Using Enterprise Extender in the Network with Cisco SNA Switch (Session 9274)

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Agenda

- Concepts
- Design Considerations
- Configuration
- Troubleshooting Tools
What Is Your Network Like?

- **OLD Technology:**
  - SA (sub area) -> APPN -> HPR -> EE
  - Token Ring -> Ethernet
  - DLSW+
  - FEP migration (esp. SNI)

- **New Technology**
  - OSA Express
  - SNASw
  - Connection network, global connection network
  - IPv6
SNA-to-IP Migration Solutions

In the Beginning

IP Client: TN3270

SNA Centric

IP Integration: SNASw

Ultimate Goal

IP Transport: DLSw+

IP Centric

In the Beginning

Ultimate Goal
What is: SNA Switching Services (SNASw) ???

- Cisco’s 2nd generation APPN feature, Cisco IOS 12.1 and above
- Simplified configuration and enhanced problem determination
- Dependent LU Requestor (DLUR) for peripheral SNA PU 2.0 devices
- Branch Extender (Bx or BEX) a.k.a. Branch Network Node (BrNN) for independent LUs (APPN scalability)
- Enterprise Extender (EE) supports HPR over IP (UDP transport)
- Global connection network (a.k.a. GVRN), EE hostname, IPv6, LDLC probe, etc.
Dependent LU Requestor (DLUR)

- Requires APPN network
- Facilitates FEP replacement
  - SNASw provides session routing and boundary function in concert with Dependent LU Server (DLUS)
- XID indicates ACTPU support
- LU 6.2 CPSVRMGR “pipe” between DLUR/S
- SSCP-PU/LU RUs (i.e. ACTPU/LU) encapsulated
Dependent LU Session Setup

- LU definitions on DLUS (in Switched Major Node) activated with PU activation
- Topology Database Updates sent by DLUR to DLUS so DLUS has potential route information ‘in pocket’
- LU requests session (i.e. INIT-SELF or USSLOGON) or APPL initiates session
- DLUS engaged in search for session partners, but no locate flows to DLUR (except for special Border Node case)
- DLUS engaged in search for session partners, but no locate flows to DLUR (except for special Border Node case)
What Is a Branch Extender (BrNN)?

- Architected APPN hybrid node type
- BrNN looks like a NN to downstream devices
- BrNN looks like an EN to upstream VTAM NNs
- NN to NN Broadcast traffic does not go to/from BrNN
- Topology exchanges are between VTAM NNs only, not BrNNs
- VTAM is shielded from downstream ENs and LENs
- Result is better network scalability
BrNN Connectivity

Upstream (uplink)
- BrNN requires a Network Node Server and Dependent LU Server (can be same)
- Backup NNS/DLUS recommended

Peer (neutral link)
- Use connection network to connect BrNN peers (and in place of defined uplinks, i.e. to upstream ENs)

Downstream (downlink)
- No NNs (unless disguised as LEN)
- BrNN allowed only if not using DLUR (Independent LU sessions only)
Independent LU Session Setup

- BrNN(EN) registers ILUs to NNS/VTAM
  - EN resources registered automatically
  - LEN nodes may require configuration (snasw location) to register

- BrNN includes ‘tail vectors’ on Locate find (Primary LU downstream) or locate found (Primary LU upstream) for NNS to use in route calculation cost

- Route calculated by NNS based on APPN COS
- BIND must pass through BrNN
- Traffic routed from BrNN directly to/from correct application host
SNASw EE Pipes

- Multiple connections between the SNASw router and NNS
- Separate RTP pipes over to the application EN’s and one for each CoS.

All session of a particular CoS between SNASw router and target normally traverse the same pipe.
Enterprise Extender (EE)

- APPN/HPR in IP Networks (RFC 2353) using UDP sockets 12000 to 12004
- Layer 3 IP routing end-to-end
  - Replace TR in the data Center with Ethernet routers / switches
  - APPN nodes mapped to IP addresses
  - Utilizes IP dynamic routing algorithms (RIP2, OSPF, EIGRP)
  - Proper design includes redundant paths
- Layer 4 HPR for reliability
  - Provides end-to-end flow, error, and segmentation control (like TCP)
  - Automatically maps SNA COS to IP precedence bits, preserving SNA traffic prioritization (QoS)
  - Provides non-disruptive rerouting around link failures

Diagram:
- SNASw EE/DLUR Access Layer Routers
- SNA Clients EN/LEN/PU 2.0
- IBM OSA-Express Catalyst 65XX Switches
- WAN IP Routers Distribution Layer
- CIP/CPA Routers
- Data Center Hosts HPR/IP
- IP WAN
Securing EE over the Intra/Internet

- Firewall ‘gotcha’
  - Allow UDP ports 12000-12004 through firewall for EE (both directions)
- Virtual Private Network
  - IPSec for data encryption and integrity
  - MPLS network for traffic separation
- IPSec can be on the same router as SNASw
  - Allow for CPU load
- Traffic shaping
  - Don’t clear IP precedence marking of SNA traffic (derived from COS)
  - Use WFQ or LLQ or MPLS (with traffic engineered bandwidth)
Connection Network

- Simplifies configuration - only define links to primary and secondary NNS and DLUS
- Reduces change impact - LPARs added without having to configure new links
- All nodes must be on common network (HPR-IP, LAN, DLSW+), all nodes add same Virtual Routing Node (VRN) to port
- Add a separate loopback interface and SNASw port for the VRN definition, to avoid a known CP-CP session problem
- CNRA (Connection Network Reachability Awareness) —allows for temporary routing around IP outages
- Must be used to connect peer BrNNs
- Define no-limres on VRN port if using CICS
Global Connection Network

- Extend connection network over entire IP network, even across APPN network boundaries
- Only supported on EE ports
- Supported in all SNASw releases
- All SNASw virtual routing nodes (VRNs) are global, but can connect to local VRNs
- NAT is often used at network boundaries, this breaks connection network … solution is EE hostname support
EE Hostname and IPv6 Support

- Hostname support allows connection network to work across NAT
- IPv6 capability added to SNASwitch in IOS version 12.4
- Hostnames are optional for IPv4 but must be used for IPv6 EE
Agenda

• Concepts
• Design Considerations
• Configuration
• Troubleshooting Tools
SNASw Supported Interfaces

