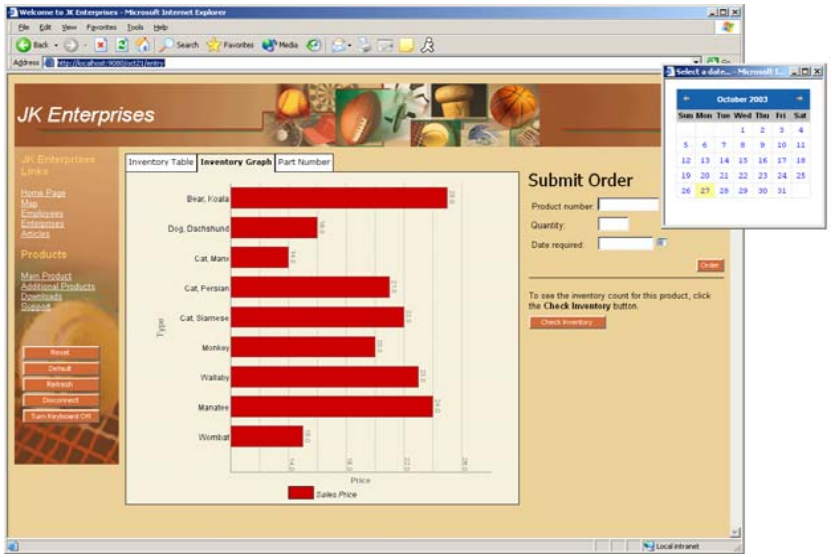
Customize navigation and user interface with HATS

- **Macros and global variables**
  - Skip unneccesary screens; combine screens; split screens; enter data on behalf of the end user
  - Store end-user input as global variables; prefill text entry fields
- **Help improve user interface with screen customization**
  - Drag and drop HATS components from the palette onto your Web page
  - Add buttons, hot links, drop-down menus, valid value lists
  - Modify graphics, fonts, colors, and layout
- **Add business logic**
- **Local print support**
- **Native keyboard support**
- **Security – HTTP(S), SSL, Java2**
- **Supports iterative development**
  - Fully functional HATS application on the Web quickly
  - Use default transformation rules
  - Customize transformation rules iteratively



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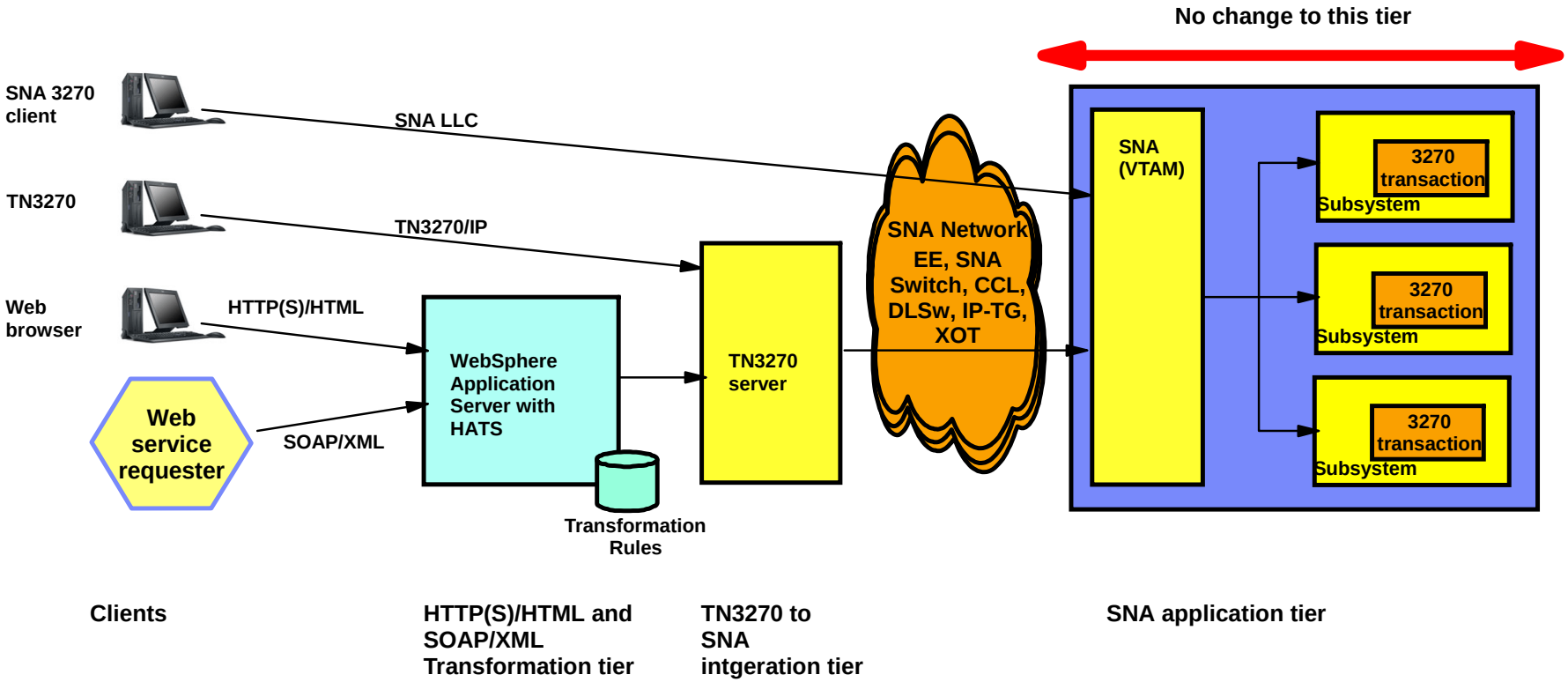
SNA 3270 mainframe application - multiple access channels, one mainframe application

- **A technology such as HATS is subsystem independent**
  - Transforms the SNA 3270 data stream
  - No change to the SNA 3270 application, the SNA application subsystem, or the SNA host operating system environment
    - The same SNA 3270 application can be used from traditional 3270 interfaces, such as real SNA 3270 terminals, SNA 3270 emulators, or TN3270 emulators
  - Transform IMS, CICS, TSO, etc. SNA 3270 applications
  - Can combine data from multiple SNA 3270 sessions into a single HTML page or Web service



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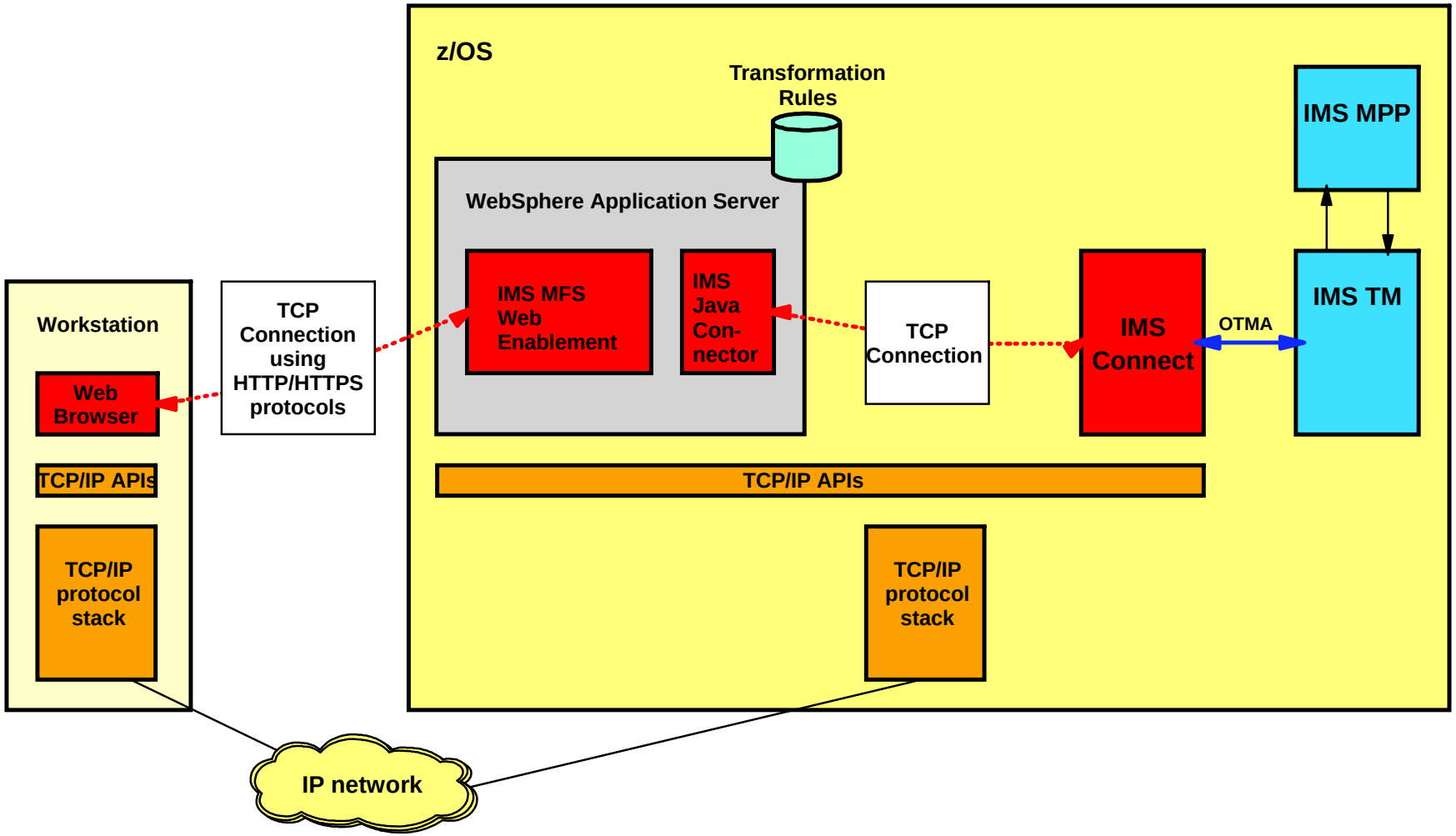
IMS-specific HTML transformation technology example



