



Maximizing Availability with DLUS/DLUR

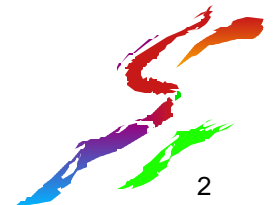
Nancy W. Gates
Advanced Technical Support
Networking Systems Center
Gaithersburg, MD



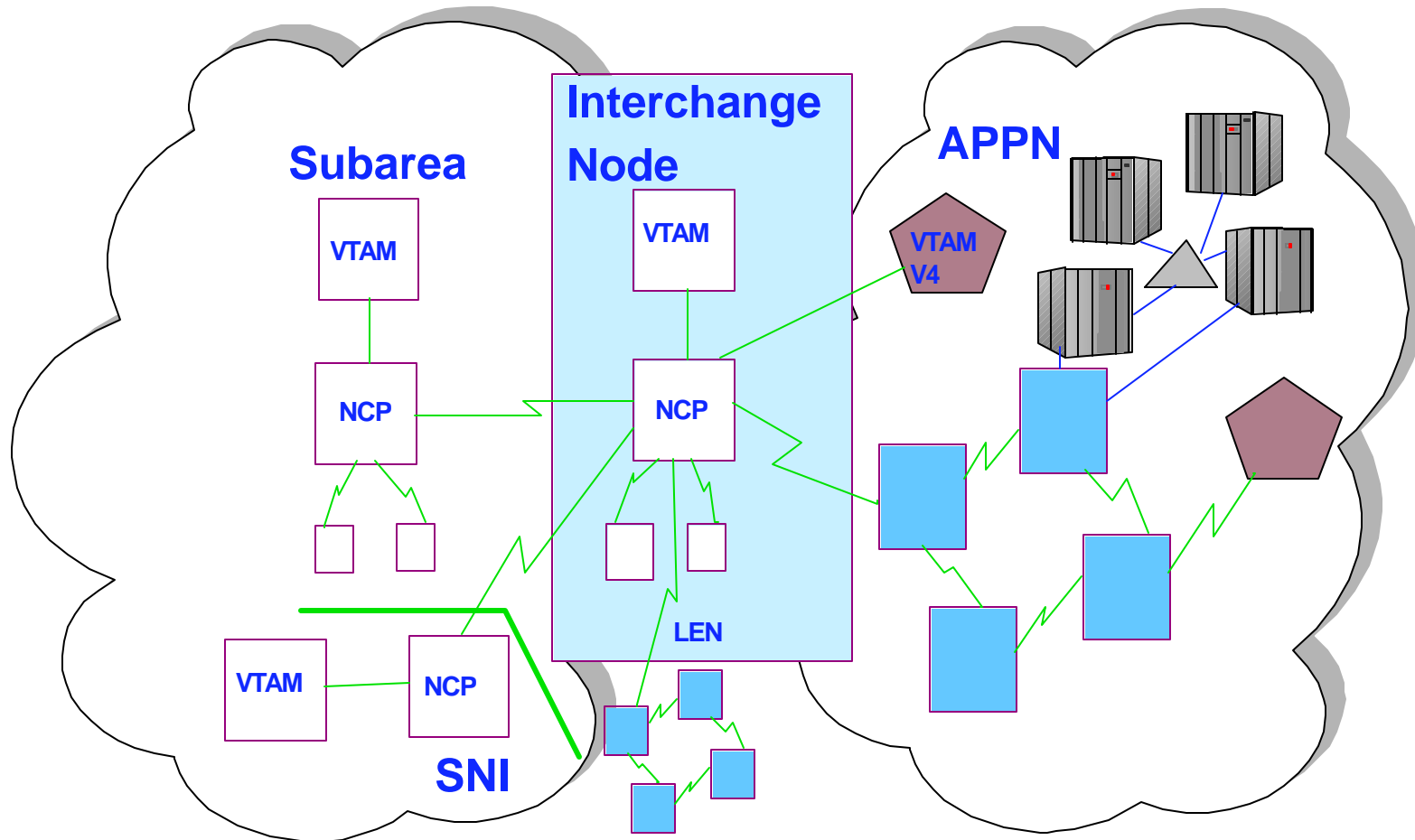
Abstract

Many VTAM / NCP networks use a CMC and backup CMC along with application hosts for high availability and backup reasons. VTAM ownership and backup processes and procedures are well known and understood in this environment. Today, many customers are evolving their VTAM/NCP networks to APPN/HPR DLUS/DLUR networks including Parallel Sysplex, where high availability and backup are even of greater importance, but the processes and procedures are not as well understood.

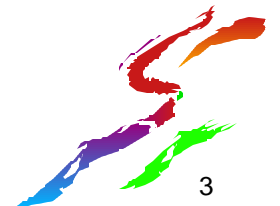
This presentation describes high availability and backup with APPN/HPR including items such as DLUS and backup DLUS, DLUR with and without HPR, mixed subarea/APPN networks, Parallel Sysplex, and mixed ISR/HPR networks.



Combined SUBAREA/APPN Networks

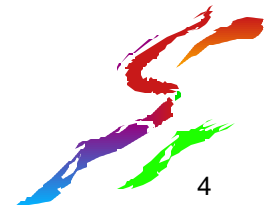


- Customers using high availability SNA networks
- Combination of APPN/HPR and Subarea
- Subarea and APPN work somewhat differently
 - CMC vs. DLUS
 - Virtual Routes vs. APPN routes

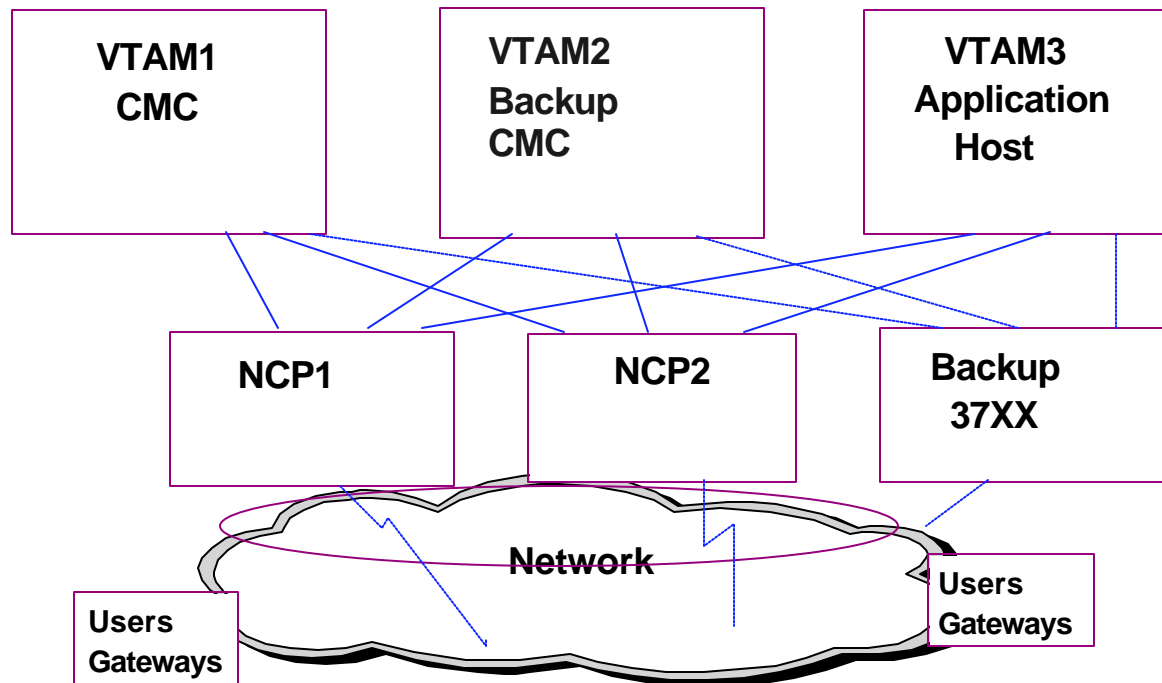


Agenda

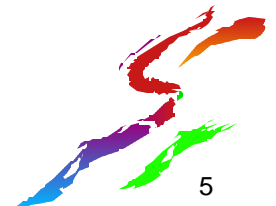
- **Availability and backup with traditional VTAM/NCP networks**
 - **Hardware backup**
 - **Alternate Routing**
 - **Parallel Sysplex Considerations**
 - **Owning and Backup VTAM**
 - **Review of operational procedures**
- **Review of DLUS/DLUR and APPN/HPR concepts**
- **Availability and backup with DLUS/DLUR networks**
 - **Hardware backup**
 - **Alternate Routing**
 - **APPN, LSA Subarea, Enterprise Extender**
 - **Parallel Sysplex Considerations**
 - **DLUS and backup DLUS**
 - **Operational procedures**



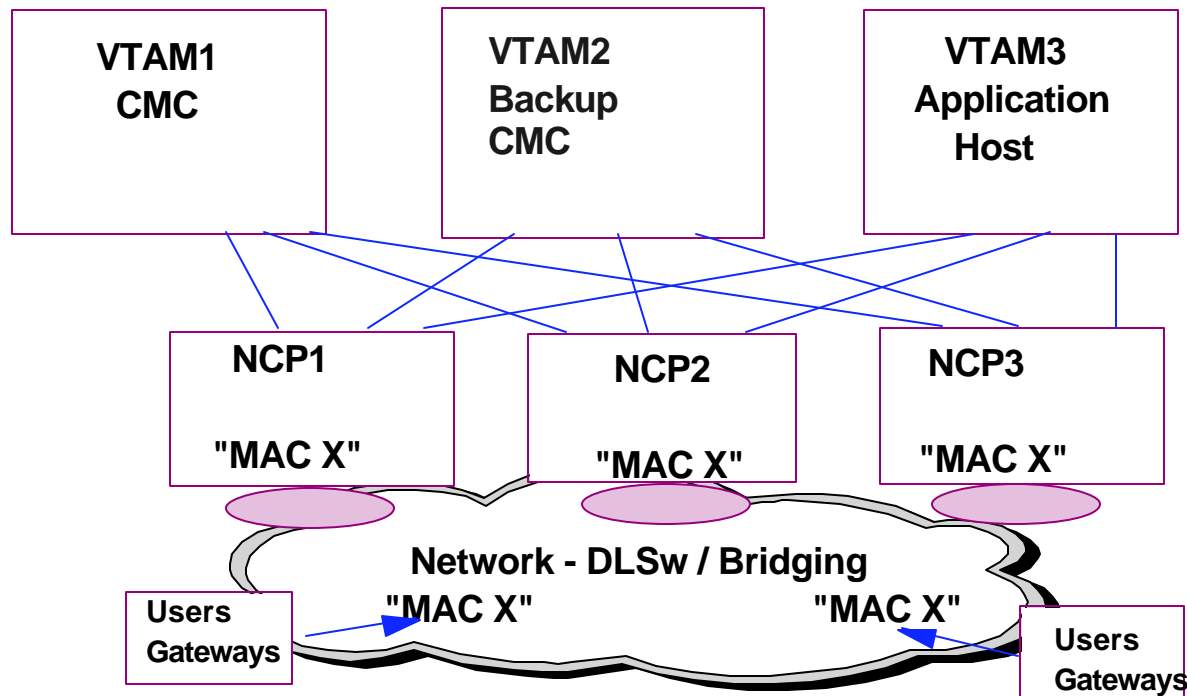
NCP Hardware Backup



- NCP can be loaded into backup 37XX upon hardware failure
- Line matrix switch used to direct lines to backup 37xx
 - 3745 Twin-Standby or Twin-Backup function for failed CCU
- Token-ring MAC addresses duplicated on backup 37XX
- Disruptive to SSCP and LU-LU sessions, but can be reestablished using backup 37XX



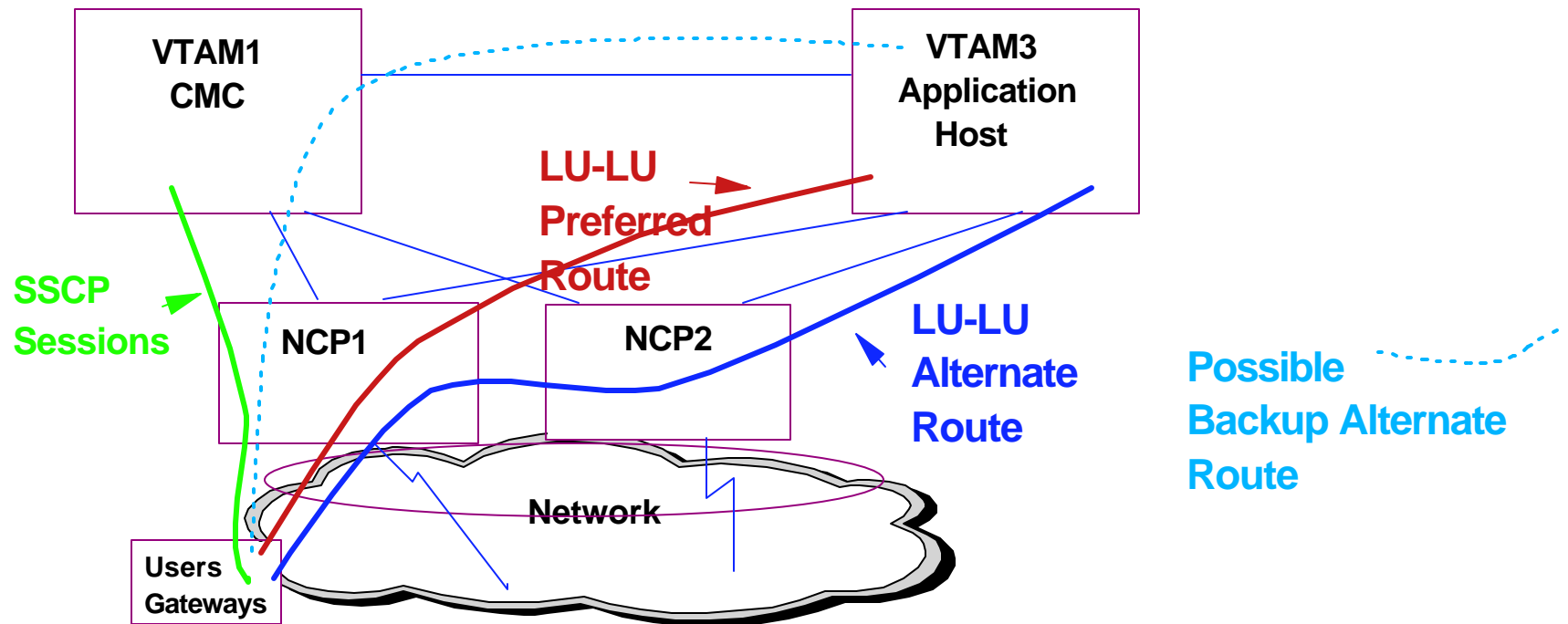
NCP Duplicate TIC Addressing



- Popular network design - remote users access NCP via source route bridging or DataLink Switching
 - Provides high availability and load balancing
- NCPs use same MAC address on different segments
- NCP/Token-Ring failure causes user station to automatically restart connection to another NCP (same destination MAC)
 - Disruptive to SSCP and LU-LU sessions, but easily reestablished