- hpr-ip (Enterprise Extender)
  - Use ip addresses
  - Any IP routed interface (Ethernet, FastEthernet, etc.)
  - Loopback is preferred
- All other connections
  - Use MAC/SAP addresses
  - Real interfaces
    - Ethernet, FDDI, ATM LANE, TokenRing
    - Can be connected via HSRP standby mac-address
  - Virtual interfaces
    - VDLC (Virtual Data Link Control)
      - DLSW+ remote (IP or direct)
      - DLSW+ local (QLLC or SDLC)
    - VTOK (Virtual Token Ring)
      - Bridged (CIP/CPA, Frame Relay BAN)
## SNASw and DLSw+ Comparison

<table>
<thead>
<tr>
<th></th>
<th>DLSw+</th>
<th>SNASw</th>
</tr>
</thead>
<tbody>
<tr>
<td>No SNA Routing</td>
<td>Provides SNA Routing Services</td>
<td></td>
</tr>
<tr>
<td>SNA/NetBIOS Transport over IP between DLSw+ Peering Routers</td>
<td>SNA Transport over IP between Host and SNASw (EE) Router</td>
<td></td>
</tr>
<tr>
<td>Sessions drop when circuit drops</td>
<td>Sessions do not drop when link drops over HPR portion of session path</td>
<td></td>
</tr>
<tr>
<td>No SNA Boundary Function Support</td>
<td>SNA Boundary Function Support (DLUR)</td>
<td></td>
</tr>
<tr>
<td>SNA COS to IP TOS Mapping Requires APPN (SNASw)</td>
<td>Automatically preserves SNA Session Priority by Mapping APPN COS to IP TOS</td>
<td></td>
</tr>
<tr>
<td>No IPv6 support</td>
<td>IPv6 fully supported including hostname support for GVRN</td>
<td></td>
</tr>
</tbody>
</table>
Advantages of SNASw/EE to the Branch

- Simple, efficient design
  - No DLSw+ peers to manage
  - Collecting traces much easier with only one branch’s traffic
- Upstream redundancy
  - Layer 3 IP network redundancy and routing protocols from branch
- Downstream options
  - Ethernet or TR
    - Redundancy strategies include Ethernet HSRP, VTOK / TR source-route bridged, Ethernet with canon/non-canonical device
  - Local DLSW with VDLC port (for SDLC or QLLC)
- Most cost effective when part of new branch strategy (i.e. VoIP rollout)
Branch Redundancy with HSRP

- Hot Standby Router Protocol (HSRP) via Ethernet
  - HSRP supports duplicate MAC addresses and multiple standby groups
  - When one router goes down the other router in the same standby group becomes active
  - HSRP can also take action based on events such as an interface shutdown or loss of IP routing
  - ‘upstream’ IP network must be redundant to avoid black-hole effect
Advantages of SNASw/EE in Data Center

- Don’t have to change existing DLSw+ network
  - Provides for stable migration path
  - Customer may be comfortable with existing DLSW infrastructure
- SNASw works with DLSw+
  - Can be on the same router using a snasw VDLC port (preferred)
  - Can be on separate routers using TR/SRB between
  - EE upstream to host
- Generally lower cost
  - No need to upgrade routers or IOS in the branch just for SNASwitch
Branch Redundancy with DLSw+, SNASw in the Data Center

- Upstream redundancy
  - Layer 3 IP network redundancy and IP routing within Data Center

- Head-end redundancy via multiple active peers/ports or back-up peers
  - Up to 4 active peer paths cached
  - Default is fault-tolerant mode (first response)
  - Customize using cost
  - Load-balancing capability (round-robin or circuit count)
  - nns-required keyword on snaswitch port

- LAN redundancy
  - Ethernet with DLSW+ Ethernet Redundancy or TR / V TOK source route bridge

- Destination MAC addresses
  - 4000.482C.6A1E
  - 0200.1234.5678
DLUR/S Redundancy

- Each SNASw DLUR has a backup (i.e. HSRP in branch or DLSw in data center)
- Normal DLUS configuration - each SNASw pair specifies same DLUS pair (primary / backup)
  - Each PU must be defined in one or the other DLUS
- Alternate DLUS configuration – each SNASw router uses its NNS as DLUS
  - Requires that each PU be defined in each potential NNS/DLUS
  - May require DUPDEFS on VTAM
Selecting the Right Platform and Cisco IOS

• Platforms: low-end (branch), mid-range (distribution layer), high-end (data center)
  • 26xxXM, 28xx, 36xx, 37xx, 38xx, 7200, 7300, 7400,
  • Newer platforms may or may not support IBM Feature Set.

• Cisco IOS® software release 12.1 and higher
  • Separately purchased IOS feature, see CCO Software Center for SNASw IOS® image combinations
  • IOS 12.4 and 12.4T has several new diagnostic enhancements

• CPU requirements for SNASw
  • Allow capacity for failure and redundancy
  • Transaction rate/size most significant factor

Recommend Cisco IOS 12.4T, latest maintenance release from CCO
SNASw Performance by Platform

SNASw (EE) CPU Load With Projected Performance for New (orange labels) Platforms

CPU% vs. FPS chart showing performance data for various platforms.
Replacing SNI

• **SNASw does NOT play a role in replacing SNI** (it is used for branches within a network, not to route between networks)

• Inventory SNI partners and types of sessions
  - SNI usually links to another company—making changes requires coordination, cooperation, and probably management support!

• May be able to move to an IP only solution (i.e. file transfer could be done via secure ftp)

• Next preference is EBN/EE

• Other possibilities…
  - Communication Controller for Linux (CCL)/DLSw solution, EBN non EE, Casual Connect, Adjacent (Single-sided) SNI
Agenda

- Concepts
- Design Considerations
- Configuration
- Troubleshooting Tools
Basic SNASw Configuration

(config)# snasw cpname NETA.SNASW1
(config)# snasw port EE hpr-ip Loopback0
(config)# snasw port ETH Gig0/0
(config)# snasw link MVSA port EE ip-dest 172.18.1.11
(config)# [int G0/0]
  (config-if)#mac-address 0200.ECA2.0080

NETA.MVSA - NN
VIPA: 172.18.1.11

lo0: 172.16.1.1

SNA

0200.ECA2.0080

target MAC: 0200.ECA2.0080

HPR/IP

snasw1

0200.ECA2.0080

SNA

target MAC: 0200.ECA2.0080

VIPA: 172.18.1.11
SNASw Main Configuration Items

- **CP Name**  Fully qualified unique CP name (1-8 characters) within your SNA NETid network (1-8 characters), i.e. NETA.CP1

- **Port**  ---  Upstream & Downstream

- **Link**  ---  Upstream Only
SNASw Ports

SNASw ports act as physical conduits for traffic into and out of the SNASw router.

