# What's New in z/OS Communications Server?

Enterprise Networking Solutions, Raleigh

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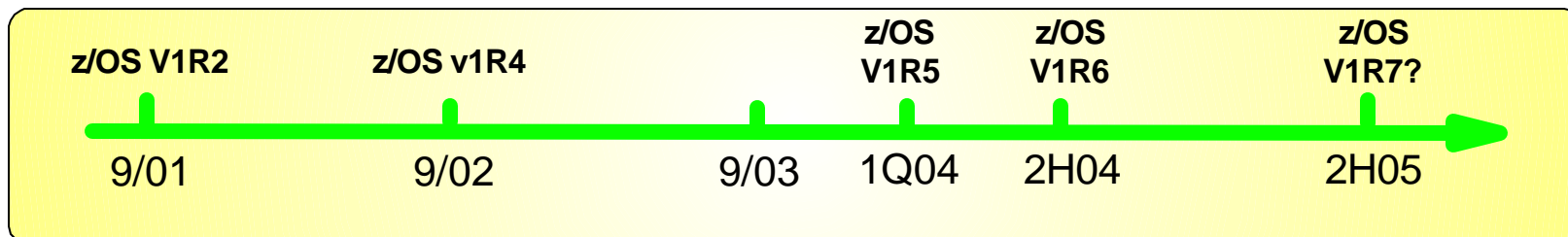Alfred B Christensen - alfredch@us.ibm.com

# z/OS V1R5 Communications Server

- **Overview**
- **Sysplex**
- **Applications**
- **Security**
- **Other TCP/IP Enhancements**
- **Enterprise Extender and SNA**
- **IPv6 Support**

# z/OS Communications Server
## Disclaimer

➤ Plans for the z/OS Communications server are subject to change prior to general availability

➤ Information provided in this presentation may not reflect what is actually shipped for z/OS Communications Server

➤ This presentation includes an early overview of future z/OS Communications Server enhancements

z/OS
CS

**Note: Plans are subject to change!**

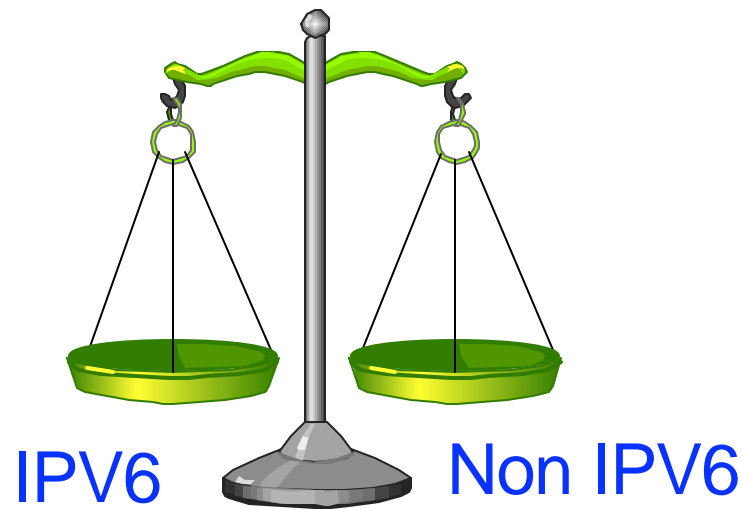| z/OS V1R2 | z/OS v1R4 | | z/OS V1R5 | z/OS V1R6 | z/OS V1R7? |
|---|---|---|---|---|---|
| 9/01 | 9/02 | 9/03 | 1Q04 | 2H04 | 2H05 |

# z/OS V1R5 Communications Server

z/OS V1R5 continues the effort started in z/OS V1R4 to provide IPV6 on z/OS and provides a lot of Non-IPV6 function also!

★ IPv6 support is technology driven in preparation for future

IPV6       Non IPV6

# V1R5 - Continue to provide a balance of IPv6 and non-IPv6 functions

## IPv6 focus in V1R5:

- ✔ Applications
- ✔ APIs
- ✔ DLCs
- ✔ Network management
- ✔ Policy
- ✔ Routing
- ✔ Security
- ✔ Enterprise Extender

## non-IPv6 focus in V1R5:

- ✔ TN3270 server enhancements
- ✔ FTP enhancements
- ✔ Sysplex enhancements
- ✔ Network management
- ✔ Policy
- ✔ Security
- ✔ Msys
- ✔ SNA enhancements
- ✔ Enhancements for new hardware
- ✔ Routing enhancements
- ✔ Mail
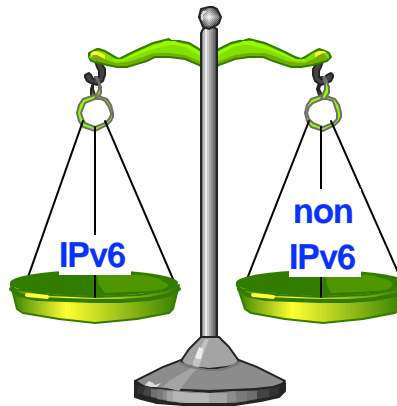
**IPv6**   **non IPv6**

# Sysplex Enhancements

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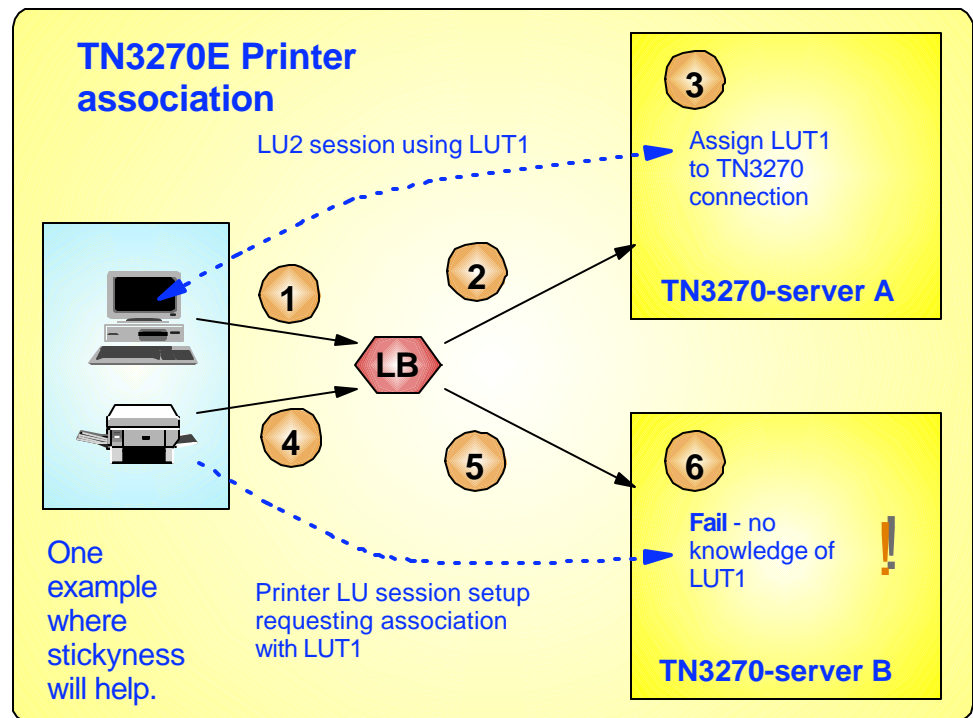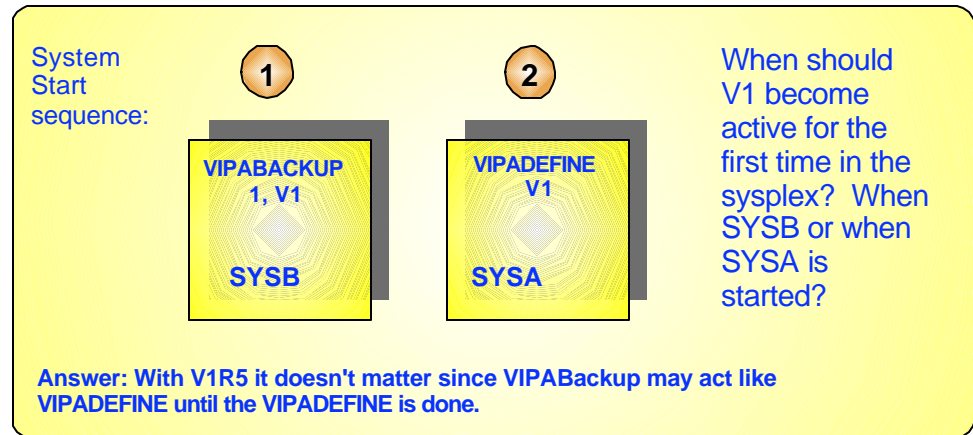# Sysplex enhancements in z/OS V1R5

## Sysplex Enhancements

- ► Increase ports on VIPADISTRIBUTE from 4 to 64 (PTFed back to z/OS V1R2 - APAR PQ65205)

- ► Dynamic port definition for VIPADISTRIBUTE dynamic VIPA when server binds to dynamic VIPA

- ► Increase limit of DVIPAs per stack from 256 to 1024

- ► Support DVIPA activation based on VIPABACKUP before VIPADEFINE ever processed

- ► Sysplex Distributor affinity
  - ● Configurable timer-based stickyness per source IP address, server DVIPA and port

- ► New round-robin distribution method in Sysplex Distributor (PTFed back to z/OS V1R4 - APAR PQ76866)
  - ● Alternative to WLM-based distribution
  - ● Useful where availability is more important than capacity

System Start sequence:

**(1)**

VIPABACKUP 1, V1

**SYSB**

**(2)**

VIPADEFINE V1

**SYSA**

When should V1 become active for the first time in the sysplex? When SYSB or when SYSA is started?

**Answer: With V1R5 it doesn't matter since VIPABackup may act like VIPADEFINE until the VIPADEFINE is done.**

**TN3270E Printer association**

LU2 session using LUT1

**(3)** Assign LUT1 to TN3270 connection

**TN3270-server A**

**(1)** **(2)**

**LB**

**(4)** **(5)** **(6)**

**Fail** - no knowledge of LUT1

**TN3270-server B**

One example where stickyness will help.

Printer LU session setup requesting association with LUT1

# Application Enhancements

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# FTP enhancements in z/OS V1R5


FTP
File Transfer

➢ **Support allocation of target PDS(E) like existing source PDS(E)**

➢ **Enable user to specify if a PDS or a PDSE should be created**

➢ **Allow configuration control of passive data port range on FTP server**

➢ **Support use of extended passive (EPSV) and active mode (EPRT) for NAT firewall relief**

➢ **Provide consistent error codes from FTP client**

➢ **Enable MVS syslog message when batch FTP client operation fails (for automation purposes)**

➢ **Allow SSL/TLS login to FTP server without password when client authentication is used**

➢ **Deliver FTP server load module as RMODE=ANY**
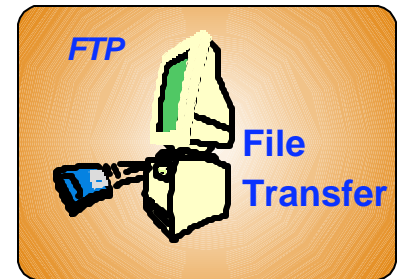
# Secure FTP and Network Address Translation (NAT) firewalls in z/OS V1R5

**Private IP address 10.1.1.1**

**Translate private address 10.1.1.1 to external address 1.1.1.1**

**Translate private address 192.168.1.1 to external address 2.2.2.2**

**Private IP address 192.168.1.1**

**Company A intranet**

**Internet / public net**

**Company B intranet**

**Passive port range configurable: 60000 - 60100**

ftp 2.2.2.2

src=10.1.1.1 dest=2.2.2.2     src=1.1.1.1 dest=2.2.2.2     src=1.1.1.1 dest=192.168.1.1

src=2.2.2.2 dest=10.1.1.1     src=2.2.2.2 dest=1.1.1.1     src=192.168.1.1 dest=1.1.1.1

**RFC2428 FTP Extensions for IPv6 and NATs**

**Active:** When data transfer is between same two hosts as control connection, then EPSV must be used! Active mode operation is only used for three-way proxy transfers, and for that purpose, the new EPRT command is to be used instead of the PORT command, but if the EPRT command does include an IP address, then NAT firewalls still cannot reside in-between the client and the active-mode server.