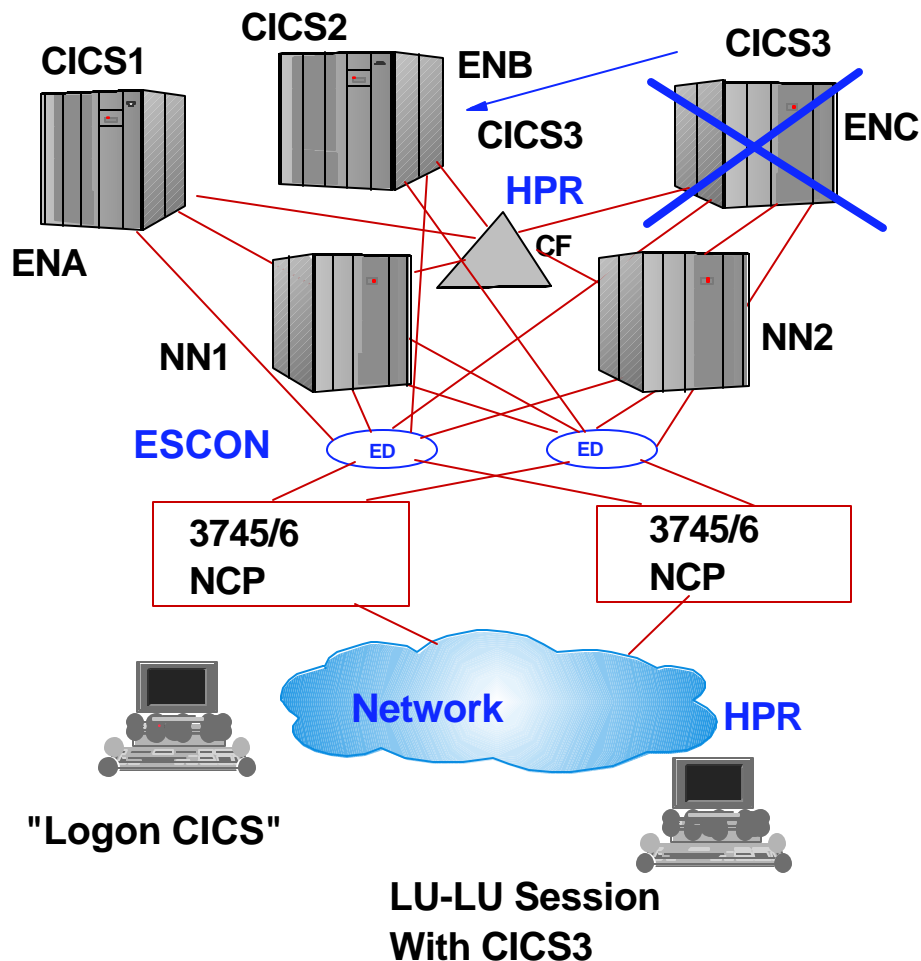
NCP and Alternate Routing



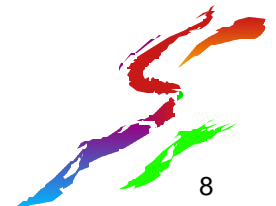
- Predefined VRs/ERs indicate preferred / alternate route(s)
- VR selected at session setup based on Class of Service (COS)
 - Loss of VR is disruptive to sessions, but can be reestablished over alternate route
 - NCP MLTG function minimizes VR INOP exposure
- Usually avoid routing through VTAM



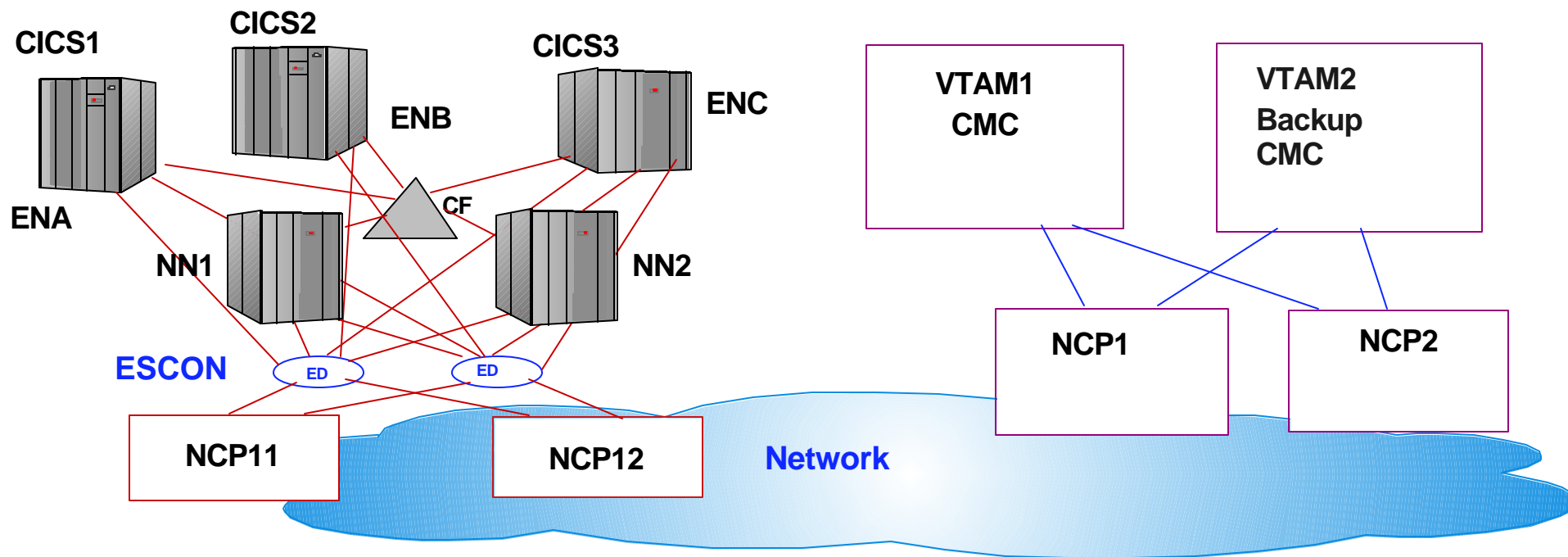
Sysplex High Availability Functions



- **Generic resources allows multiple applications to have the same generic name**
 - **Allows load balancing and high availability**
 - **Requires APPN**
- **Multinode persistent sessions allows session continuation through loss of mainframe hardware/software**
 - **Requires HPR**



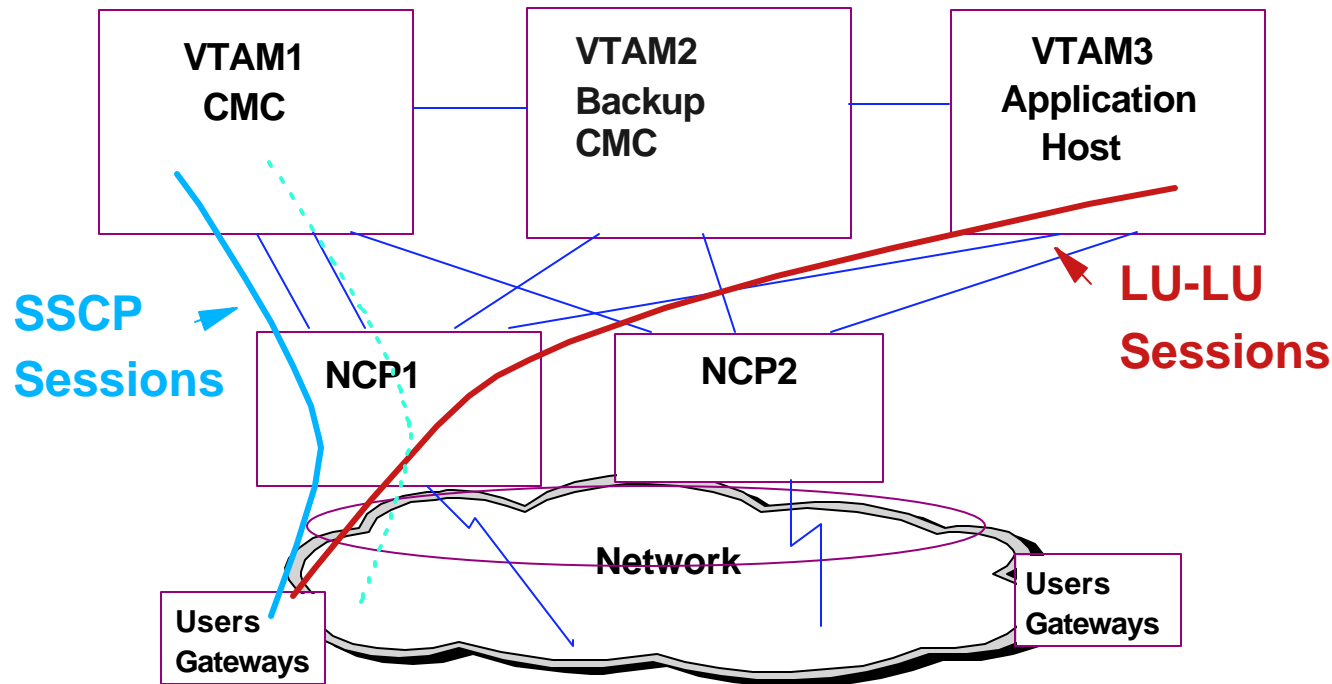
NCP and Sysplex Considerations



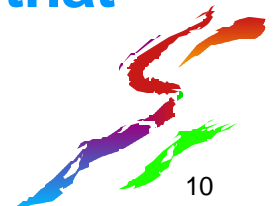
- CMC can be inside or outside of Sysplex
- APPN/HPR needed between VTAMs in Sysplex
- APPN needed - CMC to Sysplex VTAMs for optimal routing
 - If not, may route through NNs in Sysplex
 - Can use VTAM APPN channel TGs to NCPs or VRTGs
- NCP can't be RTP endpoint for MNPS
 - May use HPR routers outside of NCPs - SSCP takeover may involve APPN and PU2 linkstations in NCP



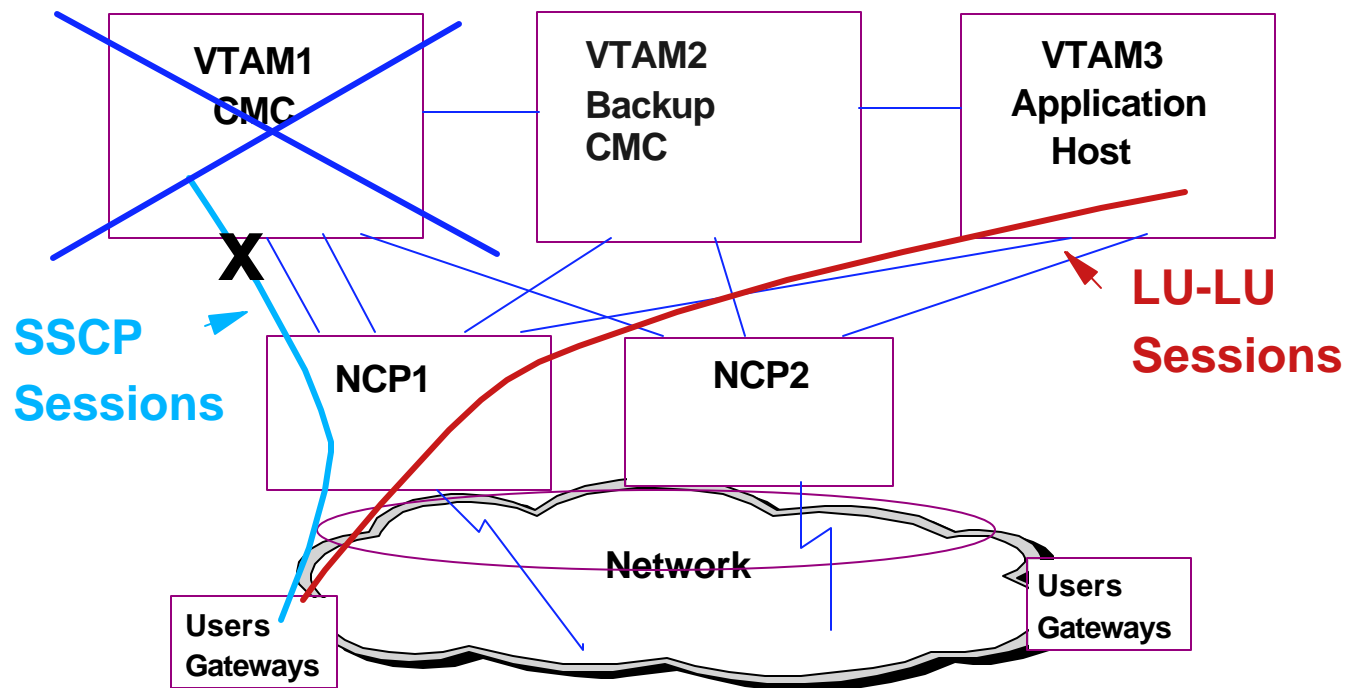
Owning VTAM and Backup



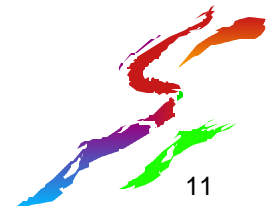
- Loss of connection between VTAM1 and NCP1 causes VTAM automatic recovery over alternate route
 - Through 2nd NCP1 channel adapter
 - Through NCP2 or VTAM2
- LU-LU sessions continue unless were running on route that went down
- SSCP sessions reestablished (ACTPU/ACTLU ERP)