- Physical
- VDLC
- HPR/IP
- Virtual Token Ring (VTOK)
SNASw Ports – Physical

Physical Interfaces

- Ethernet/Token Ring – no bridging configuration necessary. Generally requires MAC address configuration to match end device destination address.

- Serial (SDLC, QLLC, Frame Relay) – requires DLSw and VDLC to interface with SNASw

Token Ring  Ethernet

4000.3745.0001
0200.ECA2.0080

snasw1
SNASw Port: Examples

- (config)# interface loopback0
  (config-if)#ip-address 172.18.51.28 255.255.255.0
- (config)# interface loopback1
  (config-if)#ip-address 172.18.51.29 255.255.255.0
  (config)#snasw port EE hpr-ip loopback0 qsize 500
  (config)#snasw port EEVRN hpr-ip loopback1 vnname IP.IP qsize 500
- (config)# snasw port ETH0 FastEthernet0 conntype len
- (config)# source-bridge ring-group 50
  (config)# dlsw local-peer peer-id 100.1.1.1
  (config)# dlsw remote-peer 0 tcp 100.9.9.9
  (config)# snasw port DLSW vd1c 50 mac 4000.3640.ddf1 maxbtu 1496 nns-required
HPR/IP = High Performance Routing over IP
also known as EE = Enterprise Extender

Port that’s anchored to an IP interface.
In most designs this is a loopback interface, but can be any valid IP interface.

(config#) snasw port HPRIP hpr-ip Loopback0

Lo0: 10.1.1.1

VIPA – 1.1.1.1
SNASw Links

- “Upstream” links are defined
  Pre-defined Name
- “Downstream” links are dynamic
  @I link for normal downstream links (PU’s)
- Connection network links are dynamic
  @D link for connection network links
- RTP Connection rides via these links.
  @R for RTP Pipes

- snasw port HPRIP hpr-ip Loopback0
- snasw link MVSA port HPRIP ip-dest 172.18.1.11 nns
- snasw link MVSB port HPRIP ip-dest 172.18.1.21
- snasw link MVSC port HPRIP ip-dest 192.168.3.1
- snasw link MVSD port HPRIP ip-dest 192.168.4.1
SNASw RTP Path Switch

- Non-disruptive path switch
  - Used to route RTPs over failed nodes or TGs
  - Except for some delay, this is transparent to the end LU-LU sessions

- Path Switch Triggers
  - RTP connection failure ---- Most common way
  - Local link failure – SNASw Router End Point
  - Remote link failure – IBM MF End Point
  - Operator request
  - Automatic time (VTAM start option … PSRETRY)
VTAM Definitions—Start Options & XCAs

- HPR Start Options
  - APPN must be enabled – NODETYPE, NETID, SSCPNAME, etc.
  - HPRPST values should match snasw rtp pathswitch-timers
  - Use DUPDEFS=DEPLU when SMNs are active on more than one VTAM

- XCA major node HPR-IP PORT and GROUPs
  - LIVTIME/SRQTIME/SRQRETRY values should match snasw port hpr-ip ldlc
  - If using connection network, VNNNAME should match snasw port vnname
VTAM Definitions–Switched Major Nodes

• Add Switched Major Nodes(SMN) for SNASwitch or use port DYNPU
  • Matches snasw link configured on the router, SNASwitch drives activation
  • Needed on each VTAM that SNASwitch will directly connect to either via a predefined link or a link through a VRN
  • Don’t have VTAM connect out to SNASwitch.(don’t use DWACT or DWINOP)
  • Use DISC=NO
  • If using DYNPU=YES then create a DYNTYPE=VN model with DISC=NO.
  • Use a TGP or CAPACITY=16M to match SNASwitch

• Downstream PUs and their LUs – Minor changes may be required
  • SMNs for PUs with dependent LUs should be active on all VTAMs that can be a DLUS
  • Remove any LOCADDR=0 definitions, add “s nasw location” statements for independent LUs on downstream LEN nodes
  • PATHs must be converted to DLUR dial-out:
    • DLURNAME=netid.cpname, <of SNASw router>
    • DLCADDR=(1,C,TR), <always specify downstream mac address in TR format>
    • DLCADDR=(2,C,name), <snasw downstream port name, can use X with hex EBCDIC name>
    • DLCADDR=(3,X,sap), <downstream device SAP in hex>
    • DLCADDR=(4,X,mac) <downstream device MAC address in hex TR format>
Agenda

- Concepts
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- Troubleshooting Tools
Traditional IOS troubleshooting

• log messages
  (sh log – normal Router Log)
  (sh pd log – SNASw Protocol Log)
• show commands
• ip connectivity
• debugs
• crashinfo and core files
log messages

- SNASw EVENT messages

12w3d: %SNASW-3-EVENT: Link station MVSX deactivated
12w3d: %SNASW-3-EVENT: CP-CP sessions deactivated to ESPNET.MVSX
12w3d: %SNASW-3-EVENT: CP-CP sessions activated to NETA.MVSD

- Some event’s messages are always recorded (dlus, defined link stations)
- Others can be controlled via configuration option

R3745R#conf t
12w3d: %SYS-5-CONFIG_I: Configured from console by console
Enter configuration commands, one per line. End with CNTL/Z.
R3745R(config)#snasw event ?
cpcp Enable CP-CP session notifications
dlc Enable dlc notifications
implicit-1s Enable implicit link station notifications
port Enable port notifications
<cr>
log messages

- SNASw LOG messages

12w3d: %SNASW-6-RTP_LOG_0: INFO - 14001 - RTP Connection has connected
12w3d: %SNASW-6-SM_LOG_37: INFO - 14002 - LU6.2 session activated
12w3d: %SNASW-6-SS_LOG_12: INFO - 14004 - CP-CP sessions established

- Three levels of severity (information, exception, problem)
- Output to router log is controlled via configuration option
  - Default is exception
  - Set to informational for test environment
  - Set to problem in production (to reduce log messages)

R3745R(config)#snasw pdlog ?
  exception    Log problem and exception conditions
  information  Log informational messages, exceptions, and problems
  problem      Log only severe problems

