

Modernizing SNA: Enterprise Extender Concepts and Considerations

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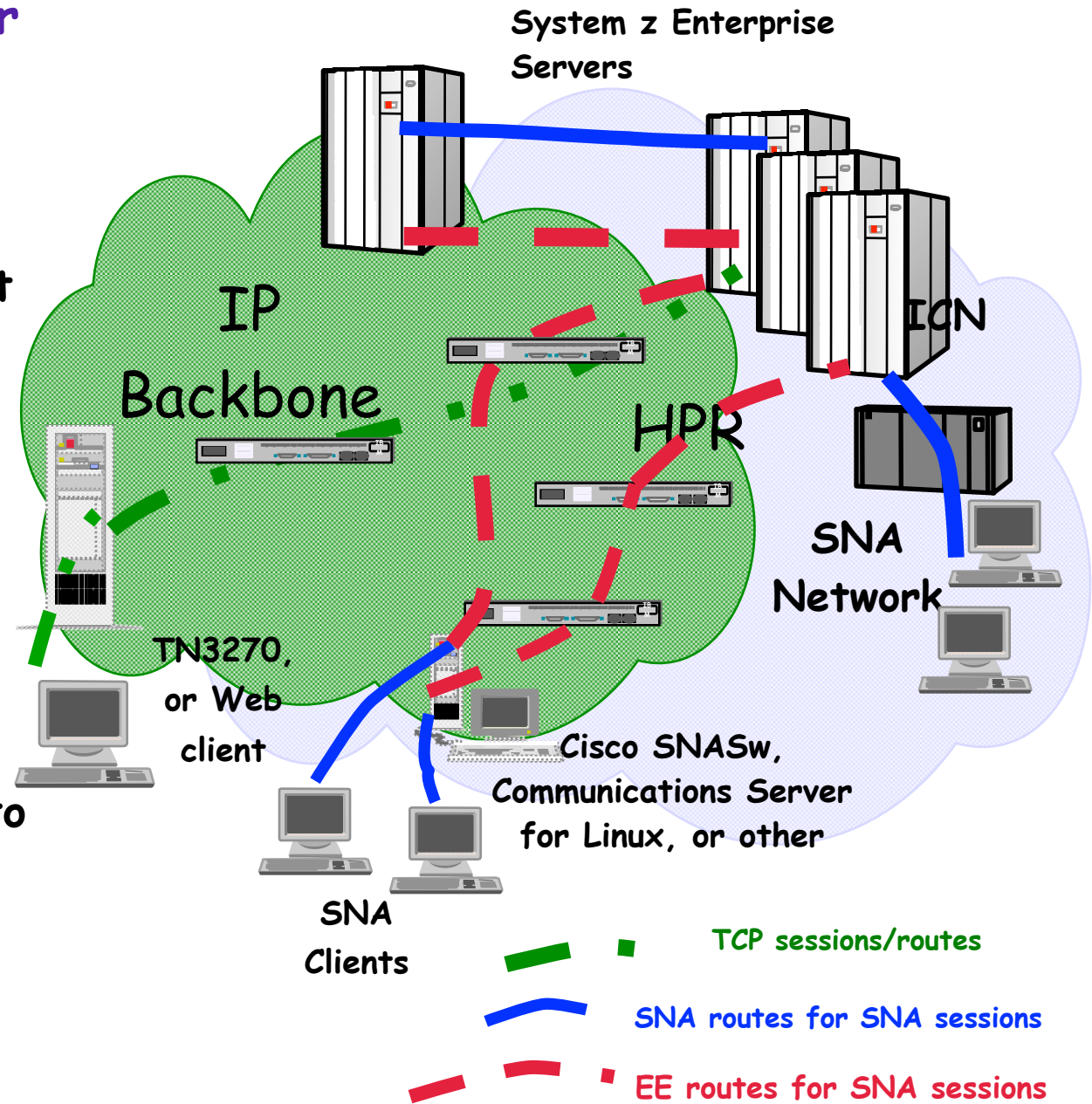
Agenda

- What is Enterprise Extender?
- Planning for Enterprise Extender
- Defining and Operating EE on z/OS
- Enterprise Extender Scenario

What is Enterprise Extender?

What is Enterprise Extender?

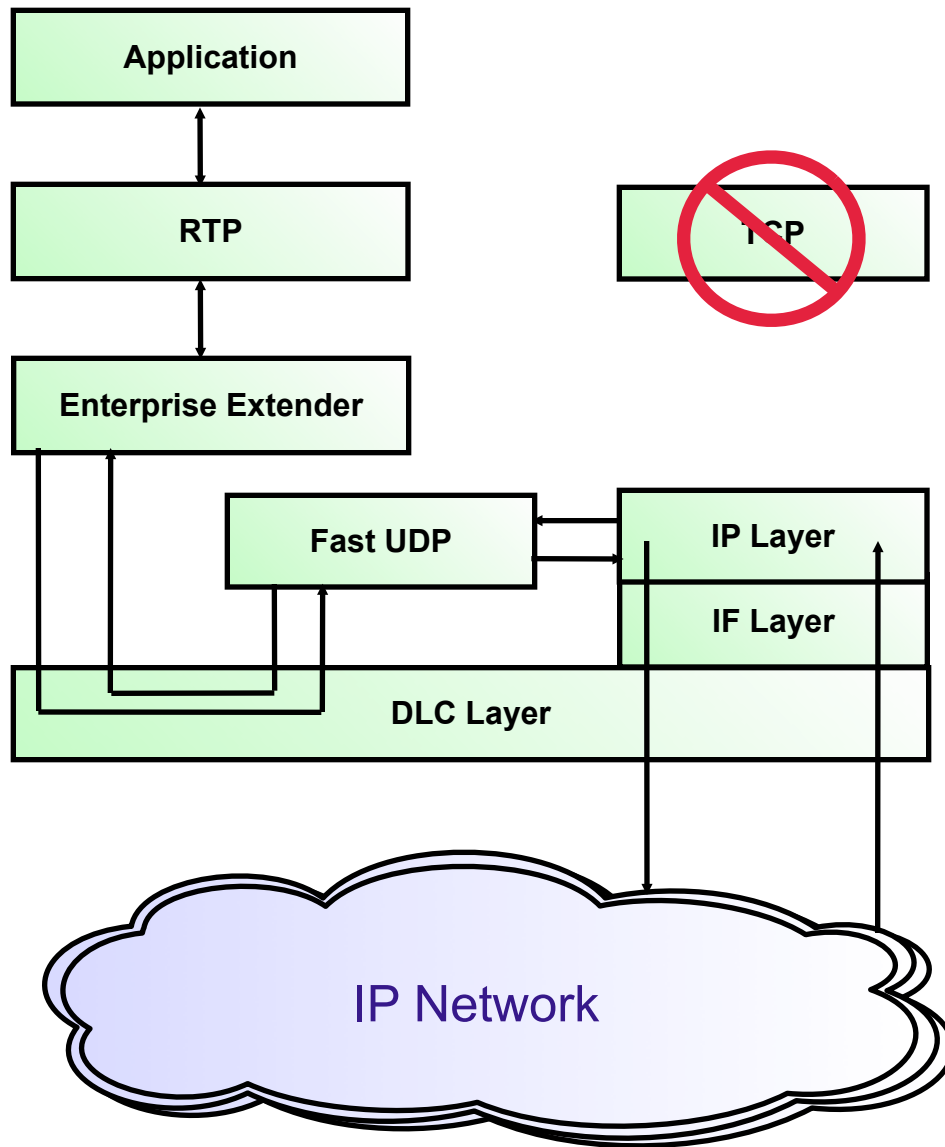
- Allows use of IP network for SNA sessions
- EE allows enablement of IP applications and convergence on a single network transport while preserving SNA application and endpoint investment.
- Conceptually, IP network looks like APPN/HPR TG in session route
 - An EE link represents IP connectivity from this host to the specified IP address or host name.
- Typically isolates SNA footprints to the "outside" of the network.