CMC and Backup CMC

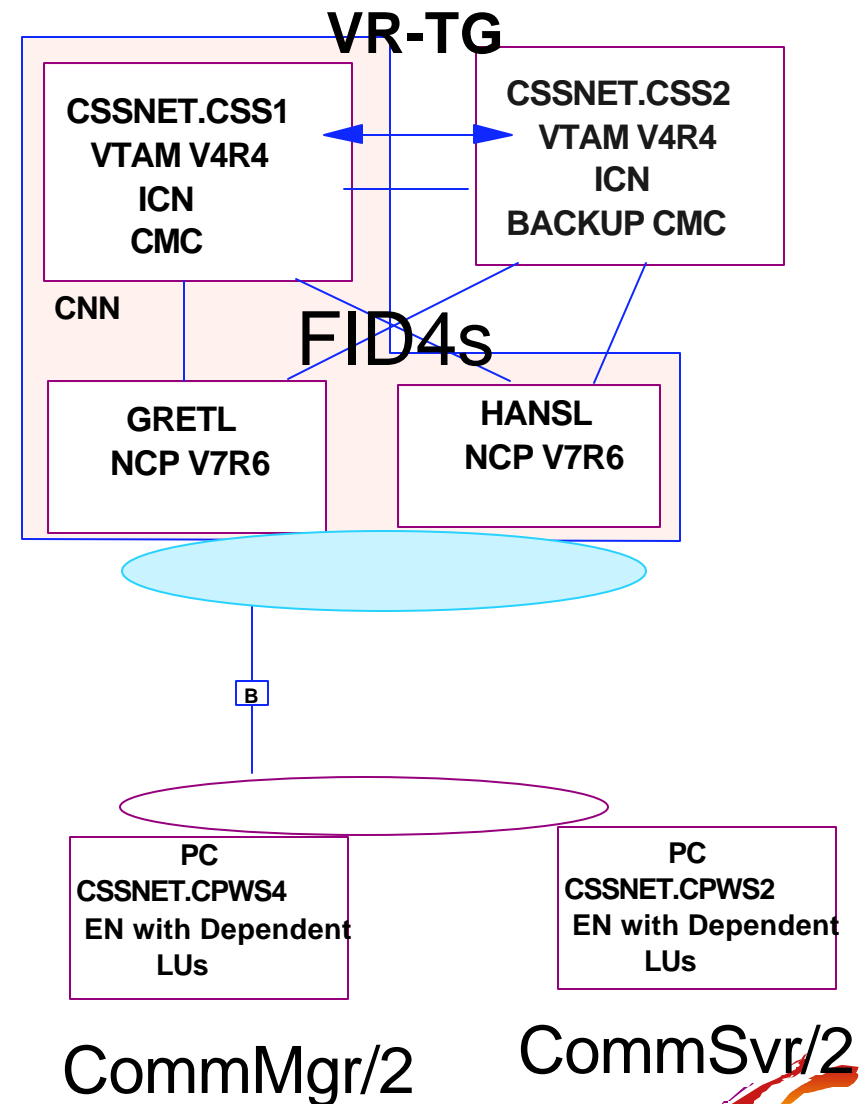


- NCP Automatic Network Shutdown (ANS) when VTAM1 lost
 - VTAM2 can activate NCP1/NCP2
 - VTAM2 needs NCP1 and NCP2 Source, RRT, and Switched Major nodes representing peripheral resources
- LU-LU sessions continue unless were to or through VTAM1
- SSCP sessions reestablished (ACTPU/ACTLU ERP)
- Later, VTAM2 can non-disruptively "giveback" NCP ownership to VTAM1



Takeover/Giveback Example with SNA Lab

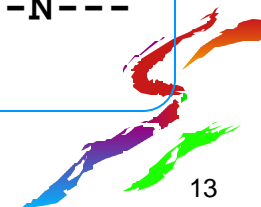
- PC Dependent LUs in session with CSS2 applications
- Automatic Network Shutdown (ANS)
- NCP function caused by:
 - Channel Adapter I/O Error
 - Channel Discontact
 - Attention Timeout
 - VTAM command
- ANS processing
 - Clear SSCP ownership of links/stations
 - LU-LU sessions continue if:
 - ANS=CONT (DELAY for BSC)



Display GRETL on CSS1

- GRETL coded with OWNER=CSS1 on definitions
- CSS1's PCCU definition does NOT indicate CSS1
- GRETL is activated and CSS1 resources acquired

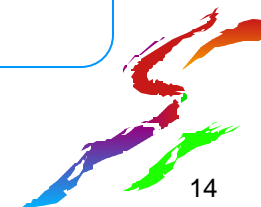
```
D NET, ID=GRETL, E
IST097I DISPLAY ACCEPTED
IST075I NAME = GRETL, TYPE = PU T4/5 454
IST486I STATUS= ACTIV, DESIRED STATE= ACTIV
IST963I LOAD MODULE = GRETL30
IST247I LOAD/DUMP PROCEDURE STATUS = RESET
IST484I SUBAREA = 111 GATEWAY CONTROL SHARED
IST336I THIS NCP MAJOR NODE WAS ACTIVATED BEFORE ACQUISITION
IST391I ADJ LINK STATION = 0016-S, LINE = 0016-L, NODE = CSS1PUS
.....
IST170I LINES:
.....
IST080I NPALA      ACTIV-N--T LGNCST      ACTIV----T TRNL1      ACTIV-N---
IST080I TRNL2      ACTIV-N--- TRNL3      RESET-N--- TRNL4      RESET-N---
.....
IST080I J003F05D  ACTIV-N--- J003F05F  ACTIV-N--- J003F061  ACTIV-N---
IST080I J003F063  ACTIV-N--- J003F065  ACTIV-N--- J003F067  ACTIV-N---
IST080I J003F069  ACTIV-N--- J003F06B  ACTIV-N--- J003F06D  ACTIV-N---
```



Display GRETL on CSS2

- GRETL has been activated but not acquired

```
D NET, ID=GRETL, E
IST097I DISPLAY ACCEPTED
IST075I NAME = GRETL, TYPE = PU T4/5 823
IST486I STATUS= ACTIV, DESIRED STATE= ACTIV
IST963I LOAD MODULE = GRETL30
IST247I LOAD/DUMP PROCEDURE STATUS = RESET
IST1656I VTAMTOPO = REPORT, NODE REPORTED - YES
IST484I SUBAREA = 111
IST391I ADJ LINK STATION = CAP015, LINE = CAL015, NODE = CA015
.....
IST170I LINES:
.....
IST080I NPALA      RESET-N--T LGNCST      NEVAC----T TRNL1      RESET-N---
IST080I TRNL2      RESET-N--- TRNL3      RESET-N--- TRNL4      RESET-N---
.....
IST080I J003F05D  RESET-N--- J003F05F  RESET-N--- J003F061  RESET-N---
IST080I J003F063  RESET-N--- J003F065  RESET-N--- J003F067  RESET-N---
IST080I J003F069  RESET-N--- J003F06B  RESET-N--- J003F06D  RESET-N---
```



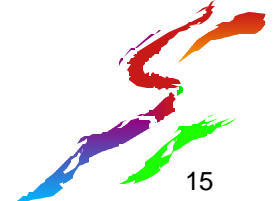
CPWS2 and CPWS4 owned by CSS1

- **Workstations connected:**

```
IST590I  CONNECTIN  ESTABLISHED FOR PU PSWWS2      ON LINE J003F063
IST1086I  APPN CONNECTION FOR CSSNET.CPWS2        IS ACTIVE - TGN = 21
IST1096I  CP-CP SESSIONS WITH CSSNET.CPWS2        ACTIVATED

IST590I  CONNECTIN  ESTABLISHED FOR PU PSWWS4      ON LINE J003F05F
IST1086I  APPN CONNECTION FOR CSSNET.CPWS4        IS ACTIVE - TGN = 21
IST1096I  CP-CP SESSIONS WITH CSSNET.CPWS4        ACTIVATED
```

- **Dependent LUs logon to CSS2 applications**
- **Identical Switched Major Nodes are active on both CSS1 and CSS2**
 - **With VTAM V4R4+, it is OK to have duplicate definitions in more than one VTAM**
 - **Important to consider DUPDEFS and DIALRTRY Start Options for this environment**

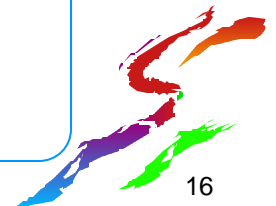


CPWS2 and CPWS4 owned by CSS1

• Switched Major Node Display:

```
D NET, ID=CPWS4SW, E
IST097I DISPLAY ACCEPTED
IST075I NAME = CPWS4SW, TYPE = SW SNA MAJ NODE 818
IST486I STATUS= ACTIV, DESIRED STATE= ACTIV
IST084I NETWORK RESOURCES:
IST089I PSWS4      TYPE = PU_T2.1           , ACTIV--L--
IST089I DSWWS401  TYPE = LOGICAL UNIT      , ACTIV
IST089I DSWWS402  TYPE = LOGICAL UNIT      , ACTIV
IST089I DSWWS403  TYPE = LOGICAL UNIT      , ACT/S
IST089I DSWWS404  TYPE = LOGICAL UNIT      , ACTIV
IST089I DSWWS405  TYPE = LOGICAL UNIT      , ACTIV
IST314I END
```

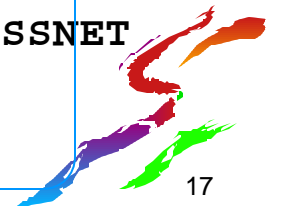
```
D NET, ID=CPWS2SW, E
IST097I DISPLAY ACCEPTED
IST075I NAME = CPWS2SW, TYPE = SW SNA MAJ NODE 824
IST486I STATUS= ACTIV, DESIRED STATE= ACTIV
IST084I NETWORK RESOURCES:
IST089I PSWS2      TYPE = PU_T2.1           , ACTIV--L--
IST089I DSWWS201  TYPE = LOGICAL UNIT      , ACTIV
IST089I DSWWS202  TYPE = LOGICAL UNIT      , ACTIV
IST089I DSWWS203  TYPE = LOGICAL UNIT      , ACT/S
IST314I END
```



Major Node and LU Displays on CSS2

```
D NET, ID=CPWS4SW, E
IST075I NAME = CPWS4SW, TYPE = SW SNA MAJ NODE 986
IST486I STATUS= ACTIV, DESIRED STATE= ACTIV
IST1656I VTAMTOPO = REPORT, NODE REPORTED - YES
IST084I NETWORK RESOURCES:
IST089I PSWWS4      TYPE = PU_T2                , CONCT
IST089I DSWWS401   TYPE = LOGICAL UNIT          , CONCT
IST089I DSWWS402   TYPE = LOGICAL UNIT          , CONCT
IST089I DSWWS403   TYPE = LOGICAL UNIT          , CONCT--S--
.....
```

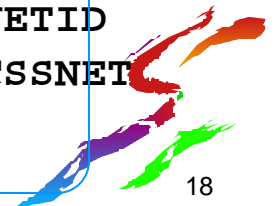
```
D NET, ID=DSWWS403, E
IST075I NAME = CSSNET.DSWWS403, TYPE = CDRSC 989
IST1046I SHADOW CSSNET.DSWWS403 ALSO EXISTS
.....
IST231I CDRSC MAJOR NODE = ISTCDRDY
IST479I CDRM NAME = CSS1, VERIFY OWNER = NO
IST1184I CPNAME = CSSNET.CSS1 - NETSRVR = ***NA***
.....
IST171I ACTIVE SESSIONS = 0000000001, SESSION REQUESTS = 0000000000
IST206I SESSIONS:
IST634I NAME      STATUS      SID          SEND  RECV  VR  TP  NETID
IST635I TS20002  ACTIV-P      FD87C05945DDBD5F 0001 000B  0  1  CSSNET
IST314I END
```



Major Node and LU Displays on CSS2

```
D NET, ID=CPWS2SW, E
IST075I NAME = CPWS2SW, TYPE = SW SNA MAJ NODE 986
IST486I STATUS= ACTIV, DESIRED STATE= ACTIV
IST1656I VTAMTOPO = REPORT, NODE REPORTED - YES
IST084I NETWORK RESOURCES:
IST089I PSWS4      TYPE = PU_T2                , CONCT
IST089I DSWWS201  TYPE = LOGICAL UNIT          , CONCT
IST089I DSWWS202  TYPE = LOGICAL UNIT          , CONCT
IST089I DSWWS203  TYPE = LOGICAL UNIT          , CONCT--S--
.....
```

```
D NET, ID=DSWWS203, E
IST075I NAME = CSSNET.DSWWS203, TYPE = CDRSC 998
IST1046I SHADOW CSSNET.DSWWS203 ALSO EXISTS
....
IST231I CDRSC MAJOR NODE = ISTDY
IST479I CDRM NAME = CSS1, VERIFY OWNER = NO
IST1184I CPNAME = CSSNET.CSS1 - NETSRVR = ***NA***
.....
IST171I ACTIVE SESSIONS = 0000000001, SESSION REQUESTS = 0000000000
IST206I SESSIONS:
IST634I NAME      STATUS      SID      SEND  RECV  VR  TP  NETID
IST635I N3P2005  ACTIV-P    FD87C05945DDBD62 0003 000A  0  1  CSSNET
IST314I END
```

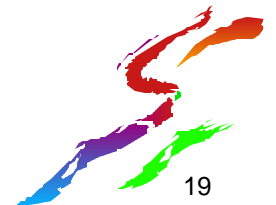


CSS1 Fails, Takeover on CSS2

- Z NET,CANCEL issued on CSS1 (VTAM abends)
 - If try to takeover NCP before ANS completed, get resource limit exceeded sense codes:
- On CSS2:

```
V NET,ACQ, ID=GRETL, OWNER=CSS1, ACT, PUSUB
IST097I VARY ACCEPTED
IST670I VARY ACQ PROCESSING FOR ID = GRETL COMPLETE
IST487I VARY ACT FOR ID = GRETL SCHEDULED BY VARY ACQ
IST093I GRETL ACTIVE
IST380I ERROR FOR ID = NPALA - REQUEST: ACTLINK, SENSE: 08010000
IST380I ERROR FOR ID = J003F015 - REQUEST: ACTLINK, SENSE: 082C0000
IST380I ERROR FOR ID = J003F017 - REQUEST: ACTLINK, SENSE: 082C0000
```

.... 082C -- Resource limit exceeded



Takeover on CSS2

```
V NET,ACQ,ID=GRETL,OWNER=CSS1,ACT,PUSUB
IST097I VARY ACCEPTED
IST670I VARY ACQ PROCESSING FOR ID = GRETL COMPLETE
IST487I VARY ACT FOR ID = GRETL SCHEDULED BY VARY ACQ
IST093I GRETL ACTIVE
IST1168I VIRTUAL NODE CSSNET.CONNET CONNECTION ACTIVE
IST1168I VIRTUAL NODE CSSNET.CONNET CONNECTION ACTIVE
IST787I SSCP TAKEOVER FOR NODE J003F05F IN PROGRESS
IST787I SSCP TAKEOVER FOR NODE J003F063 IN PROGRESS
IST1086I APPN CONNECTION FOR CSSNET.CPWS2 IS ACTIVE - TGN = 21
IST621I SSCP TAKEOVER COMPLETE FOR NETWORK RESOURCE PSWS4
IST621I SSCP TAKEOVER COMPLETE FOR NETWORK RESOURCE PSWS2
IST1096I CP-CP SESSIONS WITH CSSNET.CPWS2 ACTIVATED
IST464I LINK STATION P1028A HAS CONTACTED HANSL SA 110
```

