Enterprise Networking Solutions

Modernizing SNA: APPN & HPR - A Foundation for Enterprise Extender

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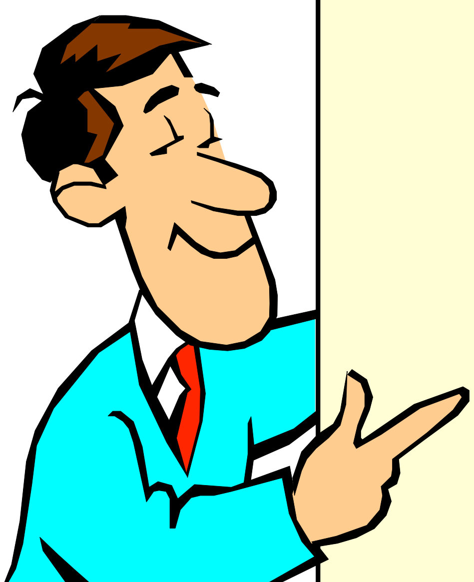
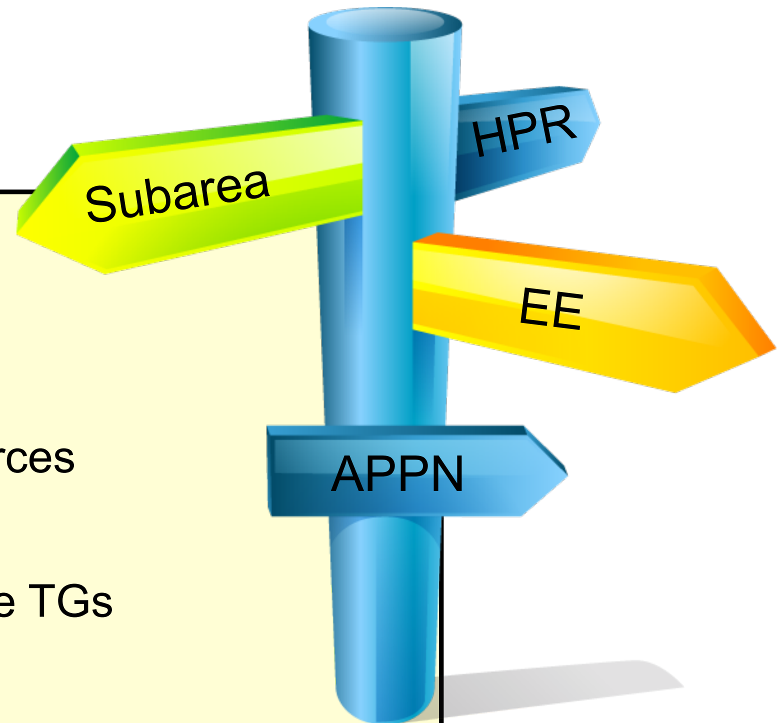
SHARE 2012 Summer Technical Conference
Session 11329

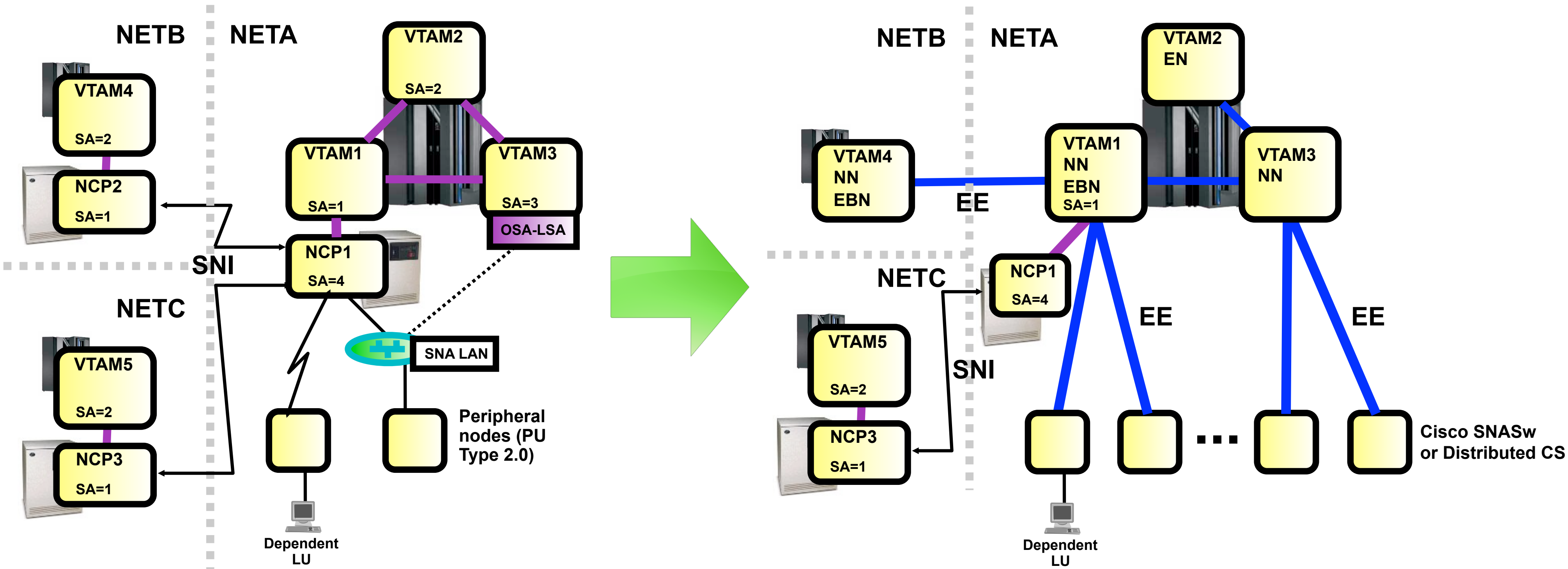
Agenda

- ❑ APPN Node Types
- ❑ Control Point (CP-CP) Sessions
- ❑ APPN Topology
- ❑ APPN Directory - Locating Resources
- ❑ Choosing Session Paths
- ❑ Interchange TGs and Virtual Route TGs
- ❑ High Performance Routing
- ❑ Enterprise Extender
- ❑ Dependent LU Requester/Server (DLUR/DLUS)
- ❑ Extended Border Node (EBN) and Branch Extender
- ❑ Roadmap
- ❑ References





Subarea SNA to Enterprise Extender



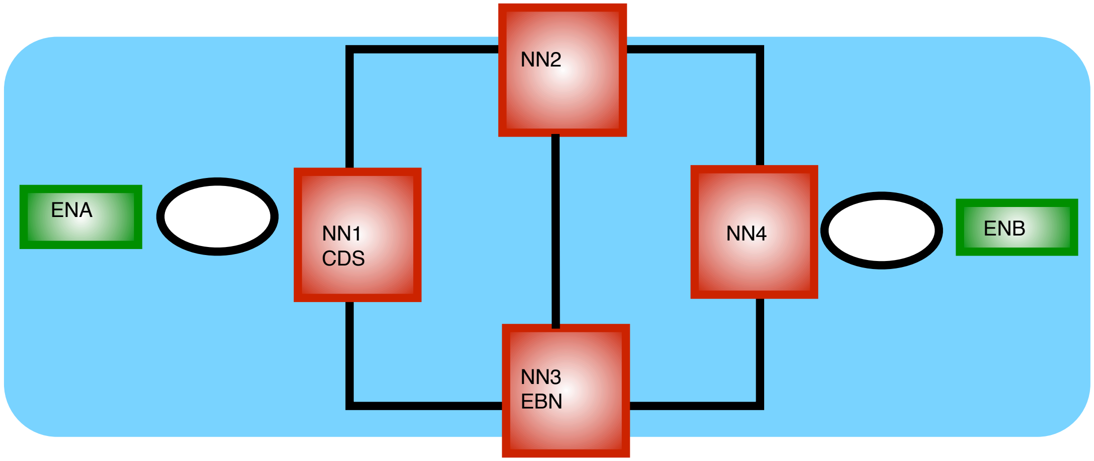
Subarea SNA

Enterprise Extender

Subarea (FID4) connections

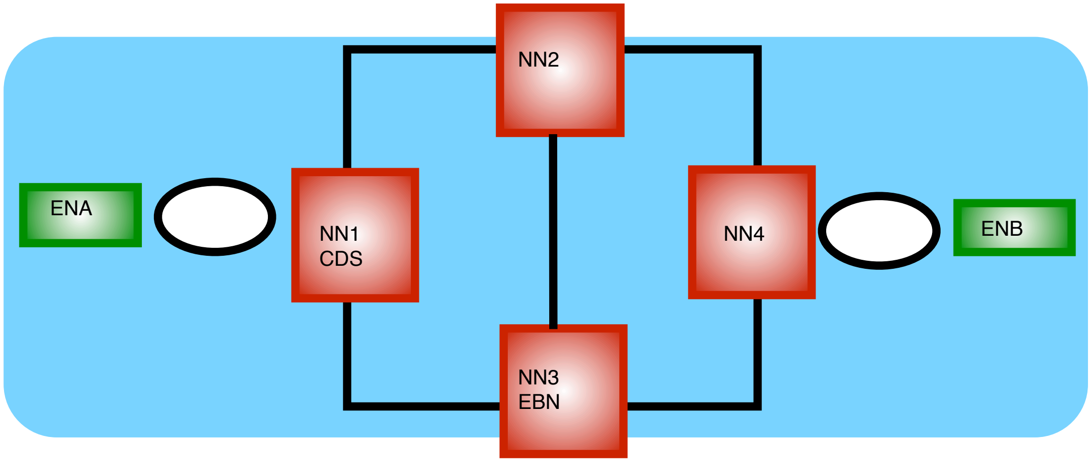
Enterprise Extender logical links

APPN Node Types - End Nodes (ENs)