**Passive:**
EPSV

229 Extended Passive Mode port (|||60001|)

**Will connect back to 2.2.2.2 port 60001**

src=10.1.1.1 dest=2.2.2.2     src=1.1.1.1 dest=2.2.2.2     src=1.1.1.1 dest=192.168.1.1

**Client EPSV support and server passive data port range configuration PTF'ed back to z/OS V1R4 - APAR PQ80281**

# TN3270 server enhancements in z/OS V1R5

- **Improve Tn3270/e connection recovery**
  - End user need not know LUNAME to recover session

- **Provide SNMP network management data for tn3270/e**
  - Support in new Enterprise-specific TN3270 MIB and new TN3270 subagent
  - Focus on connection performance data
  - Provides end-to-end stats over Tcp/Ip and SNA for connections
  - Data accessible via MIB or D TCPIP,,TELNET,CONN,CONN=connid detail command

- **Enhance usability with the following items:**
  - Support range of ipaddress on IPGroup in profile
  - Better compatibility between type ahead-capable clients and applications
    - UNLOCKKEYBOARD statement in PROFILE.TCPIP

- **Performance enhancement for definite Rsp. sessions**
  - Server turns off delay acks for clients that have negotiated it. Client can do many small sends without waiting for acks from server.
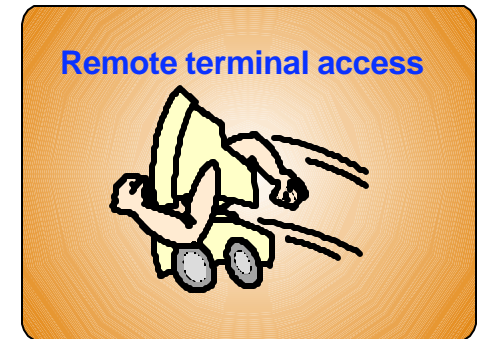
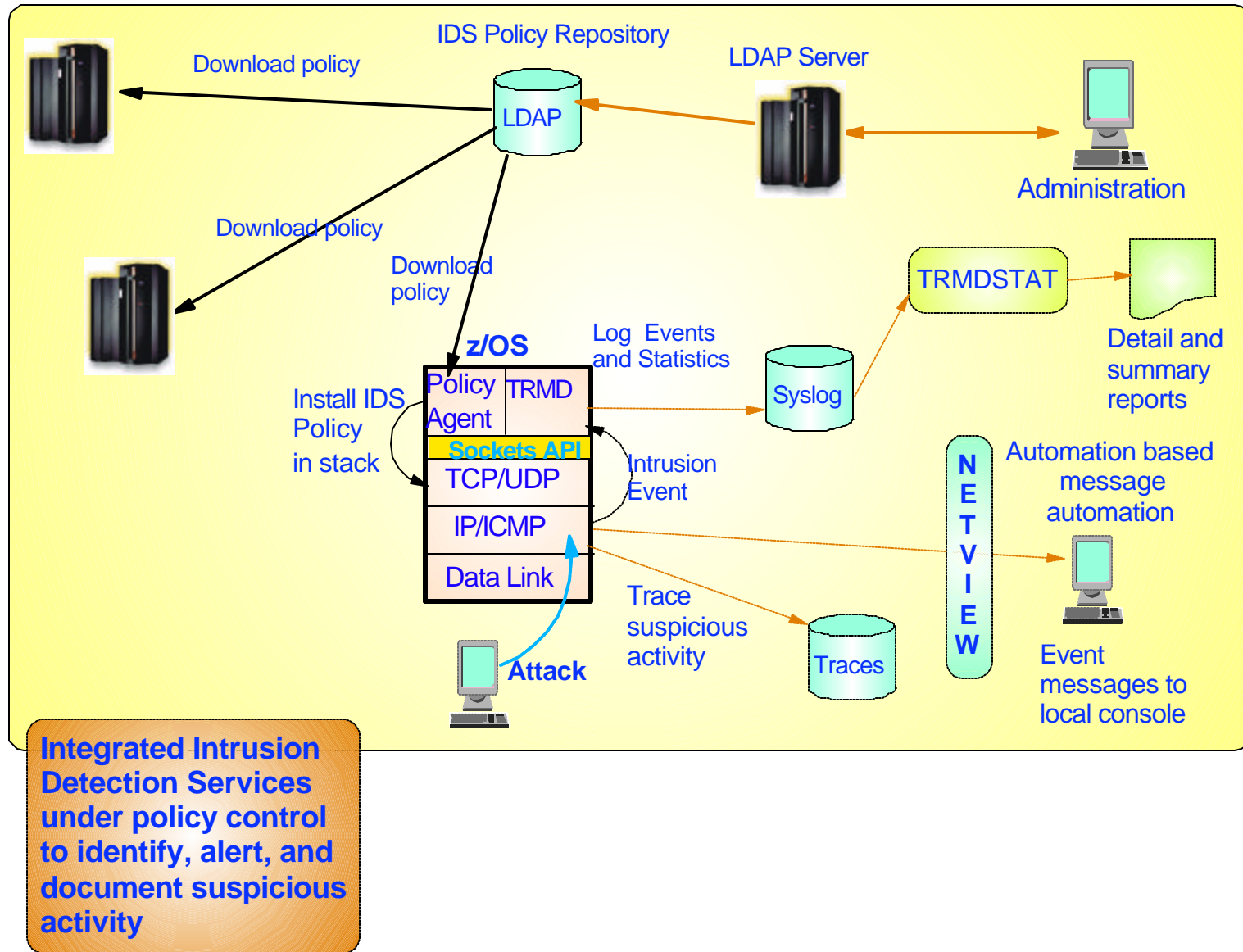**Remote terminal access**

# Security

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# Intrusion Detection Services enhancements

## Intrusion Detection Services

- Added new Policy-based interface flood detection
  - Detects floods of "garbage" data on a per-interface basis (ex:)
    - ★ Unsupported protocol
    - ★ Examine packet discards

**Integrated Intrusion Detection Services under policy control to identify, alert, and document suspicious activity**

IDS Policy Repository

LDAP Server

Download policy

LDAP

Administration

Download policy

Download policy

TRMDSTAT

Detail and summary reports

Log Events and Statistics

**z/OS**

Install IDS Policy in stack

Policy Agent | TRMD

**Sockets API**

TCP/UDP

Intrusion Event

Syslog

IP/ICMP

Data Link

**N E T V I E W**

Automation based message automation

**Attack**

Trace suspicious activity

Traces

Event messages to local console

# Multi-Level security enhancements

➢ **Governments require control over information accessed through computer networks**

▶ Applications/users and networks are classified and assigned a level of security
  ▸ Classifications are done in RACF with SECLABEL

▶ MLS for Communication's Server TCPIP stack is based upon the existing NETACESS function
  ▸ IP addresses, both INBOUND and OUTBOUND are defined to be in a security zone
  ▸ Security zone is defined to RACF using a SERVAUTH class profile
  ▸ User may be RACF PERMITted to access the SERVAUTH profile (ie. security zone)
  ▸ In an MLS environment, user and SERVAUTH profile (zone) are assigned a SECLABEL

**Key**: For a user to communicate with a partner in a security zone, SECLABELS must be equivalent (user = zone)

**TCPIP Profile:**
NETACESS INBOUND OUTBOUND
 9.27.100.0/24   ZONEB
ENDNETACESS
**In RACF:**
RDEFINE SERVAUTH  ZONEB
PERMIT  CICS  ZONEB