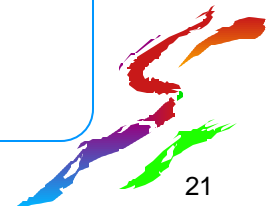
- Takeover of CPWS2 complete (is running CS/2)
- Connection to CPWS4 treated as LEN (is running CM/2 which doesn't have non-disruptive CPname change)
 - No CP-CP sessions, link not in topology
- To get APPN connection with CPWS4, need to bring link down and back up



CPWS2 Major Node and PU Display on CSS2

```
D NET, ID=CPWS2SW, E
IST075I NAME = CPWS2SW, TYPE = SW SNA MAJ NODE 322
.....
IST084I NETWORK RESOURCES:
IST089I PSWWS2     TYPE = PU_T2.1           , ACTIV--L--
IST089I DSWWS201  TYPE = LOGICAL UNIT      , ACTIV
IST089I DSWWS202  TYPE = LOGICAL UNIT      , ACTIV
IST089I DSWWS203  TYPE = LOGICAL UNIT      , ACT/S
IST314I END
```

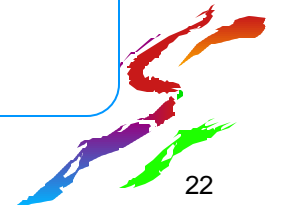
```
D NET, ID=PSWWS2, E
IST075I NAME = PSWWS2, TYPE = PU_T2.1 004
IST486I STATUS= ACTIV--L--, DESIRED STATE= ACTIV
IST1043I CP NAME = CPWS2, CP NETID = CSSNET, DYNAMIC LU = YES
IST1589I XNETALS = YES
IST1105I RESOURCE STATUS TGN CP-CP TG CHARACTERISTICS
IST1106I PSWWS2  AC/R      21 YES   982D0000000000000000000017100808080
IST1482I HPR = RTP - OVERRIDE = N/A - CONNECTION = YES
IST081I LINE NAME = J003F05D, LINE GROUP = TRNANY1, MAJNOD = GRETL
.....
IST355I LOGICAL UNITS:
IST080I DSWWS201  ACTIV      DSWWS202  ACTIV      DSWWS203  ACT/S
IST080I CPWS2     ACT/S-----Y
IST314I END
```



CPWS4 Major Node and PU Display on CSS2

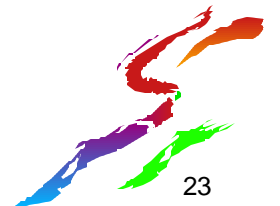
```
D NET, ID=CPWS4SW, E
  IST075I NAME = CPWS4SW, TYPE = SW SNA MAJ NODE 322
  .....
  IST084I NETWORK RESOURCES:
  IST089I PSWWS4     TYPE = PU_T2.1           , ACTIV--L--
  IST089I DSWWS401  TYPE = LOGICAL UNIT      , ACTIV
  IST089I DSWWS402  TYPE = LOGICAL UNIT      , ACTIV
  IST089I DSWWS403  TYPE = LOGICAL UNIT      , ACT/S
```

```
D NET, ID=PSWWS4, E
  IST075I NAME = PSWWS4, TYPE = PU_T2.1 004
  IST486I STATUS= ACTIV, DESIRED STATE= ACTIV
  IST1043I CP NAME = CPWS4, CP NETID = CSSNET, DYNAMIC LU = YES
  IST1589I XNETALS = YES
  IST1105I RESOURCE STATUS TGN CP-CP TG CHARACTERISTICS
  IST1106I PSWWS4  AP/N      0  *NA*  **** NA  ****
  IST1482I HPR = RTP - OVERRIDE = N/A - CONNECTION = YES
  IST081I LINE NAME = J003F05F, LINE GROUP = TRNANY1, MAJNOD = GRETL
  .....
  IST355I LOGICAL UNITS:
  IST080I DSWWS401 ACTIV          DSWWS402 ACTIV          DSWWS403 ACT/S
  IST080I DSWWS404 ACTIV          DSWWS405 ACTIV
  IST314I END
```



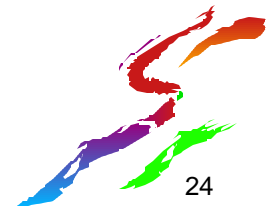
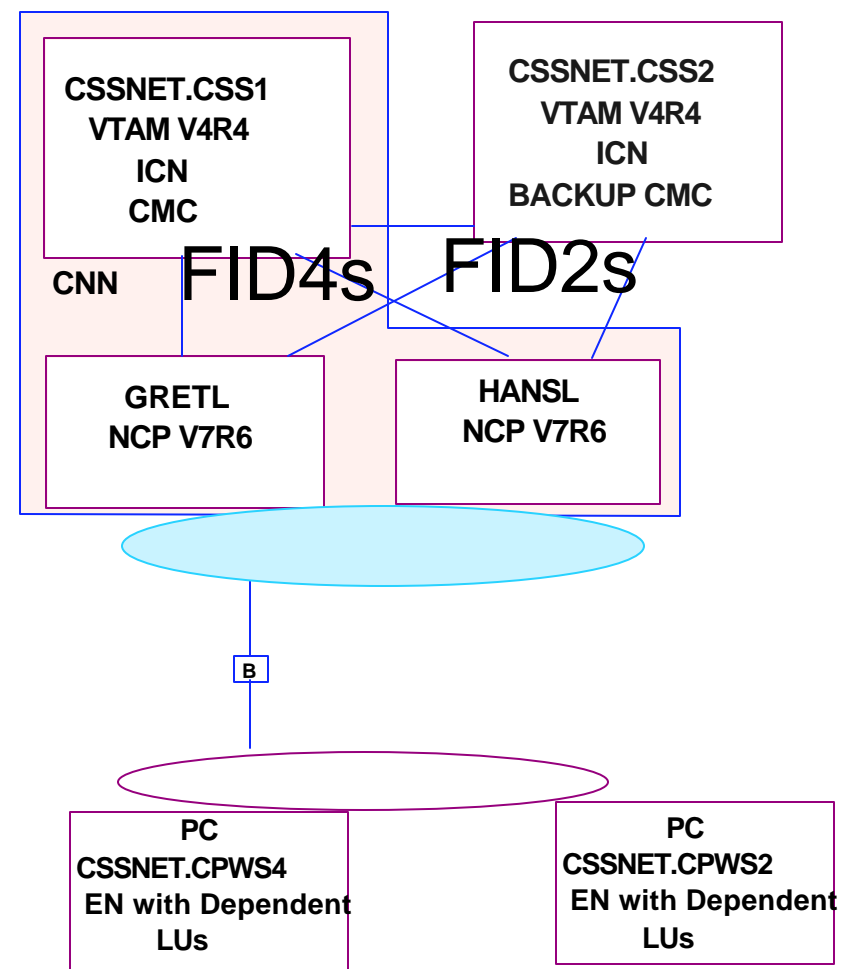
Summary of CMC Takeover/Giveback

- Ownership can be rolled back to CSS1 through use of :
 - V NET,REL,ID=GRETL,OWNER=CSS1,TYPE=GIVEBACK
- Can also relinquish ownership using INACT processing
 - V NET,INACT,TYPE=GIVEBACK issued for each LINE
- Nodes with non-disruptive CPname change:
 - Have LU-LU session continuation
 - Can automatically have CP-CP sessions with primary and backup VTAMs
 - Have SSCP-PU/LU sessions for dependent LUs with primary and backup VTAMs
- Nodes without non-disruptive CPname change:
 - Have LU-LU session continuation
 - Have no CP-CP sessions (are treated as LEN) after takeover/giveback until link recycled
 - Have SSCP-PU/LU sessions for dependent LUs with primary and backup VTAMs
 - Link not in topology so can't be computed for routes

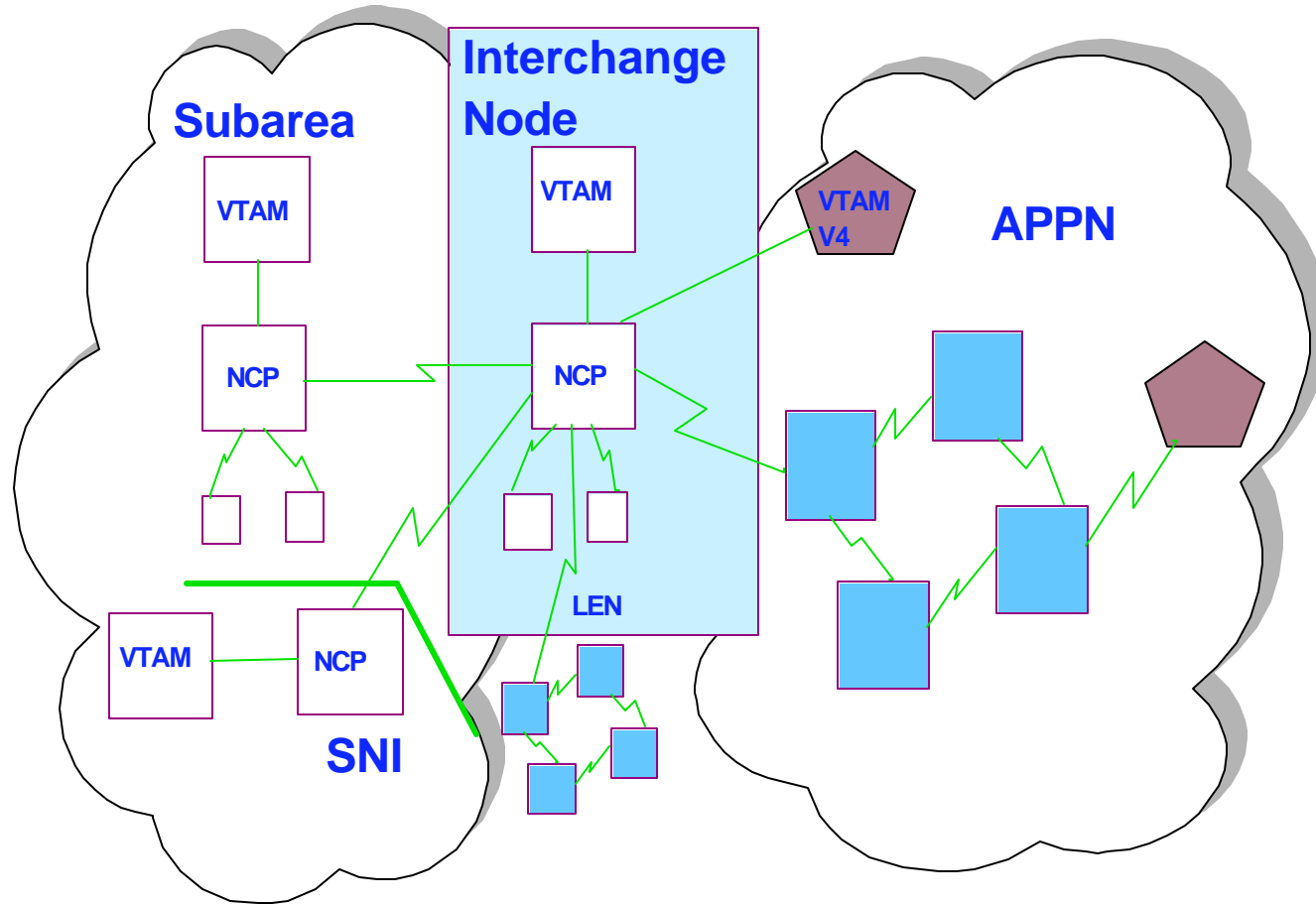


Takeover/Giveback with FID2 Configuration

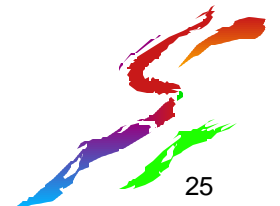
- This type of configuration is not recommended for backup CMC(s)
- PC LUs in session with CSS2 applications
- Same Switched Major Nodes active on both VTAMs
 - CSS2 uses additional FID4 connections to ACT/ACQ NCPs
- Takeover works, sessions continue, CPWS4 link treated as LEN
 - Dependent LU unusable after logoff



Combined SUBAREA/APPN Networks

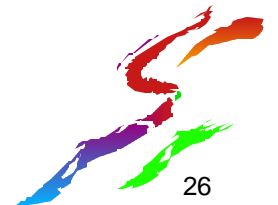


- During migration - combined Subarea/APPN networks
- Subarea and APPN work somewhat differently
 - CMC vs. DLUS
 - Virtual Routes vs. APPN routes

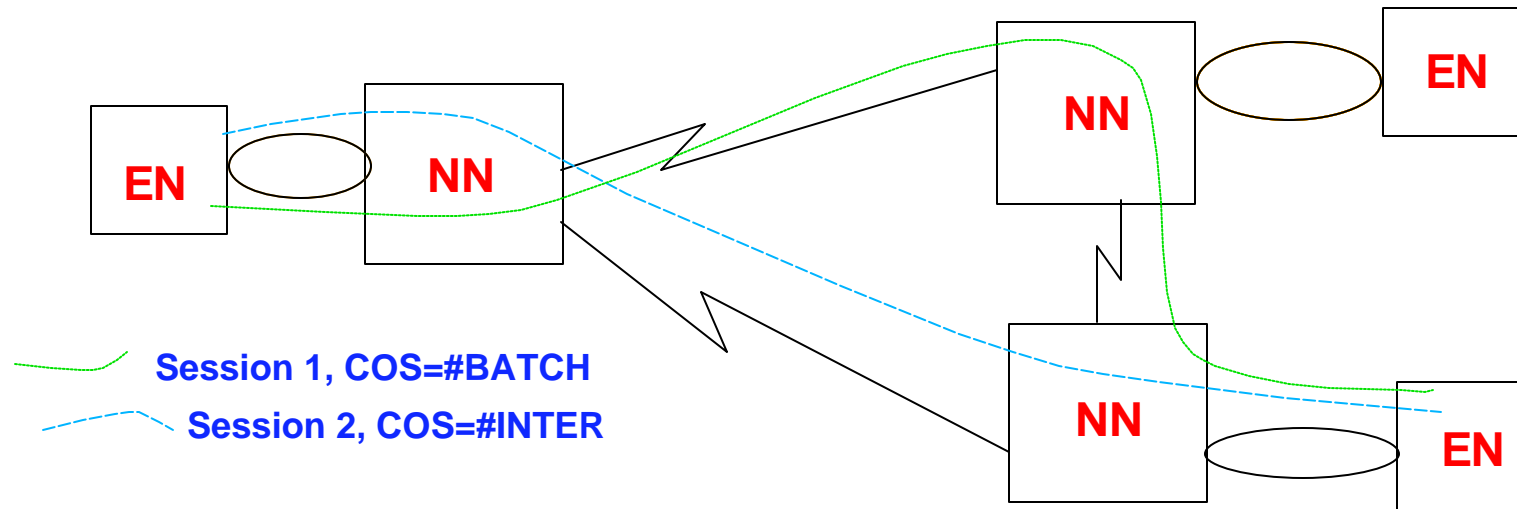


Considerations for DLURs

- Customers moving from NCPs generally want same or better high availability functions than they have with NCPs
- DLUR is independent node - not operated by command from VTAM
- Routing and recovery work differently than with VTAM/NCP
 - APPN and HPR work somewhat differently