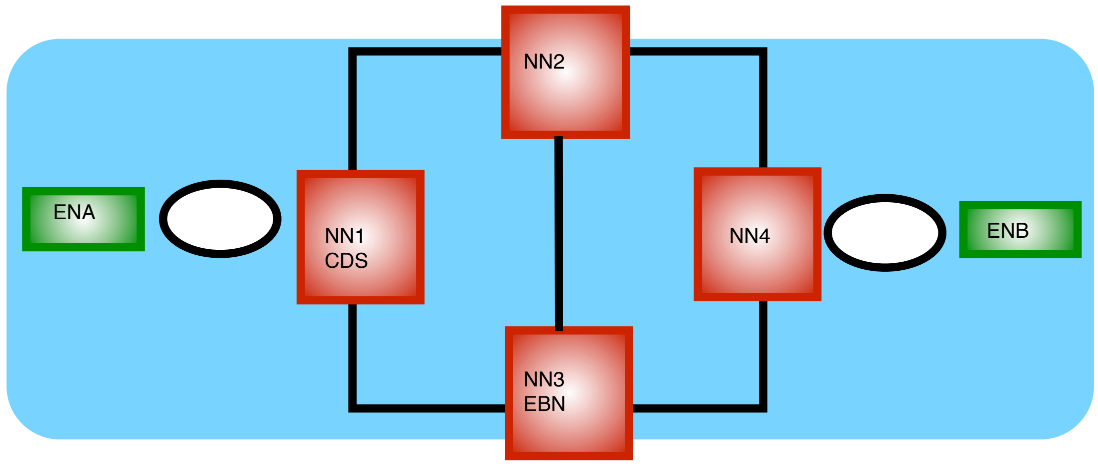
- End Nodes (ENs)
  - Do not participate in network topology exchanges (only local topology)
  - Must be a session endpoint (cannot perform intermediate node routing)
  - Typically require assistance from Network Nodes (NNs) to:
    - Locate session partners
    - Choose session paths
    - Route BINDs to establish sessions
  - Allows local resources (CPU, memory, etc.) to be dedicated to production work

APPN Node Types - Network Nodes (NNs)



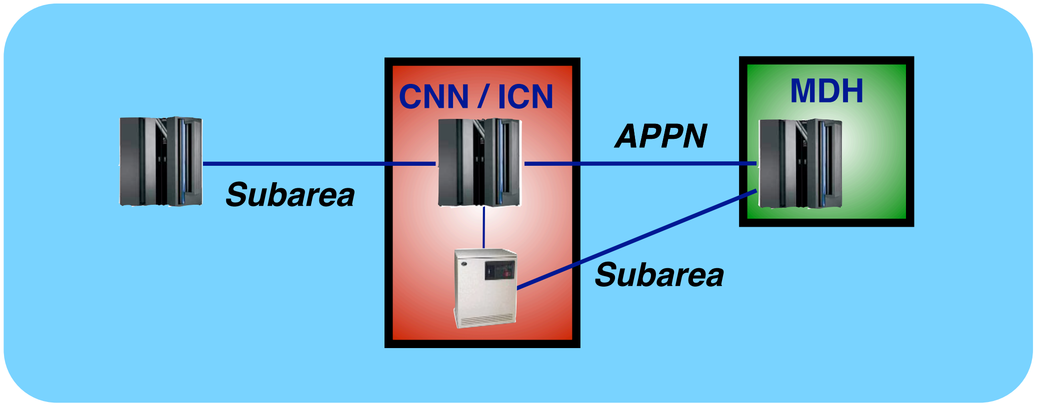
- Network Nodes (NNs)
  - Comprise the backbone of the APPN network
  - Participate in network topology exchanges and network search algorithms
  - Can be a session endpoint or an intermediate node on a session path
  - Provide Network Node Server (NNS) functions for served ENs

APPN Node Types - Specialized Network Nodes



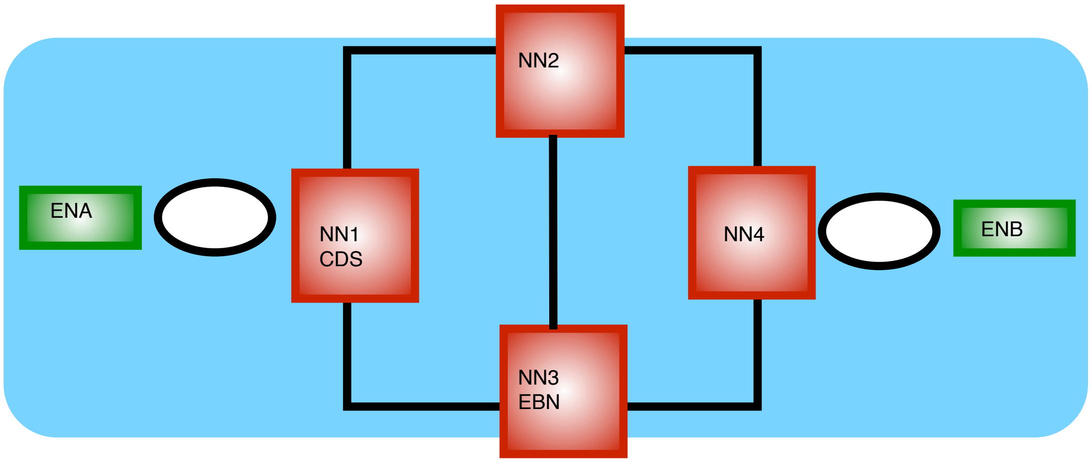
- Central Directory Server (CDS or CDSERVR)
  - Focal point for network broadcast searches
  - Central repository of resource location information
- Extended or Peripheral Border Node (BN, EBN or PBN)
  - Provides connectivity to other APPN networks (APPN version of SNI)
- Branch Extender (BEX or BrEx)
  - Provides limited EBN-like functions to small branches environments

APPN Node Types - Specialized VTAM Nodes



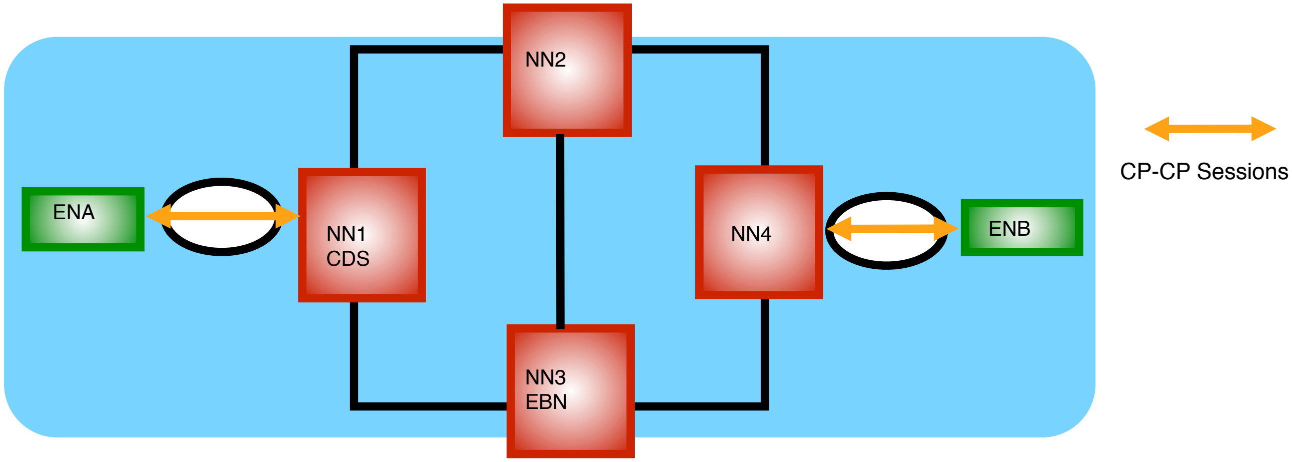
- Composite Network Nodes (CNNs)
  - VTAM and owned NCPs work together to present the appearance of a single NN
- Interchange (Network) Nodes (ICNs)
  - APPN network nodes that are also have SSCP-SSCP sessions
  - Provide "interchange" function for sessions that cross APPN/subarea boundary
- Migration Data Hosts (MDHs)
  - APPN end nodes that are also have SSCP-SSCP sessions