user = CICS
SECLABEL HIGH

ZONEB
SECLABEL  HIGH

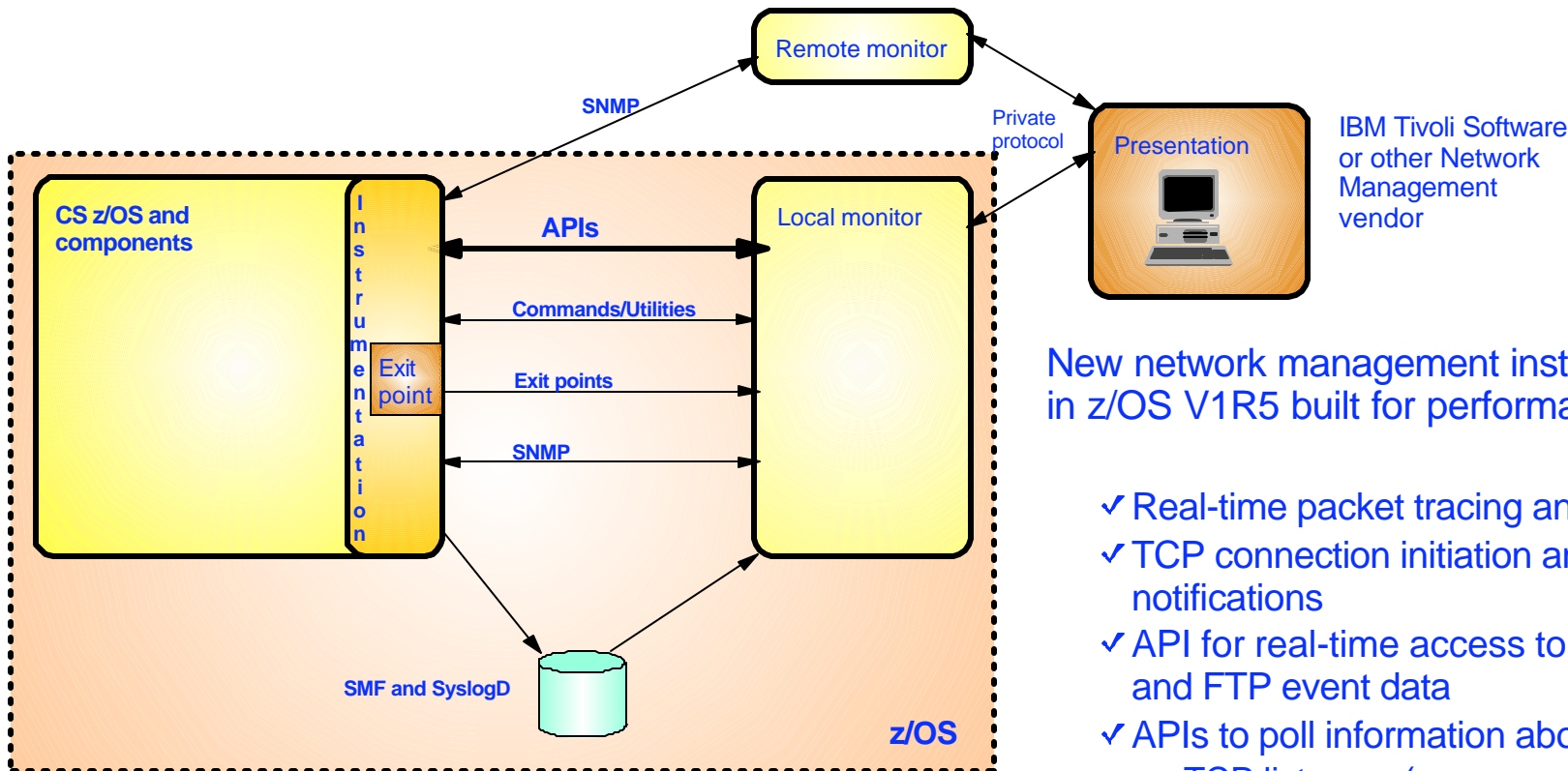ZONEK
SECLABEL
TOPSEC

9.27.100.1
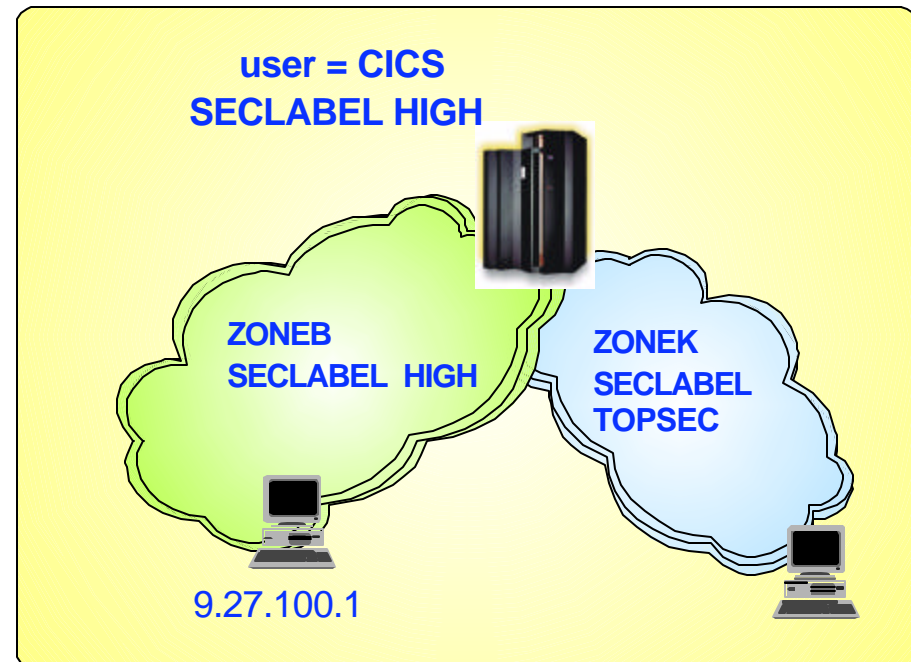
# MLS
# notes

**NOTES**

➤ For z/OS users communicating in an MLS environment across a sysplex (IUTSAMEHOST and XCF links), network packets carry the SECLABEL of the sender and are checked for SECLABEL equivalence at the destination host

➤ Packets sent /received outside of a sysplex are assume to have equivalent SECLABELS if NETACESS checks are successful

➤ NETACESS and MLS for Applications
  ▸ FTP Poe - RACF Port of Entry (PoE) checks are done to determines if client/user is permitted to logon. Applies to MLS and nonMLS environments.
    • Determines if the client's NETACESS zone is permitted to the zone of the logon userid.
    • For MLS, client and logon userid must have equivalent SECLABELs.
  ▸ Tn3270 server Poe - determines if the client's NETACESS zone has an equivalent SECLABEL to the Tn3270 LUname selected
    • LUGROUP gets a SECLABEL
  ▸ Tn3270 can also determine if a client is NETACESS permitted to a Tn3270 port
    • NonMLS
    • Port gets a security zone assigned in Tn3270 profile

# Other TCP/IP Enhancements

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# Network Management
# Instrumentation Architecture

**Remote monitor**

SNMP

Private protocol

**Presentation**

IBM Tivoli Software or other Network Management vendor

**CS z/OS and components**

**Instrumentation**

APIs

Exit point

Commands/Utilities

Exit points

SNMP

**Local monitor**

SMF and SyslogD

**z/OS**

**New network management instrumentation APIs in z/OS V1R5 built for performance:**

✓ Real-time packet tracing and formatting
✓ TCP connection initiation and termination notifications
✓ API for real-time access to TN3270 server and FTP event data
✓ APIs to poll information about currently active
 − TCP listeners (server processes)
 − TCP connections (detailed information about individual connections)
 − UDP endpoints
 − CS storage usage
✓ API to receive and poll for Enterprise Extender management data

Tivoli's IBM Tivoli Monitor / Network Performance (ITM/NP) use these new APIs

The APIs and their documentation will be available as part of CS z/OS for use by network management vendors and customer network management applications.

# Other TCPIP enhancements

- **OMPROUTE will be changed in this release to:**
  - Improved trace performance by using CTRACE
  - Multipath enhanced to support 16 routes to same destination
  - Support advertisement for more than 254 interfaces (no upper limits)
  - Some display clean-up to show N/A where an option doesn't apply
  - Ignore undefined interfaces (don't have to define everything to OSPF)

- **Enhance MVS system symbol resolution**
  - In TCPIP.DATA
    - No longer requires use of EZACFSM1 preprocessor utility
  - In Resolver setup file

- **Increase Max. Number of allowed sockets from 2000 to 65535**
  - Macro API (EZASMI), Sockets Extended (callable EZASOKET), CICS Sockets (callable EZASOKET), and IMS Sockets

- **Improve performance for asynchronous stream socket receive operations**
  - LE C/C++ API
  - z/OS UNIX Assembler Callable Services Sockets API

- **MSys support for complete configuration of the FTP client and server**

# Full VLAN support by z/OS and other OSA enhancements for z990

➤ Provide Full VLAN support for OSA-Express
- z/OS V1R2 supported only VLAN priority-tagged frames
  - ► supported via Policy Agent configuration statement as parameter on SetSubnetPrioTosMask
- Extend VLAN in z/OS V1R5 to support non-null VLAN ID (Full VLAN) with OSA Express
  - ► Supported for OSA Express QDIO Gigabit Ethernet and Fast Ethernet with IBM Server zSeries z900 (OSA driver level 3G), and z990
  - ► VLAN ID is configured in TCPIP profile on the LINK (IPv4) or Interface (IPv6) Statement
  - ► Supports only one VLAN ID for IPv4 interface and one VLAN ID for IPv6 (IDs can be different) per OSA port

➤ OSA Express QDIO performance improvements for z990
- Offload checksum to Improve performance for IPv4 packets using QDIO mode
- Provide control of storage utilization inbound per Tcpip link/interface
- Provide some controls over the inbound performance per link/interface - latency vs. CPU cost

➤ Broadcast support for Hipersockets Interface (IPv4) for z990

► IEEE standard 802.1Q defines operation of Virtual Bridged LANs
► Defines additional information in the MAC frame (tag carries VLAN-ID)
► Each port on the VLAN-aware bridge has a VLAN-ID
► VLAN-aware bridges can be configured to:
  ✔ Admit only VLAN-tagged frames (i.e.. have both priority and non-null VLAN ID)
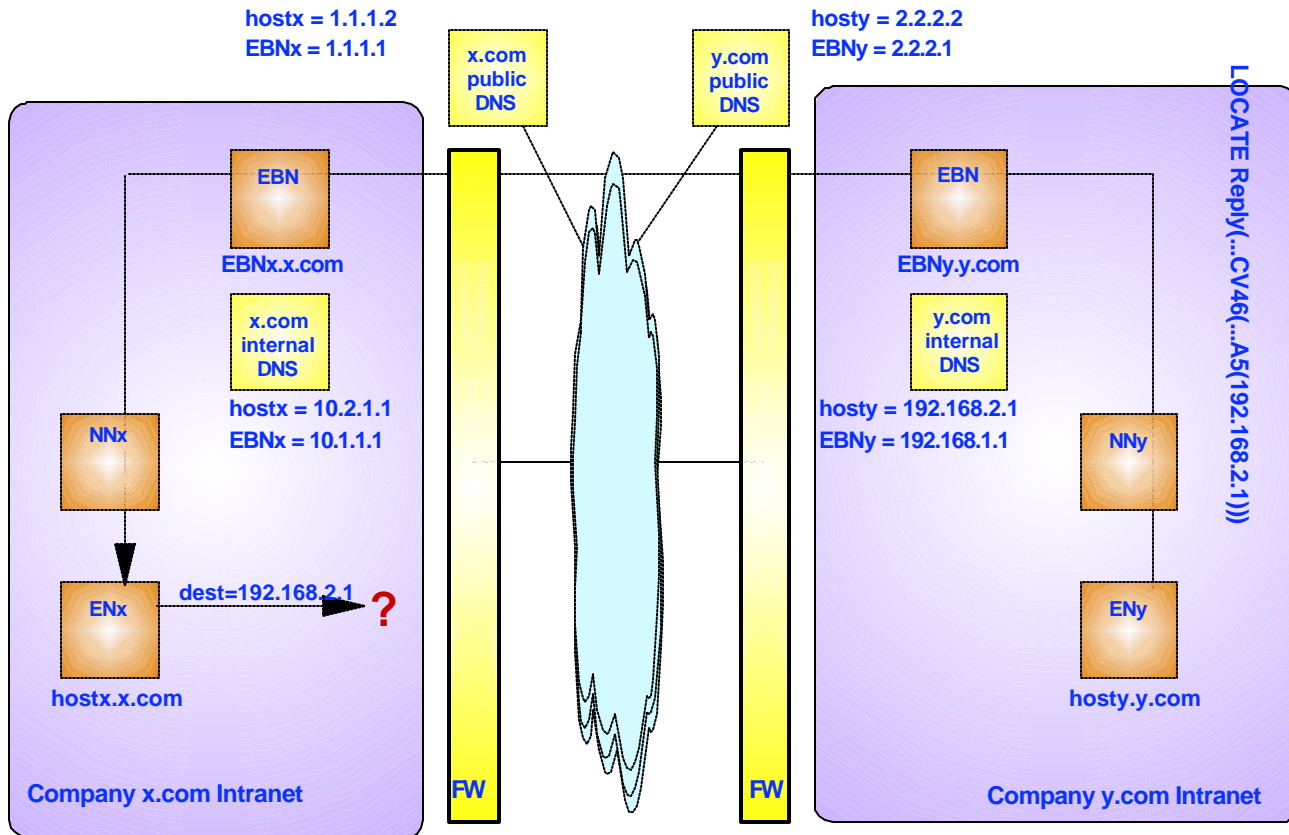  ✔ Admit all frames

★ Allows packets to be isolated to selected network interfaces and physical networks and adapters to be shared for multiple purposes, such as various security zones or customers..

# Enterprise Extender and SNA Enhancements

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# NAT Compatibility with EE VRN