- All LOG messages have detailed record written to pdlog buffer
show commands

- Brief vs. detail
- Output modifier filtering (‘include’, ‘begin’, etc.)
- Many snasw commands have additional filtering (i.e. “show snasw lu pu name”, “show snasw session pcid”, “show snasw link active”)

```
R3745R#sh snasw lu ?
show snasw lu [name <luname>] [pu <puname>]
    [brief | detail]
  brief  Show brief DLUR LU information
  detail Show detailed DLUR LU information
  name   Show DLUR LUs for a specific LU
  pu     Show DLUR LUs for a specific PU
  |       Output modifiers
  <cr>
```
show snasw commands

R3745R#sh snasw ?

class-of-service    Show class of service information
connection-network  Show connection network information
directory          Show directory information
dlctrace           Show information from the dlctrace buffer
dlus                Show DLUS information
ipstrace            Show information from the ipstrace buffer
link                Show link information
lu                  Show DLUR LU information
mode                Show mode information
node                Show local node information
pdlog               Show information from the pdlog buffer
port                Show port information
pu                  Show DLUR PU information
rtp                 Show HPR RTP connection information
session             Show session information
statistics          Show statistics
summary-ipstrace    Show information from the summary-ipstrace buffer
topology            Show topology database information
show snasw port

- Interface must be active (‘no shut’ - not shutdown) for port to be active

2612-BR1#show snasw port
Number of ports 2

<table>
<thead>
<tr>
<th>SNA Ports</th>
<th>Name</th>
<th>State</th>
<th>SAP</th>
<th>SAP</th>
<th>Interface</th>
<th>Address</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&gt;</td>
<td>ETH0EE</td>
<td>Active</td>
<td></td>
<td></td>
<td>Ethernet0/0</td>
<td>172.18.49.11</td>
</tr>
<tr>
<td>2&gt;</td>
<td>TOK0</td>
<td>I/f Down</td>
<td>x04</td>
<td>xC8</td>
<td>TokenRing0/0</td>
<td>4000.0704.1776</td>
</tr>
</tbody>
</table>
show snasw link

- Link name: defined or dynamic (@I / @U downstream, @D connection network)
- If defined links are not active, check target MAC or IP addresses
- Use “show snasw rtp” to show sessions on an HPR or HPR/IP link

2612-BR1#show snasw link
Number of links 2

<table>
<thead>
<tr>
<th>SNA Links</th>
</tr>
</thead>
<tbody>
<tr>
<td>Link Name</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>@I000002</td>
</tr>
<tr>
<td>MVSDEE</td>
</tr>
</tbody>
</table>
```
show snasw rtp

Number of RTP connections 4

<table>
<thead>
<tr>
<th>RTP Name</th>
<th>Local TCID (hex)</th>
<th>Remote CP Name</th>
<th>State</th>
<th>COS</th>
<th>Sess</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&gt; @R000001</td>
<td>0000000001000B41</td>
<td>NETA.MVSD</td>
<td>Connected</td>
<td>CPSVCMG</td>
<td>2</td>
</tr>
<tr>
<td>2&gt; @R000002</td>
<td>0000000002000B41</td>
<td>NETA.MVSD</td>
<td>Connected</td>
<td>RSETUP</td>
<td>0</td>
</tr>
<tr>
<td>3&gt; @R000003</td>
<td>0000000003000B41</td>
<td>NETA.MVSD</td>
<td>Connected</td>
<td>SNASVCMG</td>
<td>2</td>
</tr>
</tbody>
</table>
```
show snasw rtp history

- shows rtp performance details in histogram form
- shows ARB allowed send rate and actual receive rate for 3 time periods:
  - Last 60 seconds
  - Last 60 minutes
  - Last 72 hours
- Additionally shows:
  - ARB “normal” responses – OK to increase rate, no delay in network
  - ARB “slowdown” responses – Reduce rate, delay detected
  - Gaps – indicates packet loss

R3745R#sh snasw rtp history name @R000025
Total number of RTP connections 4

<table>
<thead>
<tr>
<th>SNA RTP Connections</th>
<th>RTP Name</th>
<th>Local TCID (hex)</th>
<th>Remote CP Name</th>
<th>State</th>
<th>COS</th>
<th>Sess</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&gt; @R000025</td>
<td>000000019000D23</td>
<td>NETA.MVSD</td>
<td>Connected</td>
<td>#INTER</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

R3745R 07:16:15 AM Saturday Aug 31 2002 UTC

...
show snasw rtp history (continued)

Actual receive rate (Kbits/sec) (last 60 seconds)
show snasw session

- Endpoint, Intermediate, and Intermediate DLUR sessions are shown

2612-BR1#show snasw sess
Number of local endpoint sessions 4

<table>
<thead>
<tr>
<th>PCID (hex)</th>
<th>Partner LU Name</th>
<th>Link/RTP</th>
<th>Mode</th>
<th>COS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&gt; C3BBD36E95C5AC8C</td>
<td>NETA.MVSD</td>
<td>@R000005</td>
<td>CPSVRMGR</td>
<td>SNASVCMG</td>
</tr>
<tr>
<td>2&gt; D51F15B05FB78DA1</td>
<td>NETA.MVSD</td>
<td>@R000005</td>
<td>CPSVRMGR</td>
<td>SNASVCMG</td>
</tr>
<tr>
<td>3&gt; C3BBD36E95C5AC8A</td>
<td>NETA.MVSD</td>
<td>@R000002</td>
<td>CPSVCMG</td>
<td>CPSVCMG</td>
</tr>
<tr>
<td>4&gt; D51F15B05FB78D9A</td>
<td>NETA.MVSD</td>
<td>@R000001</td>
<td>CPSVCMG</td>
<td>CPSVCMG</td>
</tr>
</tbody>
</table>

Number of intermediate DLUR sessions 1

<table>
<thead>
<tr>
<th>PCID (hex)</th>
<th>Primary LU Name</th>
<th>Secondary LU Name</th>
<th>Mode</th>
<th>COS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&gt; C3BBD36E95C5A198</td>
<td>NETA.ECHOMVSD</td>
<td>NETA.LEF00101</td>
<td>#CONNECT</td>
<td></td>
</tr>
</tbody>
</table>
show snasw dlus