Control Point (CP-CP) Sessions



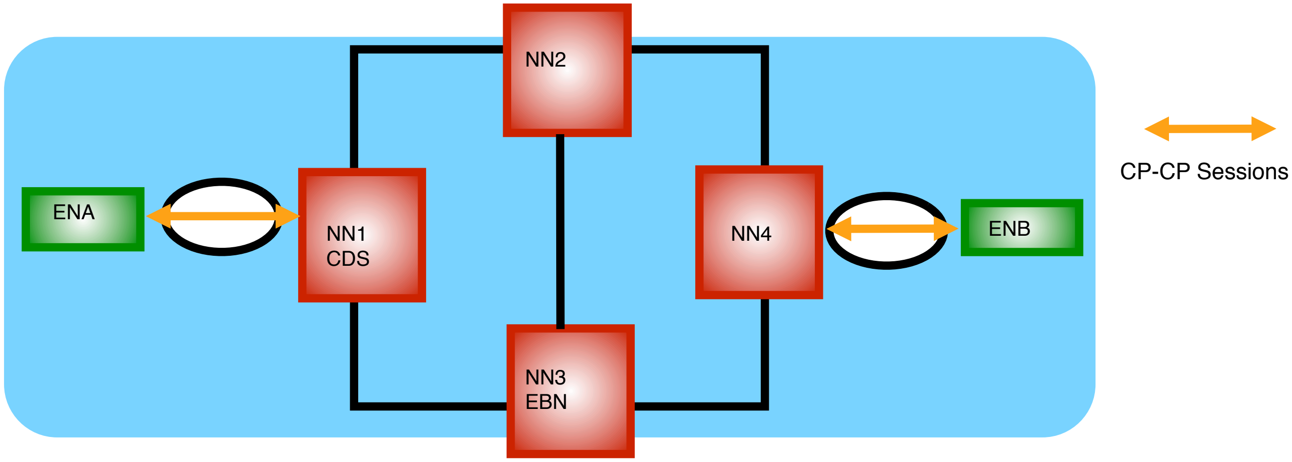
- CP-CP sessions are a pair of LU 6.2 sessions
  - CONWINNER and CONLOSER (BIND sender versus BIND receiver)
- Established between adjacent nodes only
  - One hop session path
- Used to send (CONWINNER) and receive (CONLOSER):
  - Network and/or local topology information
  - Network search requests and replies

Control Point (CP-CP) Sessions - ENs



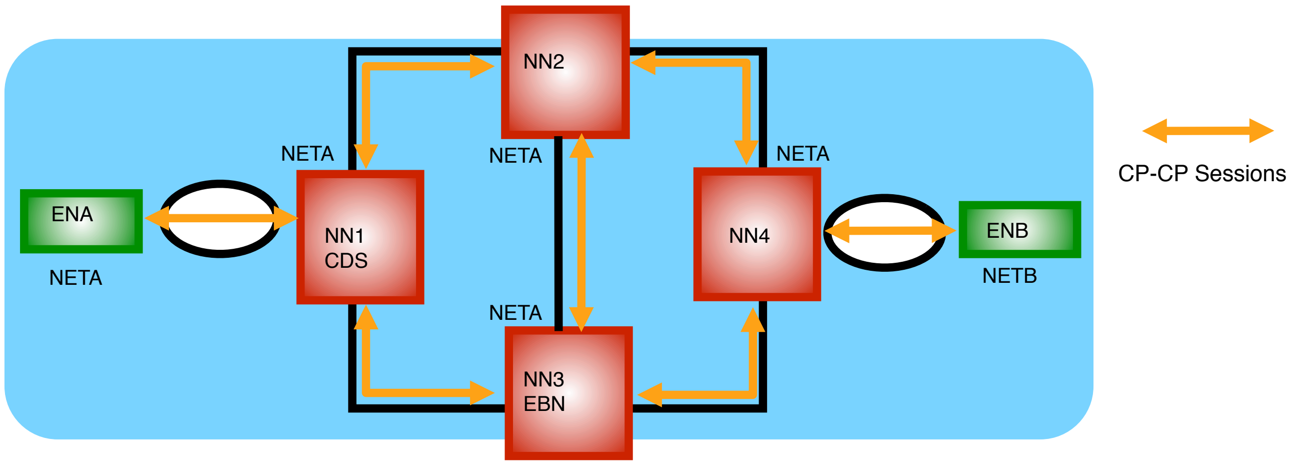
- EN CP-CP sessions are established:
  - To an adjacent NN only (no EN-to-EN CP-CP sessions)
  - To only ONE NN at a time (the EN's Network Node Server or NNS)
  - NOTE: ENs can have active links to many NNs and/or ENs at the same time. But each EN can only have CP-CP sessions to ONE NN at a time. If CP-CP sessions fail, an EN can immediately choose another adjacent NN to act as its NNS.
- EN always initiates CP-CP activation
- ENs can register local resources (LUs) with NNS

Control Point (CP-CP) Sessions - NNs



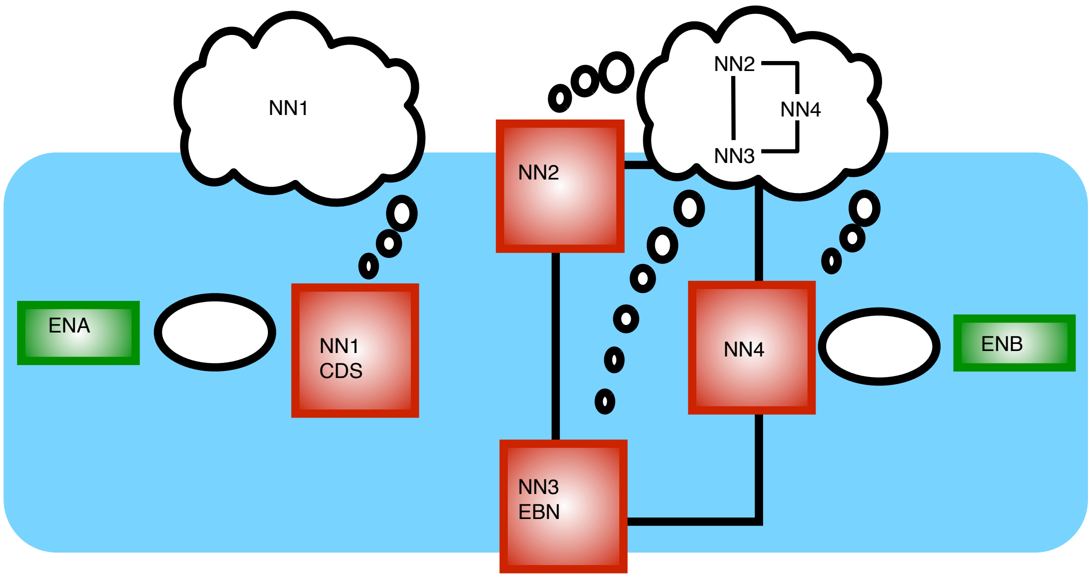
- NN CP-CP sessions are established:
  - Between adjacent NNs (as many as needed or desired)
  - To adjacent ("served") ENs, but only when requested by the EN
- How many CP-CP sessions are recommended?
  - Minimum CP-CP spanning tree of order 2 (no single point of failure)
  - Most customers establish CP-CP sessions between all adjacent NNs, but...
  - Too many CP-CP sessions can cause unnecessary network traffic

Control Point (CP-CP) Sessions - NETIDs



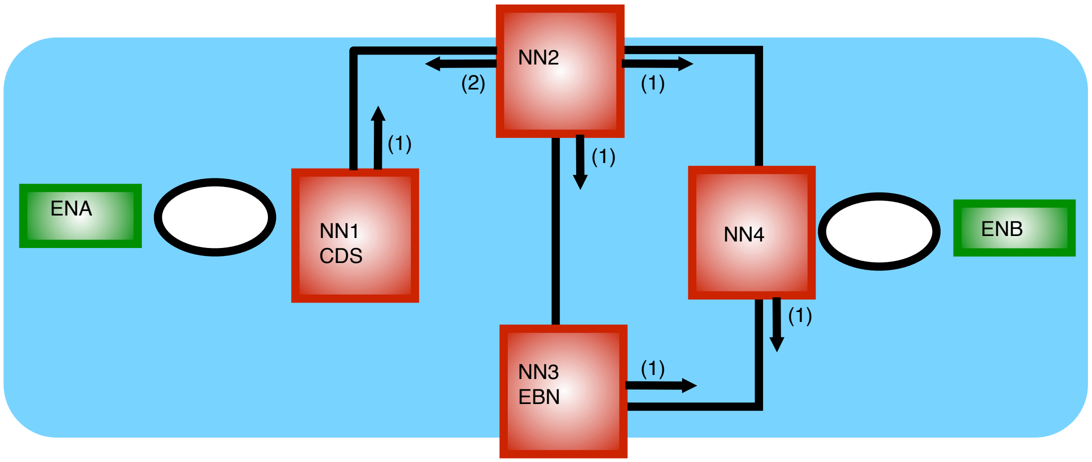
- NN-to-NN CP-CP sessions
  - Only allowed between NNs that have the same NETID, unless
  - One or both NNs are defined as border nodes
- EN-to-NN CP-CP sessions
  - ENs are allowed to have a different NETID than their network node server
  - When this occurs, the EN is said to be "Casually Connected"

APPN Network Topology - APPN's Roadmap



- Describes the nodes and links (Transmission Groups or TGs) in the network, including node and TG characteristics
- Network topology describes NNs and TGs between NNs (the backbone)
  - Changes are propagated to other adjacent NNs via Topology Database Updates (TDUs)
    - When node or TG states or characteristics change
    - When CP-CP sessions are started or ended
  - All NNs should have identical representations
- Local topology includes adjacent ENs and the links to them
  - Changes are not propagated to other nodes
  - ENs have a limited topology DB (to establish CP-CP sessions to an NNS)
- Can be check-pointed to reduce topology flows when rejoining the network