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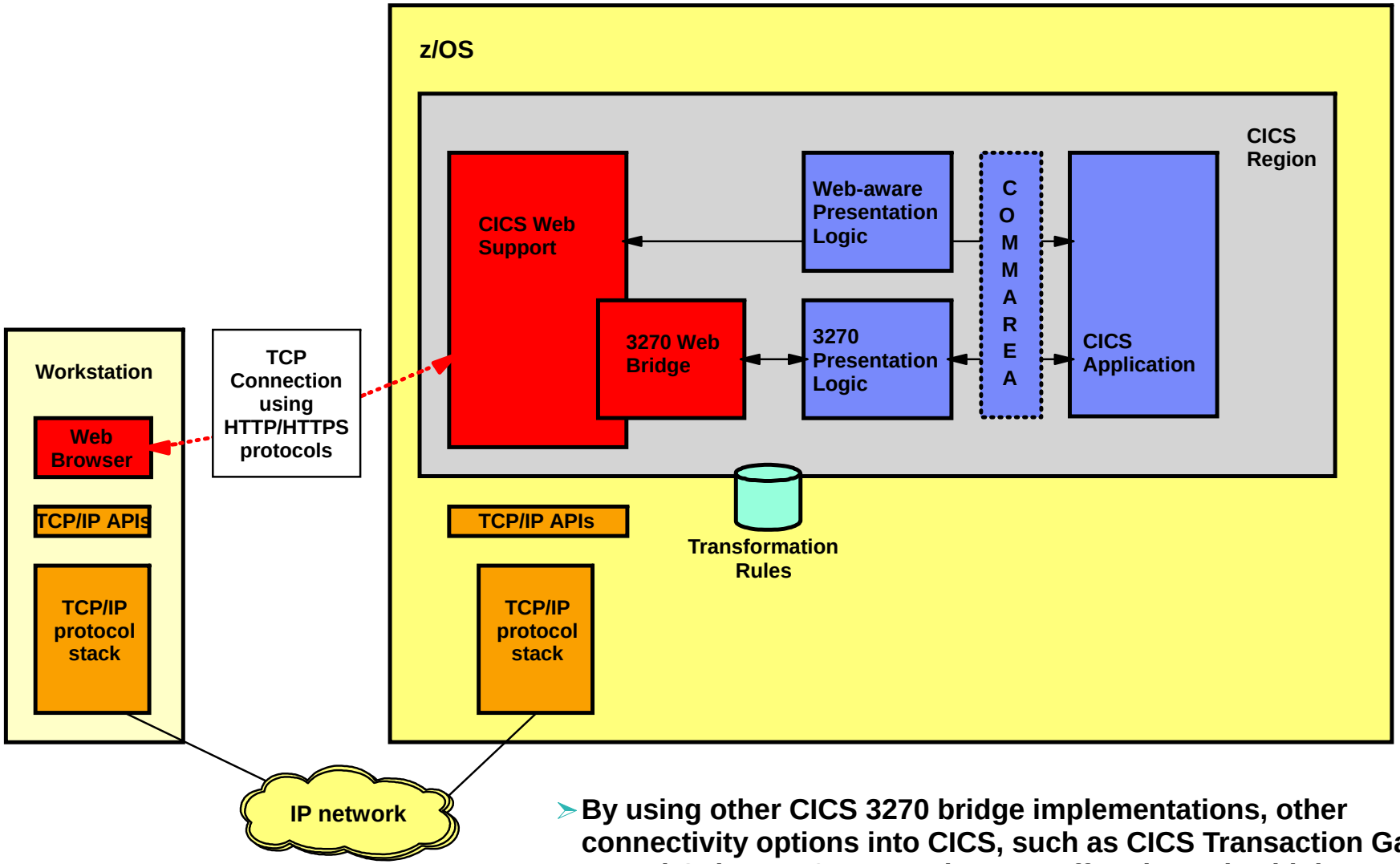
CICS-specific HTML transformation technology - example



- **By using other CICS 3270 bridge implementations, other connectivity options into CICS, such as CICS Transaction Gateway or WebSphere MQ messaging, are offered - each with its own set of Web-enablement capabilities**
  - Some amount of application development to implement the actual SNA 3270/HTML transformation may be required in those cases

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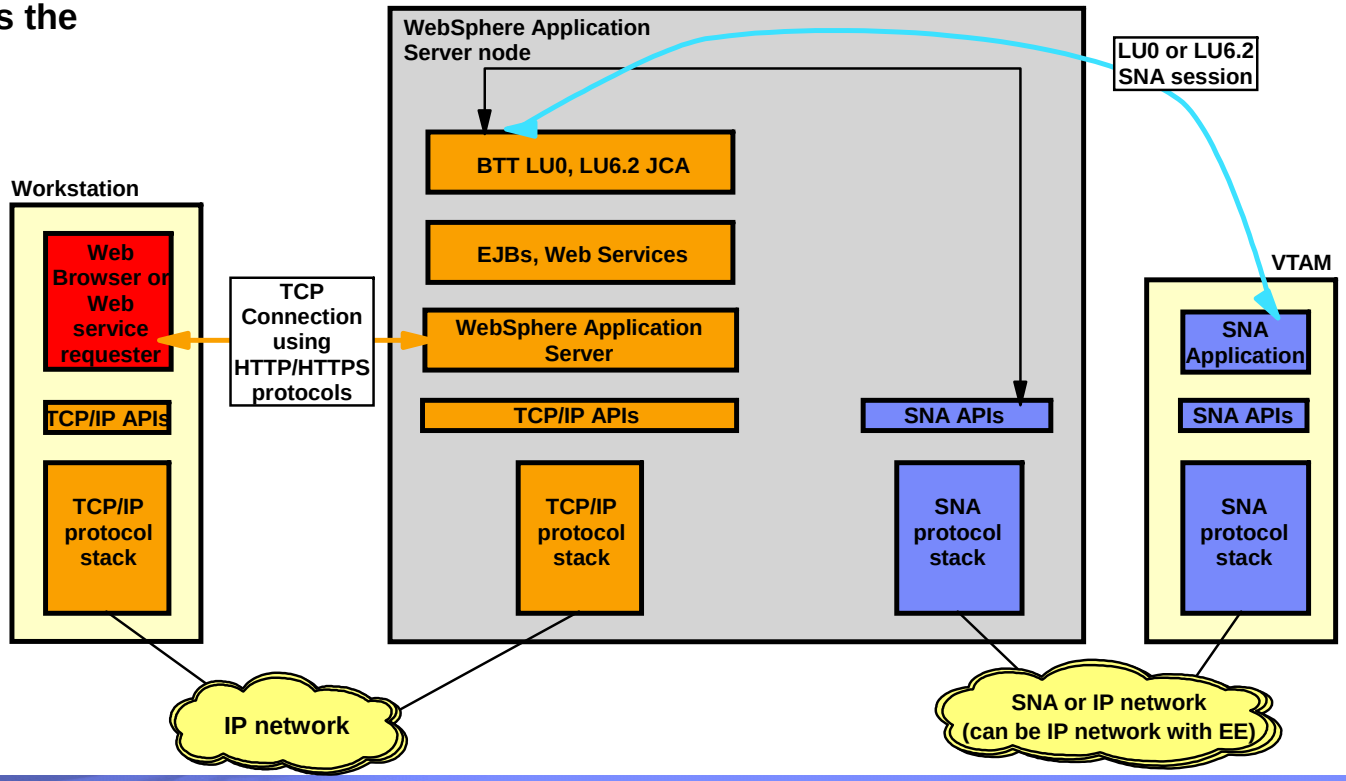
Web-enabling SNA LU0 and LU6.2 server applications using IBM Branch Transformation Toolkit (BTT)

- **BTT provides a set of adapters that allow Web applications running in a WebSphere Application Server environment to interface with existing enterprise applications and data.**
- **Two of the adapters provided by BTT are of interest from an SNA application access modernization perspective:**
  - SNA JCA LU0 resource adapter
  - SNA JCA LU6.2 resource adapter
- **Both SNA adapters are based on the Java Connector Architecture (JCA).**
- **The LU0 JCA resource adapter supports a Request Unit programming Interface (RUI). The LU6.2 resource adapter supports the Common Programming Interface for Communications (CPI-C) programming interface.**
- **Developers use the BTT toolkit to create presentation and/or business logic that uses the SNA adapters for communication with existing SNA LU0/LU6.2 applications.**
- **The SNA JCA resource adapters are supported on:**
  - Windows
  - AIX
  - Linux on Intel



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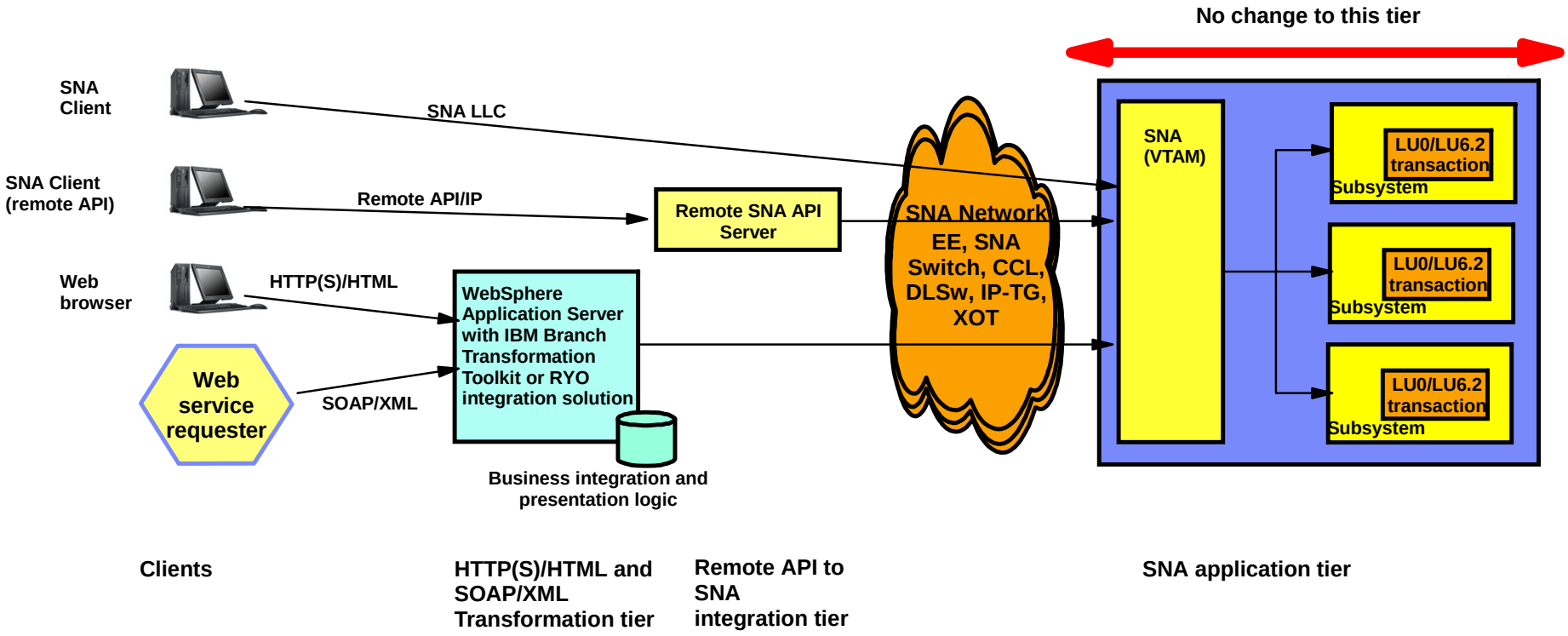
SNA LU0/LU6.2 mainframe application - multiple access channels, one mainframe application