Advantages of Enterprise Extender

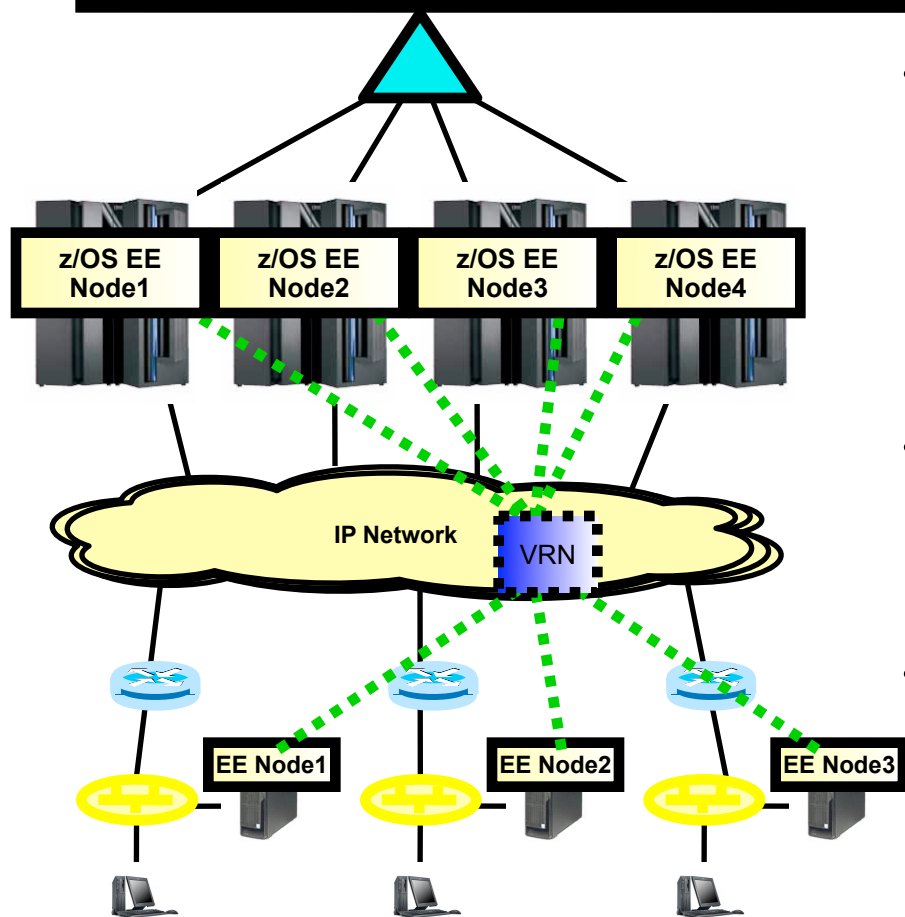
- SNA transport over native IP network
 - Native IP routing within network maximizes router efficiency
 - Enables SNA applications to take advantage of advances in IP routing
 - SNA traffic can exploit OSA Gigabit/10G Ethernet & HiperSockets (which lack native SNA support)
- No changes to SNA applications
- End-to-End failure protection and data prioritization
 - SNA priority mapped to IP Type of Service (TOS)
- EE works with IPSEC and SNA Session Level Encryption

Enterprise Extender on z/OS



- For Enterprise Extender, z/OS CS implemented a separate UDP layer (Fast UDP) optimized for EE communications
- Fast UDP communicates with EE (the APPN over UDP component in VTAM) via the IUTSAMEH device

EE Connection Network



- A connection network is an APPN technology that reduces the need for predefining APPN links between nodes that are connected to a shared transport facility, such as a LAN or general IP network.
- The shared transport facility (the IP network in the EE case) is represented as an APPN Virtual Routing Node (VRN).
- In this example topology, all EE nodes can send EE packets directly to each other without defining links to all the other nodes.
- The combination of EE with connection network technology is generally recommended with the objective of reducing the amount of link definitions that are required and to allow EE endpoint to endpoint communication to flow directly between the associated IP endpoints.
- For more information on connection network, see the follow-on presentation at: http://proceedings.share.org/client_files/SHARE_in_Denver/S3206SR100305.pdf

Planning for Enterprise Extender

Enterprise Extender Planning

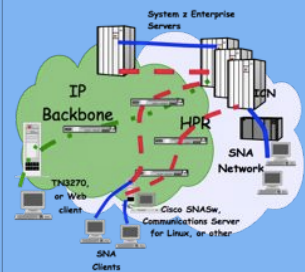
• Planning issues

- EE is supported on z/OS, Linux, AIX, Windows (CS and PComm), i5/OS, Cisco SNASw, Microsoft HIS, and Tandem
- Must implement VTAM APPN first and understand subarea/APPN interoperability
 - This may be an educational/skill issue
- IP Routing and Addressing
 - Static virtual IP address is required
 - Dynamic Routing should be used to allow redundancy
- APPN Link Weights
 - EE-specific TGPs are provided with VTAM. It is recommended that you use one of these TGPs, such as GIGENET, or a customized TGP with a capacity value representing the likely available bandwidth between the two EE endpoints.
- Router setup for packet prioritization in network

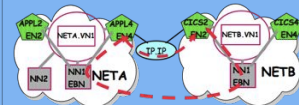
z/OS CS: EE Evolution



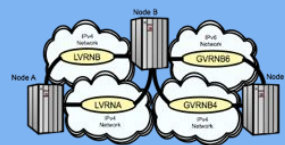
EE First Provided on OS/390 V2R7
March 1999



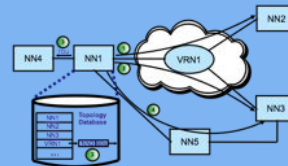
EE Global Connection Network
October 2001



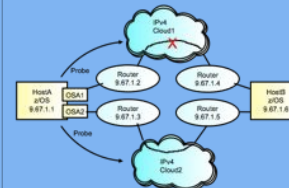
Multiple VRN, IPv6 Support, and EE NMI
March 2004



EE Connection Network Reachability Awareness
September 2004



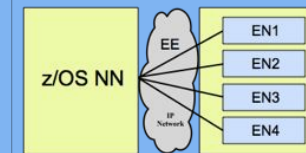
EE Connectivity Test Command
September 2006



Path MTL Discovery for EE
September 2008



Progressive Mode ARB
September 2009



EE Health Verification
September 2010



2000 2001 2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 Evolution of EE



"Recent" EE Enhancements

•EE enhancements in z/OS

V1R9 CS:

- HPR Message Enhancements
- HPR Path Switch Summarization
- EE Enhanced Packet Loss Tolerance
- EE LDLC Granularity
- Local MTU Discovery for EE

•EE enhancements in z/OS

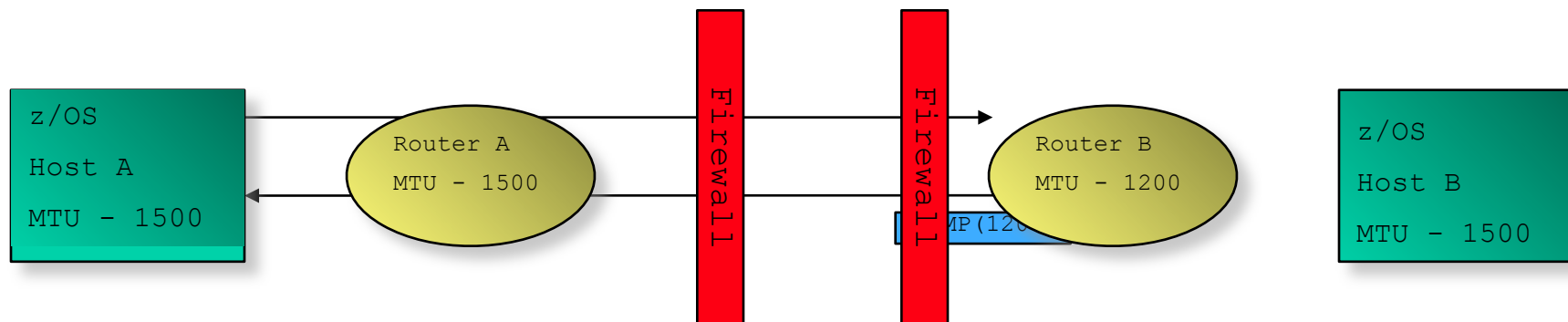
V1R10 CS:

- Path MTU Discovery for EE
- RTP Pipe Session Limit Control
- TGN Parameter for EE model PUs

•EE enhancements in z/OS

V1R11 CS:

- Progressive Mode ARB
- HPR Path Switch Delay



•EE enhancements in z/OS

V1R12 CS:

- EE Connection Health Verification
- EE Multipath Control

•EE enhancements in z/OS

V1R13 CS:

- EE Firewall-Friendly Connectivity Test
- IDS for EE

EE/EBN As An SNI Alternative

• An SNI gateway:

- Must connect to another SNA subarea node.
- Complex to define and configure
- Requires an NCP

• APPN multiple network connectivity

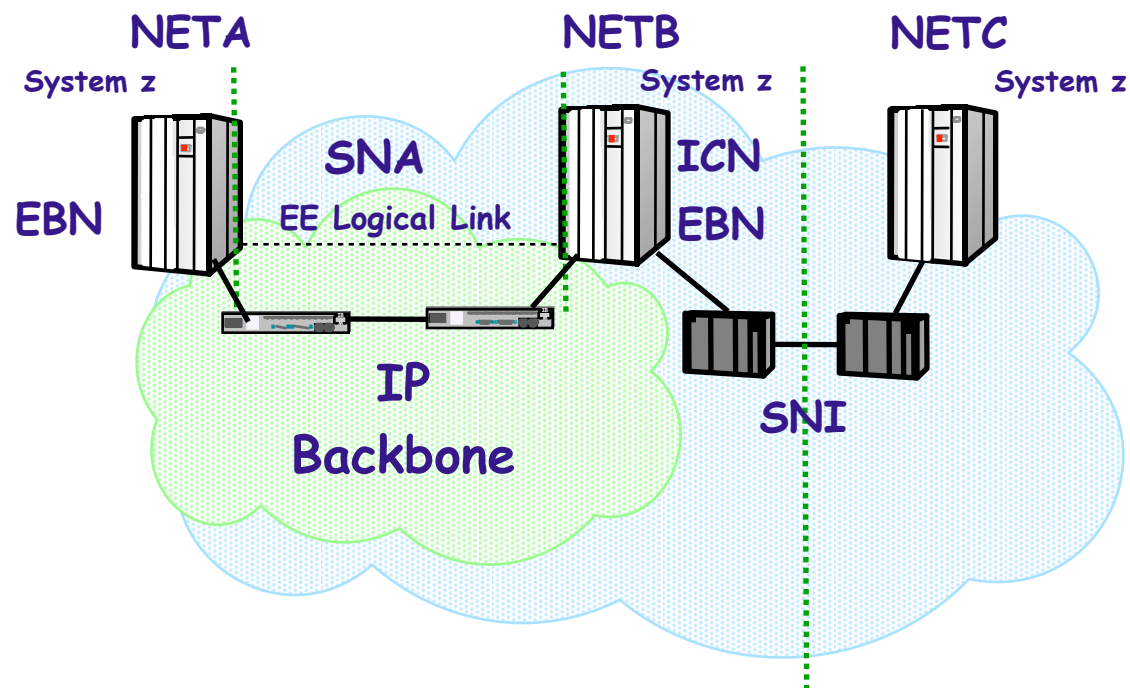
- APPN's alternative to SNI for SNA connectivity between different APPN NET IDs
- Implemented via Extended Border Node (EBN)