- At least one DLUS should be active if there are PUs to be served
- Both primary and backup DLUS can be active

```
2612-BR1#show snasw dlus
Number of Dependent LU Servers 2

<table>
<thead>
<tr>
<th>SNA Dependent LU Servers</th>
<th>DLUS Name</th>
<th>Default?</th>
<th>Backup?</th>
<th>Pipe State</th>
<th>PUs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NETA.MVSA</td>
<td>No</td>
<td>Yes</td>
<td>Inactive</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>NETA.MVSD</td>
<td>Yes</td>
<td>No</td>
<td>Active</td>
<td>1</td>
</tr>
</tbody>
</table>
```
show snasw pu

- When a downstream link is activated with an XID that indicates ACTPU is required, a pu is created automatically
- The pu name will be dynamic (beginning with @P) until ACTPU is received containing the PU’s name

2612-BR1#show snasw pu
Number of DLUR PUs 1

<table>
<thead>
<tr>
<th>SNA DLUR PUs</th>
<th></th>
<th>State</th>
<th>DLUS Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>PU Name</td>
<td>PU ID</td>
<td></td>
<td></td>
</tr>
<tr>
<td>APPNMA29</td>
<td>05D00000</td>
<td>Active</td>
<td>NETA.MVSD</td>
</tr>
</tbody>
</table>
show snasw pu detail

- “detail” command shows FSM history, used for troubleshooting by Cisco tech support

```
2612-BR1#show snasw pu det name APPNMA29
Number of DLUR PUs 1

1>
PU name          APPNMA29
Backup DLUS name NETA.MVSD
Active DLUS name X'05D00000'
PU ID (IDBLK/IDNUM) Downstream
PU location       Active
PU status         Active
DLUS session state Continuous
Automatic Network Shutdown support
DLUS retry timeout (seconds) 0
DLUS retry limit 0
DLUS pipe PCID X'D51F15B05E9ADF01'
DLUS pipe CP Name NETA.R2612BR1
PU FSM history    (00,01)->(01,03)->(02,04)->(02,06)->(03,11)->(03,07)->04
```
## SNASwitch Diagnostic Quick Reference

<table>
<thead>
<tr>
<th>SNASw control point, topology, directory</th>
<th>On Snaswitch Router</th>
<th>On VTAM</th>
<th>other commands (, etc.)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>show snasw node</td>
<td>D NET,=cpname,E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>show snasw topo</td>
<td>D NET,ID=cpname,E</td>
<td></td>
</tr>
<tr>
<td></td>
<td>show snasw dir</td>
<td>D NET,TOPO D NET,DIRECTRY</td>
<td></td>
</tr>
<tr>
<td>DLUR / DLUS</td>
<td>show snasw dlus</td>
<td>D NET,DLURS</td>
<td></td>
</tr>
</tbody>
</table>

### upstream links

- show snasw link (where `linkname` was learned from IST116I on D NET,ADJCP above)
- show snasw link (using `puiname` learned from IST089I on D NET,ID=cpname above)

### downstream links / PUs

- show snasw pu (link names beginning with @I and @U)
- show snasw link (link names beginning with @D)

### RTP pipes

- show snasw rtp

### sessions

- show snasw sessions (SID=pcid)
- show snasw pdlog all | i string

### where to look for error messages?

- show snasw pdlog all | i string on the VTAM and / or Netview console
- show snasw pdlog all | i string on the router log

### traces

- snasw dlctrace
- snasw msgdump

### test potential ee link connectivity

- ping (IP Precedence 12000)
- ping (IP Precedence 12001)
- ping (IP Precedence 12002)
- ping (IP Precedence 12003)
- ping (IP Precedence 12004)

### test session between CPs

- ping snaswitch`s CP name

<table>
<thead>
<tr>
<th>#</th>
<th>IP Precedence (default)</th>
<th>Priority</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>12000</td>
<td>110 (6) Internetwork Control</td>
<td>LDLC</td>
<td>XID, TEST, DISC, DM, XID_DONE_RQ, XID_DONE_REQ</td>
</tr>
<tr>
<td>12001</td>
<td>110 (6) Internetwork Control</td>
<td>Network</td>
<td>CPSVCMG(CP-CP), CPSVRMGR(SNASVCMG) and RSETUP</td>
</tr>
<tr>
<td>12002</td>
<td>100 (4) Flash Override</td>
<td>High</td>
<td>#INTER #INTERSC</td>
</tr>
<tr>
<td>12003</td>
<td>010 (2) Immediate</td>
<td>Medium</td>
<td>#CONNECT</td>
</tr>
<tr>
<td>12004</td>
<td>001 (1) Priority</td>
<td>Low</td>
<td>#BATCH #BATCHSC</td>
</tr>
</tbody>
</table>
Problem Determination Log (pdlog)

- Internal SNASw problem determination message logging, always active (default buffer size 500Kb)
- Three classifications of messages: exception, information, problem
- Configuration (optional): type of messages to be sent to console, buffer size and file path for uploading

(config)#snasw pdlog problem | exception | info [buffer-size size] [file file-url [timestamp]]
Data Link Control Tracing (dlctrace)

• Internal cyclic buffer trace (up to 64MB in size) with low CPU overhead (less than 10%)
• ‘sniffer-like’ trace of packets in and out of the APPN stack
• Optional filtering

```
(config)#snasw dlctrace [buffer-size size] [file file-url [timestamp]] [frame-size size | auto-terse] [format brief | detail | analyzer] [nostart]
```

```
(config)#snasw dlcfilter [link name] [port name] [rmac mac-addr] [rtp name] [type [cls] [hpr-cntl] [hpr-data][isr][xid]]
```

auto-terse: truncate data portion of frame
format analyzer: generate frame format compatible with sniffer analyzer program (Sniffer Pro, Ethereal – Wire Shark, etc.)
Inter Process Signal Tracing (ipstrace)

- Internal tracing between SNASw components
- Significant CPU overhead (about 15-25%)
- Configure with care, usually at request of Cisco Support staff
- Need to dump trace file in binary format for Cisco to interpret (capture of show ipstrace unusable, and has been removed in version 12.4)
- Optional filtering specific to APPN stack components