hostx = 1.1.1.2
EBNx = 1.1.1.1

x.com public DNS

y.com public DNS

hosty = 2.2.2.2
EBNy = 2.2.2.1

EBN

EBNx.x.com

x.com internal DNS

hostx = 10.2.1.1
EBNx = 10.1.1.1

NNx

ENx

dest=192.168.2.1 **?**

hostx.x.com

**Company x.com Intranet**

FW

FW

EBN

EBNy.y.com

y.com internal DNS

hosty = 192.168.2.1
EBNy = 192.168.1.1

NNy

ENy

hosty.y.com

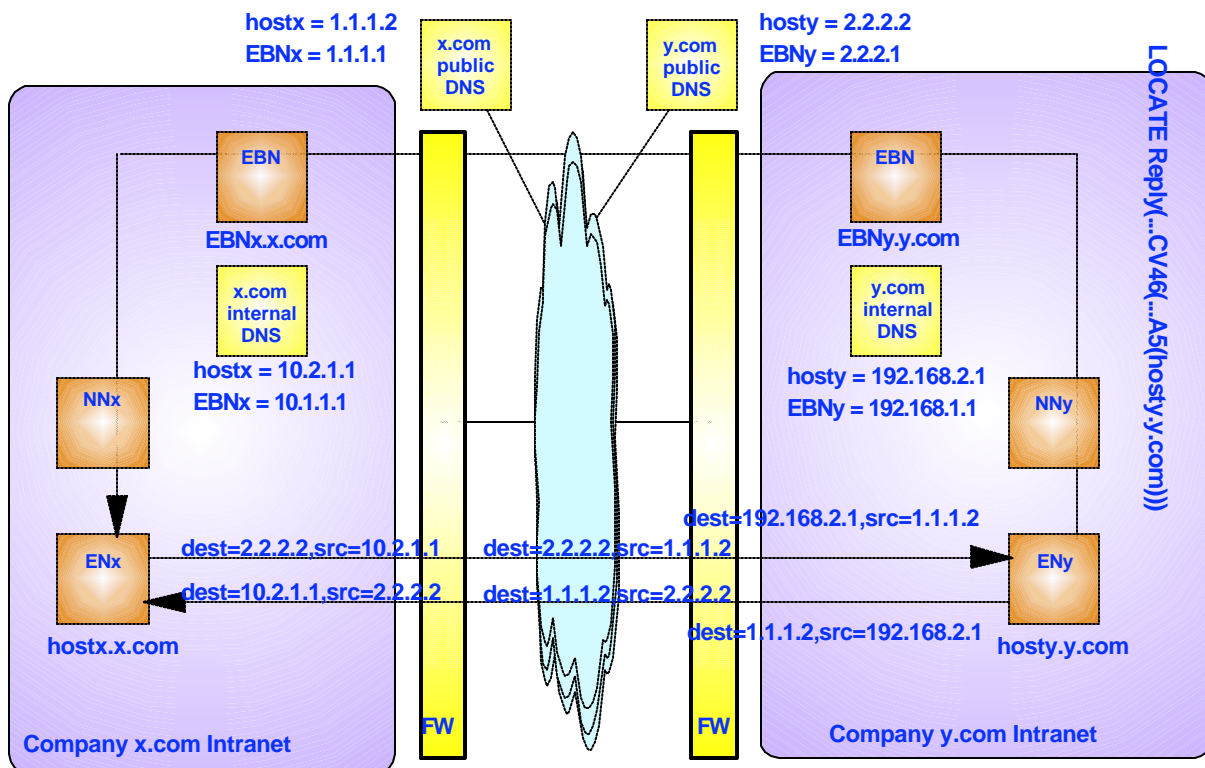**Company y.com Intranet**

LOCATE Reply(...CV46(...A5(192.168.2.1)))

➢ The control vectors representing an EE connection network carry the IP address of the node that owns the vectors.

➢ Applications that carry IP addresses in their data stream are fundamentally incompatible with Network Address Translation (NAT).

| Intranet # | Public # |
|------------|----------|
| 10.1.1.1 | 1.1.1.1 |
| 10.2.1.1 | 1.1.1.2 |
| | |

| Public # | Intranet # |
|----------|------------|
| 2.2.2.1 | 192.168.1.1 |
| 2.2.2.2 | 192.168.2.1 |
| | |

# Enhanced HOSTNAME Support



hostx = 1.1.1.2
EBNx = 1.1.1.1

x.com public DNS

y.com public DNS

hosty = 2.2.2.2
EBNy = 2.2.2.1

LOCATE Reply(...CV46(...A5(hosty.y.com)))

EBN
EBNx.x.com

x.com internal DNS

hostx = 10.2.1.1
EBNx = 10.1.1.1

NNx

ENx

dest=2.2.2.2,src=10.2.1.1
dest=10.2.1.1,src=2.2.2.2

hostx.x.com

Company x.com Intranet

FW

dest=2.2.2.2,src=1.1.1.2
dest=1.1.1.2,src=2.2.2.2

FW

EBN
EBNy.y.com

y.com internal DNS

hosty = 192.168.2.1
EBNy = 192.168.1.1

NNy

dest=192.168.2.1,src=1.1.1.2
ENy
dest=1.1.1.2,src=192.168.2.1

hosty.y.com

Company y.com Intranet

| Intranet # | Public # |
|---|---|
| 10.1.1.1 | 1.1.1.1 |
| 10.2.1.1 | 1.1.1.2 |
| | |

| Public # | Intranet # |
|---|---|
| 2.2.2.1 | 192.168.1.1 |
| 2.2.2.2 | 192.168.2.1 |
| | |

➢ EE architecture has been updated to allow the EE connection network control vectors to carry the hostname corresponding to the EE VIPA.

➢ IPv4 connection network control vectors will continue to carry IP address as well as hostname to ensure compatibility with downlevel nodes.

➢ Administrative requirement of coordinating NAT tables and public DNS entries is a known administrative procedure to installations that use NAT.

➢ There will be recommended maximum fully-qualified hostname lengths due to limited space in the route selection control vector.

# Multiple VRN/VIPA Support
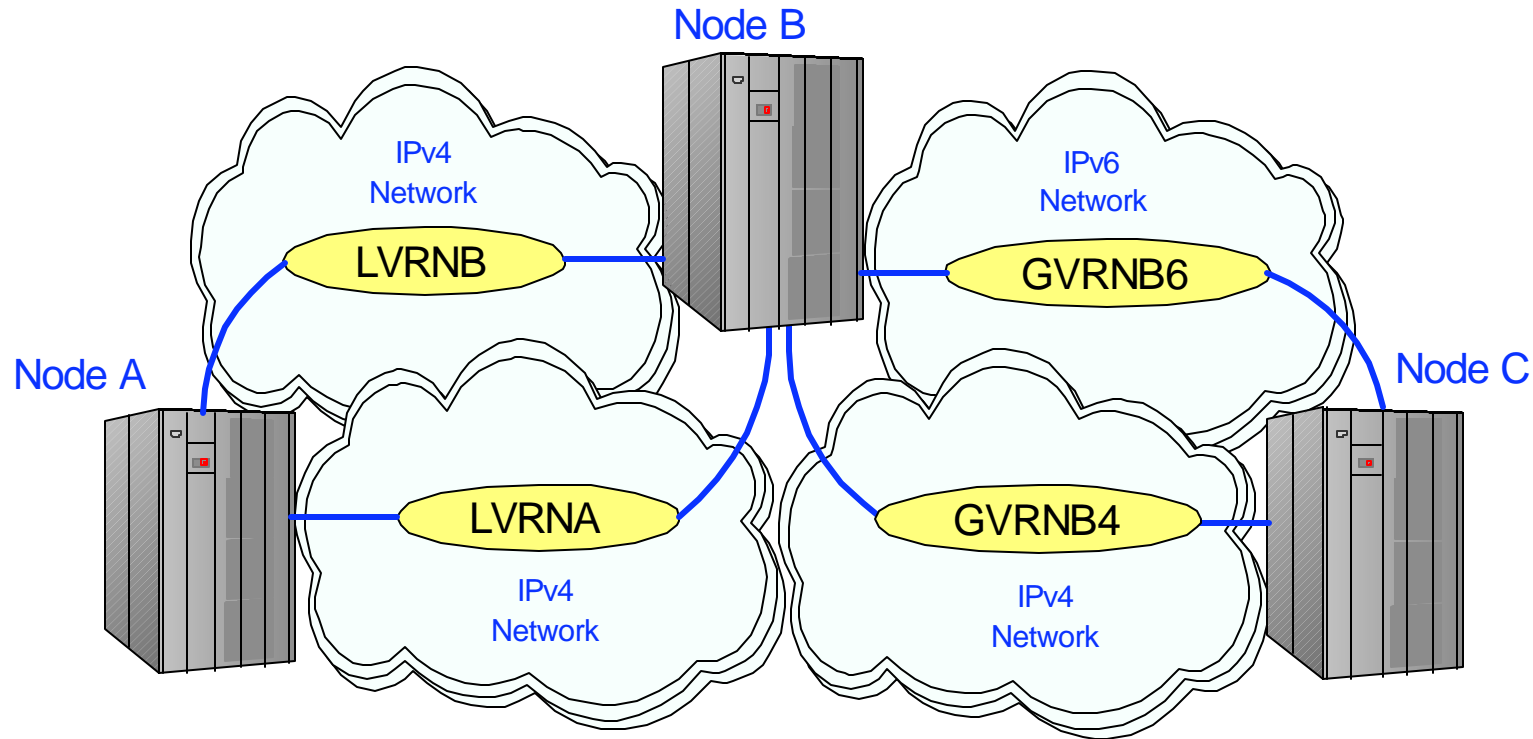


- V1R5 will allow the specification of multiple local and/or multiple global EE connection networks.

  - In the diagram above, Node B defines 2 local VRNs (both IPv4) and 2 global VRNs (one IPv4 and one IPv6)

- EE will allow multiple (static) VIPAs, defined on a GROUP basis in the EE XCA major node.

  - All EE VIPAs must still belong to a single TCP/IP stack

# Enterprise Extender Model PUs

- Currently, unless the Configuration Services XID exit is used, EE does not allow the user to code a model for non-connection- network dynamic PUs created on the dial-in side.
  - If DYNPU=YES is specified, EE creates a "vanilla" dynamic PU.
- A new model type, DYNTYPE=EE, is added to the PU statement in the Model Major Node.
- An EE model PU allows for customizing dynamic non-connection network PUs in various manners:
  - Coding the DISCNT operand so that a disconnect delay time can be specified.
  - Specifying the DWINOP, REDIAL, and REDDELAY operands to specify whether to drive redial attempts, and how often and how many times to attempt redial, when INOPs occur for the connections using these dynamic PUs.

```
MODELA1A VBUILD TYPE=MODEL
*
EEMODEL   PU       DYNTYPE=EE,
                   CAPACITY=100K,
                   COSTTIME=5,
                   CPCP=YES,
                   DISCNT=NO,
                   DWINOP=YES,
                   REDIAL=30,
                   REDDELAY=60
```

  - Overriding the default TG characteristics that in the past were used for these dynamic PUs.

# D RTPS Enhancement

- In V1R5, the DISPLAY RTPS command is enhanced to:
  - Allow the display of all RTP pipes using a particular link for the first hop. The link can be specified by either:
    - ALSNAME
    - TG number & partner CP name
  - Allow the display of all RTP pipes going to a particular Net ID (either as the destination or as the first hop).  This is done by specifying *netid.** where a CP name is specified.

```
d net,rtps,firsttg=21,firstcp=sscp2a
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = RTPS
IST1695I PU NAME       CP NAME       COS NAME SWITCH CONGEST   SESSIONS
IST1696I CNR00005 NETA.SSCP2A        #INTER      NO      NO         1
IST1696I CNR00004 NETA.SSCP2A        #BATCH      NO      NO         1
IST1454I 2 RTP(S) DISPLAYED
IST314I END
d net,rtps,cpname=neta.*
IST097I DISPLAY ACCEPTED
IST350I DISPLAY TYPE = RTPS
IST1695I PU NAME       CP NAME       COS NAME SWITCH CONGEST   SESSIONS
IST1696I CNR00005 NETA.SSCP2A        #INTER      NO      NO         1
IST1696I CNR00004 NETA.SSCP2A        #BATCH      NO      NO         1
IST1696I CNR00001 NETA.SSCP1A        CPSVCMG     NO      NO         1
IST1454I 3 RTP(S) DISPLAYED
IST314I END
```

# Other EE/SNA enhancements

➢ When dial failures occur across a connection network, the virtual routing node state is usually not affected, so the APPN topology and routing component continues to select the VRN if it is the preferred path. V1R5 adds a more specific failure message to indicate that a dial across a VRN has failed, providing an easier trigger for customer notification and automation:

```
IST1903I FAILURE OVER VRN NETA.SSCPVN TO CP NETA.SSCP2A
```

➢ V1R5 adds new messages for accounting and problem determination capability for DLUR-based sessions
  - Messages issued when a DLUR-served PU session is established or terminated with VTAM:
  - New message to include DLUR name on ACTPU and ACTLU failures
➢ Support for multiple concurrent APINGs
➢ Remove restriction that the backup NNS must be in same sysplex as the End Node for generic resource to work (allows the End Node to be searched for the resource)
➢ HPR Resequencing Optimization
  - Improves inbound processing of out of order segmented packets
➢ Modify IOBUF pool exapansion limit without recycling VTAM

# Other EE/SNA Enhancements...

**Serviceability/Problem Determination**

➢ Usability improvements to CSDUMP command (dump for sense code or message)
  ► Display settings of CSDUMP command and allow for the deletion of triggers
➢ APPN Trace enhancement
  ► New SUBTRACE option TGVC will provide TG Vectors in appropriate trace records
➢ Track CSM Buffers internally    through components
➢ Enable dumping for VTAM Inoperative conditions with new Modify INOPCode command
  ► Works in conjuction with existing Modify INOPDump command
➢ Allow for extended information to be displayed for search failures that cause sessions not to be established: DSIRFMSG start option

**Performance/Storage**

➢ Multipath Channel HPDT Packing (nonXCF) examines packet sizes for optimal outbound transmision
  ► Packing turned on/off at TRLE. Requires some workload examination for tuning.