• An EE/EBN endpoint:

- Must connect to another APPN network node (preferably another EBN)
- Availability advantages of HPR with z/OS EBN

- If a z/OS VTAM is configured for both EE/EBN and SNI connectivity, and in addition is configured as an Interchange Node (ICN), it can interconnect the SNI partner with the EE/EBN partner and support SNA sessions between the SNI partner and the EE/EBN partner

- NETA LUs can establish sessions with NETC LUs via the NETB interchange node



SNI to EE/EBN Considerations

- Partner network also needs to define APPN, BN, and EE
 - VSE and VM VTAM do not provide EE
 - IP addressing coordination
- With SNI, sessions between nodes in different networks normally route through 3745s directly to partners
 - With Border Node - sessions may route through VTAMs acting as BNs (HPR routing)
 - Global Connection Network should be considered
 - Security considerations include:
 - SME changes or use of DSME instead
 - See "Practical Guide to Optimizing APPN and EBN Searches" in SHARE Denver (Summer 2009) proceedings
 - Firewalls must allow UDP packets on ports 12000-12004
 - If defining an EE Connection Network over an IP network which employs Network Address Translation (NAT), you must define the virtual routing node's addressability using the HOSTNAME operand (not the IPADDR operand)

Defining and Operating EE on z/OS

z/OS CS Enterprise Extender Definitions

- **VTAM Definitions:**

- **Start Options**

- Must consider: IPADDR, HOSTNAME, and TCPNAME
 - Should consider: EEVERIFY, HPRCLKRT, HPRPSDLY, HPRPSMSG

- **XCA Major Node for EE DLC (Medium=HPRIP)**

- **Switched Major Nodes for Linkstations**

- **TCP/IP Definitions:**

- **Profile Definitions:**

- Port reservations - by default and recommendation, EE uses PORTS 12000-12004 and TOS C0,C0,80,40,20 (respectively)
 - IUTSAMEH device and link (or use DYNAMICXCF)
 - Static VIPA address

- **Other considerations:**

- Dynamic routing is recommended but not required

EE XCA Major Node

```
XCAEE      VBUILD TYPE=XCA
PORTEE     PORT   MEDIUM=HPRIP
GRPEEP     GROUP  DIAL=YES , AUTOGEN= (10 , E , X) ,
              CALL=INOUT , ISTATUS=ACTIVE , IPADDR=10.1.1.1
```

*

- Only one XCA with MEDIUM=HPRIP may be active
 - AUTOGEN is used to specify the maximum number of EE partners expected to be concurrently active
- Coding DYNPU=YES on GROUP allows dynamic definition of APPN PUs (CNxxxxxx)
 - Coding DYNPU=YES is not needed for connection network links to be dynamically defined
- A local EE IP address (or a hostname that will resolve to that address) can be specified at the GROUP level
- The IPADDR keyword is IPv4-only. IPv6 support requires the HOSTNAME keyword.

EE Switched Major Node Coding

- Has CPNAME (and NETID, if different) of EE partner
 - DWACT=YES causes "dial-out" to occur when SWNET activated
 - PATH Statement contains IP address or HOSTNAME of EE partner for dial-out
 - PATH statement not needed if partner always dials-in

```
CSS1SWEE VBUILD TYPE=SWNET
CSS1PUE  PU      ADDR=22 , DWACT=YES , TGP=FASTENET ,      *
          DISCNT=NO , CONNTYPE=APPN , PUTYPE=2 ,           *
          CPNAME=CSS1 , NETID=CSSNET , REDIAL=3 ,          *
          REDDELAY=30 , DWINOP=NO
CSS1EEPT PATH IPADDR=9.82.5.120 , GRPNM=GRPEEP
```

Importance of TG Characteristics

- **Recommendation:** Assign Transmission Group Profiles (TGPs) that reflect the media type being used.
- **Especially Important:** Coding TGPs for EE TGs and VR-TGs.
- The set of TGPs shipped with VTAM (in the IBMTGPS member) may be used as examples.
 - It is recommended that you customize the *CAPACITY* operand on the TGP to reflect the media speed of your network's underlying connectivity.
 - **Sample recommended TGPs from IBMTGPS:**
 - FASTENET, GIGENET, HIPERSOC, FICON, FICONEXP

Recommendation: Use `D TOPO,ORIG=,DEST=` commands to verify APPN connectivity, capacity values, and weights

Example: `D NET,TOPO,ORIG=CP1,DEST=CP2,APPNCOS=#CONNECT`

Coding TG Characteristics with EE

- IBM provides several TGPs in a member called IBMTGPS

- TGPs are a set of link characteristics like CAPACITY, SECURITY, COSTBYTE, etc. which may be associated with an APPN link
- Like other Switched Definitions, the TGP associated with an EE link is coded on the PU in the Switched Major Node

```
CSS1SWEE VBUILD TYPE=SWNET
CSS1PUE  PU      ADDR=22, TGP=FASTENET, DISCNT=NO,          *
                          CPNAME=CSS1, NETID=CSSNET, PUTYPE=2
CSS1EEPT PATH    IPADDR=9.82.5.120, GRPNM=GRPEEP
```

- Alternatively, individual link characteristics may be coded on the link definition

```
CSS1SWEE VBUILD TYPE=SWNET
CSS1PUE  PU      ADDR=22, CAPACITY=100M, PDELAY=NEGLIGIB, DISCNT=NO, *
                          CPNAME=CSS1, NETID=CSSNET, PUTYPE=2
CSS1EEPT PATH    IPADDR=9.82.5.120, GRPNM=GRPEEP
```

- EE XCA specifies Connection Network Link TGPs (or link parms):

```
XCAEE      VBUILD TYPE=XCA
PORTEE     PORT   MEDIUM=HPRIP
GRPEE     GROUP  DIAL=YES, AUTOGEN=(10,E,X),          *
                          CALL=INOUT, ISTATUS=ACTIVE,      *
                          VNNAME=CSSNET.HPRIP, TGP=FASTENET
```

EE Links: Associated "Control Flow" RTP Pipes

- When a new RTP pipe needs to be activated, a network flow known as an HPR Route Setup is sent along the route to be used for the RTP
 - This flow gathers information during both request and reply phases, such as
 - Automatic Network Routing labels to be used for the pipe
 - Minimum link speed along the path
 - A route setup also flows during HPR path switch



EE Links: Associated "Control Flow" RTP Pipes...

- EE is what the HPR architecture refers to as a "control flows" media, meaning that the delivery of route setups and CP-CP message flows is assured by setting up dedicated RTP pipes over the EE connection:
 - Route Setup RTP - The first time a route setup must flow over the connection, a route setup RTP is activated:
 - Only used to carry route setup replies and requests
 - It is associated with the link, and will be deactivated when the EE connection is deactivated
 - CP-CP RTP(s) - If CP-CP sessions come up over the connection, they will be placed on an RTP pipe (or pipes) dedicated to carrying CP-CP sessions
 - Conwinner and Conloser CP-CP sessions can come up over the same pipe or over two separate pipes
 - No explicit route setup flow is required to activate the CP-CP RTPs or the route setup RTP over an EE link.

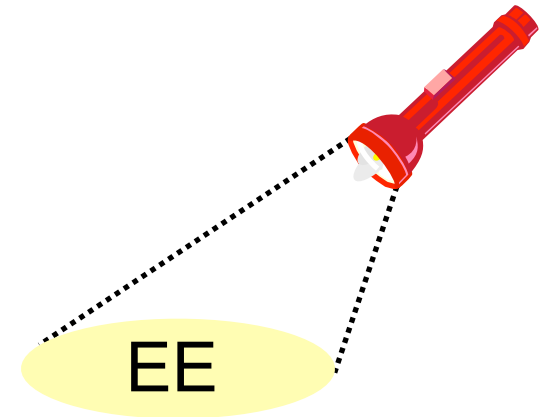


EE Links: Detecting Problems

- The EE Logical Data Link Control (LDLC) layer monitors the EE connection, and will terminate the EE connection if contact is lost with the partner
 - The LDLC inactivity trigger is controlled by three parameters on the PORT statement:
 - **LIVETIME**: The amount of time of inactivity before LDLC tests the connection
 - **SRQTIME**: The amount of time LDLC waits for a response to its test
 - **SRQRETRY**: The number of times the test is retried
 - The connection will be terminated if no activity/response for a duration of approximately:
$$\text{LIVETIME} + ((\text{SRQRETRY} + 1) * \text{SRQTIME})$$
 - The LDLC parameters can also be coded at the GROUP level

Display EE Command

- The DISPLAY EE operator command provides details about Enterprise Extender connectivity
- Three basic forms:
 - **General information**
 - Basic XCA settings
 - Local IP addresses and/or hostnames
 - RTP pipe and LU-LU session counts
 - Connection counts
 - **Specific connection information**
 - Local IP address and/or hostname
 - PU information
 - LDLC information
 - Data transfer statistics
 - **Aggregate connection information**
 - Local IP address and/or hostname
 - Connection counts
 - **Aggregate data transfer statistics**



EE Connectivity Test Command

- The Enterprise Extender connectivity test command is useful in debugging various network problems. This command can be used to test an existing Enterprise Extender connection, or it can be used to assist in diagnosing why an EE connection cannot be established.