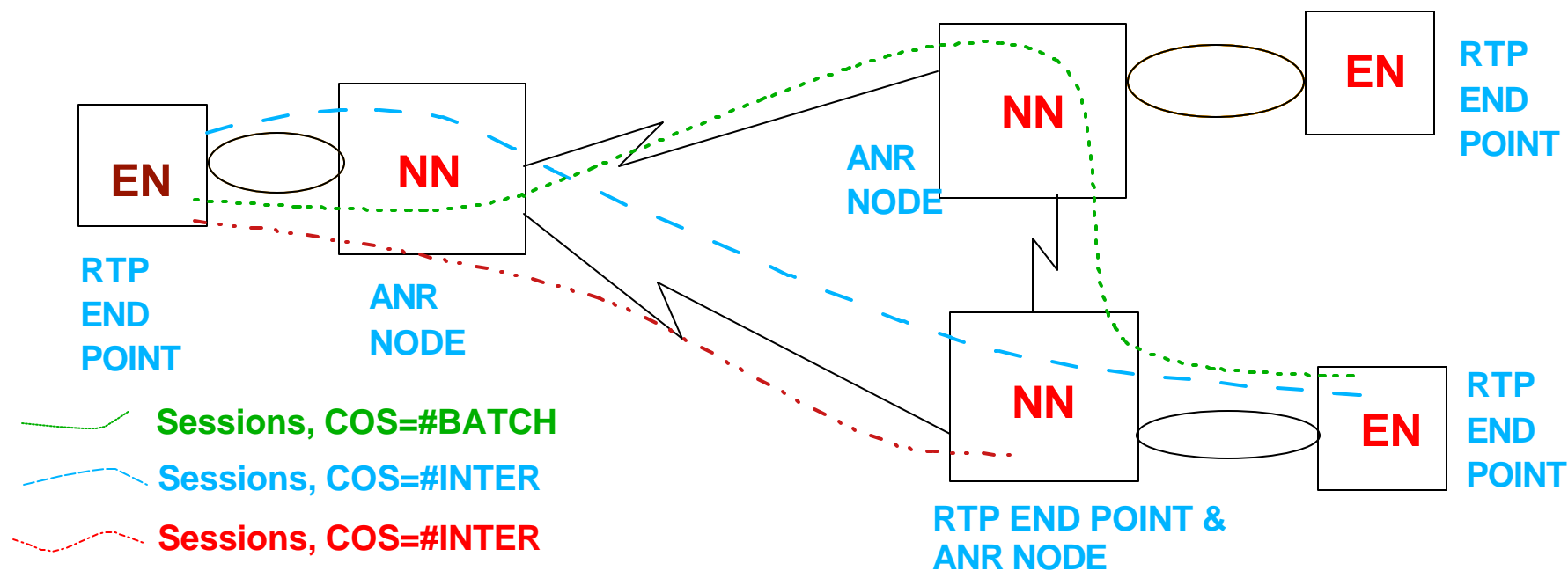
APPN Networking



- APPN allows multiple links between adjacent nodes
- Route chosen for each session according to Class of Service
- Loss of link or node on route is disruptive to sessions
- Sessions can be reestablished on next best route



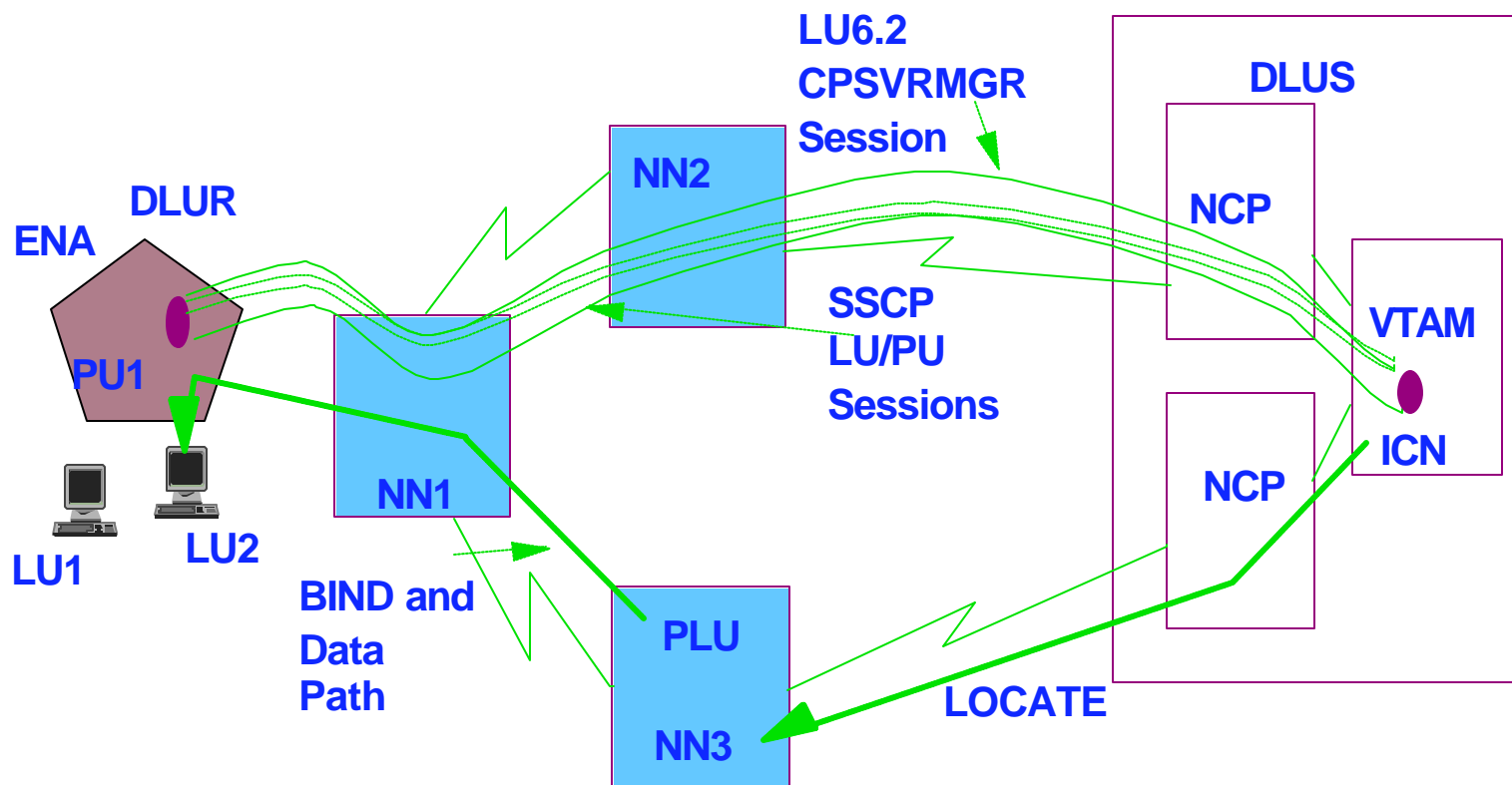
High Performance Routing



- Fast Switching through HPR ANR (Automatic Network Routing) nodes
- HPR Rapid Transport Protocol (RTP) Endpoints establish routes for sessions for each unique COS
 - Allows non-disruptive rerouting across alternate path in case of link or node failures
 - Use ARB (Adaptive Rate-Based Flow/Congestion Control) to maximize throughput and avoid congestion



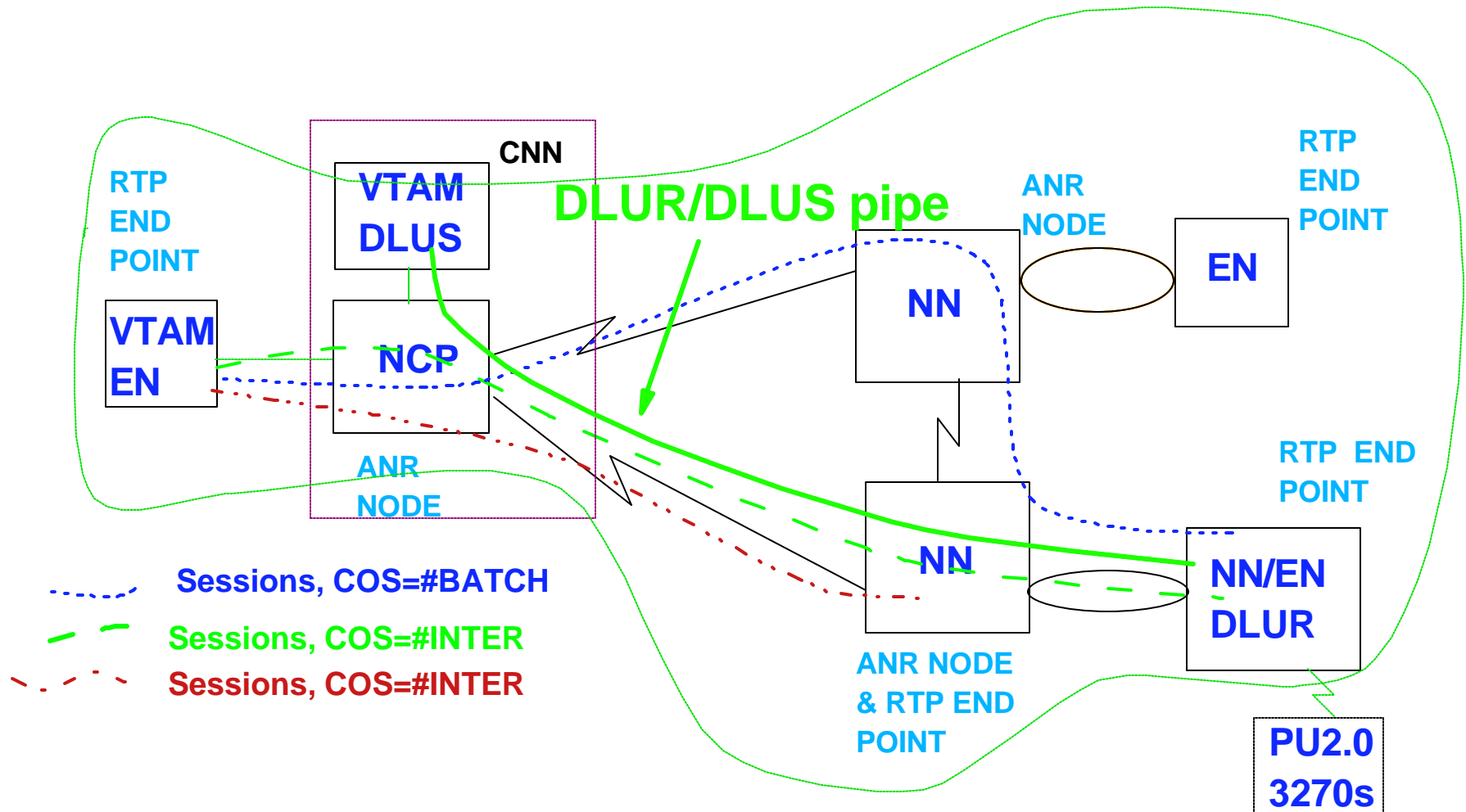
DLUS/DLUR Overview



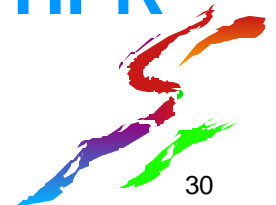
- SSCP flows encapsulated in LU6.2 CPSVGMGR pipe
- LU-LU session is not encapsulated (i.e. flows as native LU2 BIND/3270 data stream)



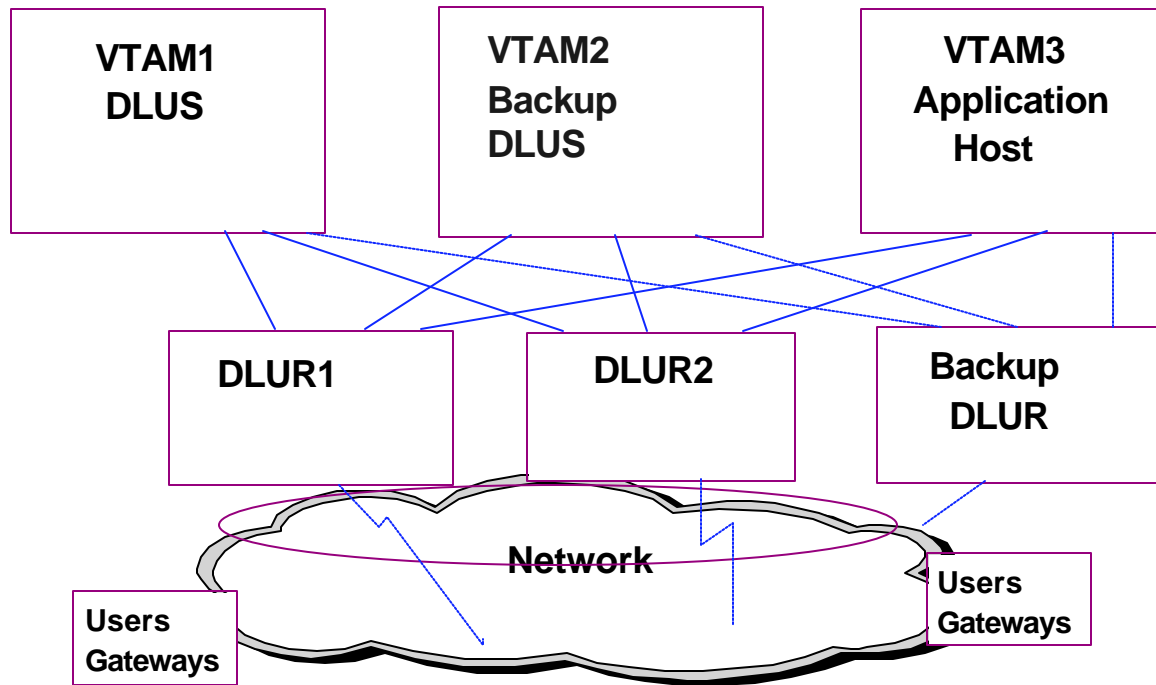
DLUS/DLUR and HPR



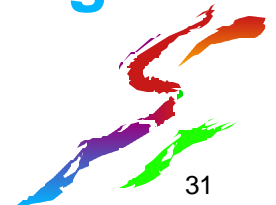
- Older node types, (i.e. 3270s) can benefit from HPR performance and availability functions