**New/Enhanced Functionality**

➢ Sift parameters from the Group on model major node for dynamic switched LUs
  ► Allows for definition reduction
➢ SWNORDER and DLRORDER
  ► Enhanced to allow greater control over PU selection during connection processing. On start option or in XCA or NCP major nodes.
➢ New search option, SSCPORD, provides granular control over searches for resources
  ► defined on start option or in ADJSSCP table

# EE Performance Improvement

- **OSA Microcode Level: 0326**
- **z/OS Communications Server Maintenance:**

| APAR | Purpose | PTF | Notes |
|------|---------|-----|-------|
| OW53393 | ARB Enhancements | UW94491 | V1R2 only, base in V1R4 |
| OW56896 | LAN Idle | UA00067 | V1R2 only, base in V1R4 |
| OW52291 | EE Packing & QDIOSTG Option | UA00131 - V1R2 UA00132 - V1R4 | |
| OW53978 | EE Outbound Data Ordering | UA00131 - V1R2 UA00132 - V1R4 | Coreq: PQ69398 |
| PQ69398 | Fast UDP Outbound Ordering | UQ73923 | V1R2 only, base in V1R4 |
| OW57459 | HPR Resequencing | UA00131 | V1R2 only, base in V1R4 |
| OA02213 | Send SRB Optimization | UA01999 - V1R2 UA02000 - V1R4 | (2) |

1. Monitor the EE Info APAR (II12223) for other announcments
2. Will prereq other VTAM APARs in table
   - Recommendation: Apply OA02213 & PQ69398; Upgrade OSA microcode to 0326

# EE Performance Improvement...

- ● Relative to our base system:

  (Includes OSA 0326 microcode, plus OW53393)

  - ▸ RR CPU reduced up to 5%
  - ▸ Stream CPU reduced 16-24% with an 8K RU
    - ● Reduced about 5% with 1920 byte RU
    - ● Flat for 16K RU
  - ▸ RR Throughput relatively flat
  - ▸ Stream Throughput up 14-16% (1920 byte and 8K)
    - ● Up 31% for 16K RU
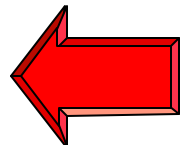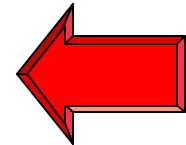
- ● Relative to previous V1R2 measurements:

  (pre-0320 OSA microcode, no maintenance)

  - ▸ Stream Throughput up 94.9%

# IPv6 on z/OS Communications Server

# We have IPv4 addresses enough - or do we?  Latest IPv4 address space usage overview

The chart shows IPv4 address allocation over time.  The "blue" line is the actual allocation, the "purple" line is the smoothed allocation.  This shows the IPv4 address pool being depleted in the next 5 years or so.

**IPv4 Address Allocation**
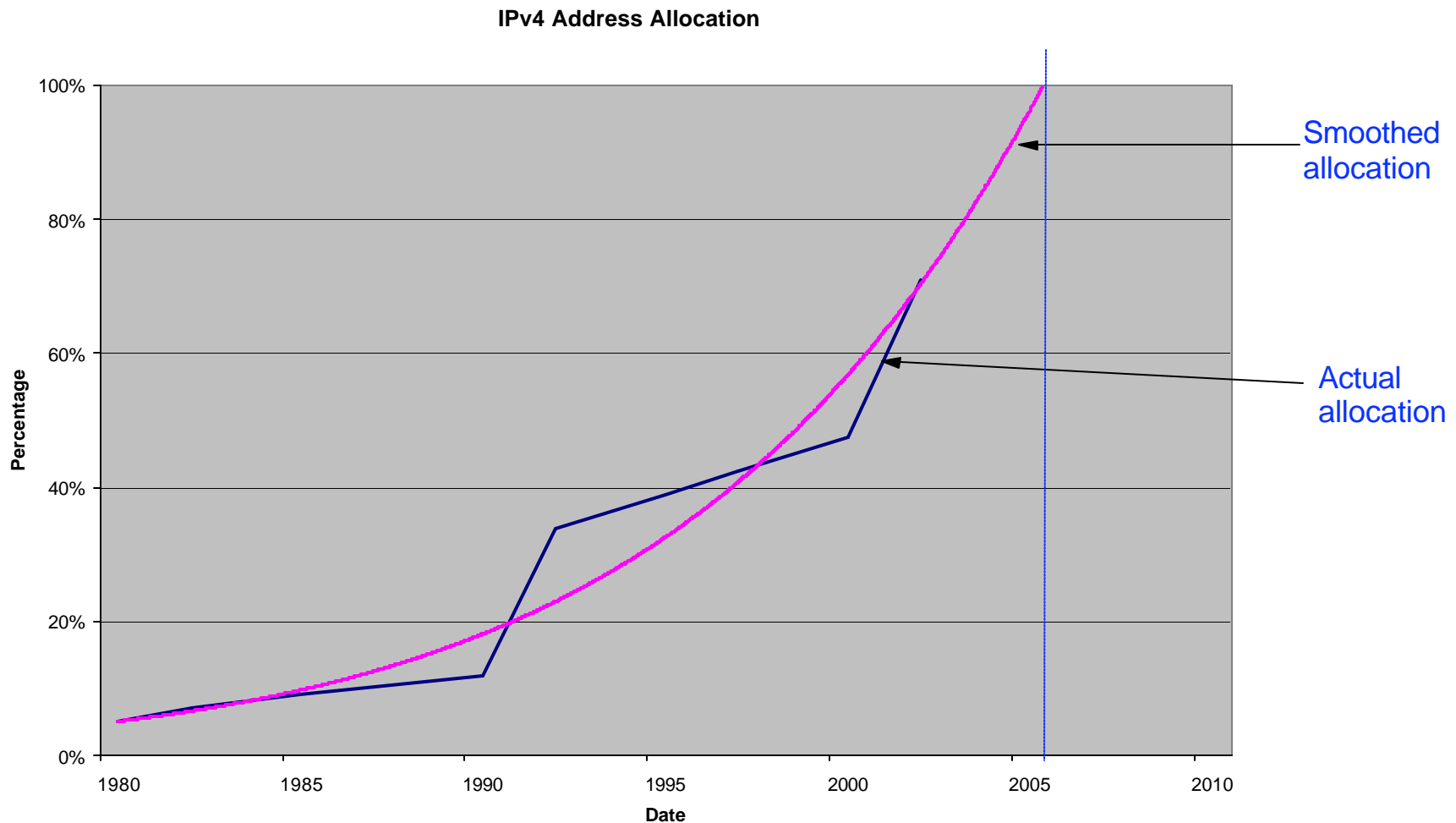
# Visible IPv4 hosts on the Internet
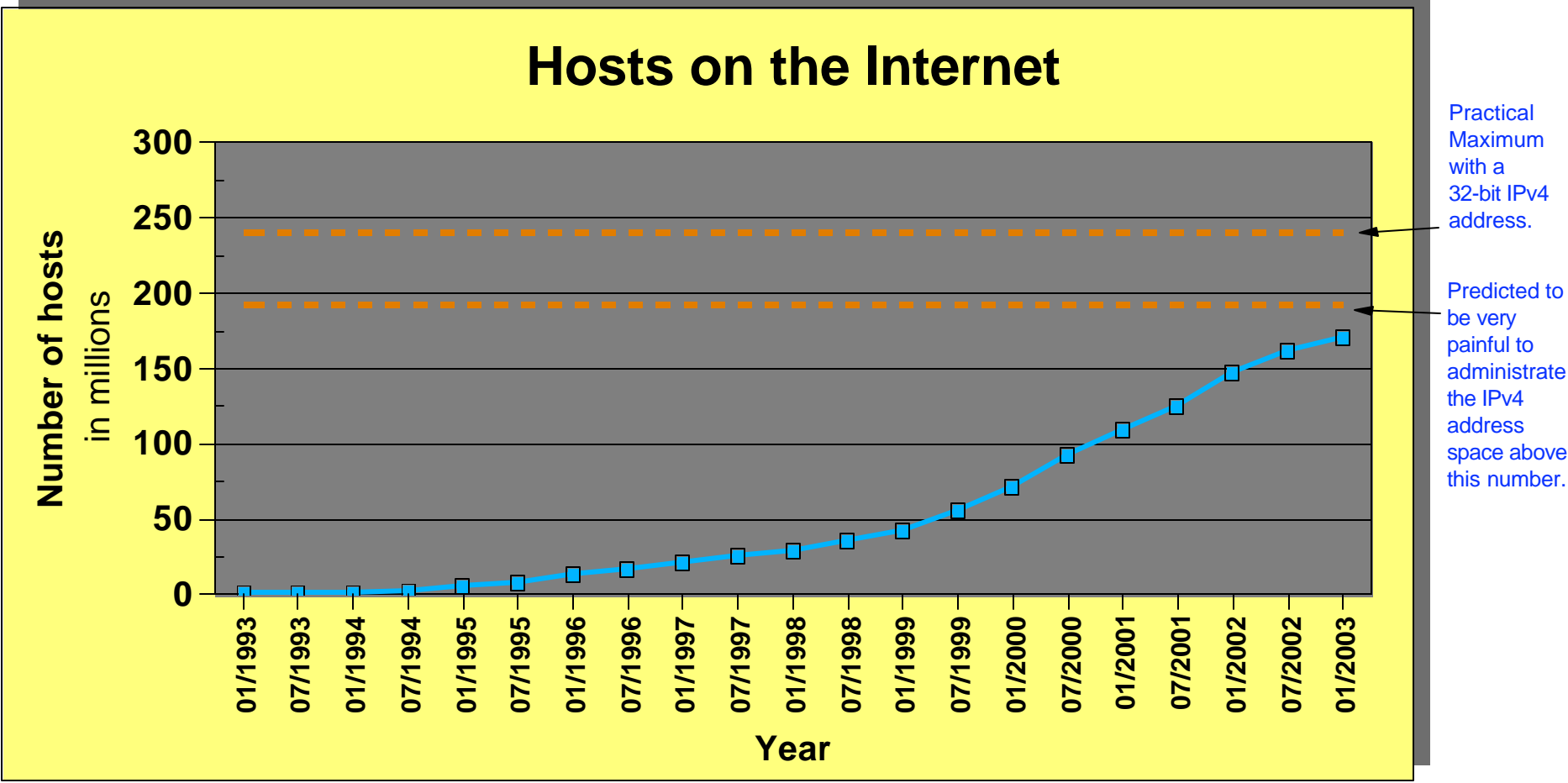## through the last 10 years

## Hosts on the Internet



Practical Maximum with a 32-bit IPv4 address.

Predicted to be very painful to administrate the IPv4 address space above this number.