(config)#snasw ipstrace [buffer-size size] [file file-url [timestamp]] [nostart]]
(config)#snasw ipsfilter am | asm | bm ...
Adding PD Tools to the Configuration

```plaintext
snasw pdlog exception file tftp://64.102.16.25/BR1-pdlog timestamp
snasw dlctrace buffer-size 3000 file tftp://64.102.16.25/BR1-dlctrc
    timestamp
snasw cpname NETA.R2612BR1
snasw dlus NETA.MVSD backup NETA.MVSA
snasw port ETH0EE hpr-ip Ethernet0/0
snasw port TOK0 TokenRing0/0 conntype len
snasw link MVSDEE port ETH0EE ip-dest 172.18.1.41
```
Show snasw pdlog

2612-BR1#
*Feb 10 10:49:40.951: %SNASW-3-EVENT: Pipe to DLUS activated, DLUS name = NETA.MVSD
*Feb 10 10:49:40.951: %SNASW-3-DLUR_LOG_2: EXCEPTION - 145 - REQACTPU rejected

2612-BR1#sho snasw pdlog id 145 det
Problem Determination Log Output

**** 00000145 - EXCEPTION 512:582 (0) ****
REQACTPU rejected with following sense code
   Sense code = 0x08060000
   DLUS name  = NETA.MVSD
   PU name    = @P000003
   XID =

   0000 3264EDED ED020000 80081100 00000000 ...................4
   0010 00010B41 0005C000 00000007 000E09F4 ........{.........4
   0020 C5D4C4E2 D7E4F0F2 103A0013 11091000 EMDSPU02.......4
   0030 10F7F2F0 F04040F2 F1F2F8F8 F0F22611 .7200 2128802..4
   0040 0C0804F1 F2F0F4F2 F20908C3 F7F2F0F0 ...120422..C7200
   0050 60C11206 8389A283 9640E2D5 C140D996 -A..cisco SNA Ro
   0060 A4A38599

From ..../dcl/ndrpufsm.c 406 :at 10:49:40, 10 February 02
Show snasw dlctrace

2612-BR1#show snasw dlctrace

237331 @I000006 Out sz:100 XID 3 NP NETA.R2612BR1 xid:FFF00000
237332 @I000006 In  sz:96  XID 3 NP NETA.MARTIN    xid:05D00000
237333 @I000006 Out sz:223 SET_MODE Rq
237334 @I000006 In  sz:223 SET_MODE +Rsp

2612-BR1#show snasw dlctrace detail id 237332
DLC Trace Output

237332 @I000006 In  sz:96  XID 3 NP NETA.MARTIN    xid:05D00000
06:19:02.65, 7 March 1993
  0000 326005D0 00000000 8034C100 00000080 *.---}.......A.....*
  0010 00010B41 00078900 01000004 000E0CF4 *.........i........4*
  0020 D5C5E3C1 4BD4C1D9 E3C9D50E 09F7D3C9 *NETA.MARTIN..7LI*
  0030 D5D2F0F0 F0F11028 00111104 0E02F5F6 *NK0001........56*
  0040 F2F1F2F5 F4F0F0F2 F1F01611 03130011 *2125400210.......*
  0050 F8F5F6F5 F0F0F0F0 F0F0F0F0 F0F0F0F0 *856500000000000*
Manual dumping of traces and pdlog

(config)# snasw dlctrace buffer-size 10000
2612-BR1#snasw dump dlctrace
Type of DLC trace file (b[rief], d[etail], a[nalyzer], q[uit]) [d]? analyzer
Address or name of remote host []? 64.102.16.25
Remote filename [2612-BR1-dlctrc]?
!!!!!!!!!!![DLC trace dumped OK]

(config)# snasw dlctrace file tftp://64.1.1.2/BR1-dlc format analyzer timestamp
2612-BR1#snasw dump dlctrace
!!!!!!!!!!![DLC trace dumped OK]

2612-BR1#snasw dump all
Attempting to dump all traces :
!!![PD log dumped OK]
!!!!!!!!!!![DLC trace dumped OK]
!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!!![IPS trace dumped OK]
Automatic dumping (snasw msgdump)

- To trigger stop/dump of the traces/pdlog when getting log message
  %SNASW-3- DLUR_LOG_2 : PROBLEM - 358 - REQACTPU rejected
- Configure:
  ```
  2612-BR1(config)#snasw msgdump DLUR_LOG_2 [writecore]
  ```
- Must have file file-url coded in configuration statement for traces/logs to be dumped
  ```
  2612-BR1(config)# snasw dlctrace buffer-size 5000 file tftp://64.1.1.2/BR1-dlctrace timestamp
  ```
- Alert issued to network focal point (NetView NPDA)
- Can also specify that a core file should be captured (writecore)
Other diagnostic commands

- **snasw stop/start arbdata**
  - Monitoring of ARB algorithm values for an RTP connection (by local TCID)
- **debug snasw** (api, dlc, ips, link, port)
  - pdlog/dlctrace/ipstrace are usually much better
- **debug cls** (errors, state, message, vdlc)
  - Cisco’s link services component
- **debug llc** (errors, state, packet)
  - llc2 component
- **debug dlsw** (peers, reachability)
  - Useful with snasw vdlc port
- **show dlsw peers, circuits**
  - Useful with snasw vdlc port

**Caution:**

These commands can generate a lot of output, so you should only use them when requested by Cisco Support staff, and only when logging to a buffer (not the console).
SNA Network Ping command

2612-BR1#ping sna neta.mvsd
2612-BR1#

SNA APING successful

Partner LU name: NETA.MVSD
Mode name: #INTER
Allocate duration: 176 ms
Duration statistics:
  Max = 24 ms  Min = 20 ms  Ave = 22 ms
Commands for EE/IP Diagnosis

• Extended Ping to destination IP address:

2612-BR1# ping
Protocol [ip]:
Target IP address: 172.18.1.41
...
Extended commands [n]: y
Source address or interface: 10.20.10.10
Type of service [0]:
...
Type escape sequence to abort.
Sending 5, 100-byte ICMP Echos to 172.18.1.41, timeout is 2 seconds:
Packet sent with a source address of 10.20.10.10
!!!!!
Success rate is 100 percent (5/5), round-trip min/avg/max = 12/12/16 ms
2612-BR1#
• Traceroute
• LDLC Probe – D NET,EEDIAG,TEST=YES,IPADDR=(x.x.x.x,y.y.y.y)
Show tech-support enhancements

- show tech-support command has been enhanced in 12.4(22) to include more SNASwitch specific information:
  
  - **Existing:**
    - show snasw node
    - show snasw statistics
    - show snasw dlus detail
  