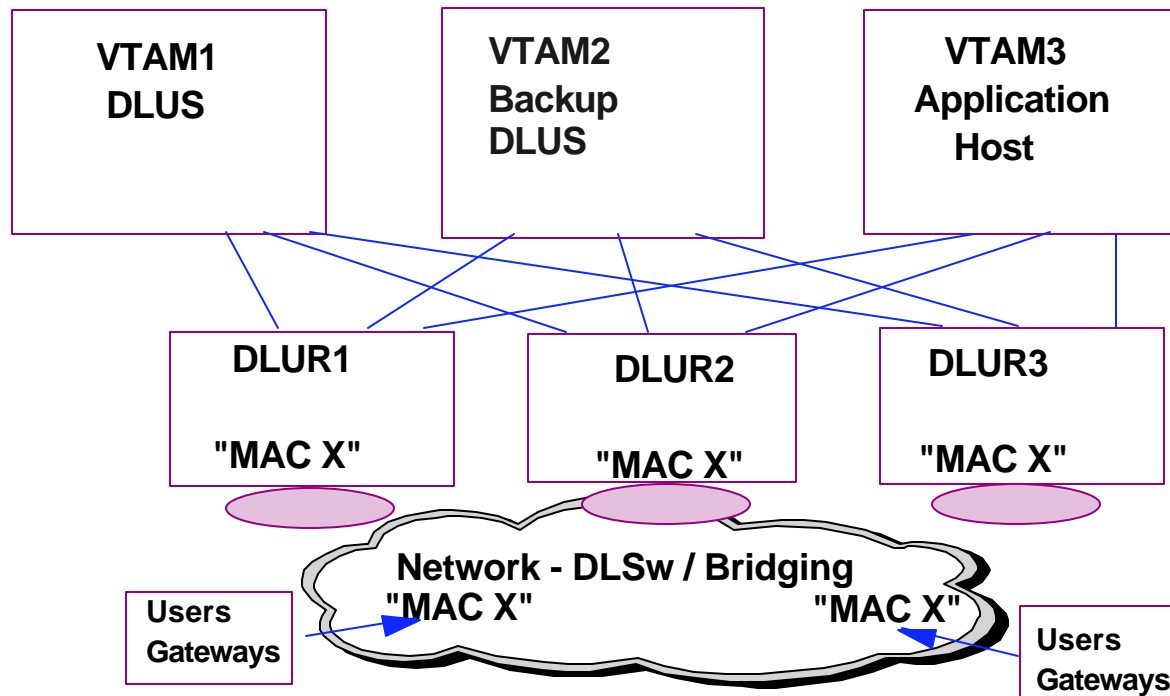
DLUR Hardware Backup



- Configuration can be loaded into backup DLUR and activated upon hardware failure of DLUR1 or DLUR2
 - Line matrix switch used to direct lines to backup DLUR
 - Token-ring MAC addresses duplicated on backup DLUR
- Disruptive to sessions, but can be reestablished using backup DLUR
 - Not disruptive for sessions using it as ANR node



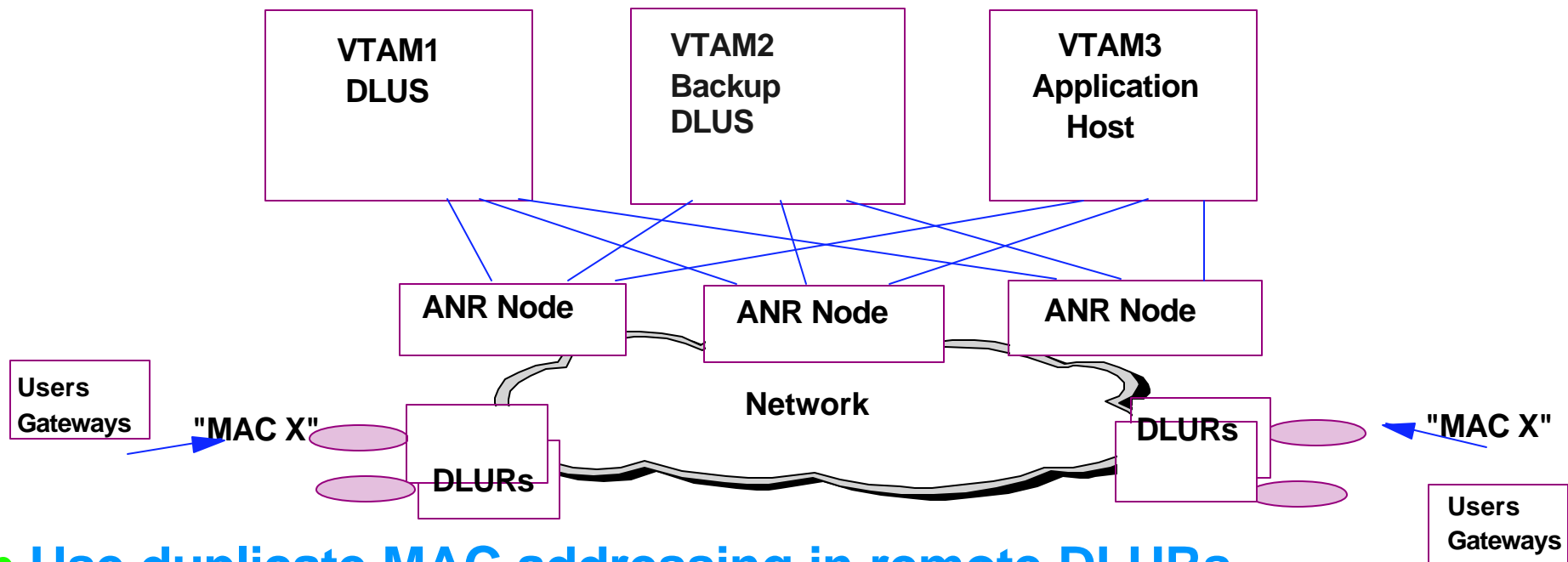
DLUR Duplicate MAC Addressing



- Use same design as with NCPs - remote users access via source route bridging or DataLink Switching
- DLURs use same MAC address on different segments
- DLUR/Token-Ring failure causes user station to automatically restart connection to another DLUR (same destination MAC)
 - Disruptive to SSCP and LU-LU sessions, but easily reestablished



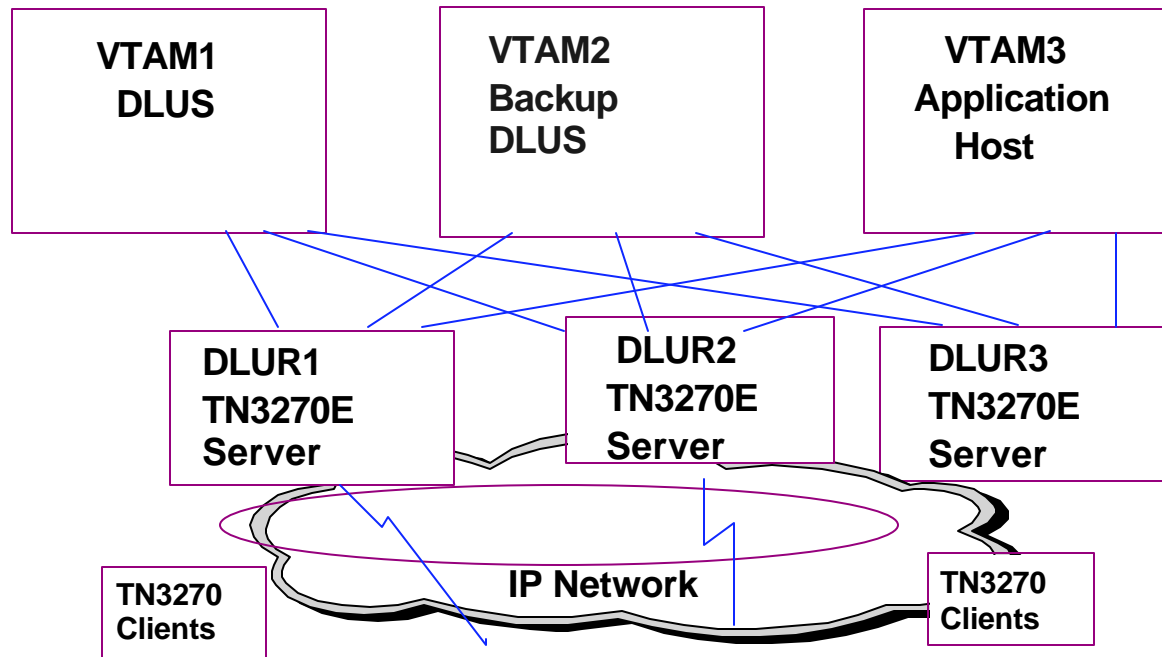
Remote DLUR Duplicate MAC Addressing



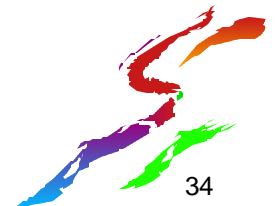
- Use duplicate MAC addressing in remote DLURs
 - Exploit HPR high availability for everything except connection to non-HPR end users
 - Only disruptive to sessions if RTP endpoint or connection to end station becomes inoperative
- Network exploits newer technologies (i.e. ATM, Enterprise Extender)
- Additional capacity added easily, also works with NCPs in datacenter



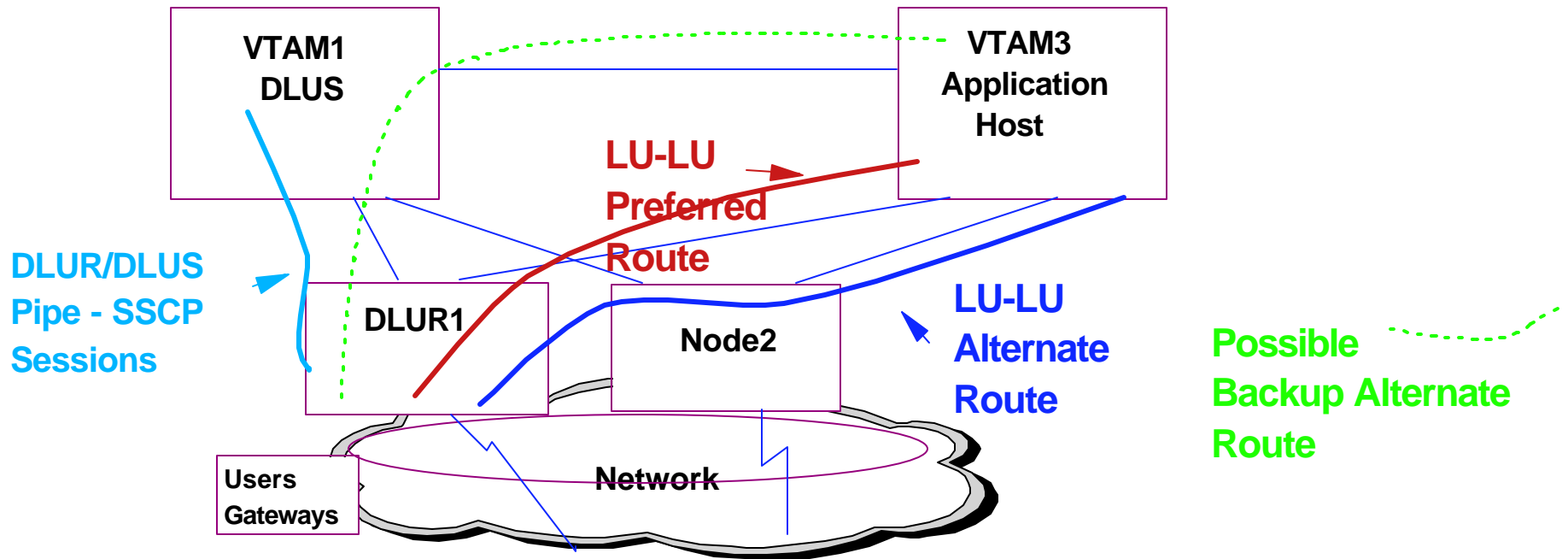
DLUR as TN3270 Server



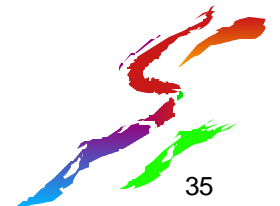
- **TN3270 Servers may use DLUR functions -- APPN/HPR network to host, IP network to clients**
 - **Alternate routing capabilities in both kinds of networks**
- **221X Network Dispatcher provides high availability and load balancing**
 - **TN3270 Clients request Server name or address**
 - **Network Dispatcher balances over available Servers**



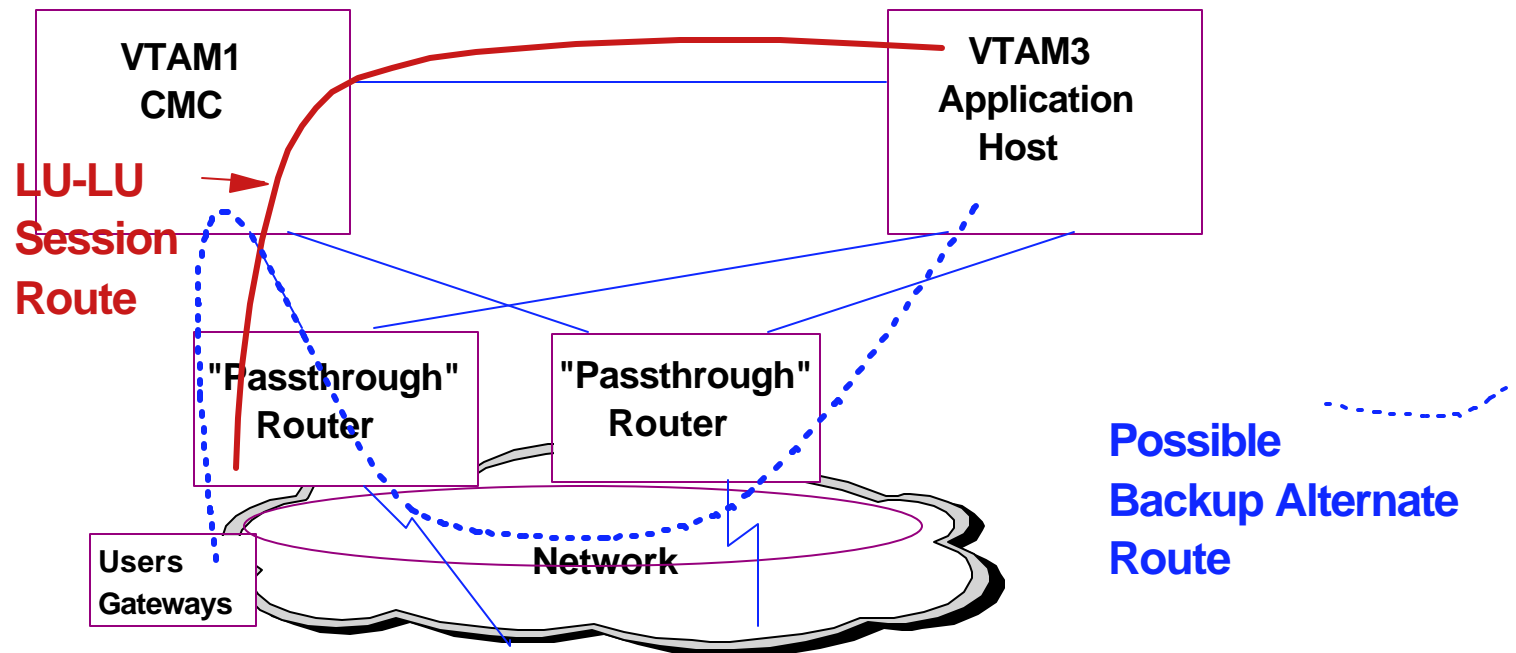
DLUR and Alternate Routing



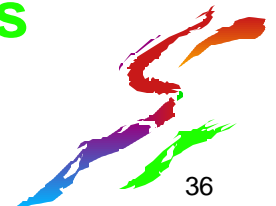
- APPN "least weight route" selected at session setup based on APPN Class of Service (COS)
 - With APPN, loss of route is disruptive to sessions, but can be reestablished over alternate route
 - With HPR, sessions can be continued using alternate route
- Usually avoid routing through VTAM
 - Need to consider "weights" of routes