APPN Network Topology - TDU Flows

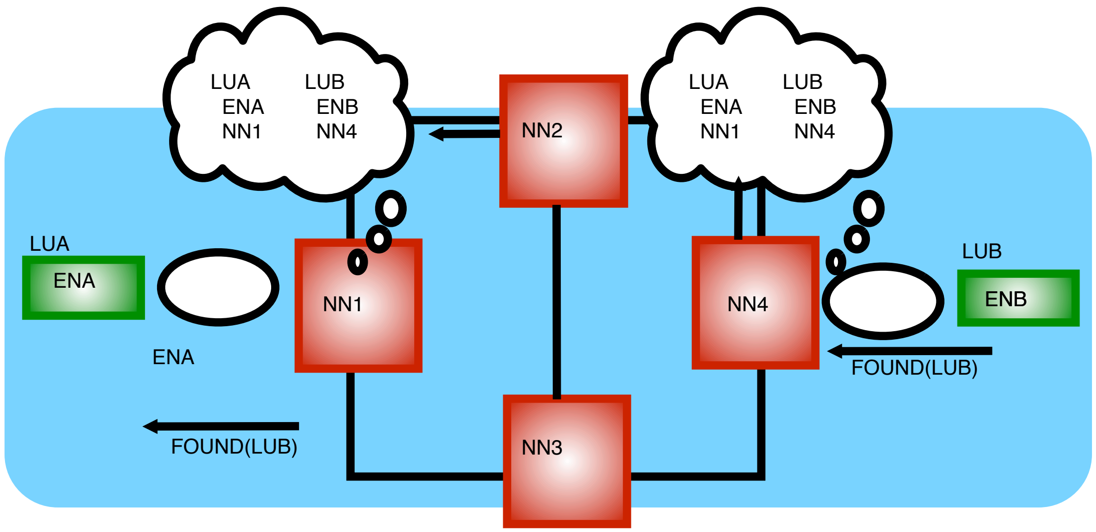


- Sample TDUs that flow when a new link becomes active
  - TDU (1) describes the TG from NN1 to NN2
    - NN2 propagates TDU (1) to all adjacent NNs (NN4 and NN3)
    - Adjacent NNs also propagate TDU (1) to all adjacent NNs
  - TDU (2) describes the entire network topology
    - Including the TG from NN2 to NN1

Directory Services Database - APPN's Telephone Book

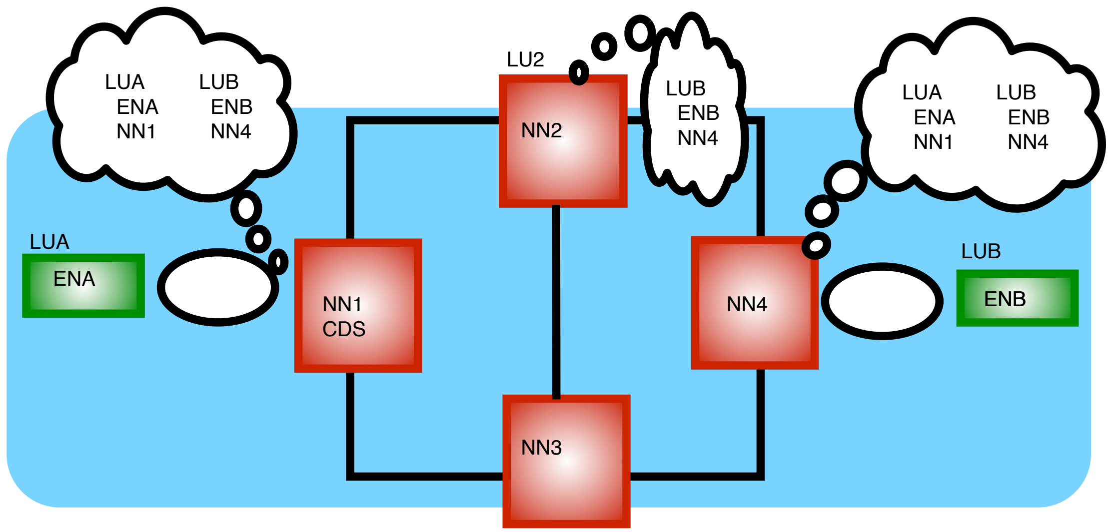
- Describes where resources (LUs) reside in the network
  - Owning CP name and NNS name (resource hierarchy)
  - Can include other information (non-native, in subarea, etc.)
  - Can be check-pointed to reduce broadcast searches when rejoining the network
  - DS DB entries are created by loading a check-pointed DB, registration, or searching
- If target resource's location is (thought to be) known:
  - Directed search sent to suspected destination
- If target resource's location is not known (or directed search fails):
  - Broadcast search of served ENs
  - Broadcast search of APPN network
  - Serial (directed) search of interchange nodes (to perform subarea search)
  - Serial (directed) search of non-native networks (border node search)
- Directory Services Management Exit (DSME)
  - Allows search steps to be eliminated

Locating Resources - Broadcast Search



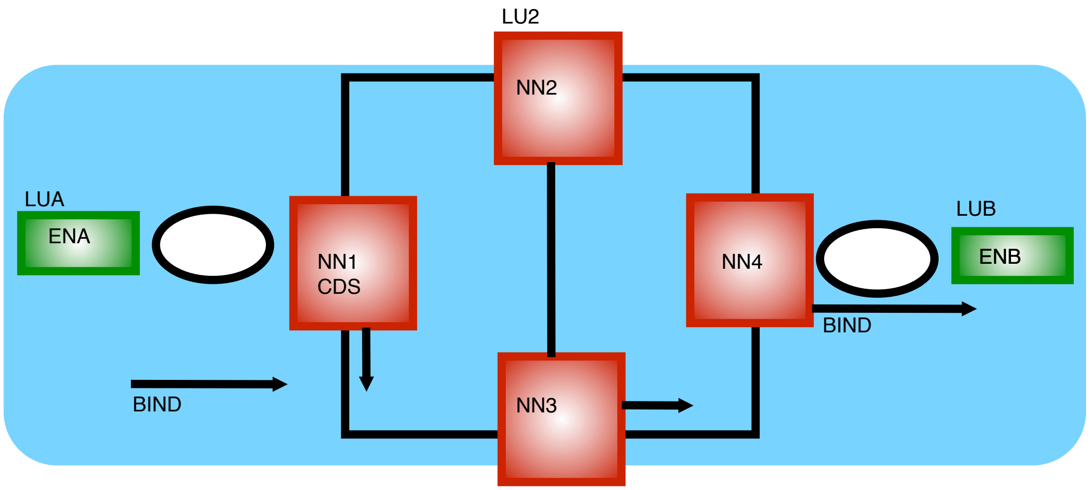
- LUA on ENA wants to start a session with LUB
  - ENA sends a one-hop Directed Search to its NNS (NN1)
  - NN1 sends a network Broadcast Search to all adjacent NNs at the same time
    - Search of other served ENs is performed first
  - Adjacent NNs propagate the broadcast search to all adjacent NNs
    - BEFORE searching local node or served ENs
  - After propagating the broadcast search, NNs search local node and served ENs
  - The positive reply is returned along the same path
    - NNS(OLU) and NNS(DLU) each save location of both the OLU and DLU

Locating Resources - Central Directory Server



- LU2 on NN2 wants to start a session with LUB
  - NN2 does not know the location of LUB
    - Instead of initiating a broadcast search, NN2 sends a directed search to the CDS
  - CDS is now completely responsible for locating LUB. This may include:
    - Sending a directed search to verify the location of LUB, if it is known
    - Sending directed search "queries" to other CDSs in the network
    - Sending a network broadcast search to determine the location of LUB
  - The positive reply is returned to the CDS along the same path
  - The CDS returns a positive reply to the requesting NN
    - NNS(OLU), NNS(DLU), and CDS all save location of both the OLU and DLU

Choosing Session Paths - Who And How



- Once the target resource has been located:
  - The NNS(PLU) calculates the session path based on APPN COS and topology
    - For sessions between NNs, network topology is all that is needed
    - For sessions to/from ENs, network and local topology are used
- How are routes calculated to/from remote ENs?
  - Remote EN's links are not in the topology database, so
  - EN (or its NNS) sends TG vectors (TGVs) on Locate request or reply
    - EN TGVs are "temporarily added" to the topology database