- The EE connectivity test will verify:

- EE line availability

- Address resolution capability

- EE partner reachability

- The output generated from this request will show the reachability to the remote EE endpoint over all five UDP ports reserved for EE.

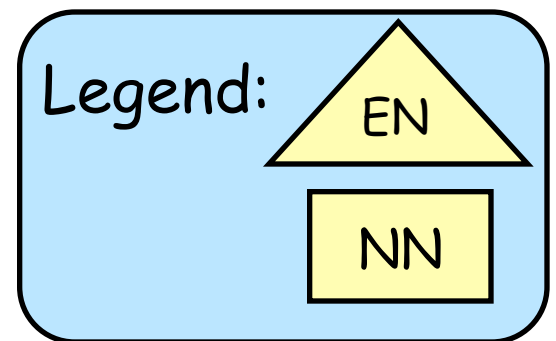
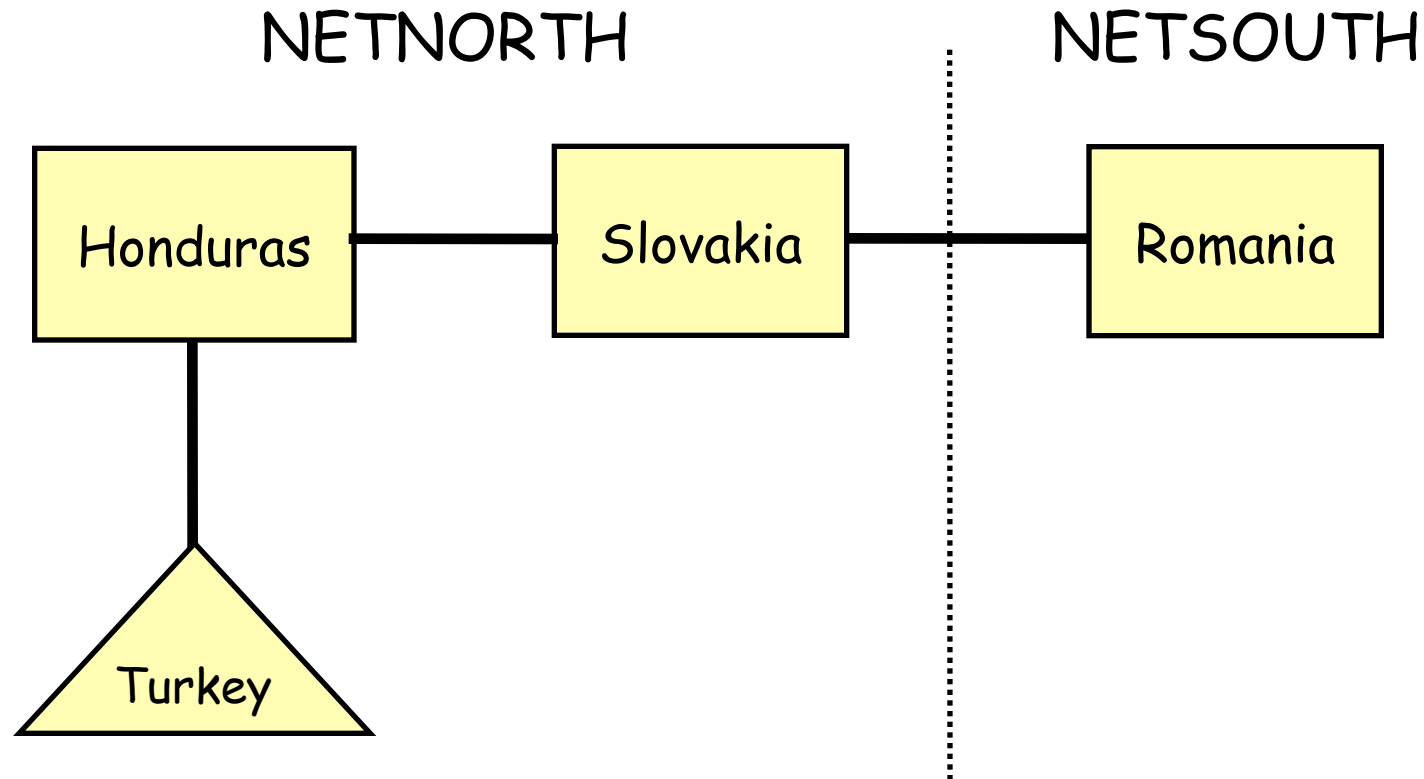
- When multipath is enabled for EE, the EE connectivity test is repeated for each valid TCP/IP interface which routes EE traffic.

```
D NET, EEDIAG, TEST=YES, LIST=DETAIL, ID=ETU2HO
...
IST2067I EEDIAG DISPLAY ISSUED ON 07/11/07 AT 10:41:12
IST1680I LOCAL IP ADDRESS 197.51.125.1
IST1680I REMOTE IP ADDRESS 197.51.153.1
...
IST924I -----
IST2133I INTFNAME: LMTU2BR55                                INTFTYPE: MPCPTP
IST2134I CONNECTIVITY SUCCESSFUL                                PORT: 12000
IST2137I 1 197.51.155.14                                RTT: 1
IST2137I 2 197.51.153.1                                RTT: 4
IST2134I CONNECTIVITY SUCCESSFUL                                PORT: 12001
IST2137I 1 197.51.155.14                                RTT: 2
IST2137I 2 197.51.153.1                                RTT: 4
IST2134I CONNECTIVITY SUCCESSFUL                                PORT: 12002
IST2137I 1 197.51.155.14                                RTT: 2
IST2137I 2 197.51.153.1                                RTT: 5
IST2134I CONNECTIVITY SUCCESSFUL                                PORT: 12003
IST2137I 1 197.51.155.14                                RTT: 2
IST2137I 2 197.51.153.1                                RTT: 6
IST2134I CONNECTIVITY SUCCESSFUL                                PORT: 12004
IST2137I 1 197.51.155.14                                RTT: 3
IST2137I 2 197.51.153.1                                RTT: 5
...
```



Enterprise Extender Scenario

Configuration Diagram



Definitions at Turkey

```
TUXCAGN  VBUILD  TYPE=XCA
TUPORTGN PORT    MEDIUM=HPRIIP
*
TUGPEE   GROUP   DIAL=YES, CALL=INOUT,                                X
                AUTOGEN=(5, EV4, P), DYNPU=YES, ISTATUS=ACTIVE
*****
* LOCAL VRN                                           *
*****
TUGVL01  GROUP   DIAL=YES, CALL=INOUT, VNNAME=NETNORTH.LVRN,          X
                AUTOGEN=(5, LV01, P), DYNPU=YES, VNTYPE=LOCAL,        X
                HOSTNAME=TUVIPA2.AREA51.SVT390.COM,                    X
                ISTATUS=INACTIVE, TGP=V002, CAPACITY=100M
*****
* GLOBAL VRN                                           *
*****
TUGVG01  GROUP   DIAL=YES, CALL=INOUT, VNNAME=CROSSNET.GVRN,          X
                AUTOGEN=(5, GV01, P), DYNPU=YES, VNTYPE=GLOBAL,        X
                HOSTNAME=TUVIPA3.AREA51.SVT390.COM,                    X
                ISTATUS=INACTIVE, TGP=V003
```

Excerpt from
Start List:

```
...
IPADDR=197.51.125.1,
NETID=NETNORTH,
NODETYPE=EN,
SSCPNAME=TURKEY,
TCPNAME=TCPSVT,
...
```

```
TOIP      VBUILD  TYPE=SWNET
***** TO HONDURAS
ETU2HO    PU      TGP=EEV4, TGN=4, NETID=NETNORTH,                    X
                CPCP=YES, CPNAME=HONDURAS,                            X
                PUTYPE=2, CAPACITY=24M
PTU2HO    PATH    GRPNM=TUGPEE, REDIAL=10, REDDELAY=120,              X
                IPADDR=197.51.153.1
```

Definitions at Honduras

```
HOXCAGN  VBUILD  TYPE=XCA
HOPORTGN  PORT    MEDIUM=HPRIP
*
HOGPEE    GROUP   DIAL=YES , CALL=INOUT ,
              AUTOGEN=( 5 , E , P ) , DYNPU=YES , ISTATUS=ACTIVE
```

X

```
TOIP      VBUILD  TYPE=SWNET
```

```
*
EHO2SL    PU      TGP=EEV4 , TGN=4 , NETID=NETNORTH ,
              CPCP=YES , CPNAME=SLOVAKIA ,
              PUTYPE=2 , CAPACITY=24M
```

X

X

```
PHO2SL    PATH    GRPNM=HOGPEE ,
              IPADDR=197.11.115.1
```

X

```
*
EHO2TU    PU      TGP=EEV4 , TGN=4 , NETID=NETNORTH ,
              CPCP=YES , CPNAME=TURKEY ,
              PUTYPE=2 , CAPACITY=24M
```

X

X

```
PHO2TU    PATH    GRPNM=HOGPEE ,
              IPADDR=197.51.125.1
```

X

Excerpt from
Start List:

```
...
IPADDR=197.51.153.1 ,
NETID=NETNORTH ,
NODETYPE=NN ,
SSCPNAME=HONDURAS ,
TCPNAME=TCPSVT
```

...