- **A technology such as BTT is subsystem independent**
  - Application logic on WebSphere transforms the application-based data stream
  - No change to the SNA LU0/LU6.2 application, the SNA application subsystem, or the SNA host operating system environment
    - The same SNA LU0/LU6.2 application can be used from SNA clients, or SNA clients that use the remote SNA API technology to traverse an IP network
  - Can be used to transform IMS, CICS, APPC/MVS, etc. SNA applications
  - Can combine data from multiple SNA sessions into a single HTML page or Web service



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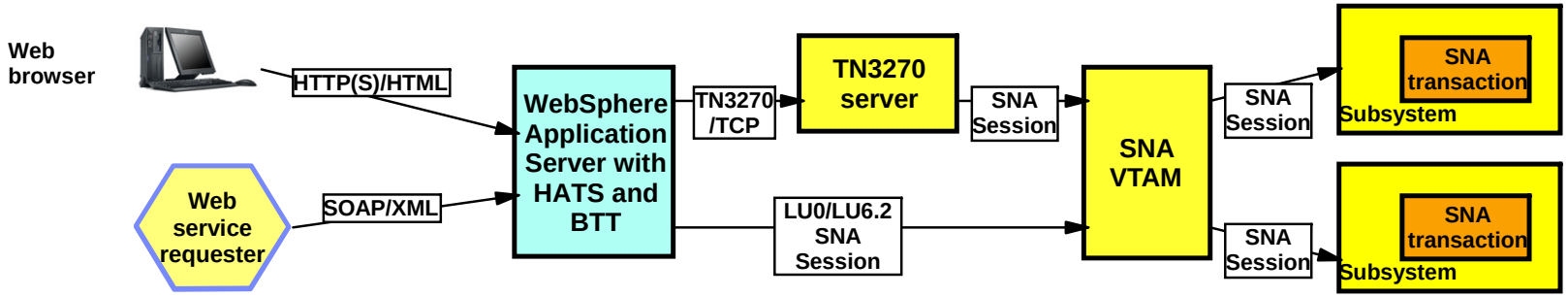
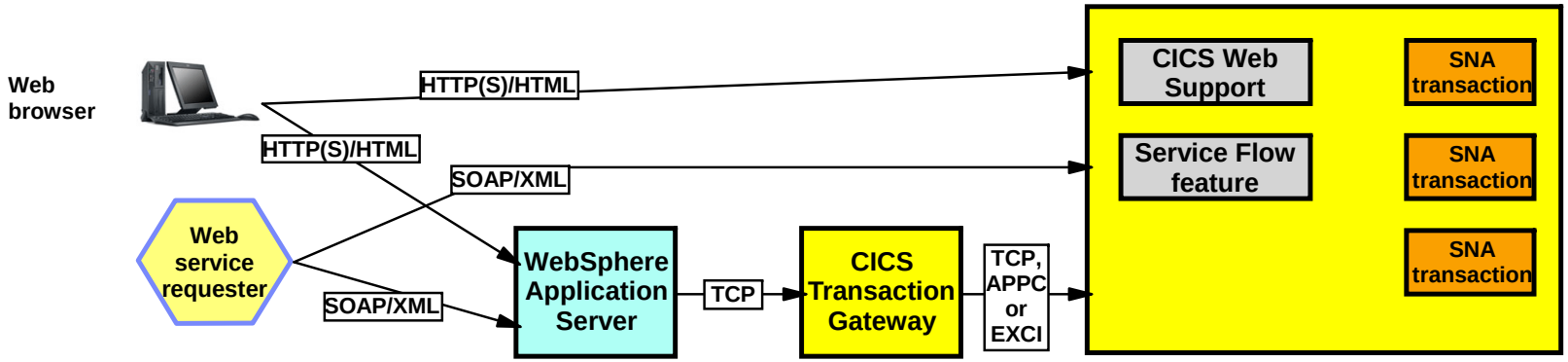
SNA application access transformation technology overview

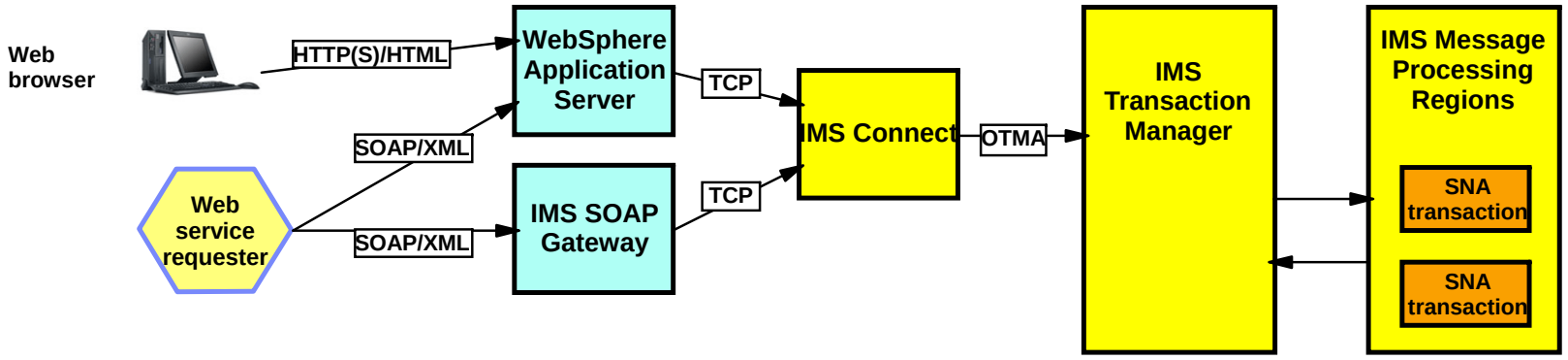
Subsystem independent topology



CICS specific topology



IMS specific topology



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Subsystem dependent or subsystem independent solution - things to consider

- **Does your Web solution need to access data in subsystems that do not have any subsystem-specific transformation technologies?**
  - Such as TSO, CMS, ICCF, APPC/MVS, etc.
- **Does your Web solution need to integrate data from multiple SNA applications and are these applications in different application subsystems?**
  - For example, CICS and IMS
- **Does your integration solution need to access data from both 3270 and 5250 applications?**
  - For example, integrating data from z/OS and i5/OS into a single Web interface
- **Do the alternative technologies provide sufficient amount of transformation capabilities to meet your requirements?**
  - This is probably one of the most important aspects of your considerations
- **What level of integration between new client presentation "logic" and existing SNA business logic are you comfortable with (from a change management perspective)?**
  - Subsystem independent technologies tend to separate those pieces into separate development groups
  - Subsystem dependent technologies tend to better integrate those pieces into a single development group
- **Is it your objective to leave the mainframe SNA environment as-is, or is it one of your objectives to completely remove SNA (even on the mainframe operating systems)?**
  - Subsystem independent technologies preserve the mainframe SNA environment and enable concurrent use of the mainframe SNA applications from both traditional clients and new client environments
  - Susbsystem dependent technologies allow one to totally remove SNA between the new client environments and the existing (SNA) business logic

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Summary and Contact Information

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SNA subarea network infrastructure modernization summary

Objectives		Modernization technologies				
		SNA subarea				APPN
		DLSw	XOT	CCL	IP-TG	EE
Enterprise Transformation Stage		0	0	0	0	0
Retain traditional 3270 screen on WS				(✓)		(✓)
Retain SNA client on WS				(✓)		(✓)
Access SNA 3270 applications from a Web browser with a web look and feel						
Enable as a Web service	SNA 3270 server application					
	SNA LU0 or LU6.2 server application					
Remove dependency on outdated hardware technologies	Token-ring			✓		(✓)
	IBM 3745/46			✓		(✓)
	Channel-attached SNA gateways			✓		(✓)
Share IP network for SNA and IP		✓	✓	(✓)	✓	✓
Consolidate SNA stacks into the data center						
Remove need for SNA						
Comments						

- **IBM Communication Controller for Linux on System z:**
  - Preserve NCP-based functions
    - SNA boundary functions
    - SNI Network Interconnect (SNI) to SNA business partners who continue to base such connectivity on SNI
  - Migrate from token-ring to Ethernet for SNA LAN connectivity
  - Remove dependence on ESCON channel-attached SNA hardware components
- **DLSw as the main SNA over IP transport technology**
  - DLSw endpoint imbedded into CCL Version 1.2.1
- **IP-TG for CCL NCP to NCP - including SNI connectivity to business partners**
  - Simple firewall administration - single TCP connection
- **XOT for non-SNA X.25 connectivity to CCL NCP with NPSI**
  - Retain mainframe NPSI application topology and support

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APPN network infrastructure modernization summary

Objectives		Modernization technologies				
		SNA subarea				APPN
		DLSw	XOT	CCL	IP-TC	EE
Enterprise Transformation Stage		0	0	0	0	0
Retain traditional 3270 screen on WS				(✓)		(✓)
Retain SNA client on WS				(✓)		(✓)
Access SNA 3270 applications from a Web browser with a web look and feel						
Enable as a Web service	SNA 3270 server application					
	SNA LU0 or LU6.2 server application					
Remove dependency on outdated hardware technologies	Token-ring			✓		(✓)
	IBM 3745/46			✓		(✓)
	Channel-attached SNA gateways			✓		(✓)
Share IP network for SNA and IP		✓	✓	(✓)	✓	✓
Consolidate SNA stacks into the data center						
Remove need for SNA						
Comments						

- **APPN with High Performance Routing over IP (Enterprise Extender)**
  - SNA traffic integrated with the IP core network
- **DLUR/DLUS support for peripheral nodes**
  - Support for peripheral nodes with dependent LUs in an APPN network environment - offering an alternative to NCP-based boundary functions in an APPN network
  - DLUR nodes are typically not limited to token-ring connectivity, but support SNA over Ethernet
  - Some DLUR nodes also support terminating serial SNA lines (SDLC, frame relay, X.25 QLLC) and performing SNA boundary functions for SNA devices connected through such transmission facilities
- **APPN connection network technology**
  - To keep manual APPN link definitions to a minimum
- **Branch Extender node technology**
  - To limit the number of APPN network nodes
  - Does not support downstream DLUR nodes
- **EE/EBN as SNI replacement**
  - For business partner connectivity where both partners are APPN/EE enabled