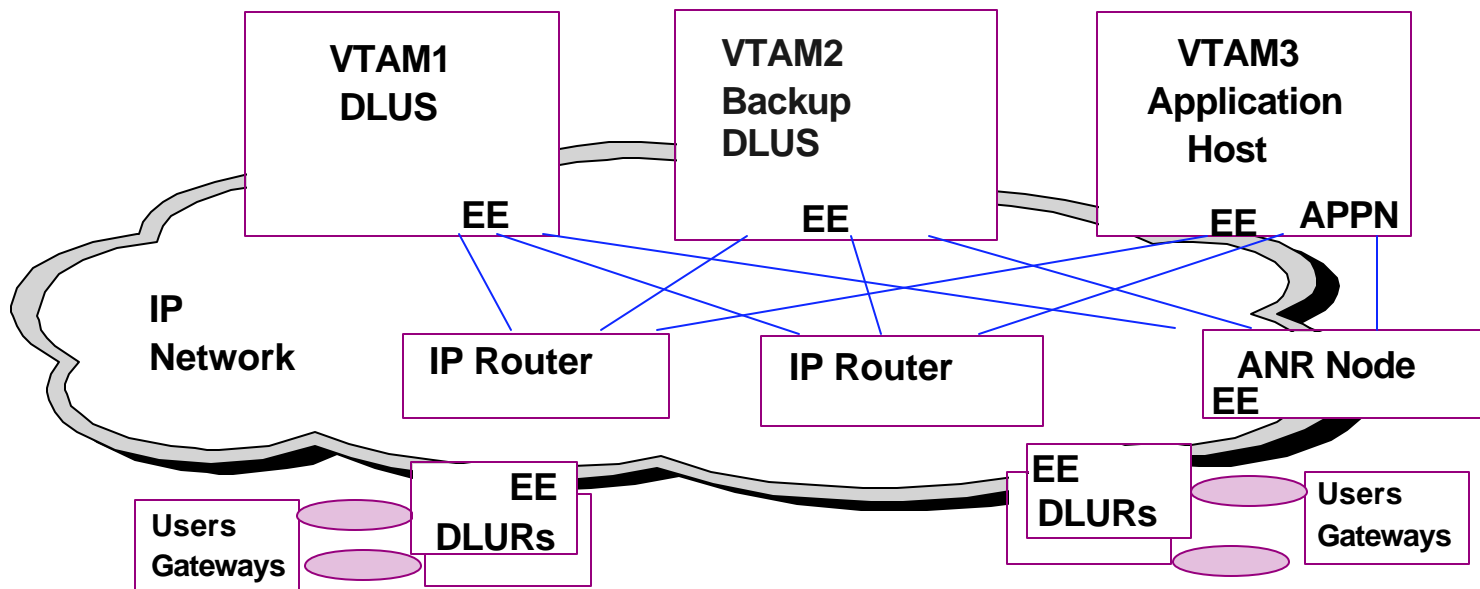
LSA Routing with VTAM



- LSA channel protocol (XCA VTAM definition) with 3172-like router causes all cross domain traffic to route through CMC
 - Channel protocol requires more cycles than alternatives such as CDLC or MPC+
 - Loss of route or owning VTAM is disruptive to sessions
 - Not easily backup up on another VTAM



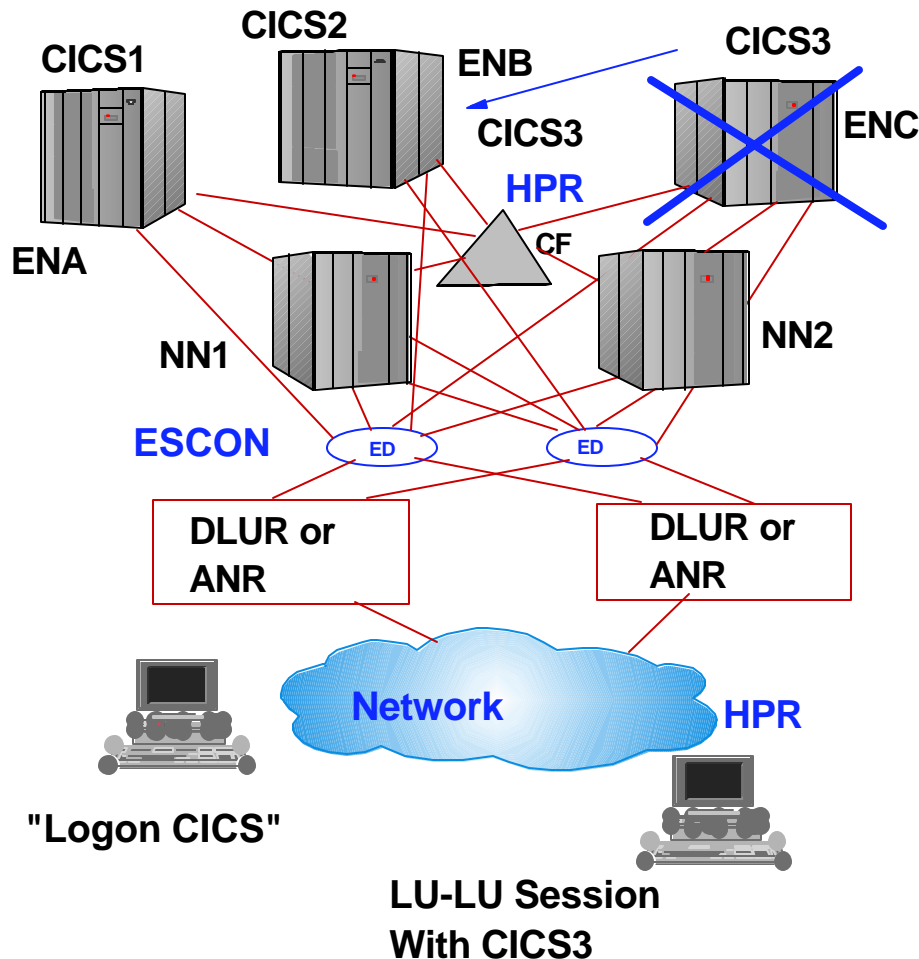
DLUR and Enterprise Extender



- Enterprise Extender (EE) allows HPR over IP
- IP Network becomes "TG" in APPN/HPR session route
- Available in CommServer and 221X products
- Data sent as UDP datagrams
- RTP endpoints recover from lost frames, provide ARB, etc.
- Allows exploitation of IP networking technologies for SNA sessions



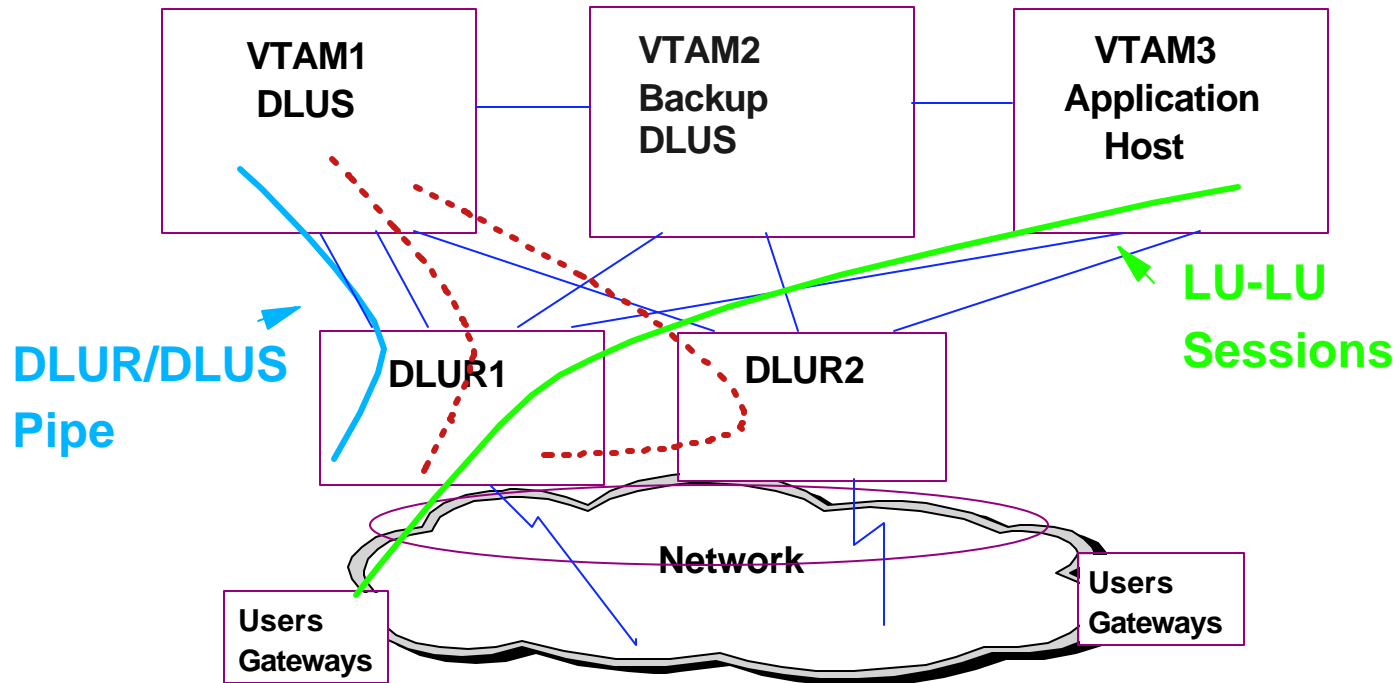
Sysplex High Availability Functions



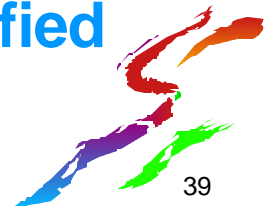
- Generic resources requires APPN in Parallel Sysplex
- Multinode persistent sessions requires HPR
- If HPR only in Sysplex, requires routing sessions through VTAM NN
- If HPR also outside Sysplex allows higher availability configurations, more options (i.e. XCF, EE)



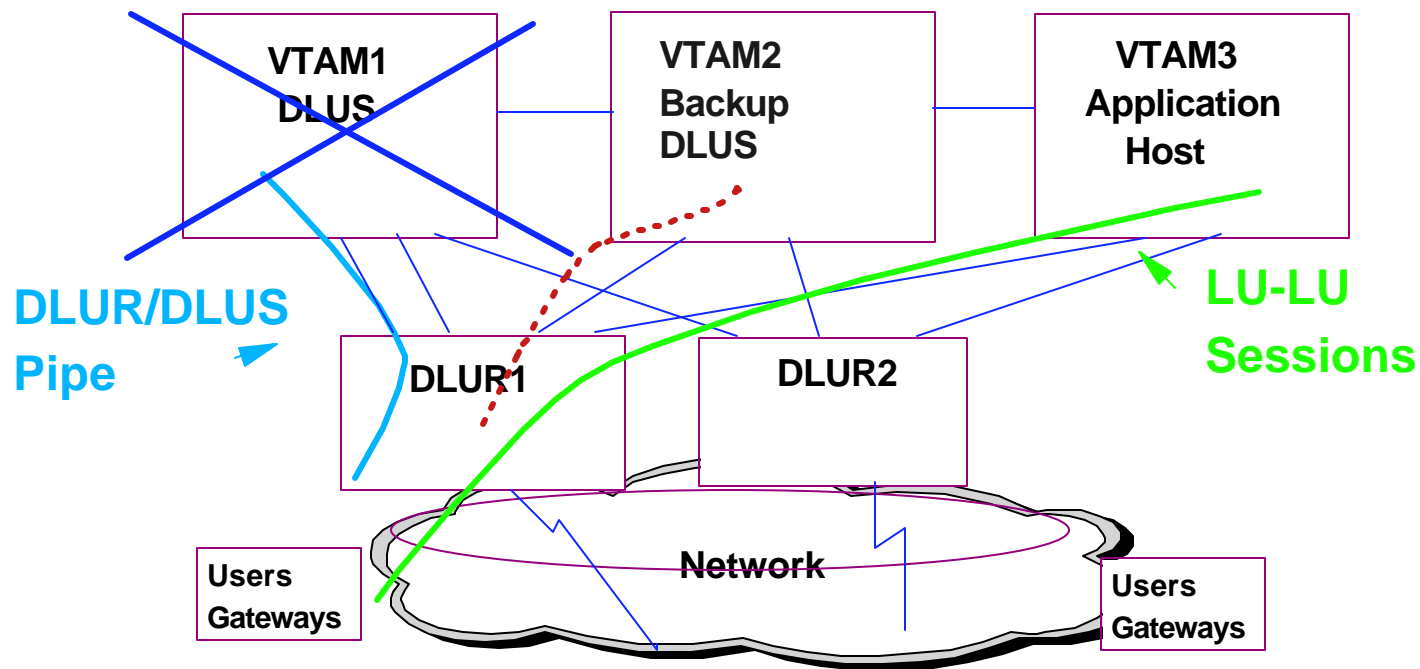
DLUR Ownership and Backup



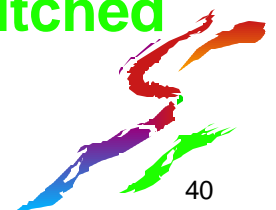
- Loss of connection between VTAM1 and DLUR1 causes automatic recovery over alternate route
 - Through 2nd DLUR1 channel adapter or other route
 - If pipe on HPR connection, sessions continue through HPR path switch
- LU-LU sessions continue if ANS=CONT has been specified
- SSCP sessions reestablished if APPN, switched if HPR