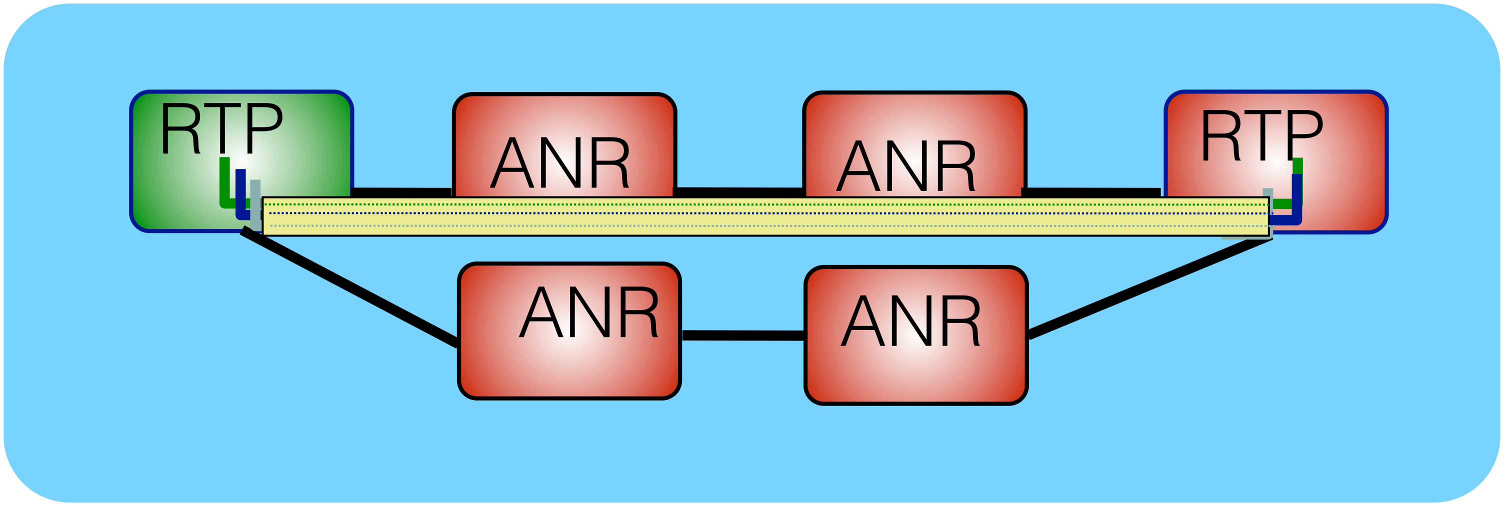
Choosing Session Paths - TG/Node Characteristics & COS

- TG characteristics are defined for each APPN TG
  - CAPACITY, COSTTIME, COSTBYTE, SECURITY, PDELAY, UPARM1, UPARM2, UPARM3
- If TG characteristics are not defined:
  - VTAM tries to use reasonable defaults, based on the type of link
  - If VTAM cannot tell, APPN architectural defaults are used (often not accurate)
- TG profiles can be used instead of defining each operand
  - IBMTGPS contains quite a few common TG Profiles (TR, MPC, XCF, EE)
  - Individual TG characteristics can be overriden by coding the appropriate operands
  - Defining accurate TG Characteristics is VERY important!
- Nodes have characteristics, too: CONGEST (Congested) and ROUTERES (Route Resistance)
- Each APPN class of service (COS) has a table of definitions
  - TG or node weight is determined by finding the first row in which all TG or node characteristics fit within the specified range
  - Least weight path (sum of TG and node weights) is used for the session
- APPN class of service definitions in COSAPPN
  - COSAPPN contains default definitions for all standard APPN COS names

High Performance Routing - Components

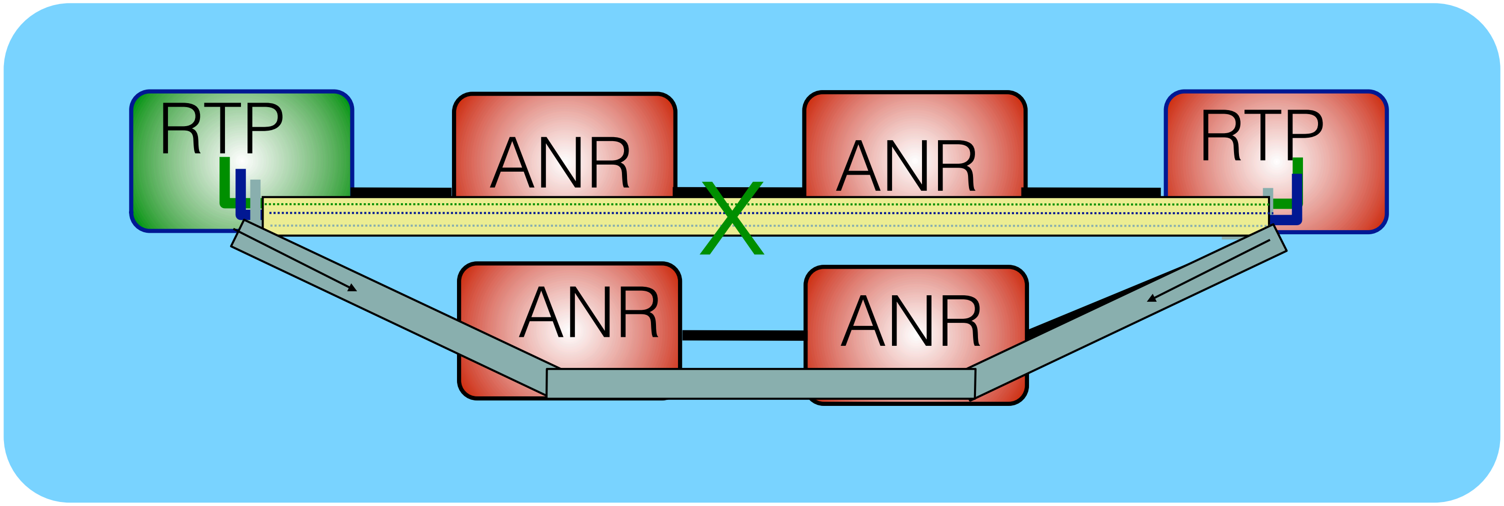
- HPR has 3 primary components
  - Rapid Transport Protocol (RTP)
    - Logical pipe between end points
    - Multiple users (sessions) per RTP
    - Error detection and retransmission
    - Congestion control
    - Prioritization
    - Non-disruptive rerouting of sessions
  - Automatic Network Routing (ANR)
    - ANR label created at initiation
    - Label contains all routing information
    - ANR router strips label and forwards packet
  - Adaptive Rate-Based Flow Control (ARB)
    - Congestion control algorithm

High Performance Routing - RTP Pipes



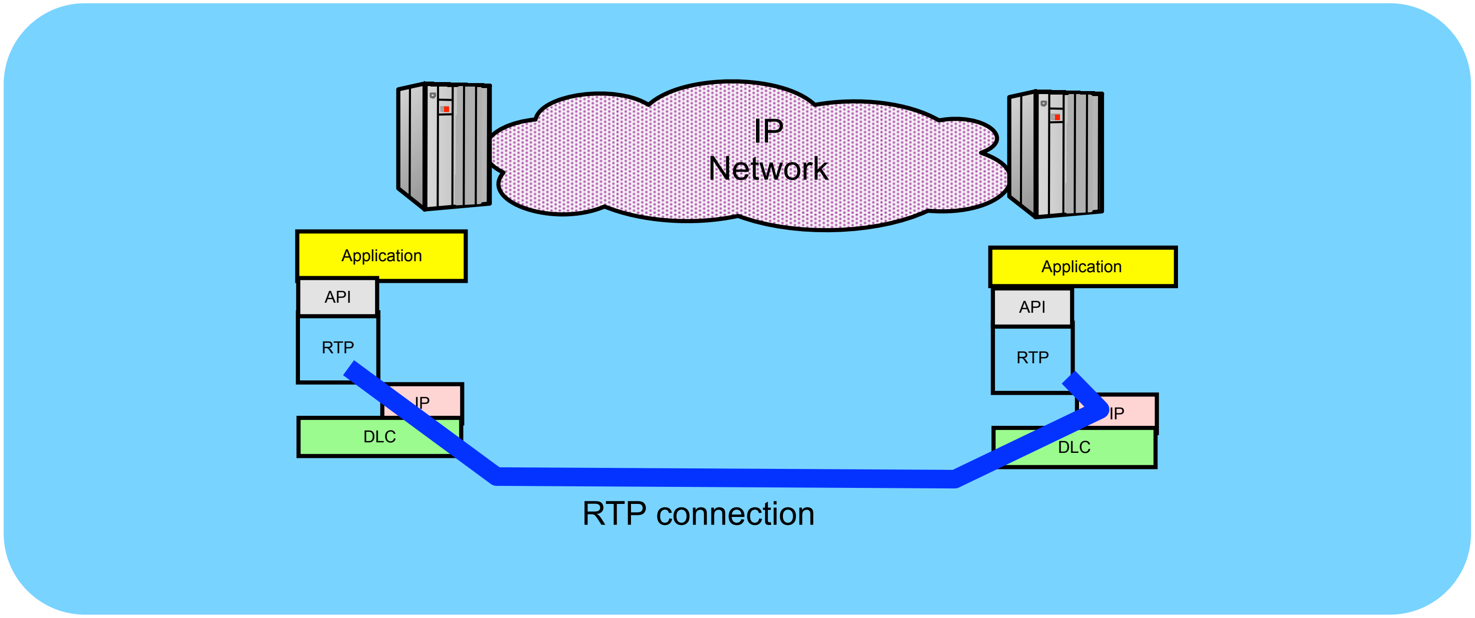
- Rapid Transport Protocol (RTP) pipes
  - Created and destroyed during normal session establishment and termination
  - Multiple sessions can traverse the same RTP pipe, provided:
    - RTP path (RSCV), APPN class of service (COS) and Network Connection Endpoints (NCEs) are identical
  - ANR labels created during RTP setup (Route Setup and Connection Setup)
    - ANR labels are included in header of each packet that flows over RTP
    - Intermediate nodes strip off their ANR label and forward the packet