**Number of hosts** in millions

300
250
200
150
100
50
0

01/1993 07/1993 01/1994 07/1994 01/1995 07/1995 01/1996 07/1996 01/1997 07/1997 01/1998 07/1998 01/1999 07/1999 01/2000 07/2000 01/2001 07/2001 01/2002 07/2002 01/2003

**Year**

Source: http://www.isc.org/ds/WWW-200301/index.html and "*An update on the H ratio*", RFC3174

# z/OS CS V1R4 and V1R5 IPv6 contents overview

## Basic IPv6 Support

- ✔ IPv6 dual-mode stack, including Neighbor Discovery, MLD, etc.
- ✔ DNS BIND 9.2
- ✔ Static VIPA
- ✔ Service Tools

## Network Management

- ► IPv6 mibs
- ► osnmp
- ► osnmpd & assoc'd functions
- ► MVS TCPIP subagent
- ► SMF119 records
- ► netstat

## DLCs

- ✔ OSA-E QDIO
- ► XCF
- ► Samehost
- ► ESCON/FICON (MPCPTP)

## Security

- ► NetAccess

## Policy

- ► OoS stack
- ► Pagent
- ► Pasearch
- ► SLAPM Mib #2

## APIs

- ✔ Basic Socket APIs
  - UNIX (LE) C/C++
  - USS Callable
  - TCP/IP Macro API
  - TCP/IP Call Instruction API
  - TCP/IP Rexx Sockets
- ✔ Advanced Socket APIs
  - UNIX (LE) C/C++
  - USS Callable
- ► CICS Sockets
  - CICS C
  - EZASOKET

## Routing
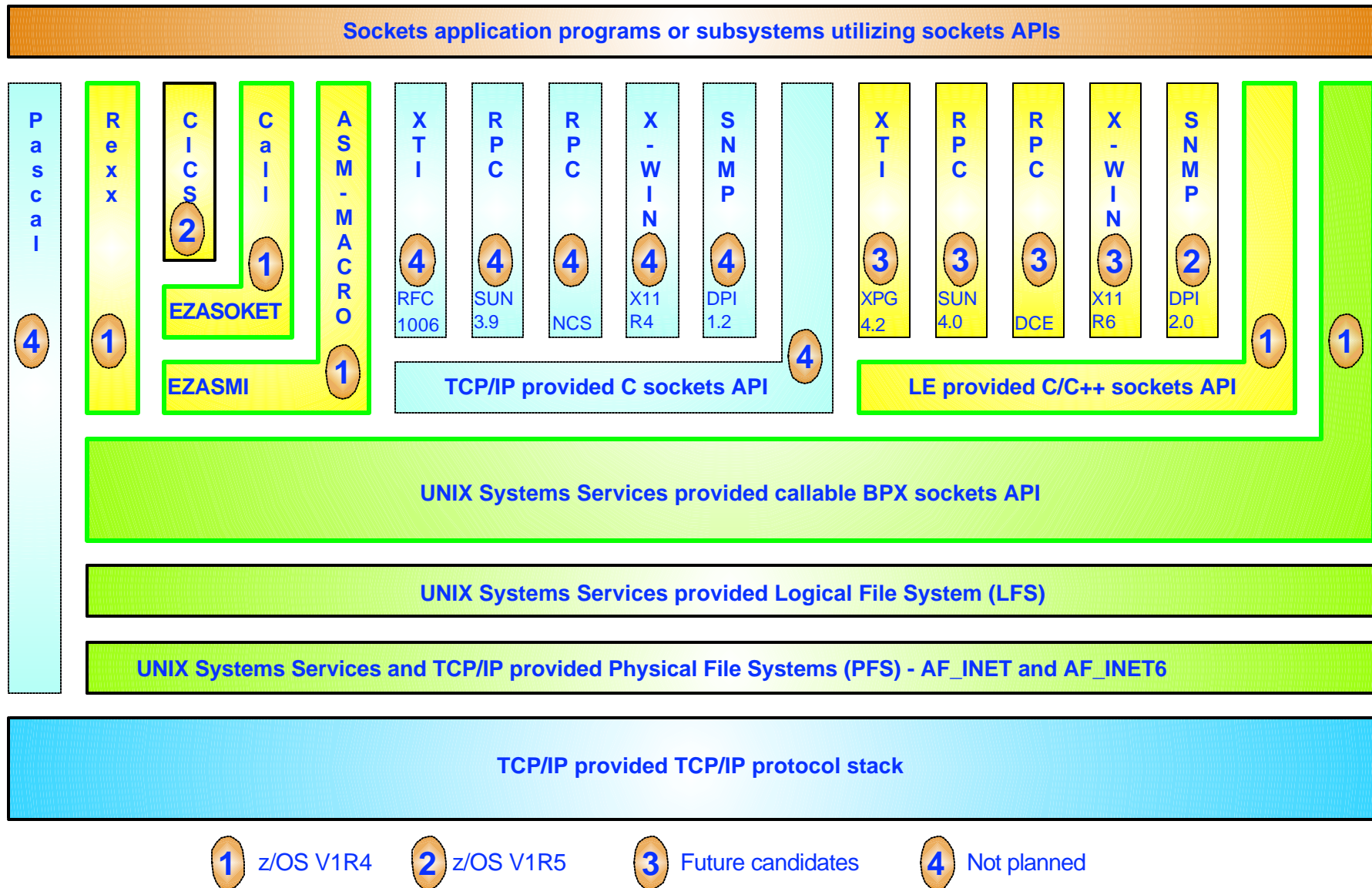
- ✔ Static Routing
- ► RIPng with OMPRoute

## Applications

- ✔ inetd, ftpd, ftp, telnetd, USS rshd, USS rexec, USS rexecd, Ping, Tracert, Netstat
- ► TN3270 server
- ► Enterprise Extender
- ► syslogd
- ► dcas
- ► sntp
- ► tfptd
- ► MVS rexecd / rshd
- ► TSO rsh /rexec client
- ► sendmail
- ► UNIX rsh clientT

## Legend:
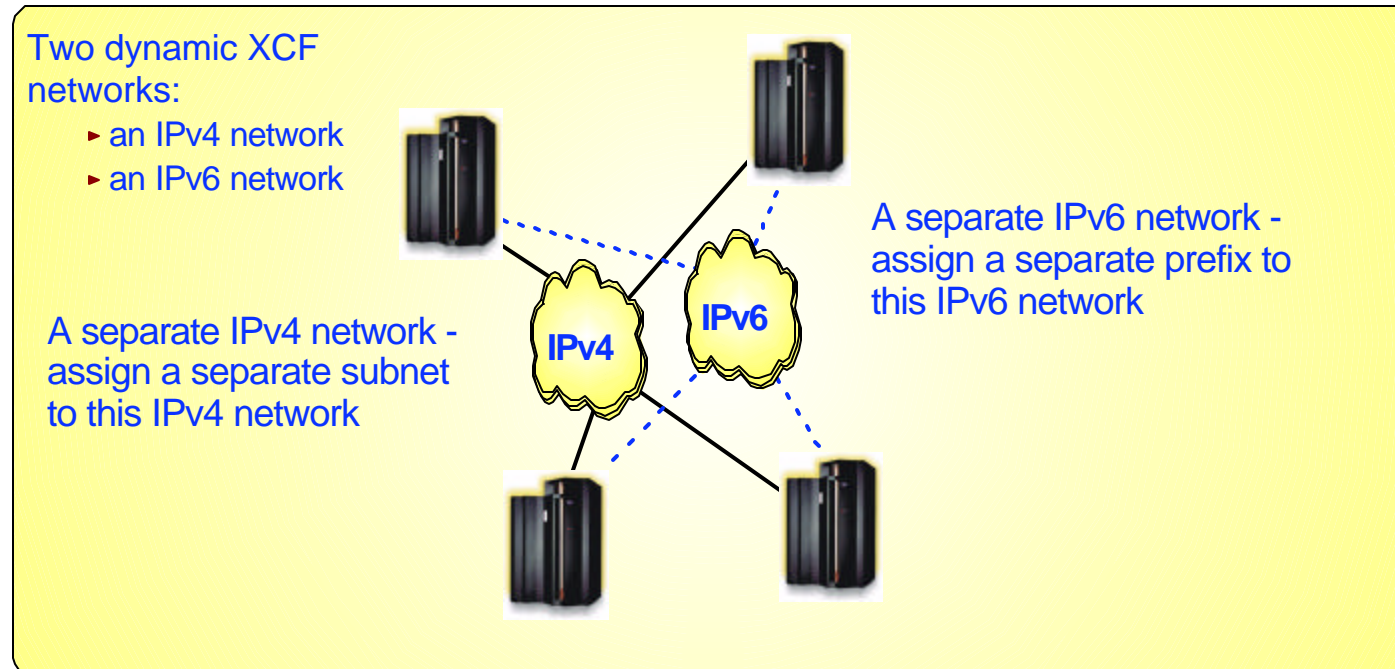- ✔ Provided in V1R4
- ► Provided in V1R5

# IPv6: Sockets-related API AF_INET6 enablement overview, status, and plans

**Sockets application programs or subsystems utilizing sockets APIs**

| Pascal | Rexx | CICS | Call | ASM-MACRO | XTI | RPC | RPC | X-WIN | SNMP | | XTI | RPC | RPC | X-WIN | SNMP | | |
|--------|------|------|------|-----------|-----|-----|-----|-------|------|--|-----|-----|-----|-------|------|--|--|
| **4** | **1** | **2** | **1** | **1** | **4** RFC 1006 | **4** SUN 3.9 | **4** NCS | **4** X11 R4 | **4** DPI 1.2 | **4** | **3** XPG 4.2 | **3** SUN 4.0 | **3** DCE | **3** X11 R6 | **2** DPI 2.0 | **1** | **1** |

EZASOKET

EZASMI

**TCP/IP provided C sockets API**

**LE provided C/C++ sockets API**

**UNIX Systems Services provided callable BPX sockets API**

**UNIX Systems Services provided Logical File System (LFS)**

**UNIX Systems Services and TCP/IP provided Physical File Systems (PFS) - AF_INET and AF_INET6**

**TCP/IP provided TCP/IP protocol stack**

**1** z/OS V1R4    **2** z/OS V1R5    **3** Future candidates    **4** Not planned

# IPv6: New interface support

**IPv6 MPCPTP-type Interface  support -  Extends connectivity options for IPV6**

- ► IUTSAMEHOST to other stacks in same LPAR

- ► XCF to other stacks in same Sysplex
  - ► Both static and dynamic XCF, but not at the sametime!  Must either have static xcf or dynamic.

- ► ESCON/FICON  to another z/OS image (not to any known Channel-attached Routers)

Two dynamic XCF
networks:
- ► an IPv4 network
- ► an IPv6 network

A separate IPv4 network -
assign a separate subnet
to this IPv4 network

A separate IPv6 network -
assign a separate prefix to
this IPv6 network

**IPv4**

**IPv6**

# IPv6: Another batch of AF_INET6 enabled applications

**IPv6-enable another batch of applications**

➤ tftpd (trivial file transfer server)

➤ syslogd

➤ dcas (digital certificate access server)

➤ sntpd (simple network time protocol server)

➤ TN3270 Server: provide connectivity to SNA applications from IPv6 TN3270 clients

➤ Enterprise Extender: allow SNA applications to communicate over IPv6 networks

➤ sendmail 8.12.5 (new port of sendmail picks up IPv6 enablement too)

➤ MVS rshd/rexecd server
  ▸ the UNIX rexecd and rshd servers were IPv6-enabled in z/OS V1R4

➤ TSO rsh/rexec clients
  ▸ provide updated version that can be used in all z/OS environments (batch, TSO, REXX, etc.)