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SNA network infrastructure simplification summary

Objectives		Modernization technologies								
		SNA 3270 applications			SNA Client/Server applications					
		TN3270 emulation (PCOMM and HOD)	User interface transformation (HATS, IMS, CICS)	Web service and SOA integration (HATS, IMS, CICS)	Remote API	Remote desktop	Web service and SOA integration (BTT, IMS, CICS)	DRDA o. IP	MQ o. IP	Rewrite applications to TCP/IP APIs or as Web services
Enterprise Transformation Stage		0	1	2	0	0	1 and 2	0	0	3
Retain traditional 3270 screen on WS		✓				(✓)				
Retain SNA client on WS					✓	(✓)				
Access SNA 3270 applications from a Web browser with a web look and feel			✓							
Enable as a Web service	SNA 3270 server application			✓						
	SNA LU0 or LU6.2 server application						✓			
Remove dependency on outdated hardware technologies	Token-ring									
	IBM 3745/46									
	Channel-attached SNA gateways									
Share IP network for SNA and IP										
Consolidate SNA stacks into the data center		✓	✓	✓	✓	✓	✓			
Remove need for SNA				(✓)			(✓)	✓	✓	✓
Comments								For DRDA traffic	For MQ traffic	

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)

Remote desktop

- Consolidate application functions on WTS server
- In combination with remote API, remove SNA protocol stack on server node (WTS or X-Windows)

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Enable new client technologies - summary

Objectives		Modernization technologies								
		SNA 3270 applications			SNA Client/Server applications					
		TN3270 emula-tion (PCOMM and HOD)	User inter-face trans-forma-tion (HATS, IMS, CICS)	Web service and SOA integra-tion (HATS, IMS, CICS)	Remote API	Remote desktop	Web service and SOA integra-tion (BTT, IMS, CICS)	DRDA o. IP	MQ o. IP	Rewrite applications to TCP/IP APIs or as Web services
Enterprise Transformation Stage		0	1	2	0	0	1 and 2	0	0	3
Retain traditional 3270 screen on WS		✓				(✓)				
Retain SNA client on WS					✓	(✓)				
Access SNA 3270 applications from a Web browser with a web look and feel			✓							
Enable as a Web service	SNA 3270 server application			✓						
	SNA LU0 or LU6.2 server application						✓			
Remove dependency on outdated hardware technologies	Token-ring									
	IBM 3745/46									
	Channel-attached SNA gateways									
Share IP network for SNA and IP										
Consolidate SNA stacks into the data center		✓	✓	✓	✓	✓	✓			
Remove need for SNA				(✓)			(✓)	✓	✓	✓
Comments								For DRDA traffic	For MQ traffic	

- **Web browser**
  - HTML transformation
  - IBM Host Access Transformation Services
  - IBM Branch Transformation Toolkit
  - CICS Web support
  - IMS Integration Solutions
  - RYO
- **Web service requester**
  - SOAP/XML transformation
  - Web services "wrapper"
  - Integrate SNA services into new business processes based on a service-oriented architecture
  - IBM Host Access Transformation Services
  - IBM Branch Transformation Toolkit
  - CICS Service Flow Feature
  - IMS Integration Solutions
  - RYO

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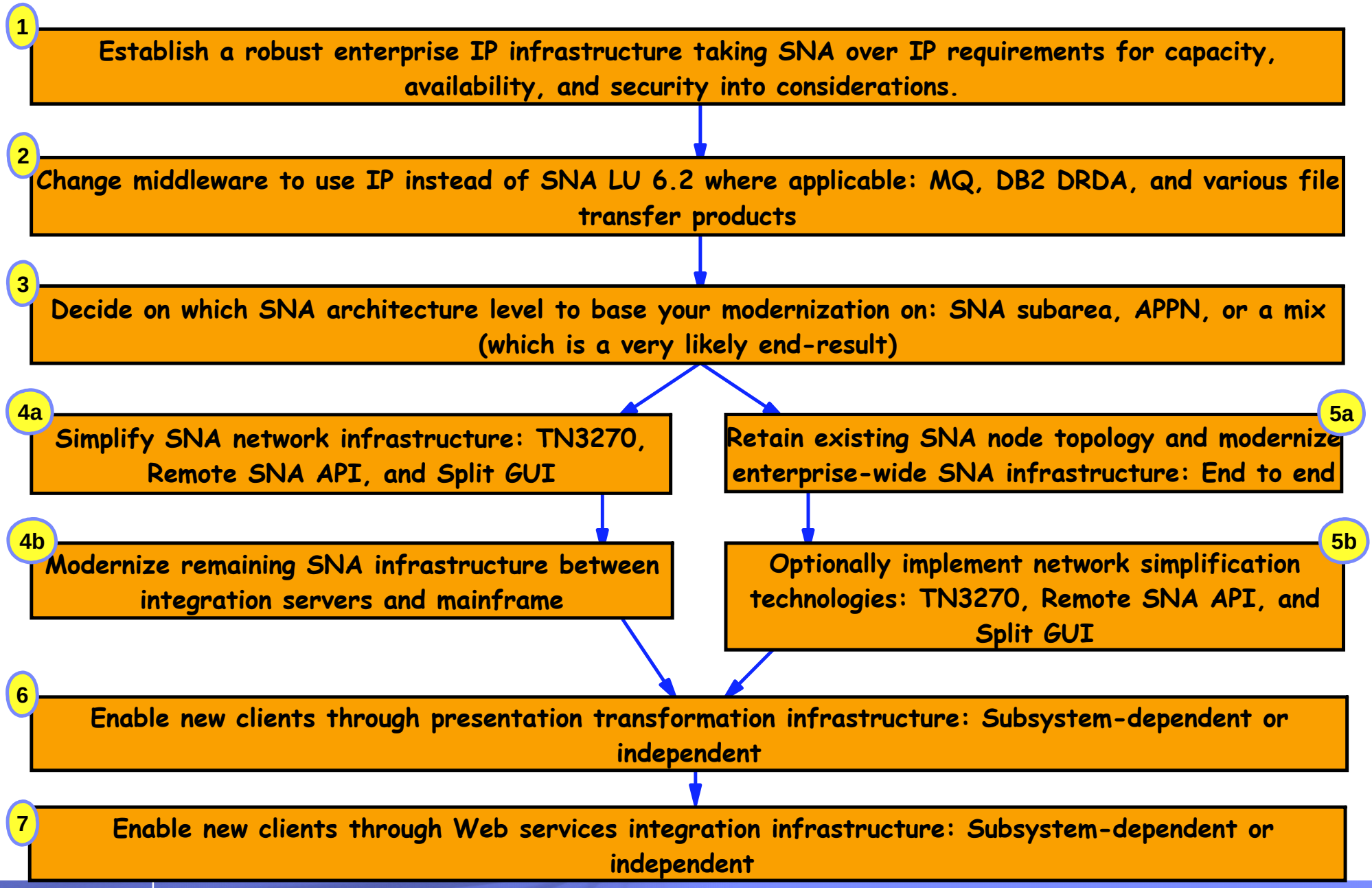
A possible roadmap (not the only roadmap, but a possible roadmap)



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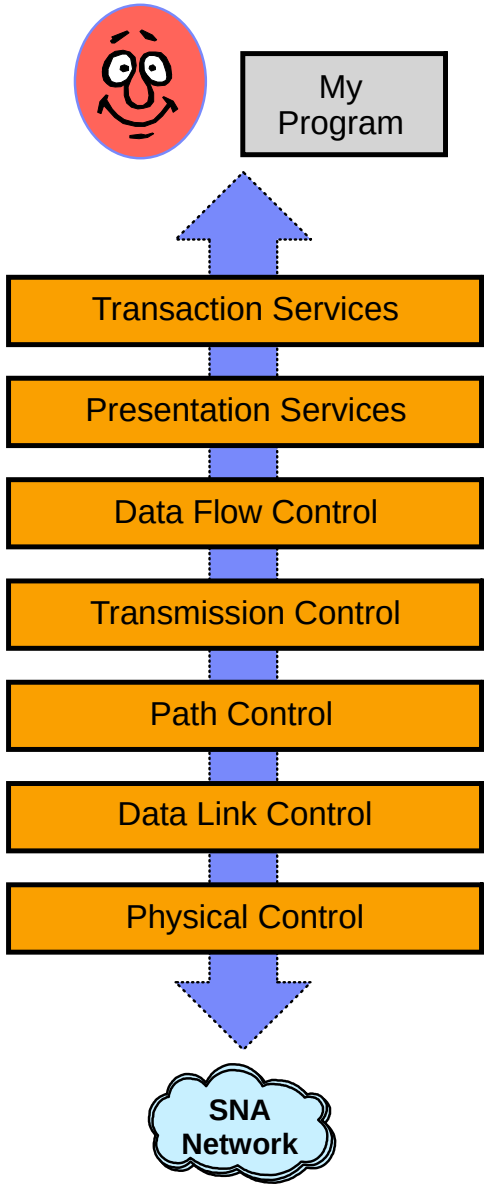
It is all thanks to a good architecture



- **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 SNA API
  - New clients can be introduced
    - TN3270
    - Web browsers
    - Web service requesters

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

- **SNA was from the beginning built for change**
- **Protecting the investments made in programming skills and applications**

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Contact - for additional information - etc.....