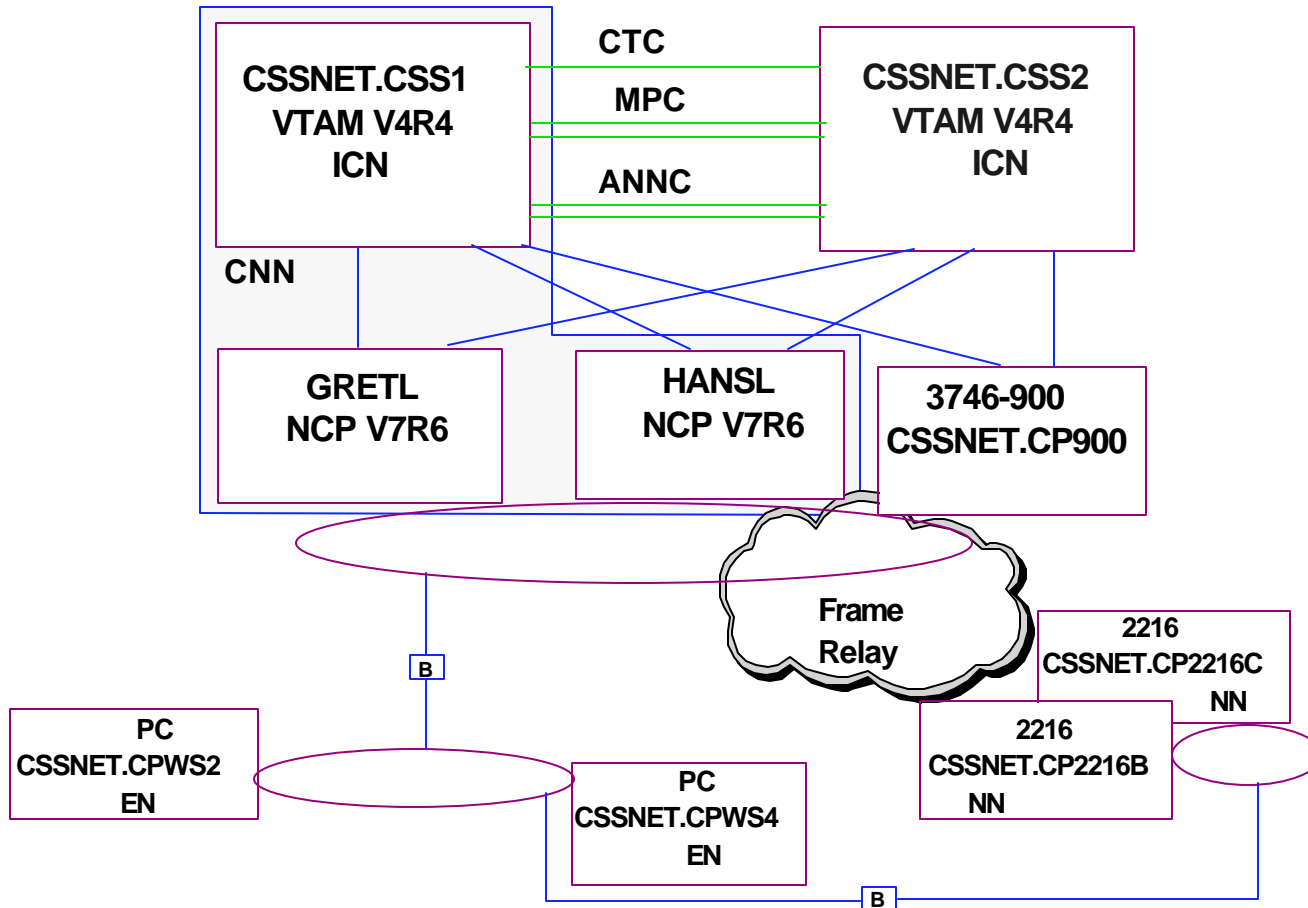
DLUS and Backup DLUS



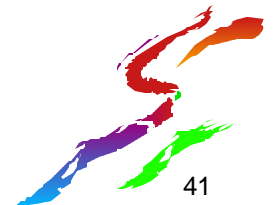
- Loss of VTAM1 causes DLUR to retry primary DLUS and then try backup DLUS to establish DLUR/DLUS pipe
 - VTAM2 needs Switched Major nodes
 - With VTAM V4R4 or higher same Switched Major nodes can be simultaneously active on VTAM1 and VTAM2
- LU-LU sessions continue if not to or through VTAM1 (ANS=CONT)
 - If through VTAM1 and using HPR are non-disruptively switched
- SSCP sessions reestablished
- Later, VTAM2 can non-disruptively "giveback" DLUR



DLUR-DLUS Lab Example



- 2216s are connected to HANSL and 3746-900
- 2216s and 3746 function as DLUR nodes
- CSS1 is primary, CSS2 is backup DLUS

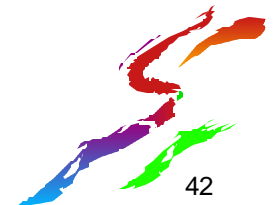


CSS1 Activation of 3746-900

```
V NET,ACT,ID=ETLOC900
IST097I VARY ACCEPTED
IST093I ETLOC900 ACTIVE
IST1086I APPN CONNECTION FOR CSSNET.CP900 IS ACTIVE - TGN = 21
IST093I PU9001 ACTIVE
IST1488I ACTIVATION FOR RTP CNR0000A AS PASSIVE PARTNER COMPLETED
IST1488I ACTIVATION FOR RTP CNR0000B AS ACTIVE PARTNER COMPLETED
IST1096I CP-CP SESSIONS WITH CSSNET.CP900 ACTIVATED
IST1488I ACTIVAION FOR RTP CNR0000C AS PASSIVE PARTNER COMPLETED
IST1488I ACTIVATION FOR RTP CNR0000D AS ACTIVE PARTNER COMPLETED
```

```
D NET,DLURS
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = DLURS
IST1352I DLUR NAME DLUS CONWINNER STATE DLUS CONLOSER STATE
IST1353I CSSNET.CP2216C ACTIVE ACTIVE
IST1353I CSSNET.CP900 ACTIVE ACTIVE
IST314I END
```

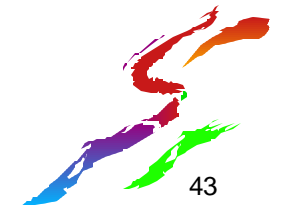
- **CSS1 activates channel connection to 3746-900**
- **HPR connections for CP-CP, RTSETUP, & DLUR/DLUS pipe**
- **CSS1 is DLUS for CP900 and CP2216C**



CSS1 Display of CP900

```
D NET, ID=CP900
IST097I DISPLAY ACCEPTED
IST075I  NAME = CSSNET.CP900      , TYPE = ADJACENT CP
IST486I  STATUS= ACT/S----Y, DESIRED STATE= ACTIV
.....
IST206I SESSIONS:
IST1081I ADJACENT LINK STATION = CNR0000D
IST634I NAME      STATUS          SID          SEND  RECV  VR  TP  NETID
IST635I CSS1      ACTIV/DL-S  C4CBD9093A6BD079 0014 0000  0  0  CSSNET
IST635I CSS1      ACTIV/DL-P  FD87C3E940E434CE 0000 0017  0  0  CSSNET
IST1081I ADJACENT LINK STATION = CNR0000A
IST634I NAME      STATUS          SID          SEND  RECV  VR  TP  NETID
IST635I CSS1      ACTIV/CP-S  C4CBD9093A6BD076 0007 0001          CSSNET
IST1081I ADJACENT LINK STATION = CNR0000B
IST634I NAME      STATUS          SID          SEND  RECV  VR  TP  NETID
IST635I CSS1      ACTIV/CP-P  FD87C3E940E434CC 0001 000A  0  0  CSSNET
IST1355I PHYSICAL UNITS SUPPORTED BY DLUR CSSNET.CP900
IST089I PSWS4     TYPE = PU_T2.1      , ACTIV-----
.....
```

- **CSS1 VTAM to 3746-900 DLUR-DLUS pipe is on HPR connection CNR0000D**



CSS1 Inactivates Channel to 3746-900

```
VARY NET,INACT,ID=ETLOC900,F
IST097I  VARY      ACCEPTED
IST1196I  APPN CONNECTION FOR CSSNET.CP900      INACTIVE - TGN = 21
IST1494I  PATH SWITCH STARTED FOR RTP CNR0000D  ←
IST1494I  PATH SWITCH STARTED FOR RTP CNR0000B
IST105I  PU9001  NODE NOW INACTIVE
IST105I  ETLOC900 NODE NOW INACTIVE
IST1494I  PATH SWITCH STARTED FOR RTP CNR0000A
IS488I  INACTIVATION FOR RTP CNR0000C AS PASSIVE PARTNER COMPLETED
IST619I  ID = CNR0000C FAILED - RECOVERY IN PROGRESS
IST129I  UNRECOVERABLE OR FORCED ERROR ON NODE CNR0000C - VARY INACT SCHE
IST105I  CNR0000C NODE NOW INACTIVE
IST871I  RESOURCE CNR0000C DELETED
IST1494I  PATH SWITCH COMPLETED FOR RTP CNR0000D
IST1480I  RTP END TO END ROUTE - PHYSICAL PATH
IST1460I  TGN  CPNAME          TG TYPE      HPR
IST1461I   21  CSSNET.CP2216C  APPN      RTP
IST1461I   21  CSSNET.CP900    APPN      RTP
IST314I  END
```

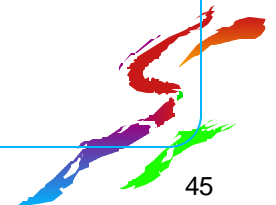
- **Bringing down channel causes HPR Path Switch**
 - **New route for CNR0000D is CSS1(HANSL) - CP2216C - CP900**



Procedure for Use of Backup DLUS

- To start CSS1 and CSS2 have active channel connections to CP900 - DLUR-DLUS pipe is between CP900 and CSS1
- CSS1 Display of 3746-900 topology information:

```
D NET,TOPO,ID=CP900,LIST=ALL
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = TOPOLOGY 697
IST1295I CP NAME                NODETYPE  ROUTERES  CONGESTION  CP-CP  WEIGHT
IST1296I CSSNET.CP900          NN         128       NONE        YES    *NA*
IST1579I
IST1297I                        ICN/MDH   CDSERVR   RSN          HPR
IST1298I                        NO        NO        34          RTP
IST1579I
IST1223I                        BN        NATIVE    TIME LEFT
IST1224I                        NO        YES       15
IST1299I TRANSMISSION GROUPS ORIGINATING AT CP CSSNET.CP900
IST1357I
IST1300I DESTINATION CP        TGN        STATUS     TGTYPE      VALUE  WEIGHT
IST1301I CSSNET.CP2216B       21         OPER      INTERM      YES    *NA*
IST1301I CSSNET.CP2216C       21         OPER      INTERM      YES    *NA*
IST1301I CSSNET.CSS1          21         OPER      INTERM      YES    *NA*
IST1301I CSSNET.CSS2          21         OPER      INTERM      YES    *NA*
IST314I END
```



Change DLUS to CSS2

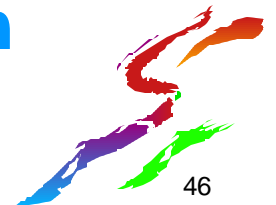
- **At CSS1:**

```
V NET,INACT,ID=CP900,TYPE=GIVEBACK,FINAL=YES
IST097I  VARY          ACCEPTED
IST129I  UNRECOVERABLE OR FORCED ERROR ON NODE CP900      - VARY INACT SCHE
IST241I  INACT GVBK COMMAND COMPLETE FOR CSSNET.CP900
IST663I  BFINIT      REQUEST FROM CSS1PUS  FAILED  , SENSE=080A000D
IST664I  REAL  OLU=CSSNET.CP900          REAL  DLU=CSSNET.CSS1
IST889I  SID = C4CBD9093AB204C3
IST314I  END
```

- **At CSS2:**

```
D NET,DLURS
IST097I  DISPLAY ACCEPTED
IST350I  DISPLAY TYPE = DLURS 313
IST1352I  DLUR NAME          DLUS CONWINNER STATE  DLUS CONLOSER STATE
IST1353I  CSSNET.CP900      ACTIVE          ACTIVE
IST314I  END
```

- **When 3746-900 can't start DLUR-DLUS pipe with CSS1, starts pipe with DLUS coded as backup**



Change DLUS Back to CSS1

- **At CSS1:**

```
V NET,ACT,ID=CP900
IST097I  VARY          ACCEPTED
IST093I  CP900        ACTIVE

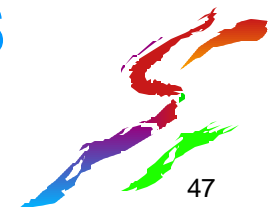
D NET,DLURS
IST097I  DISPLAY ACCEPTED
IST350I  DISPLAY TYPE = DLURS 313
IST1352I DLUR NAME           DLUS CONWINNER STATE  DLUS CONLOSER STATE
IST1353I CSSNET.CP2216C      ACTIVE                ACTIVE
IST314I  END
```

- **At CSS2:**

```
V NET,INACT,ID=CP900,TYPE=GIVEBACK,FINAL=YES
IST097I  VARY          ACCEPTED
IST129I  UNRECOVERABLE OR FORCED ERROR ON NODE CP900    - VARY INACT
SCHE
IST241I  INACT GVBK COMMAND COMPLETE FOR CSSNET.CP900
```

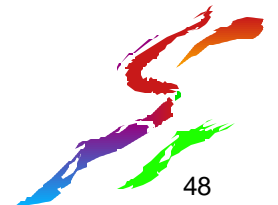
.....

- **May take a short time for CSS1 to become DLUS**



Summary of DLUR-DLUS Operation

- DLUS function can rolled between hosts through use of :
 - V NET,INACT,ID=dlurcpname,TYPE=GIVEBACK,FINAL=YES
- When primary VTAM available again, can issue:
 - V NET,ACT,ID=dlurcpname
 - **No need for this if VTAM has been recycled**
 - Present DLUS needs to INACT with GIVEBACK
- Roll to backup DLUS can also be accomplished through taking down ALL connectivity into primary DLUS
- Even without HPR, DLUR node attempts sessions with primary DLUS before trying backup DLUS



Summary

- **Availability and backup with traditional VTAM/NCP networks**
 - **Hardware backup**
 - **Alternate Routing**
 - **Parallel Sysplex Considerations**
 - **Owning and Backup VTAM**
 - **Review of operational procedures**
- **Review of DLUS/DLUR and APPN/HPR concepts**
- **Availability and backup with DLUS/DLUR networks**
 - **Hardware backup**
 - **Alternate Routing**
 - **APPN, LSA Subarea, Enterprise Extender**
 - **Parallel Sysplex Considerations**
 - **DLUS and backup DLUS**
 - **Operational procedures**