  - **Added:**
    - show snasw pu
    - show snasw pu not-active detail
    - show snasw link
    - show snasw link not-active detail
    - show snasw port not-active detail
    - show snasw session local
    - show snasw session not-active detail
    - show snasw rtp
    - show snasw pdlog last 50 detail
Simple PD Exercise: PU Cannot Connect

- End-user just replaced old workstation; he calls the helpdesk to report that he cannot connect to the host
Check Status of PU on DLUS

0280  D NET,ID=APPNRA12,E
0090  IST097I DISPLAY ACCEPTED
0090  IST075I NAME = APPNRA12, TYPE = PU_T2 204
0090  IST486I STATUS= CONCT, DESIRED STATE= CONCT
0090  IST1043I CP NAME = APUNAME, CP NETID = NETA, DYNAMIC LU = YES
0090  IST1589I XNETALS = YES
0090  IST136I SWITCHED SNA MAJOR NODE = SWAPPNRA
0090  IST654I I/O TRACE = OFF, BUFFER TRACE = OFF
0090  IST1500I STATE TRACE = OFF
0090  IST1656I VTAMTOPO = REPORT, NODE REPORTED - YES
0090  IST1657I MAJOR NODE VTAMTOPO = REPORT
0090  IST355I LOGICAL UNITS:
0090  IST080I APULU1 CONCT APULU2 CONCT APULU3 CONCT
0090  IST080I APULU4 CONCT
0090  IST314I END
Check DLUS Console

0081 IST680I CONNECTION REQUEST DENIED - ID = ***NA*** PU GEN NOT SUPPORTED
0090 IST1354I DLUR NAME = NETA.PO MAJNODE = ***NA***
0090 IST1394I CPNAME = NETA.APU STATION ID = 020005D01983
0090 IST314I END
show snasw dlus

pogo#sh snasw dlus
Number of Dependent LU Servers 1

<table>
<thead>
<tr>
<th>SNA Dependent LU Servers</th>
<th>Default?</th>
<th>Backup?</th>
<th>Pipe State</th>
<th>PUs</th>
</tr>
</thead>
<tbody>
<tr>
<td>NETA.MVSD</td>
<td>Yes</td>
<td>No</td>
<td>Active</td>
<td>67</td>
</tr>
</tbody>
</table>
Check Router Log

1w3d: %SNASW-3-DLUR_LOG_2: PROBLEM - 2275 - REQACTPU rejected
show snasw pdlog detail

pogo#sh snasw pdlog id 2275 detail
Problem Determination Log Output

**** 00002275 - PROBLEM 512:582 (0) ****
REQACTPU rejected with following sense code
   Sense code = 0x08060000
   DLUS name   = NETA.MVSD
   PU name     = @P000122

From ../dcl/ndrpufsm.c 408 :at 3:17:06, 10 March 00

Note: XID information added in IOS 12.3(13) and later
Look Up Sense Code

From *SNA Formats* reference book

0806 Resource Unknown: For example, the request contained a name or address not identifying a PU, LU, SSCP, link, or link station known to the receiver or the sender.

Bytes 2 and 3 following the sense code contain sense code specific information. Settings allowed are:

- 0000 No specific code applies.
Check in dlctrace

pogo#snasw stop dlctrace
DLC tracing stopped
pogo#sh snasw dlc all | i ReqActPU

607837 MVSDEE Out sz:284 HPR fmh5 DLUR Rq ReqActPU
607846 MVSDEE In sz:108 HPR fmh5 DLUR -Rsp ReqActPU 08060000
607912 MVSDEE Out sz:284 HPR fmh5 DLUR Rq ReqActPU
607921 MVSDEE In sz:108 HPR fmh5 DLUR -Rsp ReqActPU 08060000
607981 MVSDEE Out sz:284 HPR fmh5 DLUR Rq ReqActPU
607990 MVSDEE In sz:108 HPR fmh5 DLUR -Rsp ReqActPU 08060000
608050 MVSDEE Out sz:284 HPR fmh5 DLUR Rq ReqActPU
608059 MVSDEE In sz:108 HPR fmh5 DLUR -Rsp ReqActPU 08060000
Verify name in dlctrace

pogo#sh snasw dlc id 608050 detail
DLC Trace Output

608050 MVSDEE   Out sz:284  HPR fmh5 DLUR Rq ReqActPU
TCID(2ECB1E72 BDD) DL(E8) BSQ(96) SM EM ST(86) SA(0 7F000019)
03:38:10.38, 10 March 2000
0000 C600D000 00000000 0000FF00 2ECB1E72 *F.}...............*
0010 00000BDD 3004000A 000000E8 00000096 ........................Y.o*
0020 050E0000 00000001 0000086E 00000000 ..................f....*
0030 00000000 5C000001 00000000 7F000019 ........................*
0040 0B910129 0502FF00 03D00000 0422F0F0 *.j...........}....00*
0050 F6001007 D5C5E3C1 4BD76DB4 AA3B5DC2 *6...NETA.PO...)B*
0060 14000108 78400004 61D8898C 00B01500 ................../Qi.....*
0070 00112C00 00000029 0B800041 023E0000 ........................*
0080 005F8132 5D05D019 83000080 38C10000 *.^a.).}.c....A..*
0090 00008000 010B7100 07890001 00000400 ........................*
00A0 0E094D5C 0D3C14B 0D74E40E 09F7D3C9 ........................*
00B0 D5D2F0F0 F0F11028 00111104 0E02F5F6 *NK0001...........56*
00C0 F2F1F2F5 F4F0F0F2 F1F01611 03130011 *2125400210........*
00D0 F8F5F6F5 F0F0F0F0 F0F0F0F0 F0F0F0F0 *8565000000000000*
00E0 1C460491 E3D90393 04089410 005ACC84 *.jTR..l..m..!..d*
00F0 FD039504 08964000 12281983 0E510101 *.n..o.....c.....*
0100 00000000 00180000 00001260 CECFB8A8 ........................y*
0110 BF41263B 07D5C5E3 C14BD7D6 ............................NETA.PO
Check PU Definition on the DLUS

APPNRA12 PU
ADDR=01,
ISTATUS=ACTIVE,
MAXPATH=1,
MODETAB=ALAMODE,
MAXOUT=7,ANS=CONTINUE,
DLOGMOD=SX32702S,
USSTAB=USSSNA,
CPNAME=APUNAME
Correct PU Definition (Host or Workstation)

