

SHARE San Francisco 2013

Session 12861

IPv6 Configuration on z/OS Hands-on Lab Introduction



Speaker:

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IMPORTANT: *Lab handout hard copy is available only if you attend the lab.
Labs handouts are not available on the website or in soft copy.*

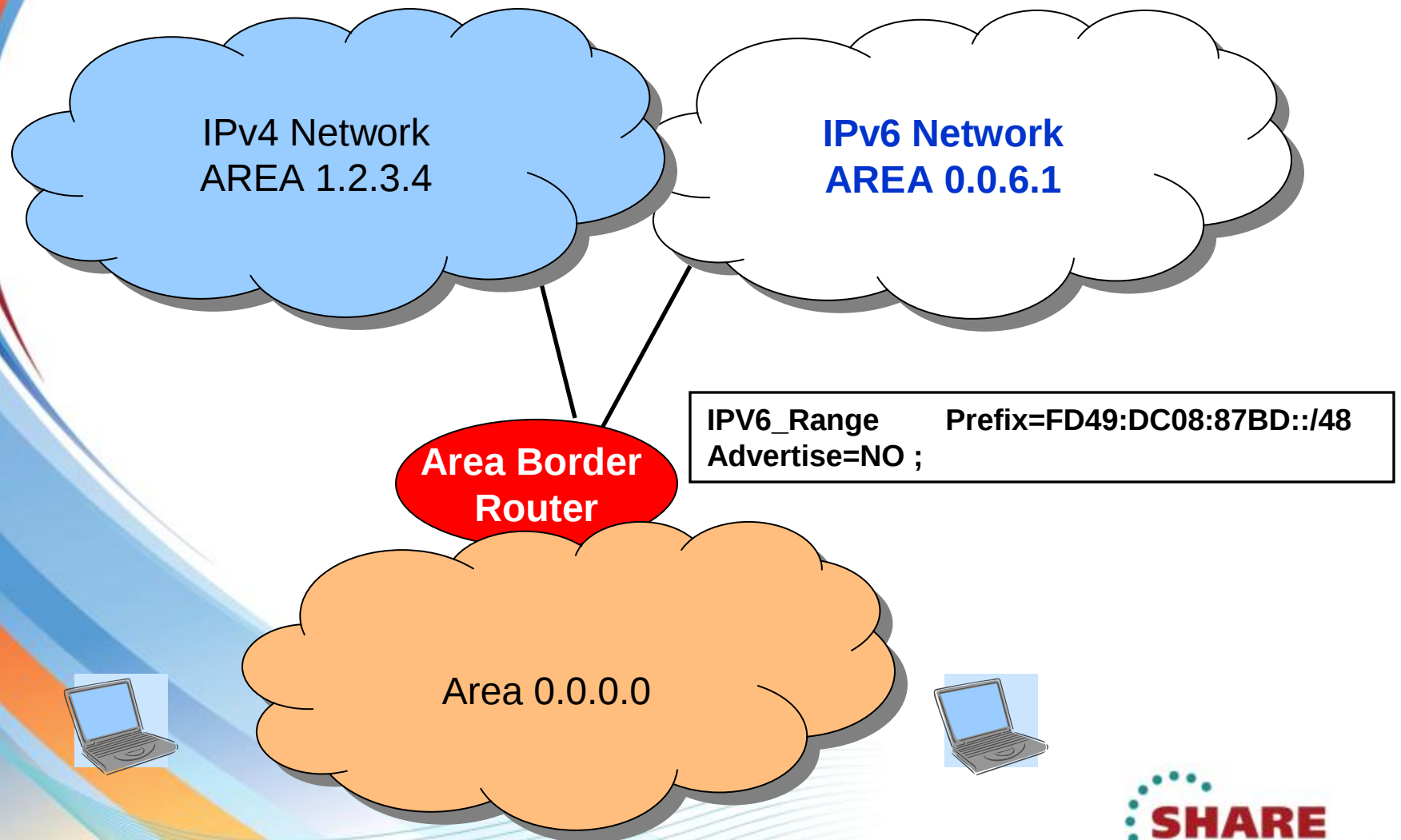
Thursday, Feb 7, 2013
1:30 PM-2:30PM

(4th Floor: Union Square 23-24 at
San Francisco Hilton)