➤ New UNIX rsh client that is IPv6-enabled from start
  ▸ the UNIX rexec client was IPv6-enabled in z/OS V1R4

**IPv6-enable the CICS listener, sockets infrastructure, and sockets libraries**

Changes to support partners with V6 addresses:
- Changes to socket api calls and structures
- Configuration file changes

# IPv6: Add RIPng to OMPRoute and other OMPROUTE enhancements



➤ **OMPROUTE has been enhanced to support IPv6 and RIPng**
- Like IPv4, there is support for the routing protocol, plus support for basic IPv6 routing concepts
  - ► generic interfaces
  - ► static routes
  - ► direct routes
  - ► prefix and router advertisement routes
- This new support has been added to OMPROUTE alongside its existing IPv4 dynamic routing support
- You use new sets of IPv6 configuration statements and display commands to activate and monitor this new support

➤ **OMPROUTE has also been changed in this release to:**
- Improved trace performance by using CTRACE
- Multipath enhanced to support 16 routes to same destination
- Support advertisement for more than 254 interfaces (no upper limits)
- Some display clean-up to show N/A where an option doesn't apply
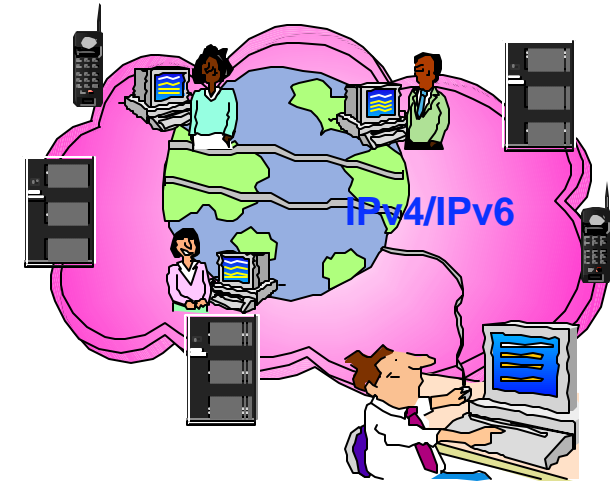- Ignore undefined interfaces (don't have to define everything to OSPF)
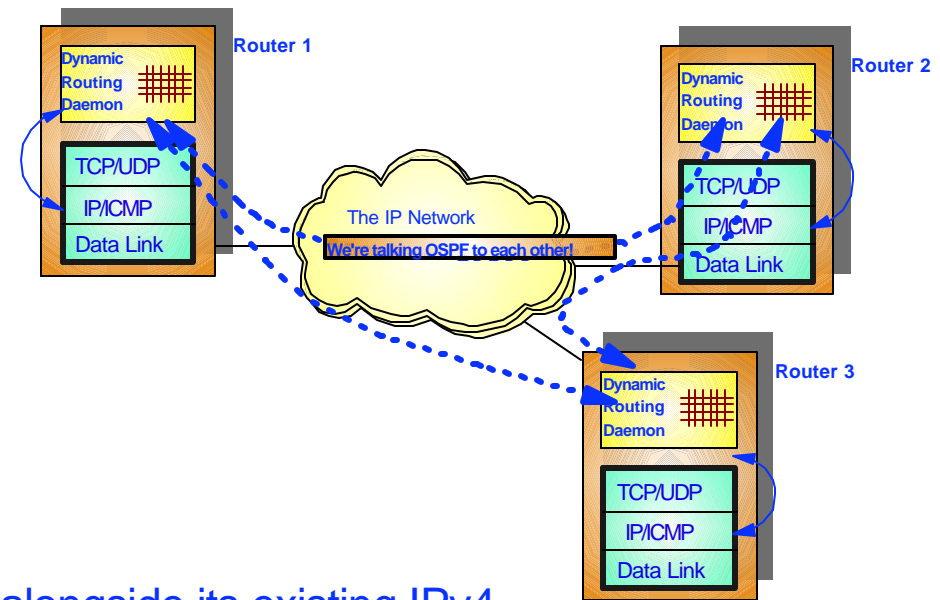
# IPv6: Network management support for IPv6

➤ **Network management SNMP support**
- Support SNMP agent (OSNMPD)
- DPI 2.0 enabled for AF_INET6
- Support MVS TCPIP subagent
- osnmp command
- The trap forwarder daemon enabled for AF_INET6
- IPv6 MIB support - new RFC drafts have been published that define IP version neutral objects
  - ► RFC2011 (IP and ICMP)
  - ► RFC2012 (TCP)
  - ► RFC2096 (IP routes)
  - ► RFC2233 (Interfaces) - this one is not version neutral

➤ **SMF119 records support**
- The redesign in z/OS V1R2 did factor in IPv6 addresses, so most subtypes are already in z/OS V1R4 supporting IPv6 addresses
- Some changes needed to selected records to capture additional IPv6-related data, such as interface records and statistics records

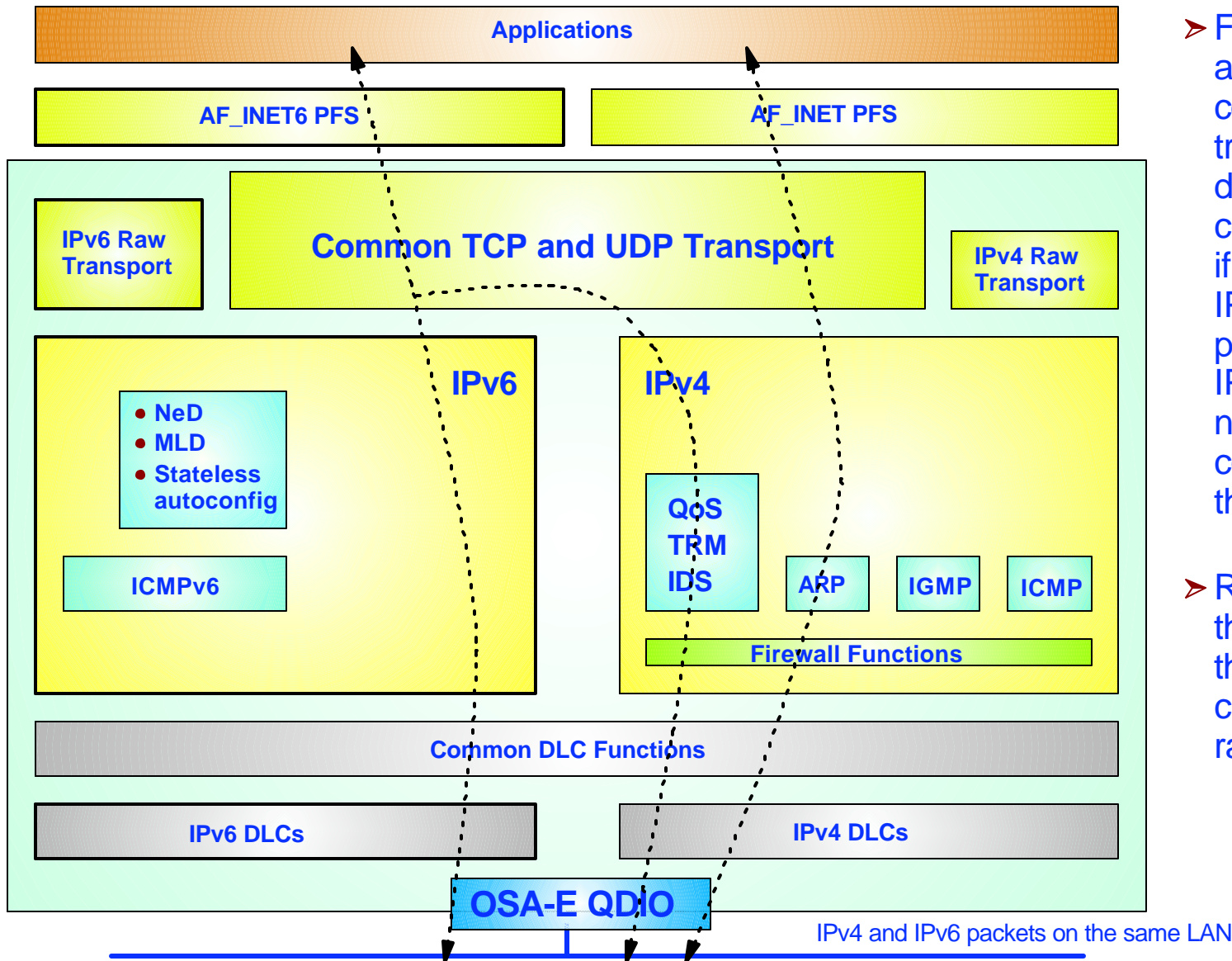➤ **Non IPv6-specific enhancements to SMF119 records:**
- Security information has been added to the FTP server and client file transfer completion records
- TCP connection termination records now, for TN3270 server connections, include TN3270-specific information: LU name, SNA Application name, protocol, etc.

> Must be able to monitor an IPv6 network

**IPv4/IPv6**

➤ And some netstat goodies:
- ► add support for a hostname filter for connection-type reports
- ► add existing IP address filter to BYETINFO report
- ► add interface/link filter to DEVLINKS reports
- ► add interface statistics sections to DEVLINKS report

> At this time, the UDP MIB draft was very unstable and too risky to implement - will follow in a later release when RFCs have stabilized.

# Flow between LAN and applications on an IPv6-enabled z/OS LPAR



**Applications**

**AF_INET6 PFS**

**AF_INET PFS**

**IPv6 Raw Transport**

**Common TCP and UDP Transport**

**IPv4 Raw Transport**

**IPv6**

**IPv4**

- NeD
- MLD
- Stateless autoconfig

**ICMPv6**

**QoS TRM IDS**

**ARP**

**IGMP**

**ICMP**

**Firewall Functions**

**Common DLC Functions**

**IPv6 DLCs**

**IPv4 DLCs**

**OSA-E QDIO**

IPv4 and IPv6 packets on the same LAN

➢ For AF_INET6 applications, the common TCP or UDP transport layer determines per communication partner if the partner is an IPv4 or an IPv6 partner - and chooses IPv4 or IPv6 networking layer component based on that.

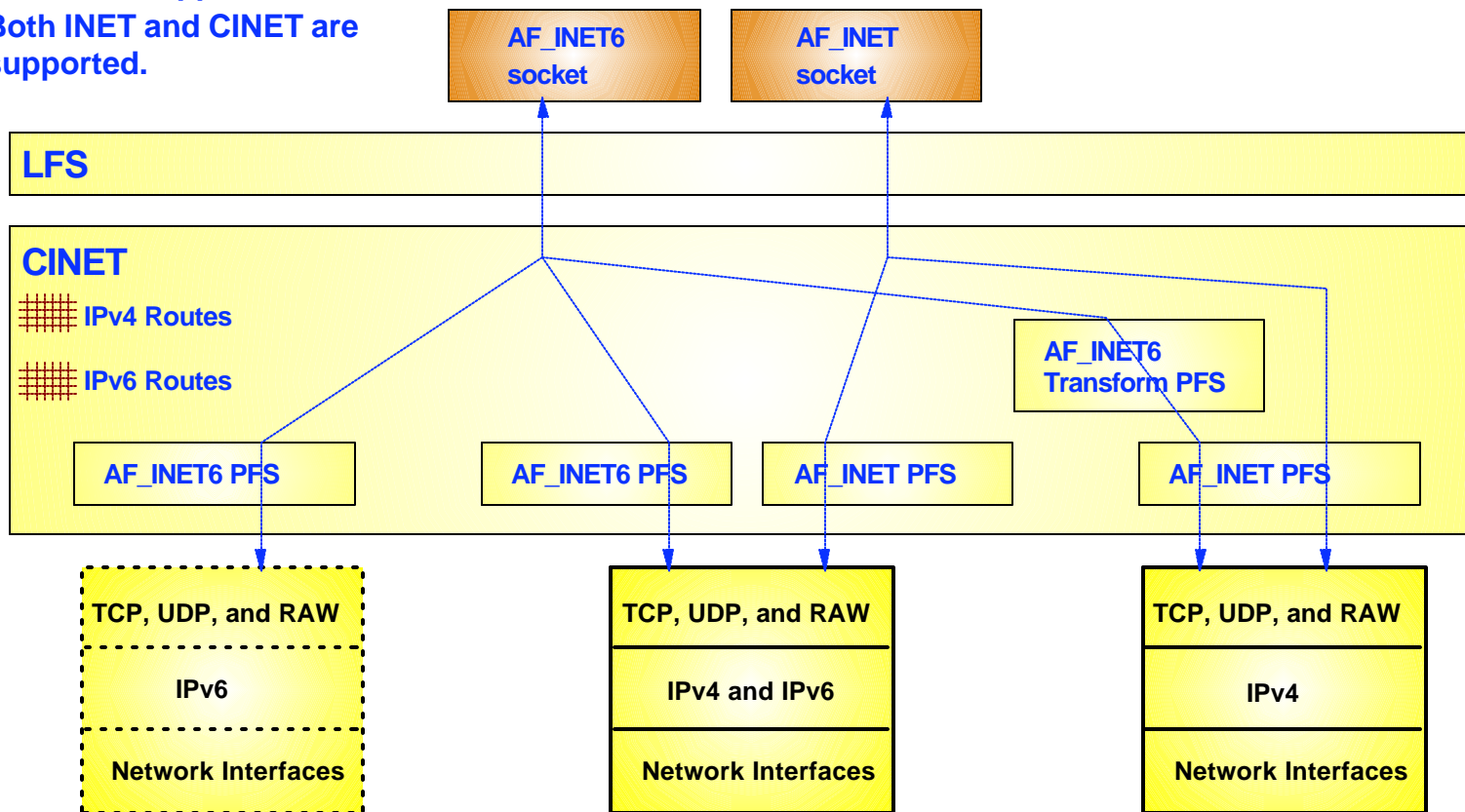➢ Raw applications make the determination themselves when they choose IPv4 or IPv6 raw transport.