D NET,ID=APPNRA12,E
IST097I DISPLAY ACCEPTED
IST075I NAME = APPNRA12, TYPE = PU_T2.1 704
IST486I STATUS= ACTIV, DESIRED STATE= ACTIV
IST1043I CP NAME = APU, CP NETID = NETA, DYNAMIC LU = YES
IST1589I XNETALS = YES
IST1354I DLUR NAME = PO, MAJNODE = SWAPPNRA
IST136I SWITCHED SNA MAJOR NODE = SWAPPNRA
IST654I I/O TRACE = OFF, BUFFER TRACE = OFF
IST1500I STATE TRACE = OFF
IST1656I VTAMTOPO = REPORT, NODE REPORTED - YES
IST1657I MAJOR NODE VTAMTOPO = REPORT
IST355I LOGICAL UNITS:
IST080I APULU1 ACTIV APULU2 ACTIV APULU3 ACTIV
IST080I APULU4 ACTIV
IST314I END
Customizing Configuration

- **s nasw cp name**
  - hung-pu-awareness: hung PU awareness timer interval (300 sec)
  - hung-session-awareness: hung session awareness timer interval (180 sec)
  - locate-timeout: locate search timeout interval (540 sec)
  - max-pacing-window: ISR session max pacing window size
  - remove-rscvs: strips rscvs on all downstream BINDs (downstream LEN/NN)
  - station-segmentation: no interleaving of RUs for XID0 devices

- **s nasw dl us**
  NOTE: if you do not configure a DLUS, SNASwitch will use its current Network Node Server
  - once: retry primary and backup just once each, then disconnect
  - prefer-active: if a dlus is already active, use it exclusively
  - retry: specify number of retries to each dlus and delay time between retries

- **s nasw ip-precedence**
  - TOS customization for EE traffic (low, med, high, network, ldlc)
Customizing Configuration (Cont.)

• **snasw link**

  NOTE: you only configure links to upstream nodes. All other links come up dynamically with the following naming convention:
  
  @D link names are for dynamic connection network links  
  @I link names are for normal downstream (implicit) links  
  @U link names are for DLUR connect out links

  • **ip-dest**: specifies EE destination ip address (ipv4 ONLY)  
  • **host-dest**: specifies EE destination hostname (ipv4 or ipv6)  
  • **rmac**: specifies remote MAC addresses for non EE links  
  • **rsap**: specifies remote SAP  
  • **nns**: identifies a link to a preferred NNS  
  • **tgp**: low, med, high, or secure characteristics
Customizing Configuration (Cont.)

- **snasw location**
  - Only applies to LEN nodes (i.e. snasw port is configured with conntype len)
  - Not needed (registered automatically) if the Independent Logical Unit (ILU) name is LEN node’s cpname, or if the ILU always initiates the session
  - Causes the ILU to be registered with SNASw's Network Node Server so an upstream Primary LU can find the LEN ILU
  - Registration only occurs when the LEN node connects in, allowing for redundant SNASw routers (TR, HSRP, DLSw downstream)
  - Wildcards are allowed (in both names or only in owning-cp name) to save configuration steps when a naming convention is present
  - Use xid if owning node does not have a CP name (new in recent 12.4)

```
(config)#snasw location MARTILU owning-cp NETA.MARTIN
```

```
(config)#snasw location NETA.LU* owning-cp NETA.CP*
```

```
(config)#snasw location NETA.LU xid 05e00001
```
Customizing Configuration (Cont.)

- **s nasw port**
  - **conntype:** non-EE only… nohpr, len, dynple len, dialoutlen
  - **hostname:** enable hostname (predefined or connection network, ipv4 or ipv6) for this port
  - **ldlc:** tuning of LDLC liveness timer (LIVTIME), short request retry timer (SRQTIME), and short request retry interval (SRQRETRY)
  - **maxbtu:** specify maximum btu size for segmentation (use 1496 for VDLC)
  - **max-links:** limit number of links on this port
  - **nns-required:** drop downstream links when CP-CP sessions to NNS lost to allow downstream PUs to connect to another SNASw router (used with vtok and vdlc ports only)
  - **no-limres:** treat dynamic connection network links as non-limited resources
  - **qsize:** number of packets allowed on IP/UDP inbound queue. Increase from default of 50 if “show ip socket detail” showing drops on ports 12000-12003 and highwater mark is 50, and also consider adjusting interface input hold queues and ip spd queue thresholds as well
  - **vnname:** specify virtual routing node name (connection network)—**use separate loopback interface!**
Customizing Configuration (Cont.)

- `snasw rtp`
  - `pathswitch-timers`: set HPR pathswitch timers (HPRPST-low, med, high, network)
Conclusion: What Did We Learn?

• Concepts
  • SNASw is a DLUR, BrNN, and supports EE (the solution for replacing SNA routing in the data center)

• Design Considerations
  • SNASw in the branch is the best practice (full benefits of COS to TOS mapping and redundancy via IP network), but data center solution is commonly done

• Configuration Basics
  • SNASw configuration is relatively simple

• Troubleshooting Tools
  • SNASw has powerful tools for tracking down problems … the pdlog, dlctrace, ipstrace, etc.
Information on APARs

II11220 – lists all z/OS informational APARs

This is an index to VTAM information APARs that contain lists of recommended maintenance. Each info APAR referred to is for a specific functional area of VTAM.

Releases:
HVT6140 = R140 = V1R4 = z/OS V1R4 R14
HVT6150 = R150 = V1R5 = z/OS V1R5 R15
HVT6160 = R160 = V1R6 = z/OS V1R6 R16
HVT6170 = R170 = V1R7 = z/OS V1R7 R17
HVT6180 = R180 = V1R8 = z/OS V1R8 R18
HVT6190 = R190 = V1R9 = z/OS V1R9 R19

II13456 DLUR/DLUS for HVT6140, z/OS v1r4
II13783 DLUR/DLUS for HVT6150 HVT6160 HVT6170 HVT6180
II12223 Enterprise Extender (EE)
II14056 HPR HVT6160, HVT6170
II10953 HPR HVT510A, HVT6120, HVT6140, HVT6150
II11952 OSA Express (QDIO)
Reference Materials

- SNASw — release guide, performance, troubleshooting, etc., also has links (on the left) to other Cisco IBM related technologies:

- Network management options:

- Redbook on FEP migration options:

- APPN Implementer’s Workshop (architecture documents):
End of Session