Definitions at Slovakia

```

SLXEE    VBUILD TYPE=XCA
SLPORTGN PORT  MEDIUM=HPRIP
*
SLGPEE   GROUP  DIAL=YES, CALL=INOUT,                                X
          AUTOGEN=(5, E, P), DYNPU=YES, ISTATUS=ACTIVE
*****
* LOCAL VRN                                           *
*****
SLGVL01  GROUP  DIAL=YES, CALL=INOUT, VNNAME=NETNORTH.LVRN,        X
          AUTOGEN=(5, LV01, P), DYNPU=YES, VNTYPE=LOCAL,          X
          HOSTNAME=SLVIPA1, ISTATUS=INACTIVE, TGP=V002,          X
          CAPACITY=100M
*****
* GLOBAL VRN                                           *
*****
SLGVG01  GROUP  DIAL=YES, CALL=INOUT, VNNAME=CROSSNET.GVRN,        X
          AUTOGEN=(5, GV01, P), DYNPU=YES, VNTYPE=GLOBAL,          X
          HOSTNAME=SLVIPA1, ISTATUS=INACTIVE, TGP=V004,          X
          CAPACITY=100M

```

Excerpt from
Start List:

```

...
BN=YES,
IPADDR=197.11.115.1,
NETID=NETNORTH,
NODETYPE=NN,
SSCPNAME=SLOVAKIA,
TCPNAME=TCPSVT,
...

```

```

TOIP     VBUILD TYPE=SWNET
*
ESL2RO   PU      TGP=EEV4, TGN=4, NETID=NETSOUTH,                    X
          CPCP=YES, CPNAME=ROMANIA,                                X
          PUTYPE=2, CAPACITY=24M
PSL2RO   PATH    GRPNM=SLGPEE,                                       X
          HOSTNAME=ROVIPA1
*
ESL2HO   PU      TGP=EEV4, TGN=4, NETID=NETNORTH,                    X
          CPCP=YES, CPNAME=HONDURAS,                                X
          PUTYPE=2, CAPACITY=24M
PSL2HO   PATH    GRPNM=SLGPEE,                                       X
          IPADDR=197.51.153.1

```

Definitions at Romania

```
ROXEE      VBUILD  TYPE=XCA
ROPORTGN  PORT    MEDIUM=HPRIIP
*
ROGPEE    GROUP   DIAL=YES, CALL=INOUT,                                X
                AUTOGEN=(5, E, P), DYNPU=YES, ISTATUS=ACTIVE
*****
* GLOBAL VRN                                           *
*****
ROGVG01   GROUP   DIAL=YES, CALL=INOUT, VNNAME=CROSSNET.GVRN,          X
                AUTOGEN=(5, GV01, P), DYNPU=YES, VNTYPE=GLOBAL,       X
                HOSTNAME=ROVIPA1, ISTATUS=INACTIVE, TGP=V004,         X
                CAPACITY=100M
```

```
TOIP      VBUILD  TYPE=SWNET
*
ERO2SL    PU      TGP=EEV4, TGN=4, NETID=NETNORTH,                    X
                CPCP=YES, CPNAME=SLOVAKIA,                            X
                PUTYPE=2, CAPACITY=24M
PRO2SL    PATH    GRPNM=ROGPEE,                                        X
                HOSTNAME=SLVIPA1
*
ERO2BR    PU      TGP=EEV4, TGN=4, NETID=NETSOUTH,                    X
                CPCP=YES, CPNAME=BRAZIL,                              X
                PUTYPE=2, CAPACITY=24M
PRO2BR    PATH    GRPNM=ROGPEE,                                        X
                IPADDR=197.51.155.1
```

Excerpt from
Start List:

```
...
BN=YES,
IPADDR=197.11.116.1,
NETID=NETSOUTH,
NODETYPE=NN,
SSCPNAME=ROMANIA,
TCPNAME=TCPSVT,
...
```

Turkey: Initialization

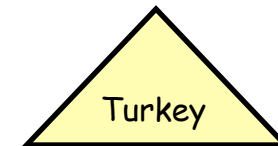
Starting VTAM

```
...
IST020I VTAM INITIALIZATION COMPLETE FOR CSV1R8
IST1348I VTAM STARTED AS MIGRATION DATA HOST
...
IST1137I TUXEEI IS ACTIVE, TYPE = XCA MAJOR NODE
IST1132I TUSEEI IS ACTIVE, TYPE = SW SNA MAJ NODE
...
EZZ4313I INITIALIZATION COMPLETE FOR DEVICE IUTSAMEH
EZZ4324I CONNECTION TO 197.51.125.1 ACTIVE FOR DEVICE IUTSAMEH
IST1685I TCP/IP JOB NAME = TCPSVT
IST1680I LOCAL IP ADDRESS 197.51.125.1
...
```

D NET,EE,LIST=DETAIL

```
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = EE
IST2000I ENTERPRISE EXTENDER GENERAL INFORMATION
IST1685I TCP/IP JOB NAME = TCPSVT
IST2003I ENTERPRISE EXTENDER XCA MAJOR NODE NAME = TUXEEI
IST2004I LIVTIME = (10,0) SRQTIME = 15 SRQRETRY = 3
IST2005I IPRESOLV = 0
IST2231I CURRENT HPR CLOCK RATE = STANDARD
IST924I -----
IST2006I PORT PRIORITY = SIGNAL NETWORK HIGH MEDIUM LOW
IST2008I IPPORT NUMBER = 12000 12001 12002 12003 12004
IST2008I IPTOS VALUE = C0 C0 80 40 20
IST924I -----
IST1680I LOCAL IP ADDRESS 197.51.125.1
IST2009I RTP PIPES = 0 LU-LU SESSIONS = 0
IST2010I INOPS DUE TO SRQRETRY EXPIRATION = 0
IST2013I AVAILABLE LINES FOR PREDEFINED EE CONNECTIONS = 5
IST2014I ACTIVE PREDEFINED EE CONNECTIONS = 0
IST2015I ACTIVE LOCAL VRN EE CONNECTIONS = 0
IST2016I ACTIVE GLOBAL VRN EE CONNECTIONS = 0
IST924I -----
IST2017I TOTAL RTP PIPES = 0 LU-LU SESSIONS = 0
IST2018I TOTAL ACTIVE PREDEFINED EE CONNECTIONS = 0
IST2019I TOTAL ACTIVE LOCAL VRN EE CONNECTIONS = 0
IST2020I TOTAL ACTIVE GLOBAL VRN EE CONNECTIONS = 0
IST2021I TOTAL ACTIVE EE CONNECTIONS = 0
IST314I END
```

NETNORTH



EE XCA and switched major nodes activated from config list

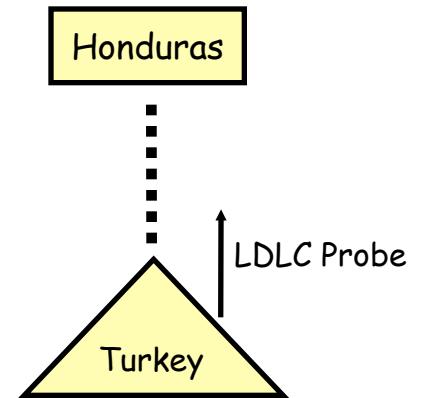
No EE connections active yet

Turkey: Connectivity Test

Verify that EE is possible to Honduras (Turkey's NNS)

```
D NET,EEDIAG,TEST=YES,IPADDR=(197.51.125.1,197.51.153.1)
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = EEDIAG
IST2119I ENTERPRISE EXTENDER DISPLAY CORRELATOR: EE000006
IST2067I EEDIAG DISPLAY ISSUED ON 07/05/07 AT 10:18:54
IST1680I LOCAL IP ADDRESS 197.51.125.1
IST1680I REMOTE IP ADDRESS 197.51.153.1
IST2023I CONNECTED TO LINE EV4001
IST2126I CONNECTIVITY TEST IN PROGRESS
IST314I END
IST350I DISPLAY TYPE = EEDIAG
IST2130I ENTERPRISE EXTENDER CONNECTIVITY TEST INFORMATION
IST2119I ENTERPRISE EXTENDER DISPLAY CORRELATOR: EE000006
IST2131I EEDIAG DISPLAY COMPLETED ON 07/05/07 AT 10:19:04
IST2132I LDLC PROBE VERSIONS: VTAM = V1          PARTNER = V1
IST1680I LOCAL IP ADDRESS 197.51.125.1
IST1680I REMOTE IP ADDRESS 197.51.153.1
IST924I -----
IST2133I INTFNAME: LMTU2ME56          INTFTYPE: MPCPTP
IST2134I CONNECTIVITY SUCCESSFUL          PORT: 12000
IST2137I 2 197.51.153.1          RTT: 4
IST2134I CONNECTIVITY SUCCESSFUL          PORT: 12001
IST2137I 2 197.51.153.1          RTT: 5
IST2134I CONNECTIVITY SUCCESSFUL          PORT: 12002
IST2137I 2 197.51.153.1          RTT: 5
IST2134I CONNECTIVITY SUCCESSFUL          PORT: 12003
IST2137I 2 197.51.153.1          RTT: 6
IST2134I CONNECTIVITY SUCCESSFUL          PORT: 12004
IST2137I 2 197.51.153.1          RTT: 6
IST924I -----
IST2139I CONNECTIVITY TEST RESULTS DISPLAYED FOR 1 INTERFACES
IST314I END
```