OSA-E for IPv6 requires zSeries hardware

# How do we enable IPv6 support and what are the consequences?

IPv6 is enabled at an LPAR level via an option in BPXPRMxx to enable AF_INET6 support.
Both INET and CINET are supported.

When IPv6 is enabled, a z/OS V1R4 TCP/IP stack will always have an IPv6 Loopback interface. You can define real IPv6 interfaces in addition to the loopback interface.

► Existing AF_INET sockets programs will continue to work as they always did - no difference in behavior or support.
► AF_INET6 enabled sockets programs will be able to communicate with IPv4 partners (just as before they were changed to support IPv6), but in addition to that they will also be able to communicate with IPv6 partners.

AF_INET6 socket

AF_INET socket

LFS

CINET

▦ IPv4 Routes

▦ IPv6 Routes

AF_INET6 Transform PFS

AF_INET6 PFS

AF_INET6 PFS

AF_INET PFS

AF_INET PFS

TCP, UDP, and RAW

IPv6

Network Interfaces

**IPv6-only TCP/IP Stack**

This will not be the case on z/OS for the forseeable future! An AF_INET6 stack is required to also support AF_INET!

TCP, UDP, and RAW

IPv4 and IPv6

Network Interfaces

**Dual Mode TCP/IP Stack**

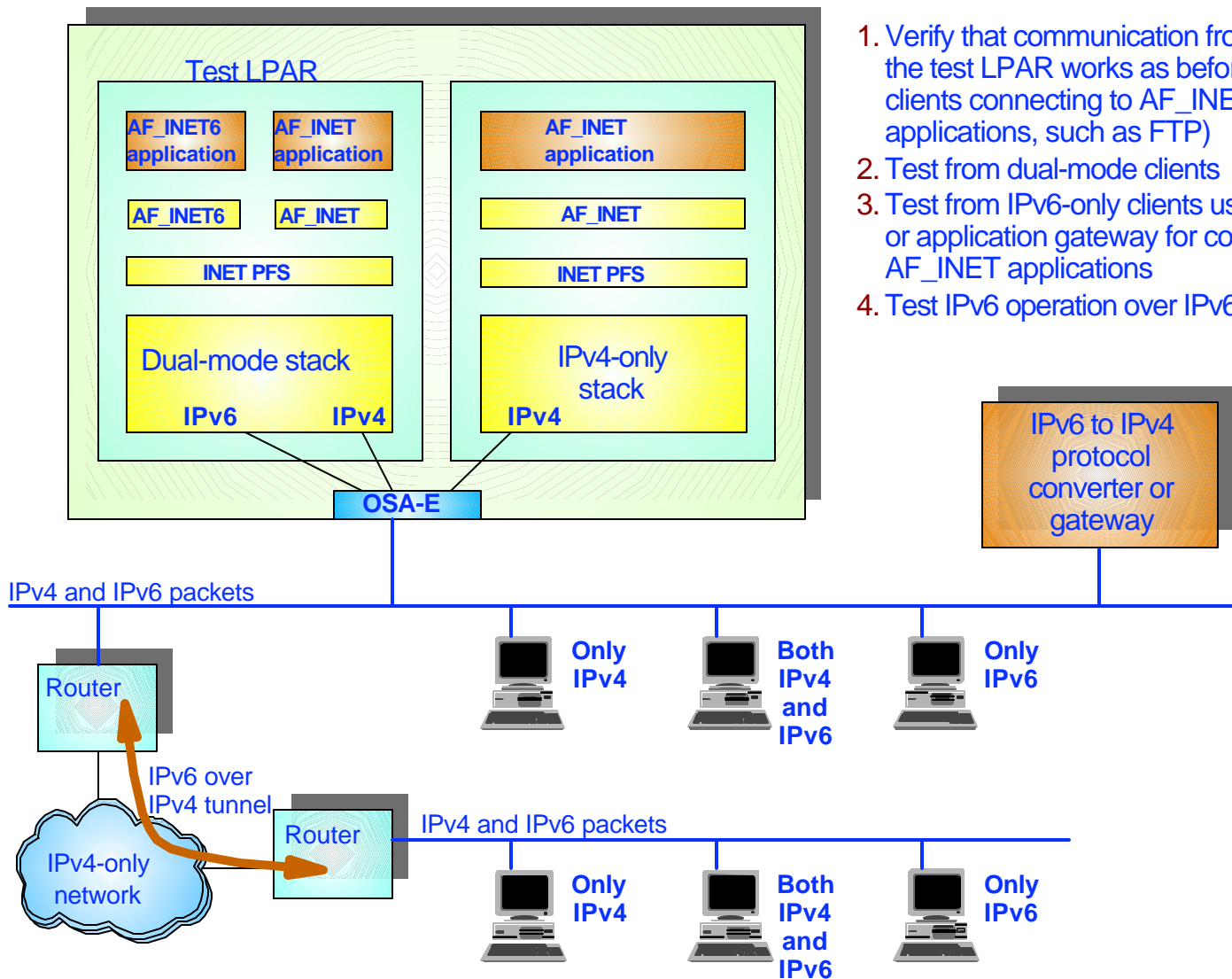A z/OS V1R4 TCP/IP stack will always come up as dual-mode if AF_INET6 is enabled in BPXPRMxx

TCP, UDP, and RAW

IPv4

Network Interfaces

**IPv4-only TCP/IP Stack**

(such as AnyNet or an OEM TCP/IP stack)

When IPv6 is enabled, most netstat reports will look different because of the potential for long IPv6 addresses.
Make sure you have modified any netstat screen-scraping REXX programs you might have developed in the past!

# Start testing IPv6 on z/OS



Test LPAR

AF_INET6 application
AF_INET application
AF_INET application

AF_INET6
AF_INET
AF_INET

INET PFS
INET PFS

Dual-mode stack
IPv6          IPv4

IPv4-only stack
IPv4

OSA-E

IPv6 to IPv4 protocol converter or gateway

IPv4 and IPv6 packets

Router

IPv6 over IPv4 tunnel

IPv4-only network

Router

IPv4 and IPv6 packets

Only IPv4
Both IPv4 and IPv6
Only IPv6

Only IPv4
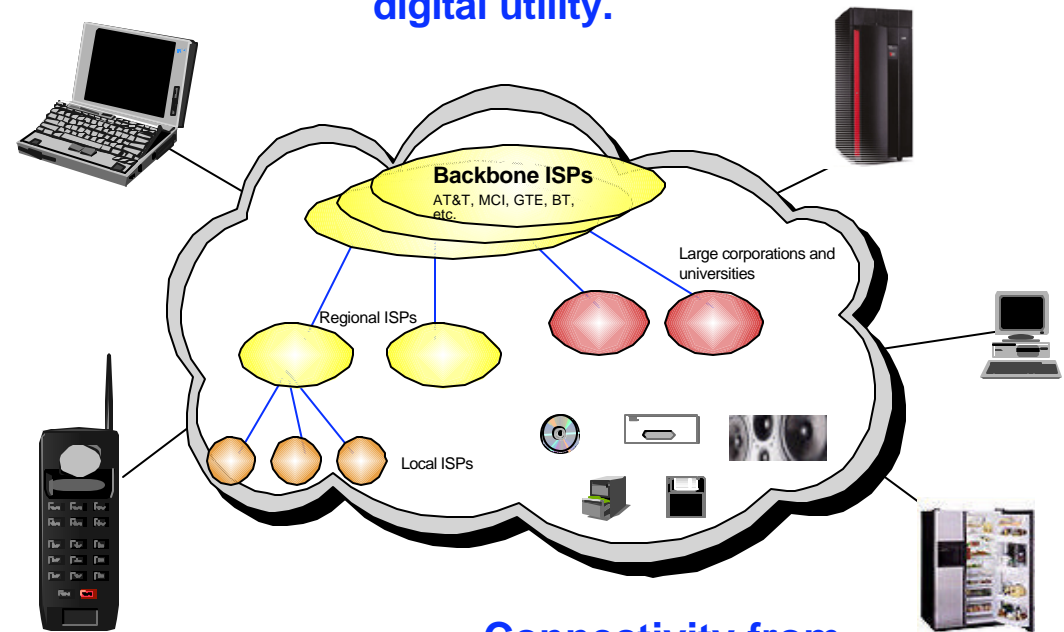Both IPv4 and IPv6
Only IPv6

1. Verify that communication from IPv4-only clients to the test LPAR works as before (including IPv4-only clients connecting to AF_INET6-enabled server applications, such as FTP)
2. Test from dual-mode clients
3. Test from IPv6-only clients using protocol converter or application gateway for communication with AF_INET applications
4. Test IPv6 operation over IPv6 tunnel

# The Journey to IPv6 for z/OS Comm Server

## IPv6 Development Phases

- The first phase (V1R4)
  - Stack support for IPv6 base functions
  - Resolver
  - High speed attach (QDIO DLCs)
  - Service tools (Trace, Dump, etc.)
  - Configuration and netstat
  - Static Routing
  - FTP, otelnetd,unix rexec, unix rshd/rexecd
- The second phase (V1R5)
  - Network Management
    - Applications and DPI
    - Version neutral Tcp/Ip Standard MIBs
    - Additional SMF records
  - Applications/Clients/APIs
    - Tn3270 server,CICS sockets, sendmail,ntp,dcas, rxserve,rsh client
  - Enterprise Extender
  - Point to Point - type DLCS
  - Dynamic Routing Protocol (RIPng)
- To follow:
  - Sysplex Exploitation
  - Dynamic Routing Protocol (OSPFv3)
  - Complete Network Management MIBs
  - HiperSockets
  - Security (IPSec, IDS, SWSA etc.)
  - Remaining applications and DLCs
  - Additional IPV6 technologies

## The Internet - a worldwide digital utility.

**Backbone ISPs**
AT&T, MCI, GTE, BT, etc.

Large corporations and universities

Regional ISPs

Local ISPs

**Connectivity from anywhere (car, home, office) to anything!**

*Note: Plans are subject to change!*

# For More Information....

| URL | Content |
|-----|---------|
| http://www.ibm.com/servers/eserver/zseries | IBM eServer zSeries Mainframe Servers |
| http://www.ibm.com/servers/eserver/zseries/networking | Networking: IBM zSeries Servers |
| http://www.ibm.com/servers/eserver/zseries/networking/technology.html | IBM Enterprise Servers: Networking Technologies |
| http://www.ibm.com/software/network | Networking & communications software |
| http://www.ibm.com/software/network/commserver | Communications Server |
| http://www.ibm.com/software/network/commserver/library | Communications Server white papers, product documentations, etc. |
| http://www.redbooks.ibm.com | ITSO redbooks |
| http://www.ibm.com/software/network/commserver/support | Communications Server technical Support |
| http://www.ibm.com/support/techdocs/ | Advanced technical support (flashes, presentations, white papers, etc.) |
| http://www.rfc-editor.org/rfcsearch.html | Request For Comments (RFC) |