- **For more information on any of the solutions mentioned in this session, please contact:**
  - EMEA: Peter Redman - Peter_Redman@uk.ibm.com
  - North America: Erika Lewis - erika@us.ibm.com
  - Latin America: Suvas Shah - suvas@us.ibm.com
  - AP: Chuck Gardiner - cgardine@us.ibm.com
- **For planning and installation services, contact:**
  - Heather Johnson-Dunnings in IBM SWG Application and Integration Middleware Software e-Server Services - hjd@us.ibm.com
- **For technical assistance in the Americas, IBMers can submit a TechExpress through w3.ibm.com or a question through WWQ&A**
- **Information in this session is based on the following Redbook.**
  - "A Structured Approach to Modernizing the SNA Environment from a System z Perspective", SG24-7334
  - This Redbook is planned to be made available early 4Q2006

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Appendix A
Selected SNA Modernization Scenarios

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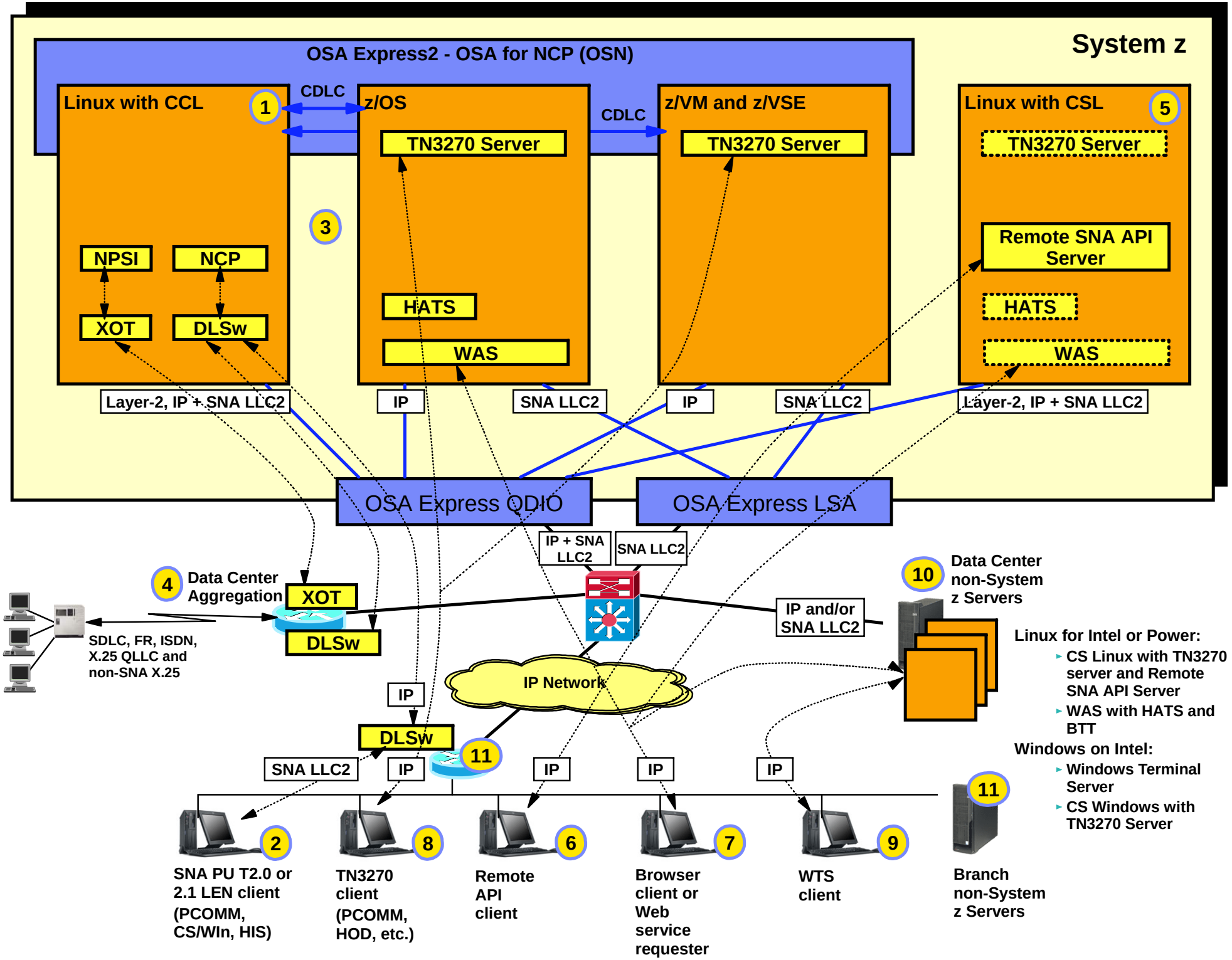
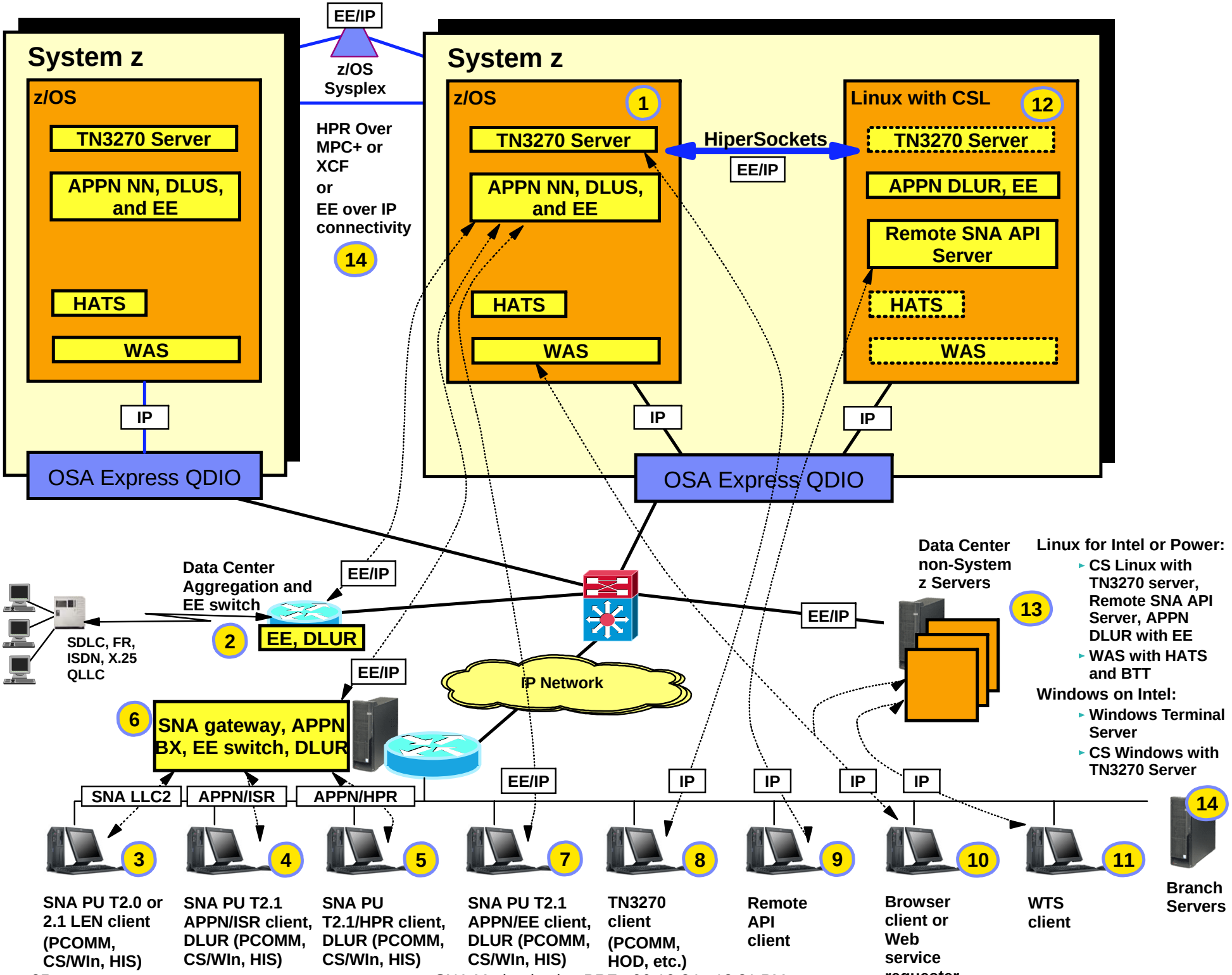
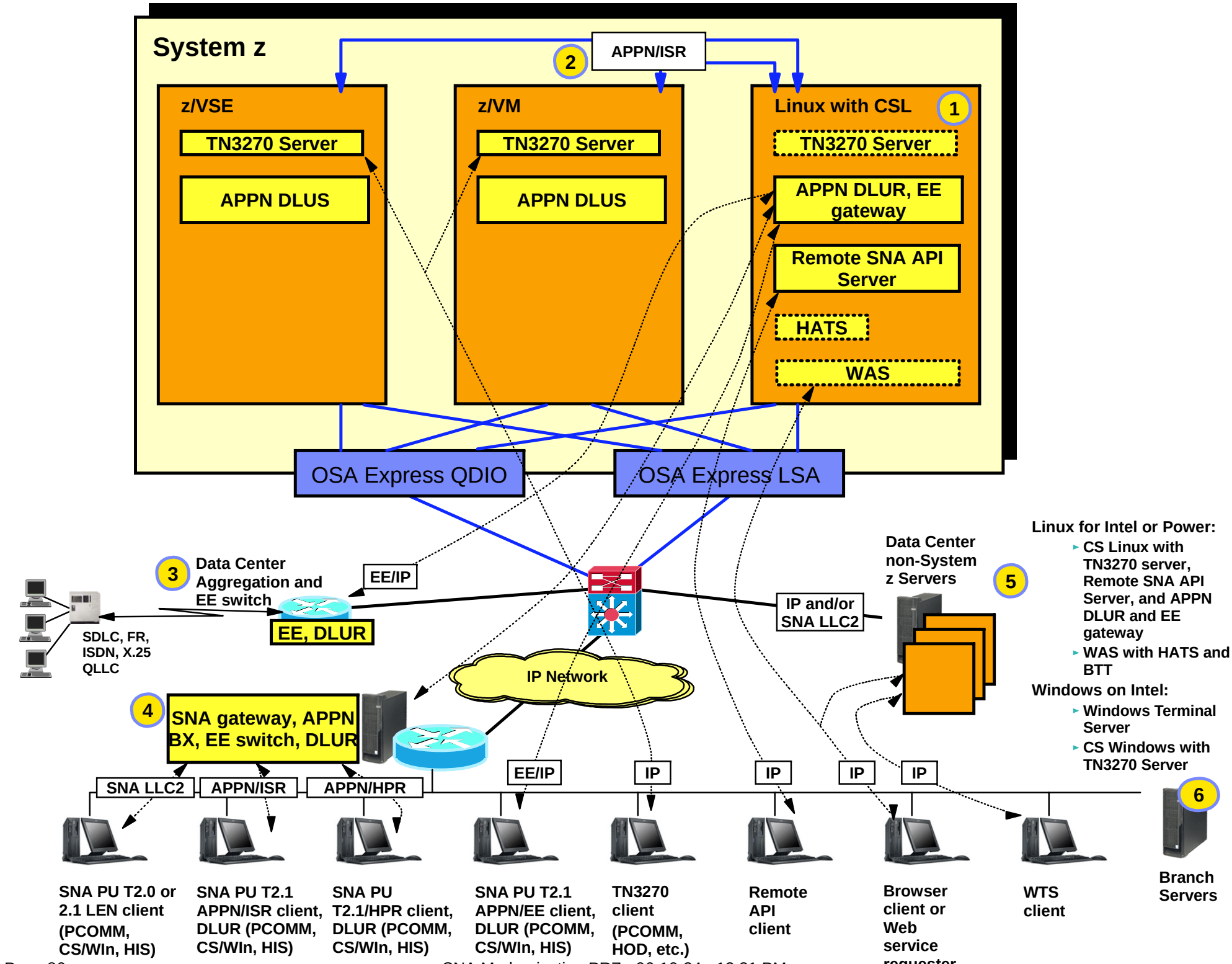
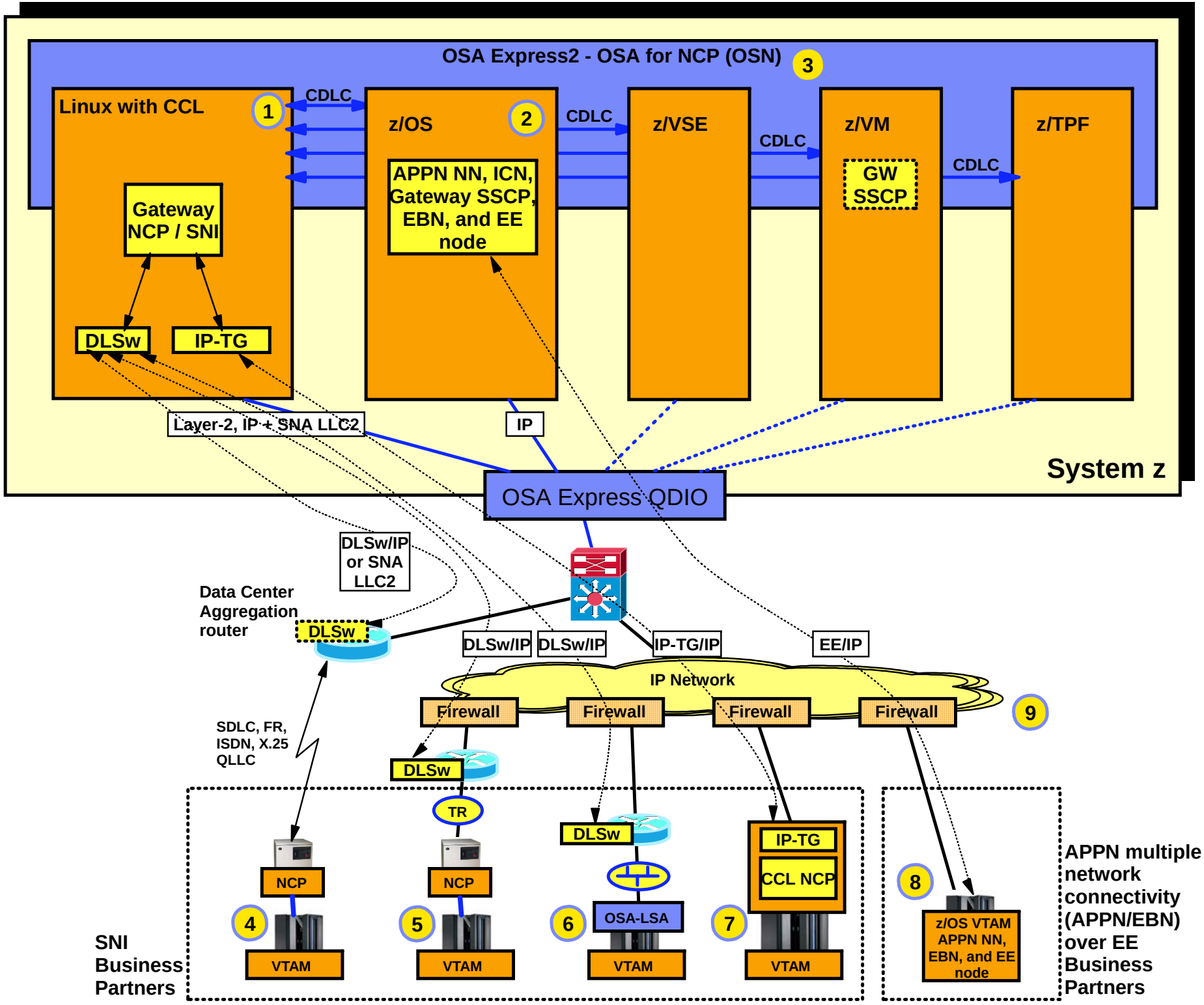
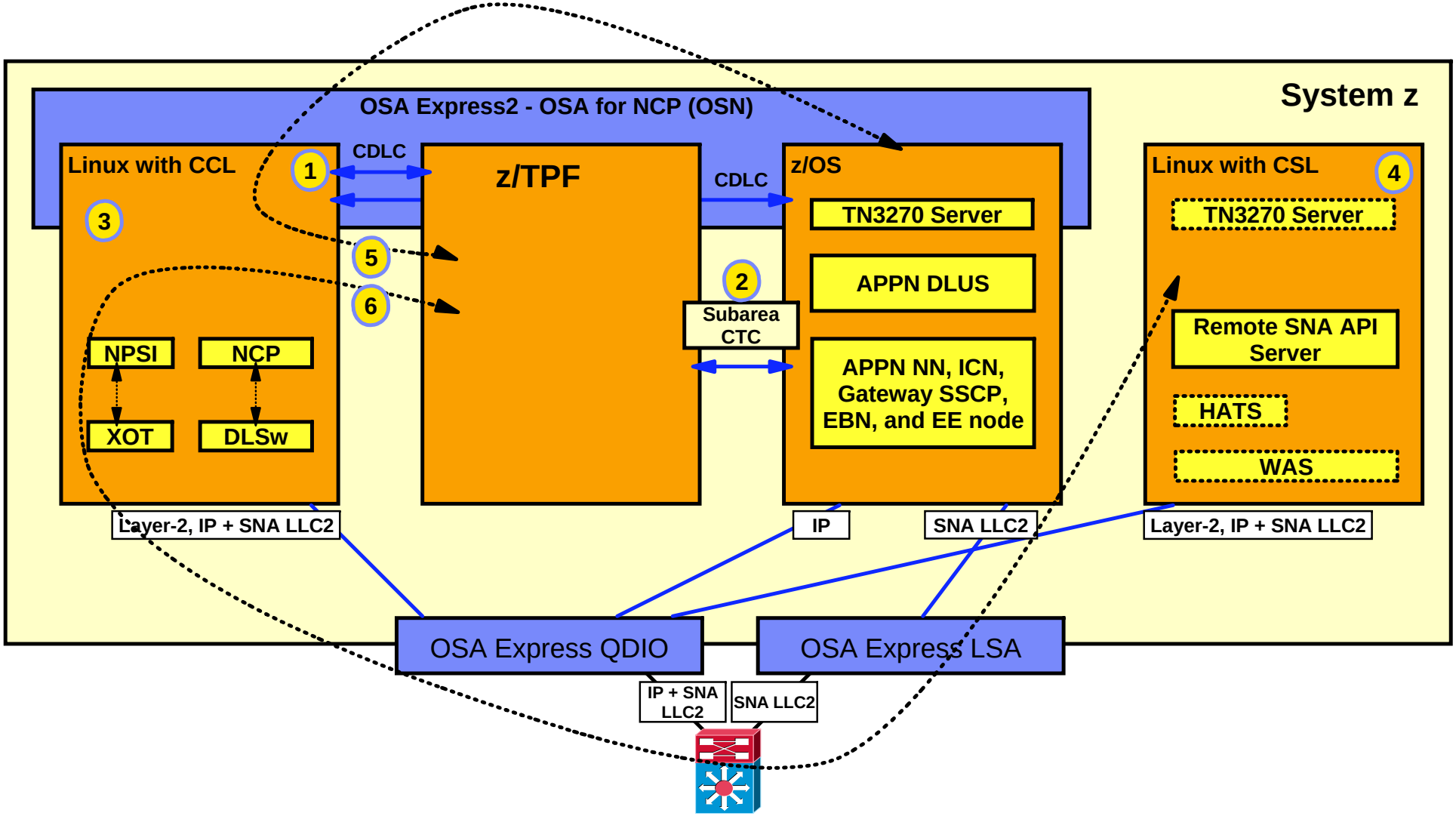