High Performance Routing - Link Failures & Path Switch



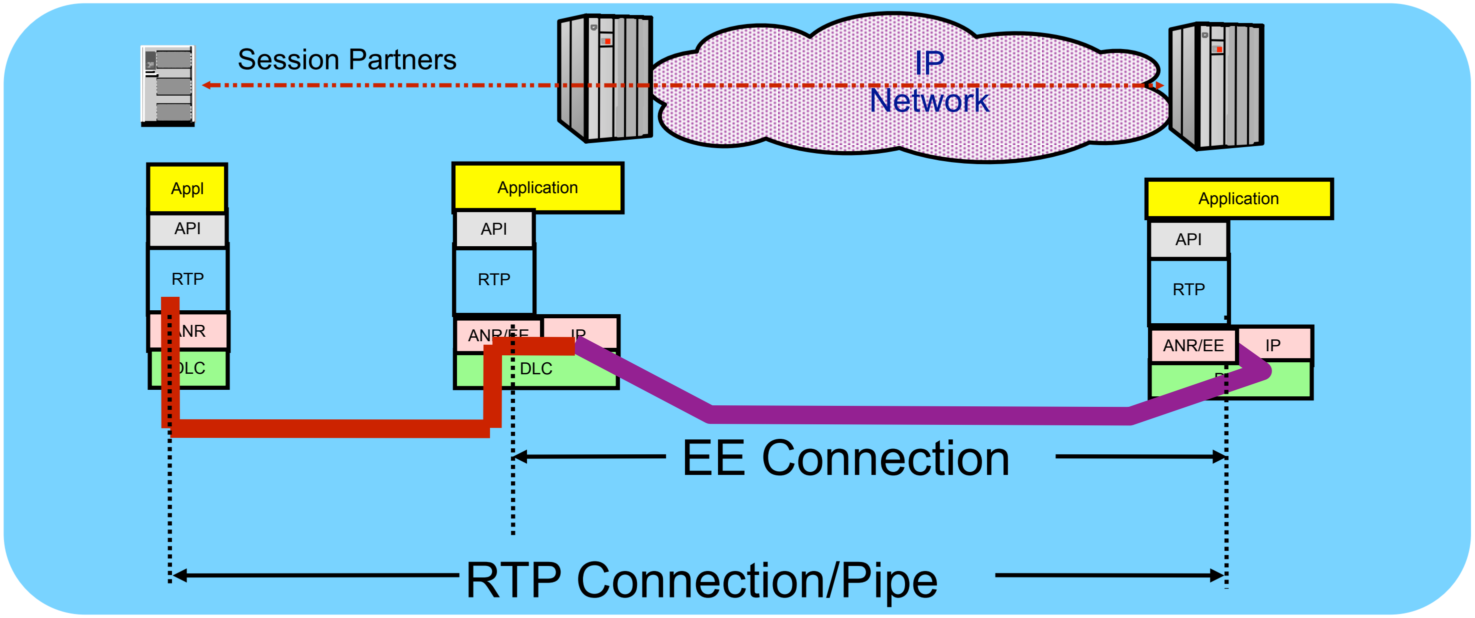
- Link failures
  - Detected by RTP Pipe endpoints when:
    - First link on RTP Pipe path fails (INOPs)
    - Data packets (or periodic status queries) are not acknowledged
  - One (or both) RTP endpoints detect the failure and re-drive RTP setup
    - Send another APPN Locate, if necessary (like when EBNs are involved)
    - Compute a new (or the same) RTP path (RSCV)
  - Sessions are non-disruptively switched to new path
- Other causes of RTP path switches:
  - MODIFY RTP,ID=CNRxxxxx (RTP PU name)
  - Periodic path switches triggered by using the PSRETRY start option

Enterprise Extender - What Is It?



- EE is "APPN/HPR over IP Networks"
  - EE is a logical connection (link) that represents IP connectivity from this host to the specified partner IP address or host name
  - EE allows:
    - Enablement of IP applications on the host
    - Convergence to a single (IP) network transport while preserving investment in SNA applications and SNA endpoints (workstations)
    - SNA functions to take full advantage of advances in IP routing

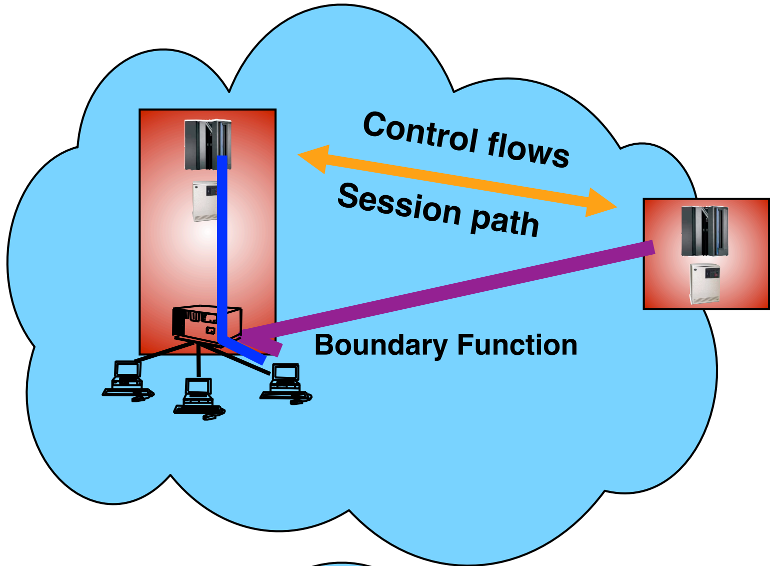
Enterprise Extender - EE Versus HPR

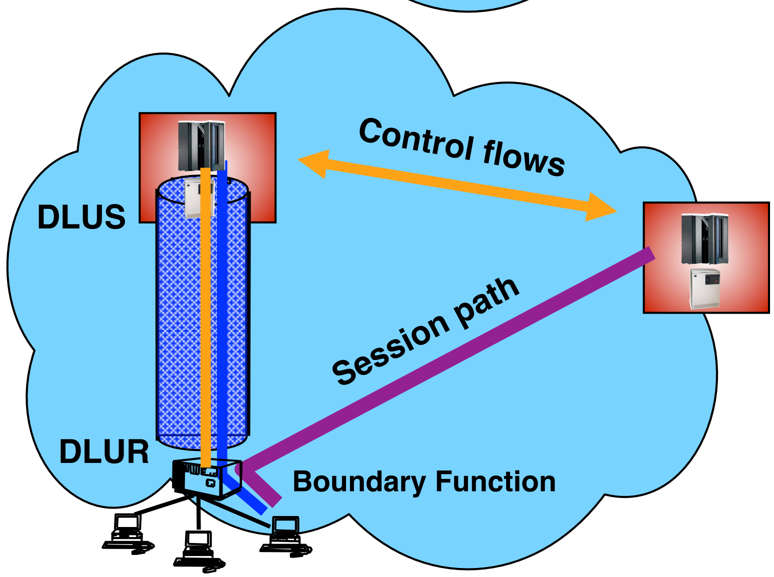


- EE connection (link) vs HPR connection (RTP pipe)
  - In the example above, there is a single RTP connection (pipe) that is composed of two hops:
    - The first is an HPR hop of unspecified type
    - The second an EE connection
  - SNA's view of EE: EE is just another DLC.
  - IP's view of EE: EE is just another (UDP) application.

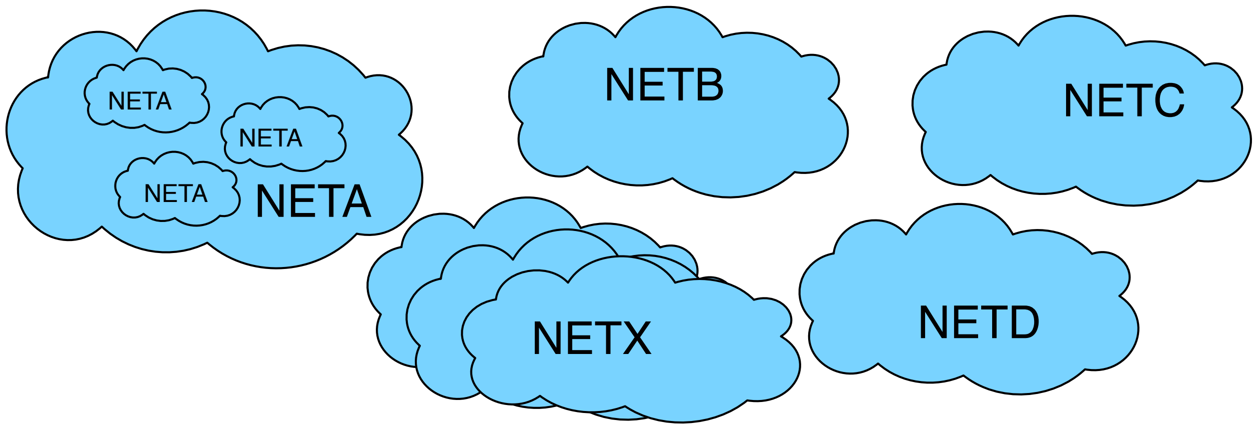
Dependent LU Requester/Server - Overview