NETNORTH



All five EE ports tested

6

Round-Trip Time

Turkey: Establish NNS

Activate Connection from Turkey to Honduras

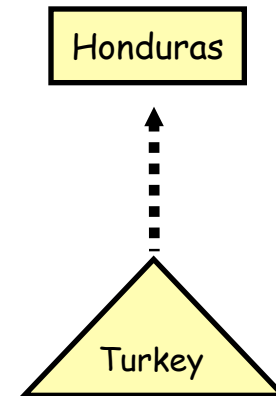
V NET,DIAL,ID=ETU2HO

```
IST097I VARY ACCEPTED
IST2180I DYNLU = YES FOR NETNORTH.HONDURAS SET FROM ETU2HO
IST590I CONNECTOUT ESTABLISHED FOR PU ETU2HO ON LINE EV4001
IST1086I APPN CONNECTION FOR NETNORTH.HONDURAS IS ACTIVE - TGN = 4
IST241I VARY DIAL COMMAND COMPLETE FOR ETU2HO
IST1488I ACTIVATION OF RTP CNR00001 AS ACTIVE TO NETNORTH.HONDURAS
IST1096I CP-CP SESSIONS WITH NETNORTH.HONDURAS ACTIVATED
```

D NET,EE,LIST=DETAIL

```
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = EE
IST2000I ENTERPRISE EXTENDER GENERAL INFORMATION
IST1685I TCP/IP JOB NAME = TCPSVT
IST2003I ENTERPRISE EXTENDER XCA MAJOR NODE NAME = TUXEEI
IST2004I LIVTIME = (10,0) SRQTIME = 15 SRQRETRY = 3
IST2005I IPRESOLV = 0
IST2231I CURRENT HPR CLOCK RATE = STANDARD
IST924I -----
IST2006I PORT PRIORITY = SIGNAL NETWORK HIGH MEDIUM LOW
IST2008I IPPORT NUMBER = 12000 12001 12002 12003 12004
IST2008I IPTOS VALUE = C0 C0 80 40 20
IST924I -----
IST1680I LOCAL IP ADDRESS 197.51.125.1
IST2009I RTP PIPES = 1 LU-LU SESSIONS = 2
IST2010I INOPS DUE TO SRQRETRY EXPIRATION = 0
IST2013I AVAILABLE LINES FOR PREDEFINED EE CONNECTIONS = 4
IST2014I ACTIVE PREDEFINED EE CONNECTIONS = 1
IST2015I ACTIVE LOCAL VRN EE CONNECTIONS = 0
IST2016I ACTIVE GLOBAL VRN EE CONNECTIONS = 0
IST924I -----
IST2017I TOTAL RTP PIPES = 1 LU-LU SESSIONS = 2
IST2018I TOTAL ACTIVE PREDEFINED EE CONNECTIONS = 1
IST2019I TOTAL ACTIVE LOCAL VRN EE CONNECTIONS = 0
IST2020I TOTAL ACTIVE GLOBAL VRN EE CONNECTIONS = 0
IST2021I TOTAL ACTIVE EE CONNECTIONS = 1
IST314I END
```

NETNORTH



Conwinner & conloser
CP-CP sessions

CPSVCMG (CP-CP)
RTP pipe

Four lines left for
additional EE
connections

Turkey: LU-LU Session Active

An LU-LU session is initiated from Honduras: Examine the RTP list and EE connections

```
IST1488I ACTIVATION OF RTP CNR00002 AS PASSIVE TO NETNORTH.HONDURAS
IST1488I ACTIVATION OF RTP CNR00003 AS PASSIVE TO NETNORTH.HONDURAS
```

Route setup pipe

D NET, RTPS

```
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = RTPS
IST1695I PU NAME          CP NAME          COSNAME SWITCH CONGEST STALL SESS
IST1960I CNR00003 NETNORTH.HONDURAS EEV4      NO      NO      NO      1
IST1960I CNR00002 NETNORTH.HONDURAS RSETUP    NO      NO      NO      0
IST1960I CNR00001 NETNORTH.HONDURAS CPSVCMG   NO      NO      NO      2
IST2084I 3 OF 3 MATCHING RTP PIPES DISPLAYED
IST314I END
```

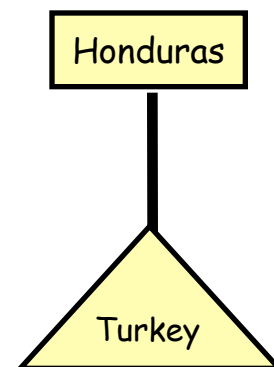
LU-LU session pipe

D NET, EE, LIST=DETAIL

```
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = EE
IST2000I ENTERPRISE EXTENDER GENERAL INFORMATION
IST1685I TCP/IP JOB NAME = TCPSVT
IST2003I ENTERPRISE EXTENDER XCA MAJOR NODE NAME = TUXEEI
IST2004I LIVTIME = (10,0)      SRQTIME = 15  SRQRETRY = 3
IST2005I IPRESOLV = 0
IST2231I CURRENT HPR CLOCK RATE = STANDARD
IST924I -----
IST2006I PORT PRIORITY = SIGNAL NETWORK HIGH MEDIUM LOW
IST2008I IPPORT NUMBER = 12000 12001 12002 12003 12004
IST2008I IPTOS VALUE = C0 C0 80 40 20
IST924I -----
IST1680I LOCAL IP ADDRESS 197.51.125.1
IST2009I RTP PIPES = 3 LU-LU SESSIONS = 3
IST2010I INOPS DUE TO SRQRETRY EXPIRATION = 0
IST2013I AVAILABLE LINES FOR PREDEFINED EE CONNECTIONS = 4
IST2014I ACTIVE PREDEFINED EE CONNECTIONS = 1
IST2015I ACTIVE LOCAL VRN EE CONNECTIONS = 0
IST2016I ACTIVE GLOBAL VRN EE CONNECTIONS = 0
IST924I -----
IST2017I TOTAL RTP PIPES = 3 LU-LU SESSIONS = 3
IST2018I TOTAL ACTIVE PREDEFINED EE CONNECTIONS = 1
IST2019I TOTAL ACTIVE LOCAL VRN EE CONNECTIONS = 0
IST2020I TOTAL ACTIVE GLOBAL VRN EE CONNECTIONS = 0
IST2021I TOTAL ACTIVE EE CONNECTIONS = 1
IST314I END
```

3 RTP pipes carrying 3 LU-LU sessions (including the 2 CP-CP sessions) over 1 EE connection

NETNORTH

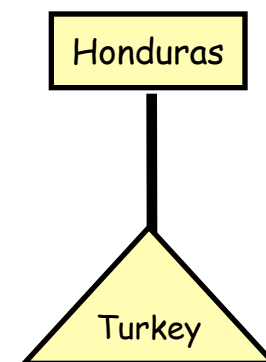


Turkey: Examine RTP Pipe

Examine the RTP pipe for the LU-LU session to Honduras

```
D NET, ID=CNR00003, E
IST097I DISPLAY ACCEPTED
IST075I NAME = CNR00003, TYPE = PU_T2.1
IST1392I DISCNTIM = 00010 DEFINED AT PU FOR DISCONNECT
IST486I STATUS= ACTIV--LX-, DESIRED STATE= ACTIV
IST1043I CP NAME = HONDURAS - CP NETID = NETNORTH - DYNAMIC LU = YES
IST1589I XNETALS = YES
IST2178I RPNCB ADDRESS 3AACC800
IST1963I APPNCOS = EEV4 - PRIORITY = HIGH
IST1476I TCID X'1920930C00010540' - REMOTE TCID X'19208FC700010501'
IST1481I DESTINATION CP NETNORTH.HONDURAS - NCE X'D00000000000000000'
IST1587I ORIGIN NCE X'D000000000000000000'
IST1967I ACTIVATED AS PASSIVE ON 07/05/07 AT 10:20:40
IST1477I ALLOWED DATA FLOW RATE = 1100 KBITS/SEC
IST1516I INITIAL DATA FLOW RATE = 1100 KBITS/SEC
IST1841I ACTUAL DATA FLOW RATE = 0 BITS/SEC
IST1511I MAXIMUM NETWORK LAYER PACKET SIZE = 8065 BYTES
IST1478I NUMBER OF UNACKNOWLEDGED BUFFERS = 0
IST1479I RTP CONNECTION STATE = CONNECTED - MNPS = NO
IST1959I DATA FLOW STATE = NORMAL
IST1855I NUMBER OF SESSIONS USING RTP = 1
IST1697I RTP PACING ALGORITHM = ARB RESPONSIVE MODE
IST1480I RTP END TO END ROUTE - RSCV PATH
IST1460I TGN CPNAME TG TYPE HPR
IST1461I 4 NETNORTH.HONDURAS APPN RTP
IST875I ALSNAME TOWARDS RTP = ETU2HO
IST1738I ANR LABEL TP ER NUMBER
IST1739I 8001001001000000 *NA* *NA*
IST231I RTP MAJOR NODE = ISTRTPMN
IST654I I/O TRACE = OFF, BUFFER TRACE = OFF
IST1500I STATE TRACE = OFF
IST355I LOGICAL UNITS:
IST080I ECHOHOZ ACT/S----Y
IST314I END
```

NETNORTH



Initial rate is approx.
5% of CAPACITY

Route used by the pipe

DLC PU used by pipe
(EE PU in this config)

A great deal of additional detail about an RTP pipe can be revealed by specifying HPRDIAG=YES when displaying the pipe