System z
OSA Express2 - OSA for NCP (OSN)
Linux with CCL
1
CDLC
z/OS
CDLC
z/VM and z/VSE
Linux with CSL
5
TN3270 Server
TN3270 Server
TN3270 Server
3
NPSI
NCP
XOT
DLSw
HATS
WAS
Remote SNA API Server
HATS
WAS
Layer-2, IP + SNA LLC2
IP
SNA LLC2
IP
SNA LLC2
Layer-2, IP + SNA LLC2
OSA Express QDIO
OSA Express LSA
IP + SNA LLC2
SNA LLC2
4
Data Center Aggregation
XOT
DLSw
SDLC, FR, ISDN, X.25 QLLC and non-SNA X.25
IP and/or SNA LLC2
10
Data Center non-System z Servers
IP Network
IP
DLSw
11
SNA LLC2
IP
IP
IP
IP
Linux for Intel or Power:
CS Linux with TN3270 server and Remote SNA API Server
WAS with HATS and BTT
Windows on Intel:
Windows Terminal Server
CS Windows with TN3270 Server
2
8
6
7
9
11
SNA PU T2.0 or 2.1 LEN client (PCOMM, CS/WIn, HIS)
TN3270 client (PCOMM, HOD, etc.)
Remote API client
Browser client or Web service requester
WTS client
Branch non-System z Servers