- APPN supports dependent LUs without DLUR!
  - Dependent LUs attach as usual
    - Usually through NCPs
  - Session path must include owning VTAM
    - HPR is only possible to VTAM (not NCP)
- DLUR extends this support to:
  - Remove VTAM/NCP adjacency requirement
    - DLURs can be located in remote sites
  - More fully exploit HPR (out to the DLUR)
  - DLUR routes traffic intelligently
    - Session path need not include owning VTAM
- Most APPN platforms support DLUR:
  - IBM Distributed Communications Server
  - iSeries
  - Cisco SNASw
  - Microsoft HIS



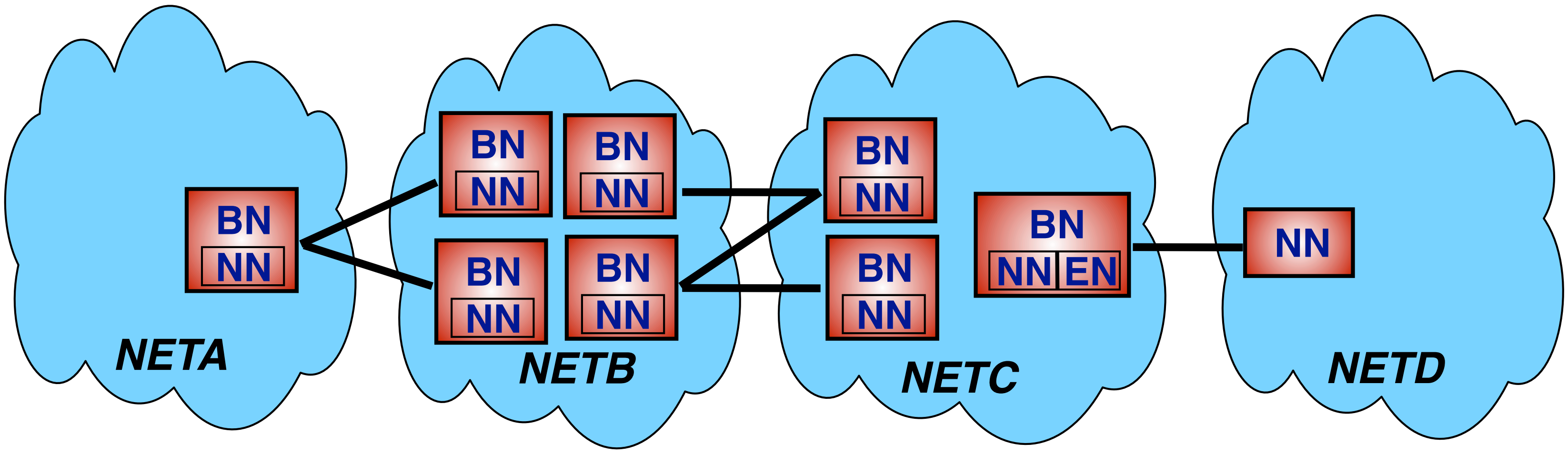


Extended Border Nodes - APPN Subnetworks



- APPN (topology) subnetwork
  - APPN NNs that share a common topology database
    - Node or resource in the same subnetwork is said to be "native"
    - Node or resource in a different subnetwork is said to be "non-native"
  - EN's subnetwork is determined by its NNS (not by NETID)
- Subnetwork boundary
  - By default, only between NNs with different NETIDs
  - With definition, can also be between NNs with the same NETID (clustering)
  - Link between networks: InterSubnetwork Link (ISL) or InterCluster Link (ICL)
    - Parallel ISLs are allowed; load balancing over them is automatic

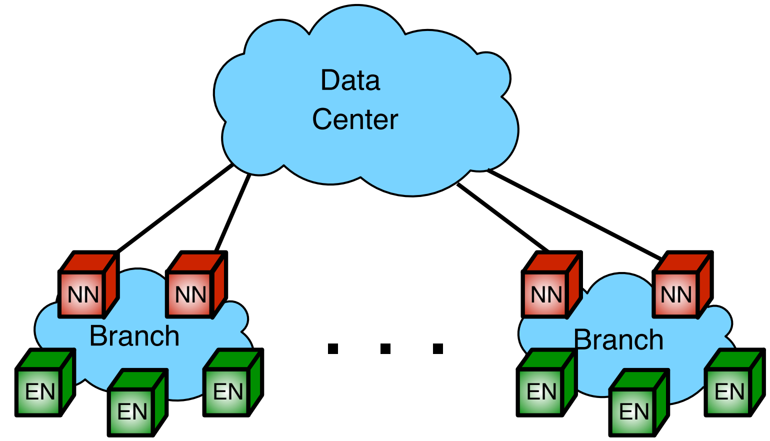
Extended Border Nodes - Description

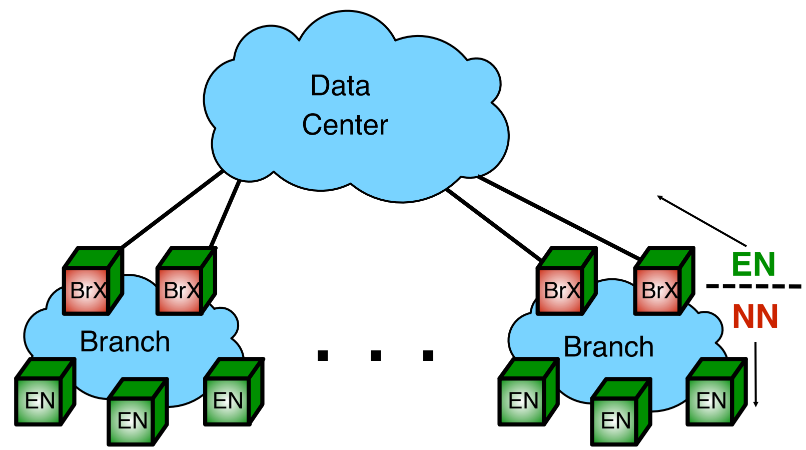


- Border node description
  - Enhancement to base NN
  - Limits topology exchange
  - Allows intersubnetwork searching
    - User controlled
    - Completely dynamic
    - Combination of both
- Peripheral subnetwork connection
  - EBN to non-native NN (only one EBN)
  - EBN presents EN image to NN
  - Restricted to first and/or last subnetworks
    - Must be **ONLY** connection to that subnet!
- Extended subnetwork connection
  - EBN to EBN
  - Both EBNs present NN image
  - Allows intermediate subnetwork routing

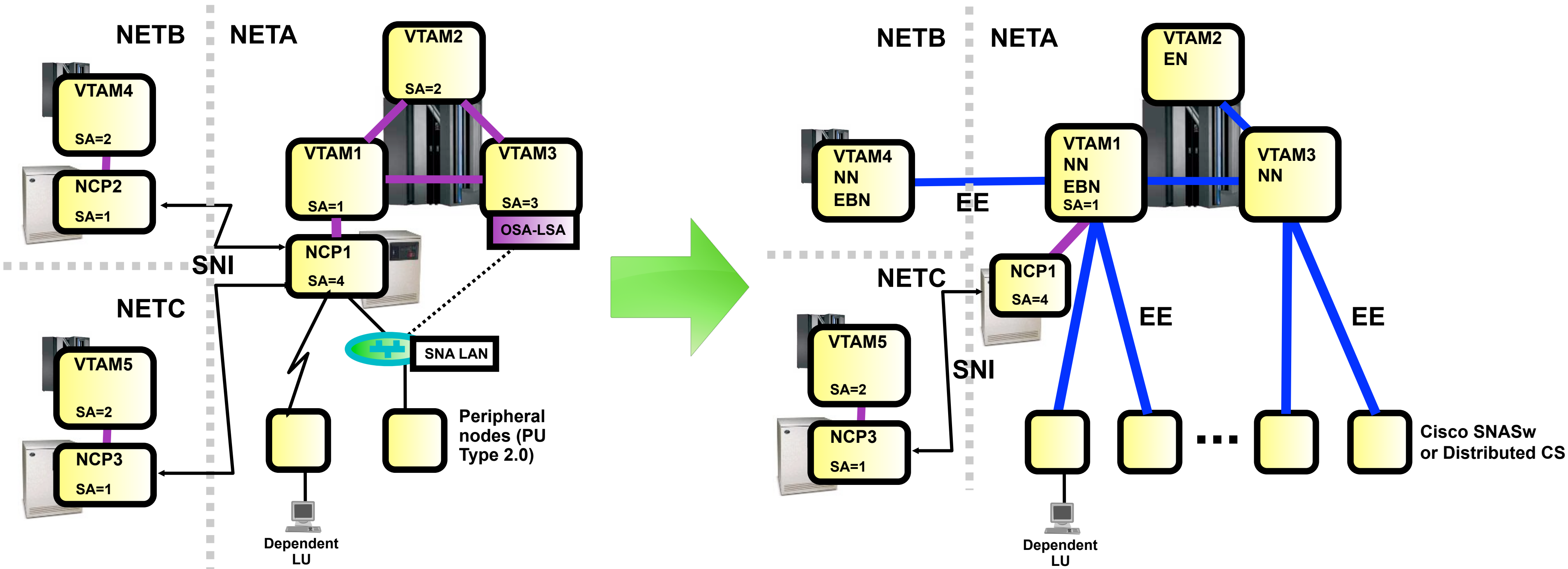
Branch Extenders

- A common configuration:
  - Central data center; many branches
  - Topology updates and searches can overwhelm branch network nodes
- Branch Extender (BEX or BX):
  - Designed for use within a single network
  - Supports DLUR at the BEX node
  - Supports HPR to all branch nodes
  - No NNs downstream from BEX node
  - Downstream VTAMs not recommended!
- How it works:
  - BEX presents EN image upstream
  - BEX presents NN image downstream
- Benefits:
  - Reduces branch topology size & traffic
  - Resource registration into WAN
    - Supports independent & dependent LUs