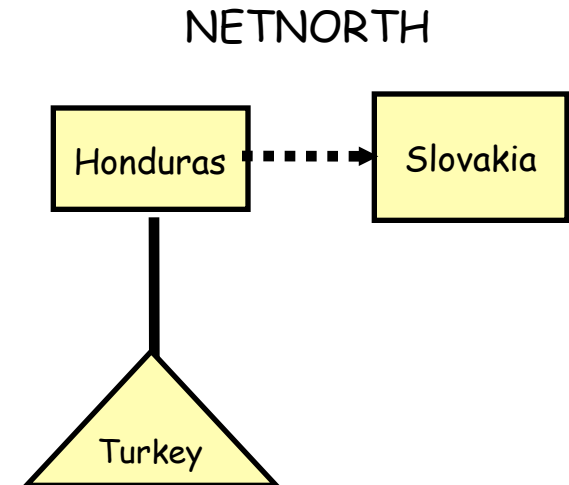
Honduras: Connect to Slovakia

Activate the Honduras to Slovakia connection

```
V NET,DIAL,ID=EHO2SL
IST097I VARY ACCEPTED
IST2180I DYNLU = YES FOR NETNORTH.SLOVAKIA SET FROM EHO2SL
IST590I CONNECTOUT ESTABLISHED FOR PU EHO2SL ON LINE E0000001
IST1086I APPN CONNECTION FOR NETNORTH.SLOVAKIA IS ACTIVE - TGN = 4
IST241I VARY DIAL COMMAND COMPLETE FOR EHO2SL
IST1488I ACTIVATION OF RTP CNR00003 AS PASSIVE TO NETNORTH.SLOVAKIA
IST1488I ACTIVATION OF RTP CNR00002 AS ACTIVE TO NETNORTH.SLOVAKIA
IST1096I CP-CP SESSIONS WITH NETNORTH.SLOVAKIA ACTIVATED
```

Verify Honduras' connections

```
D NET,TOPO,LIST=ALL,ID=HONDURAS
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = TOPOLOGY
IST1295I CP NAME          NODETYPE ROUTERES CONGESTION CP-CP WEIGHT
IST1296I NETNORTH.HONDURAS NN          1          NONE      *NA*  *NA*
IST1579I -----
IST1297I                  ICN/MDH  CDSERVR  RSN          HPR
IST1298I                  NO        NO        2            RTP
IST1579I -----
IST1223I                  BN          NATIVE   TIME LEFT   LOCATE SIZE
IST1224I                  NO        YES      15          16K
...
IST1299I TRANSMISSION GROUPS ORIGINATING AT CP NETNORTH.HONDURAS
IST1357I                  CPCP
IST1300I DESTINATION CP   TGN      STATUS   TGTYPE   VALUE WEIGHT
IST1301I NETNORTH.TURKEY  4      OPER    ENDPT   YES  *NA*
IST1301I NETNORTH.SLOVAKIA 4      OPER    INTERM  YES  *NA*
IST314I END
```



Honduras has an endpoint TG to Turkey and an intermediate routing TG to Slovakia

Honduras: Examine RTPs and EE

After starting an LU-LU session (not shown) to Slovakia, examine RTP pipes and EE connectivity

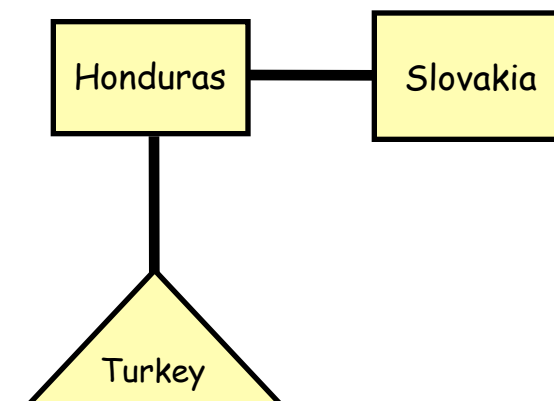
D NET, RTPS

```
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = RTPS
IST1695I PU NAME          CP NAME          COSNAME SWITCH CONGEST STALL SESS
IST1960I CNR00007 NETNORTH.TURKEY  EEV4      NO      NO      NO      1
IST1960I CNR00006 NETNORTH.TURKEY  RSETUP    NO      NO      NO      0
IST1960I CNR00005 NETNORTH.SLOVAKIA EEV4      NO      NO      NO      1
IST1960I CNR00004 NETNORTH.SLOVAKIA RSETUP    NO      NO      NO      0
IST1960I CNR00003 NETNORTH.SLOVAKIA CPSVCMG   NO      NO      NO      1
IST1960I CNR00002 NETNORTH.SLOVAKIA CPSVCMG   NO      NO      NO      1
IST1960I CNR00001 NETNORTH.TURKEY  CPSVCMG   NO      NO      NO      2
IST2084I 7 OF 7 MATCHING RTP PIPES DISPLAYED
IST314I END
```

D NET, EE, LIST=DETAIL

```
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = EE
IST2000I ENTERPRISE EXTENDER GENERAL INFORMATION
IST1685I TCP/IP JOB NAME = TCPSVT
IST2003I ENTERPRISE EXTENDER XCA MAJOR NODE NAME = HOXEEI
IST2004I LIVTIME = (10,0)      SRQTIME = 15  SRQRETRY = 3
IST2005I IPRESOLV = 0
IST2231I CURRENT HPR CLOCK RATE = STANDARD
IST924I -----
IST2006I PORT PRIORITY = SIGNAL NETWORK HIGH MEDIUM LOW
IST2008I IPPORT NUMBER = 12000 12001 12002 12003 12004
IST2008I IPTOS VALUE = C0 C0 80 40 20
IST924I -----
IST1680I LOCAL IP ADDRESS 197.51.153.1
IST2009I RTP PIPES = 7 LU-LU SESSIONS = 6
IST2010I INOPS DUE TO SRQRETRY EXPIRATION = 0
IST2013I AVAILABLE LINES FOR PREDEFINED EE CONNECTIONS = 3
IST2014I ACTIVE PREDEFINED EE CONNECTIONS = 2
IST2015I ACTIVE LOCAL VRN EE CONNECTIONS = 0
IST2016I ACTIVE GLOBAL VRN EE CONNECTIONS = 0
IST924I -----
IST2017I TOTAL RTP PIPES = 7 LU-LU SESSIONS = 6
IST2018I TOTAL ACTIVE PREDEFINED EE CONNECTIONS = 2
IST2019I TOTAL ACTIVE LOCAL VRN EE CONNECTIONS = 0
IST2020I TOTAL ACTIVE GLOBAL VRN EE CONNECTIONS = 0
IST2021I TOTAL ACTIVE EE CONNECTIONS = 2
IST314I END
```

NETNORTH



The conwinner & conloser CP-CP sessions to Slovakia are on different RTP pipes (which is usually the case when one partner is an EN)

Honduras: Examine EE Connection to Slovakia

Examine EE connection to Slovakia

D NET,EE,LIST=DETAIL,IO=**EHO2SL** ← EE switched PU

```

IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = EE
IST2001I ENTERPRISE EXTENDER CONNECTION INFORMATION
IST075I NAME = EHO2SL, TYPE = PU T2.1
IST1680I LOCAL IP ADDRESS 197.51.153.1 ← IP address pair
IST1690I REMOTE IP ADDRESS 197.11.115.1
IST2022I EE CONNECTION ACTIVATED ON 07/05/07 AT 10:22:15
IST2114I LIVTIME: INITIAL = 10 MAXIMUM = 0 CURRENT = 10
IST2023I CONNECTED TO LINE E0000001
IST2025I LDLC SIGNALS RETRANSMITTED AT LEAST ONE TIME = 0
IST2026I LDLC SIGNALS RETRANSMITTED SRQRETRY TIMES = 0
IST2009I RTP PIPES = 4 LU-LU SESSIONS = 3
IST2027I DWINOP = NO REDIAL = *NA* REDDELAY = *NA*
IST2028I KEEPACT = YES
IST2029I MTU SIZE = 1464
IST924I -----

```

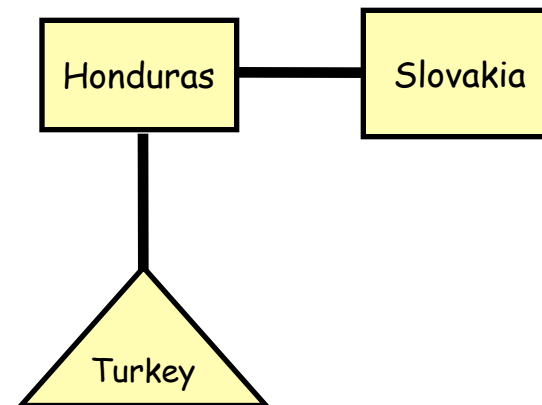
```

IST2030I PORT PRIORITY = SIGNAL
IST2036I NLPS SENT = 793 ( 000K )
IST2037I BYTES SENT = 3239 ( 003K )
IST2038I NLPS RETRANSMITTED = 0 ( 000K )
IST2039I BYTES RETRANSMITTED = 0 ( 000K )
IST2040I NLPS RECEIVED = 794 ( 000K )
IST2041I BYTES RECEIVED = 3475 ( 003K )
IST924I -----
IST2031I PORT PRIORITY = NETWORK
IST2036I NLPS SENT = 1663 ( 001K )
IST2037I BYTES SENT = 239642 ( 239K )
IST2038I NLPS RETRANSMITTED = 0 ( 000K )
IST2039I BYTES RETRANSMITTED = 0 ( 000K )
IST2040I NLPS RECEIVED = 1660 ( 001K )
IST2041I BYTES RECEIVED = 230297 ( 230K )
IST924I -----
IST2032I PORT PRIORITY = HIGH
IST2036I NLPS SENT = 41 ( 000K )
IST2037I BYTES SENT = 2595 ( 002K )
IST2038I NLPS RETRANSMITTED = 0 ( 000K )
IST2039I BYTES RETRANSMITTED = 0 ( 000K )
IST2040I NLPS RECEIVED = 42 ( 000K )
IST2041I BYTES RECEIVED = 2426 ( 002K )