System z
z/OS
TN3270 Server
APPN NN, DLUS, and EE
HATS
WAS
IP
OSA Express QDIO
EE/IP
z/OS Sysplex
HPR Over MPC+ or XCF
or
EE over IP connectivity
14
System z
z/OS
1
TN3270 Server
APPN NN, DLUS, and EE
HATS
WAS
IP
OSA Express QDIO
HiperSockets
EE/IP
Linux with CSL
12
TN3270 Server
APPN DLUR, EE
Remote SNA API Server
HATS
WAS
IP
Data Center Aggregation and EE switch
EE/IP
2
EE, DLUR
SDLC, FR, ISDN, X.25 QLLC
EE/IP
IP Network
EE/IP
6
SNA gateway, APPN BX, EE switch, DLUR
SNA LLC2
APPN/ISR
APPN/HPR
EE/IP
IP
IP
IP
IP
Data Center non-System z Servers
13
Linux for Intel or Power:
CS Linux with TN3270 server, Remote SNA API Server, APPN DLUR with EE
WAS with HATS and BTT
Windows on Intel:
Windows Terminal Server
CS Windows with TN3270 Server
14
Branch Servers
3
SNA PU T2.0 or 2.1 LEN client (PCOMM, CS/WIn, HIS)
4
SNA PU T2.1 APPN/ISR client, DLUR (PCOMM, CS/WIn, HIS)
5
SNA PU T2.1/HPR client, DLUR (PCOMM, CS/WIn, HIS)
7
SNA PU T2.1 APPN/EE client, DLUR (PCOMM, CS/WIn, HIS)
8
TN3270 client (PCOMM, HOD, etc.)
9
Remote API client
10
Browser client or Web service requester
11
WTS client


System z
APPN/ISR
2
z/VSE
TN3270 Server
APPN DLUS
z/VM
TN3270 Server
APPN DLUS
Linux with CSL
1
TN3270 Server
APPN DLUR, EE gateway
Remote SNA API Server
HATS
WAS
OSA Express QDIO
OSA Express LSA
3
Data Center Aggregation and EE switch
EE/IP
EE, DLUR
SDLC, FR, ISDN, X.25 QLLC
IP and/or SNA LLC2
Data Center non-System z Servers
5
IP Network
4
SNA gateway, APPN BX, EE switch, DLUR
SNA LLC2
APPN/ISR
APPN/HPR
EE/IP
IP
IP
IP
IP
6
Linux for Intel or Power:
CS Linux with TN3270 server, Remote SNA API Server, and APPN DLUR and EE gateway
WAS with HATS and BTT
Windows on Intel:
Windows Terminal Server
CS Windows with TN3270 Server
SNA PU T2.0 or 2.1 LEN client (PCOMM, CS/WIn, HIS)
SNA PU T2.1 APPN/ISR client, DLUR (PCOMM, CS/WIn, HIS)
SNA PU T2.1/HPR client, DLUR (PCOMM, CS/WIn, HIS)
SNA PU T2.1 APPN/EE client, DLUR (PCOMM, CS/WIn, HIS)
TN3270 client (PCOMM, HOD, etc.)
Remote API client
Browser client or Web service requester
WTS client
Branch Servers


OSA Express2 - OSA for NCP (OSN)
3
Linux with CCL
1
CDLC
z/OS
2
CDLC
z/VSE
CDLC
z/VM
GW SSCP
CDLC
z/TPF
APPN NN, ICN, Gateway SSCP, EBN, and EE node
Gateway NCP / SNI
DLSw
IP-TG
Layer-2, IP + SNA LLC2
IP
System z
OSA Express QDIO
DLSw/IP or SNA LLC2
Data Center Aggregation router
DLSw
DLSw/IP
DLSw/IP
IP-TG/IP
EE/IP
IP Network
Firewall
Firewall
Firewall
Firewall
9
SDLC, FR, ISDN, X.25 QLLC
DLSw
TR
DLSw
IP-TG
CCL NCP
NCP
NCP
OSA-LSA
4
5
6
7
8
VTAM
VTAM
VTAM
VTAM
z/OS VTAM APPN NN, EBN, and EE node
SNI Business Partners
APPN multiple network connectivity (APPN/EBN) over EE Business Partners


System z
OSA Express2 - OSA for NCP (OSN)
Linux with CCL
1
CDLC
z/TPF
CDLC
z/OS
Linux with CSL
4
TN3270 Server
TN3270 Server
3
5
6
2
APPN DLUS
Subarea CTC
Remote SNA API Server
NPSI
NCP
APPN NN, ICN, Gateway SSCP, EBN, and EE node
HATS
XOT
DLSw
WAS
Layer-2, IP + SNA LLC2
IP
SNA LLC2
Layer-2, IP + SNA LLC2
OSA Express QDIO
OSA Express LSA
IP + SNA LLC2
SNA LLC2

Appendix B
Reference Material

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Reference information

- **The publications listed in this section are considered particularly suitable for a more detailed discussion of the topics covered today.**
  - IBM Communication Controller for Linux on System z V1.2.1 Implementation Guide, SG24-7223-00
  - IBM Communication Controller Migration Guide, SG24-6298-02
  - Using IBM WebSphere Host Access Transformation Services V5, SG24-6099-00
  - IBM Branch Transformation Toolkit 5.1 Migration and Usage Guidelines, SG24-7160-00
  - CICS Transaction Gateway for z/OS Version 6.1, SG24-7161-00
  - Revealed! Architecting e-business Access to CICS, SG24-5466-04
  - IMS Connectivity in an On Demand Environment: A Practical Guide to IMS Connectivity, SG24-6794-00
  - Communications Server for z/OS V1R7 TCP/IP Implementation, Volume 1: Base Functions, Connectivity, and Routing, SG24-7169-00
  - Communications Server for z/OS V1R7 TCP/IP Implementation, Volume 2 - Standard Applications, SG24-7170-00
  - Communications Server for z/OS V1R7 TCP/IP, Implementation Volume 3 - High Availability, Scalability, and Performance, SG24-7171-00
  - Communications Server for z/OS V1R7 TCP/IP Implementation, Volume 4: Policy-Based Network Security, SG24-7172-00
- **Other sources of information:**
  - HATS Version 6 Information Center: http://publib.boulder.ibm.com/infocenter/hatshelp/v60/index.jsp

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Appendix C
SNA Architecture Level Review

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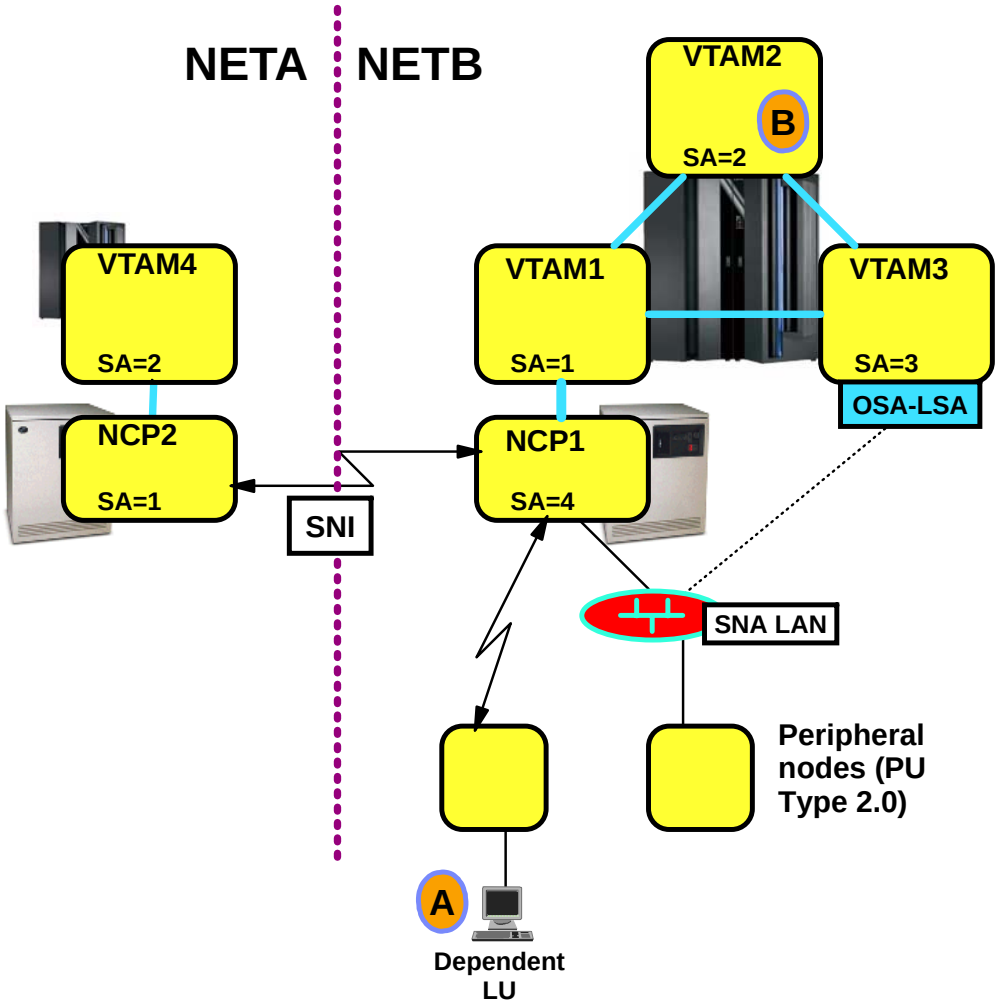
SNA tutorial - SNA subarea networking



- SNA nodes are either subarea nodes (VTAM, NCP) or peripheral nodes.
- All resources (nodes, links, paths) in an SNA network (a NETID) must be defined on each subarea node for it to be able to establish sessions through the SNA subarea network:
  - For application B on SA=2 to establish sessions with an SNA Logical Unit A that belongs to an SNA peripheral node attached to the NCP in SA=4, the network topology between SA=2 and SA=4 must be defined on SA=2 and the LU name A must be defined as owned by VTAM1.
- All possible session paths (routes between subarea nodes) must be predefined on all the subarea nodes.
  - The dreaded SNA path tables
- Worked fine for a relatively static, hierarchical network environment.
- If A and B are in session with each other over the link between SA=1 and SA=2 and that link fails, the SNA session between A and B will break.
  - A new session can be set up via alternate links.
- Different SNA subarea networks can be interconnected using SNA Network Interconnection (SNI) functions.