Subarea SNA to Enterprise Extender



Subarea SNA

Enterprise Extender

Subarea (FID4) connections

Enterprise Extender logical links

Roadmap

Subarea SNA

Enterprise Extender

- Determine scope of the migration
  - Just SNI replacement at enterprise border, or complete elimination of legacy SNA?
- Determine node roles and control session placement
  - Minimize number of network nodes
  - Is subarea presence still needed? (ICN/MDH vs. pure NN/EN)
  - Identify CP-CP session partners
    - Enough for redundancy, but avoid mesh CP-CP sessions
  - Which VTAMs will provide DLUS services? Which will be the Extended Border Nodes?
- Optimize the search strategy
  - Avoid unproductive (CPU and network bandwidth-wasting) searches
  - Enhances security as well as improves performance
  - More complex (and important) in mixed APPN/subarea environments
- Understand logmode/COS resolution
  - Converging on one logmode table will make it easier
  - More complex in mixed APPN/subarea environments

Roadmap ...

Subarea SNA

Enterprise Extender

- Learn diagnostic controls and commands
  - xSIRFMSG
  - HPRPSMSG
  - DISPLAY Commands
    - CPCP, DIRECTRY, EE, EEDIAG, RTPS, SRCHINFO, TOPO
- Consider security aspects
  - For a good overview of SNA security considerations, read the white paper:

    "Securing an SNA Environment for the 21st Century"

    http://www-01.ibm.com/support/docview.wss?rs=852&uid=swg27013237
- Assuming you already have a robust IP infrastructure, enabling EE is a relatively simple final step
  - For details, see session 11332: "Modernizing SNA: Enterprise Extender Concepts & Considerations", and session 11333: "z/OS CS Enterprise Extender Hints and Tips"
- Education: Along the way, make extensive use of the references on the next two charts!

References

- Redbooks
  - SG24-5957-00 Migrating Subarea to an IP Infrastructure
  - SG24-7359-00 Enterprise Extender Implementation Guide
  - SG24-7334-00 A Structured Approach to Modernizing the SNA Environment
- Screencasts
  - APPN Configurations: Recommendations & Limitations:
    - http://www.youtube.com/zoscommserver#p/a/u/0/TC1gaiARPgM
  - APPN Logmodes and Class of Service:
    - http://www.youtube.com/zoscommserver#p/u/14/-rPxj2ImP-Y
  - Practical Guide to Optimizing APPN and Extended Border Node Searches:
    - http://ibm.co/mxWyE3
- Sessions at SHARE in Anaheim
  - 11330: Exploring VTAM's Performance Parameters (Monday, 3:00 PM)
  - 11332: Modernizing SNA: Enterprise Extender Concepts & Considerations (Tuesday, 9:30 AM)
  - 11333: z/OS CS Enterprise Extender Hints and Tips (Tuesday, 11:00 AM)
  - 11343: A Journey Through the Layers of Enterprise Extender Packets or How to Translate VTAM Messages into IP Talk (Thursday, 8:00 AM)

References ...

- Prior SHARE sessions
  - Searching in Mixed APPN/Subarea Networks
    - http://proceedings.share.org/client_files/SHARE_in_Austin/S3618JH145212.pdf
  - APPN Logmodes and Class of Service
    - Presentation: http://proceedings.share.org/client_files/SHARE_in_Austin/S3620JH145658.pdf
    - Script: http://proceedings.share.org/client_files/SHARE_in_Austin/S3620JH145712.pdf
  - APPN Configurations: Recommendations & Limitations
    - http://proceedings.share.org/client_files/SHARE_in_Austin/S3608JH144707.pdf
  - Searching and Security in APPN/HPR Border Node Networks (Parts 1 and 2)
    - http://proceedings.share.org/client_files/SHARE_in_Austin/S3615JH145455.pdf
  - Enterprise Extender: Implementing Connection Network
    - http://proceedings.share.org/client_files/SHARE_in_Austin/S3602SR224007.pdf
  - SNA Security Considerations
    - http://proceedings.share.org/client_files/SHARE_in_Austin/S3612RW083850.pdf
  - SNA 101: Basic VTAM, APPN, and EE Concepts:
    - http://proceedings.share.org/client_files/SHARE_in_San_Jose/S3431SR132942.pdf
  - Diagnosing Enterprise Extender Problems
    - http://proceedings.share.org/client_files/SHARE_in_San_Jose/S3611MB092402.pdf
  - It's Gr-EE-k to Me! What Do All those Enterprise Extender Messages Mean?
    - http://proceedings.share.org/client_files/SHARE_in_Orlando/S3618GD171929.pdf

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- Modernizing SNA: APPN & HPR - A Foundation for Enterprise Extender
- Session # 11329
- QR Code:

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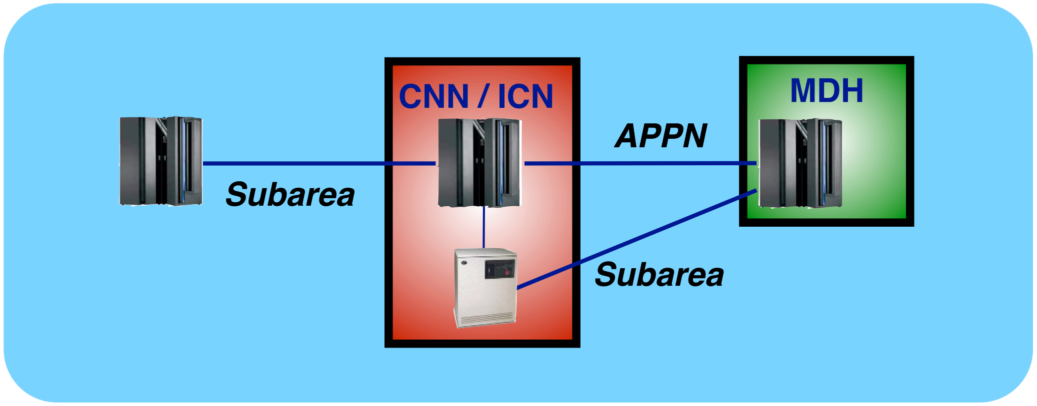
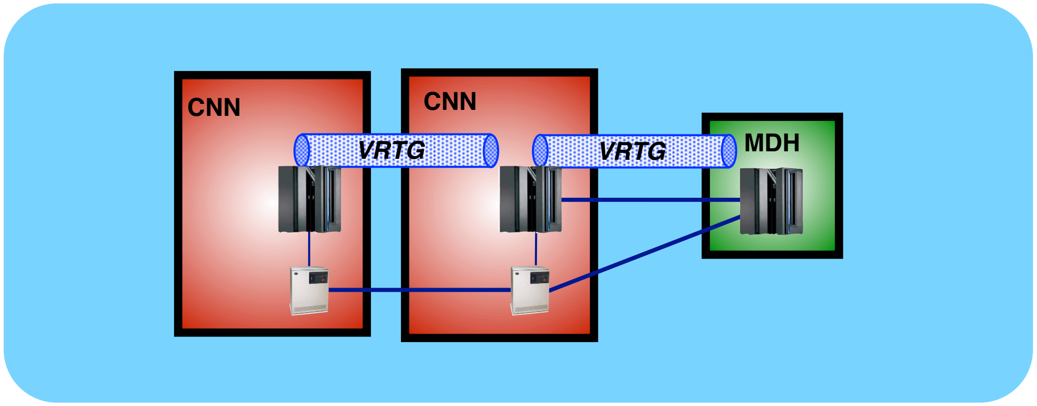
Appendix

Interchange TGs - Description



- Interchange Transmission Groups (ICTGs)
  - Logical connection between APPN VTAM APPN node and subarea node
    - Subarea node need not be adjacent nor be enabled for APPN
  - Allows base APPN nodes to interoperate with ICNs by representing subarea network resources in terms that they currently understand
    - All subarea-attached nodes look like ENs that are served by the ICN
    - ICTG always looks like an endpoint (EN) TG
  - ICTGs are not "real" APPN TGs though....
    - No definitions required
    - Not displayable using DISPLAY TOPO command
    - No HPR support

Virtual Route TGs - Description



- Virtual Route Transmission Groups (VRTGs)
  - Logical connection between same-network VTAM APPN nodes (no SNI)
    - Represents all possible virtual routes between the two VTAM domains
  - Activated when CDRM session between VTAMs is activated
    - TDU reported to TRS and propagated (DISPLAYable)
  - No need to mesh VRTGs; but meshed CDRM sessions are still required
- Why use VRTGs?
  - Allows CMCs to share (or takeover/giveback) NCP resources
  - Allows APPN CP-CP sessions and HPR over subarea links
  - Resolves NCP performance/storage concerns
  - Integrates APPN topology and directory

Virtual Route TGs - Network Views