```

Total NLPS (network layer packets) and total bytes sent, received, and retransmitted over this EE connection

NETNORTH



```

...
IST924I -----
IST2033I PORT PRIORITY = MEDIUM
IST2036I NLPS SENT = 0 ( 000K )
IST2037I BYTES SENT = 0 ( 000K )
IST2038I NLPS RETRANSMITTED = 0 ( 000K )
IST2039I BYTES RETRANSMITTED = 0 ( 000K )
IST2040I NLPS RECEIVED = 0 ( 000K )
IST2041I BYTES RECEIVED = 0 ( 000K )
IST924I -----
IST2034I PORT PRIORITY = LOW
IST2036I NLPS SENT = 0 ( 000K )
IST2037I BYTES SENT = 0 ( 000K )
IST2038I NLPS RETRANSMITTED = 0 ( 000K )
IST2039I BYTES RETRANSMITTED = 0 ( 000K )
IST2040I NLPS RECEIVED = 0 ( 000K )
IST2041I BYTES RECEIVED = 0 ( 000K )
IST924I -----
IST2035I TOTALS FOR ALL PORT PRIORITIES
IST2036I NLPS SENT = 2497 ( 002K )
IST2037I BYTES SENT = 245476 ( 245K )
IST2038I NLPS RETRANSMITTED = 0 ( 000K )
IST2039I BYTES RETRANSMITTED = 0 ( 000K )
IST2040I NLPS RECEIVED = 2496 ( 002K )
IST2041I BYTES RECEIVED = 236198 ( 236K )
IST314I END

```

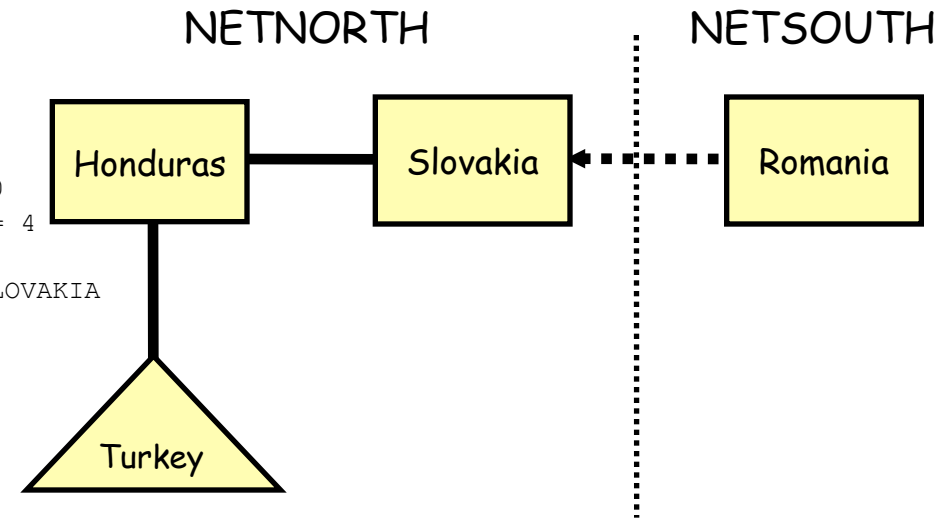
Romania: Connect to Slovakia

Activate cross-net connection from Romania to Slovakia

```
V NET, DIAL, ID=ERO2SL
IST097I VARY ACCEPTED
IST2180I DYNLU = YES FOR NETNORTH.SLOVAKIA SET FROM ERO2SL
IST590I CONNECTOUT ESTABLISHED FOR PU ERO2SL ON LINE E0000000
IST1086I APPN CONNECTION FOR NETNORTH.SLOVAKIA IS ACTIVE - TGN = 4
IST241I VARY DIAL COMMAND COMPLETE FOR ERO2SL
IST1488I ACTIVATION OF RTP CNR00003 AS ACTIVE TO NETNORTH.SLOVAKIA
IST1096I CP-CP SESSIONS WITH NETNORTH.SLOVAKIA ACTIVATED
```

Verify Romania's connection

```
D NET, TOPO, LIST=ALL, ID=ROMANIA
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = TOPOLOGY
IST1295I CP NAME          NODETYPE  ROUTERES  CONGESTION  CP-CP  WEIGHT
IST1296I NETSOUTH.ROMANIA NN         1         NONE        *NA*   *NA*
IST1579I -----
IST1297I                ICN/MDH   CDSERVR   RSN         HPR
IST1298I                NO        NO        6           RTP
IST1579I -----
IST1223I                BN         NATIVE    TIME LEFT   LOCATE  SIZE
IST1224I                YES        YES       15          16K
...
IST1299I TRANSMISSION GROUPS ORIGINATING AT CP NETSOUTH.ROMANIA
IST1357I                CPCP
IST1300I DESTINATION CP   TGN       STATUS    TGTYPE     VALUE  WEIGHT
IST1301I NETNORTH.SLOVAKIA 4         OPER     INTERCLUST YES    *NA*
IST314I END
```



The TG to Slovakia is an "intercluster" TG (a cross-subnet link)

Slovakia: Verify Connections

Messages at Slovakia when connection is established with Romania:

```
IST2180I DYNLU = YES FOR NETSOUTH.ROMANIA SET FROM ESL2RO
IST590I CONNECTIN ESTABLISHED FOR PU ESL2RO ON LINE E0000003
IST1086I APPN CONNECTION FOR NETSOUTH.ROMANIA IS ACTIVE - TGN = 4
IST1488I ACTIVATION OF RTP CNR00008 AS PASSIVE TO NETSOUTH.ROMANIA
IST1096I CP-CP SESSIONS WITH NETSOUTH.ROMANIA ACTIVATED
```

Verify Slovakia's connections:

D NET, TOPO, LIST=ALL, ID=SLOVAKIA

IST097I DISPLAY ACCEPTED

IST350I DISPLAY TYPE = TOPOLOGY

CP NAME	NODETYPE	ROUTERES	CONGESTION	CP-CP	WEIGHT
NETNORTH.SLOVAKIA	NN	1	NONE	*NA*	*NA*

ICN/MDH	CDSEVR	RSN	HPR
NO	NO	6	RTP

IST1579I

BN	NATIVE	TIME LEFT	LOCATE	SIZE
YES	YES	15	16K	

DESTINATION CP	TGN	STATUS	TGTYPE	VALUE	WEIGHT
NETNORTH.HONDURAS	4	OPER	INTERM	YES	*NA*
NETSOUTH.ROMANIA	4	OPER	INTERCLUST	YES	*NA*

IST1579I

IST1223I

IST1224I

...

IST1299I TRANSMISSION GROUPS ORIGINATING AT CP NETNORTH.SLOVAKIA

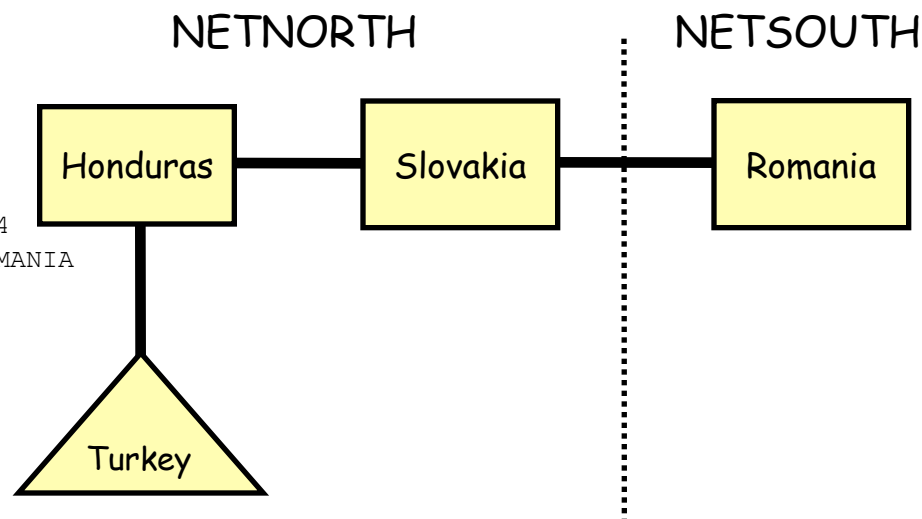
IST1357I

IST1300I



IST1301I

IST1301I

IST314I END



For More Information

URL	Content
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http://www.ibm.com/software/network/commserver/support	IBM Communications Server Technical Support
http://www.ibm.com/support/techdocs/	Technical Support Documentation (techdocs, flashes, presentations, white papers, etc.)
http://www.rfc-editor.org/rfcsearch.html	Request For Comments (RFCs)
http://publib.boulder.ibm.com/infocenter/ieduasst/stgv1r0/index.jsp	IBM Education Assistant

• Recommended Redbooks:

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

Please Complete Session Evaluation

- Modernizing SNA:
Enterprise Extender
Concepts and
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