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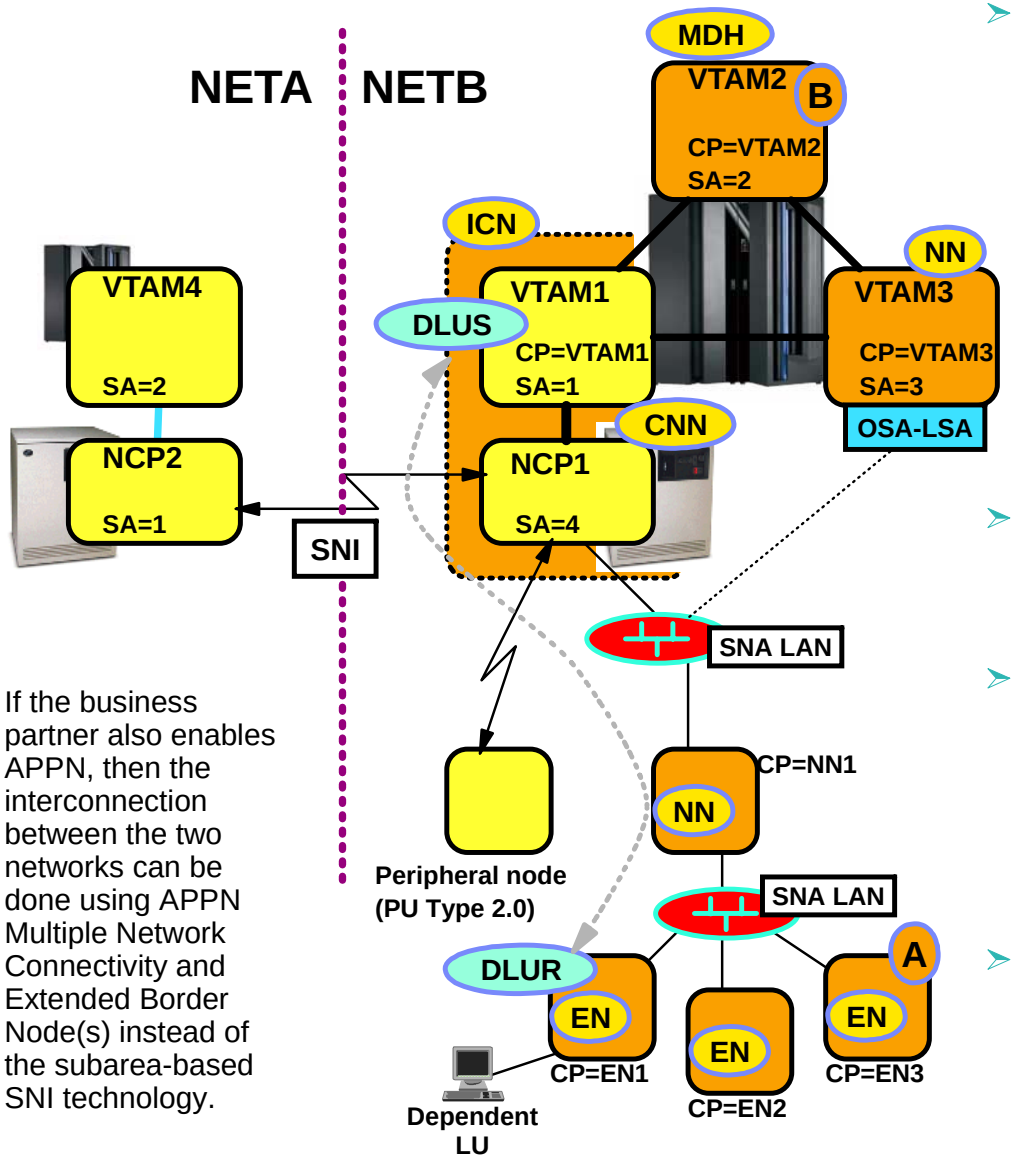
SNA tutorial - SNA Advanced Peer to Peer Networking (APPN)



If the business partner also enables APPN, then the interconnection between the two networks can be done using APPN Multiple Network Connectivity and Extended Border Node(s) instead of the subarea-based SNI technology.

- SNA subarea and APPN networking may interact and some nodes may be both APPN node types and subarea node types.
  - NN: Network Node
  - EN: End Node
  - ICN: Inter Change Node (can control session setup between the SNA subarea network and the APPN network)
  - EBN: Extended Border Node (controls session setup between two APPN networks)
  - CNN: Composite Network Node (An APPN NN that is comprised of a VTAM and one or more NCPs)
  - MDH: Migration Data Host (An EN that is also a subarea node)
- Non-subarea adjacent dependent LU access through an APPN network uses Dependent LU Requester/Server technology (DLUR/DLUS)
- Session paths are computed dynamically in an APPN network and need not be predefined.
  - When Application A on EN1 wants to talk to Application B on VTAM2, directory information locally and on NN1 will be searched - if not found, a search will flow to the other NNs in the APPN network and the location of and how to reach B will be identified and returned to EN1.
- If A and B are in session with each other over the link between VTAM2 and VTAM1 and that link fails, the SNA session between A and B will still break.
  - A new session can then be established between A and B by going via VTAM3 (as long as VTAM3 is an NN)

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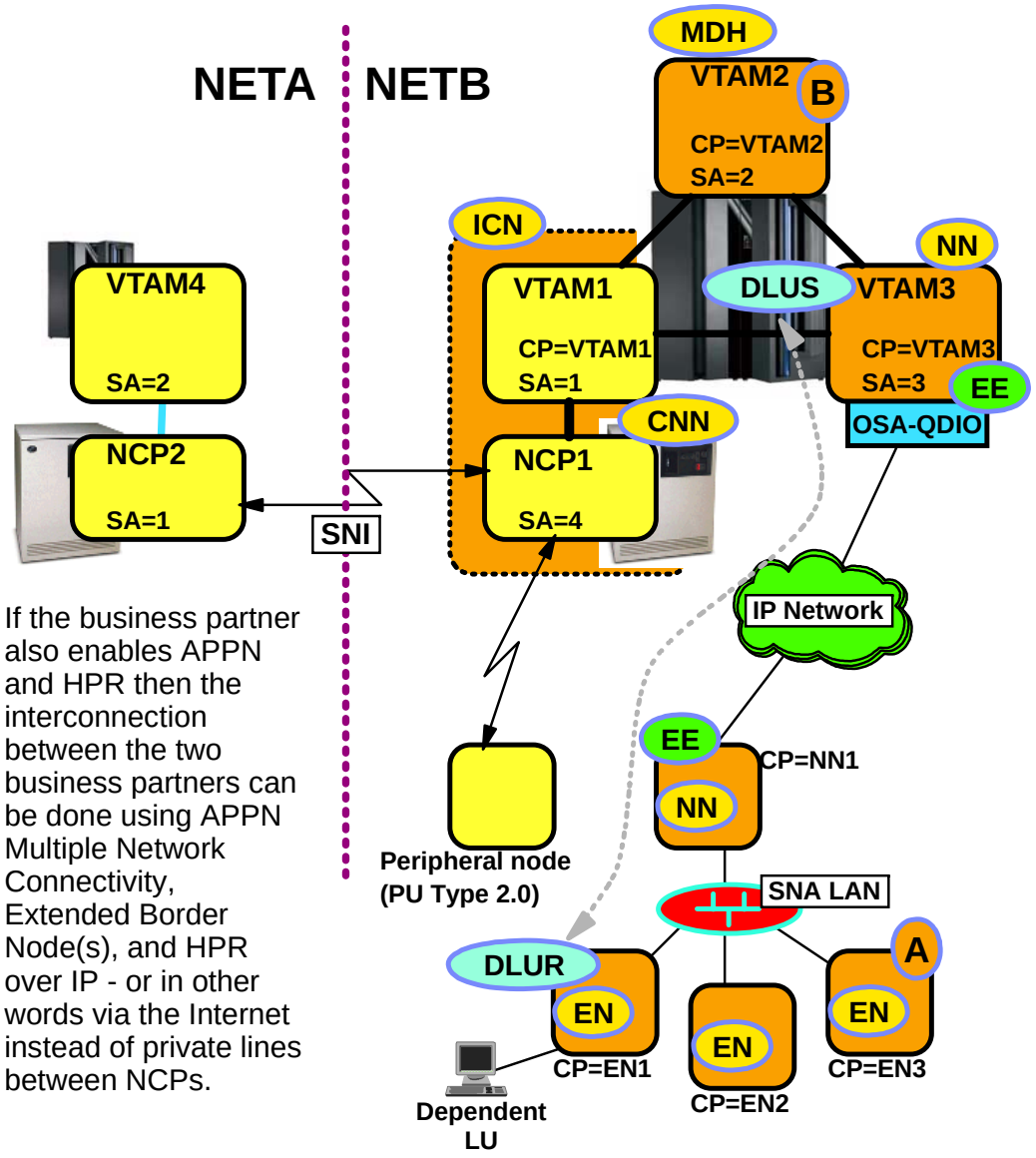
SNA tutorial - SNA High Performance Routing (HPR)



If the business partner also enables APPN and HPR then the interconnection between the two business partners can be done using APPN Multiple Network Connectivity, Extended Border Node(s), and HPR over IP - or in other words via the Internet instead of private lines between NCPs.

- HPR is an extension to APPN, so an HPR environment inherits all the characteristics of APPN.
- If A and B are in session with each other over the link between VTAM2 and VTAM3 and that link fails, the SNA session between A and B will no longer break as long as the links between VTAM2, VTAM1, and VTAM3 are HPR links, such as XCF or MPC+ channels.
  - When the link breaks, HPR will make a non-disruptive path switch and switch the session to go between VTAM2, via VTAM1, to VTAM3 and then further on via NN1 to EN3.
- An extension to HPR is to use an IP network as an HPR link - this is known as HPR over IP (HPR/IP) or more generally as Enterprise Extender (EE)
  - HPR looks at the entire IP network - regardless of the size of that IP network - as a single HPR link
  - If topology in the IP network changes, it is up to the IP infrastructure to recover from that change and reroute IP packets via alternate routes
  - With EE enabled on z/OS, SNA traffic leaves and enters z/OS as IP packets, which means SNA/HPR/EE traffic can benefit from OSA-Express QDIO high-capacity network adapters such as Gigabit Ethernet and HiperSockets connectivity

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For more information....

URL	Content
http://www.ibm.com/servers/eserver/zseries	IBM eServer zSeries Mainframe Servers
http://www.ibm.com/servers/eserver/zseries/networking	Networking: IBM zSeries Servers
http://www.ibm.com/servers/eserver/zseries/networking/technology.html	IBM Enterprise Servers: Networking Technologies
http://www.ibm.com/software/network/commserver	Communications Server product overview
http://www.ibm.com/software/network/commserver/zos/	z/OS Communications Server
http://www.ibm.com/software/network/commserver/z_lin/	Communications Server for Linux on zSeries
http://www.ibm.com/software/network/ccl	Communication Controller for Linux on zSeries
http://www.ibm.com/software/network/commserver/library	Communications Server products - white papers, product documentation, etc.
http://www.redbooks.ibm.com	ITSO Redbooks
http://www.ibm.com/software/network/commserver/support	Communications Server technical support
http://www.ibm.com/support/techdocs/	Technical support documentation (techdocs, flashes, presentations, white papers, etc.)
http://www.rfc-editor.org/rfcsearch.html	Request For Comments (RFC)

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