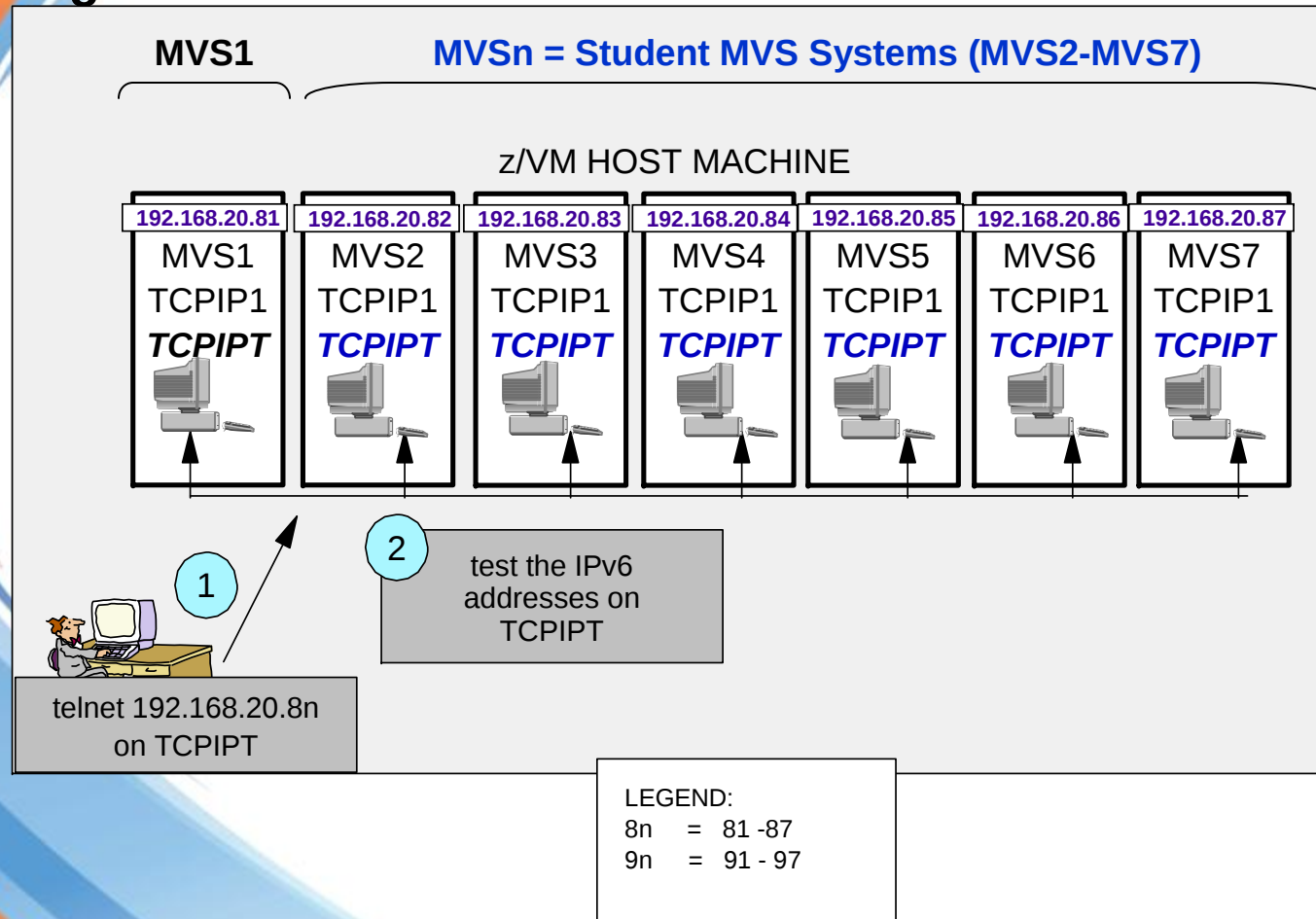
Abstract

- Now that you have heard about the basics of IPv6, your next step is to implement it!
- This lab will let you change z/OS to support a TCP/IP stack capable of handling both IPv4 and IPv6 flows.
 - You will code IPv6 interfaces for QDIO ports, HiperSockets, and Static VIPAs.
 - Then you will create static routes for IPv6 routing and an “ipnodes” files so that you will not have to deal with remembering 128-bit IPv6 addresses.
 - Next you will configure OMROUTE to support IPv6 addresses.
- As you proceed through the lab you will test the results of your configuration changes and you will leave the lab having created an IPv6 network based on Unique Local Unicast Addresses (ULAs) and Link-Local Addresses.
- **RECOMMENDATION:** Please be sure to attend the IPv6 presentations (Overview and Addressing) prior to participating in this lab.

Overview of Isolated Routing for IPv6 Test Environment: Suppressing IPv6 Advertisement into Area 0 during Test



MVS_n Tests with MVS1; TCPIPT Is the IPv6 Stack for Testing



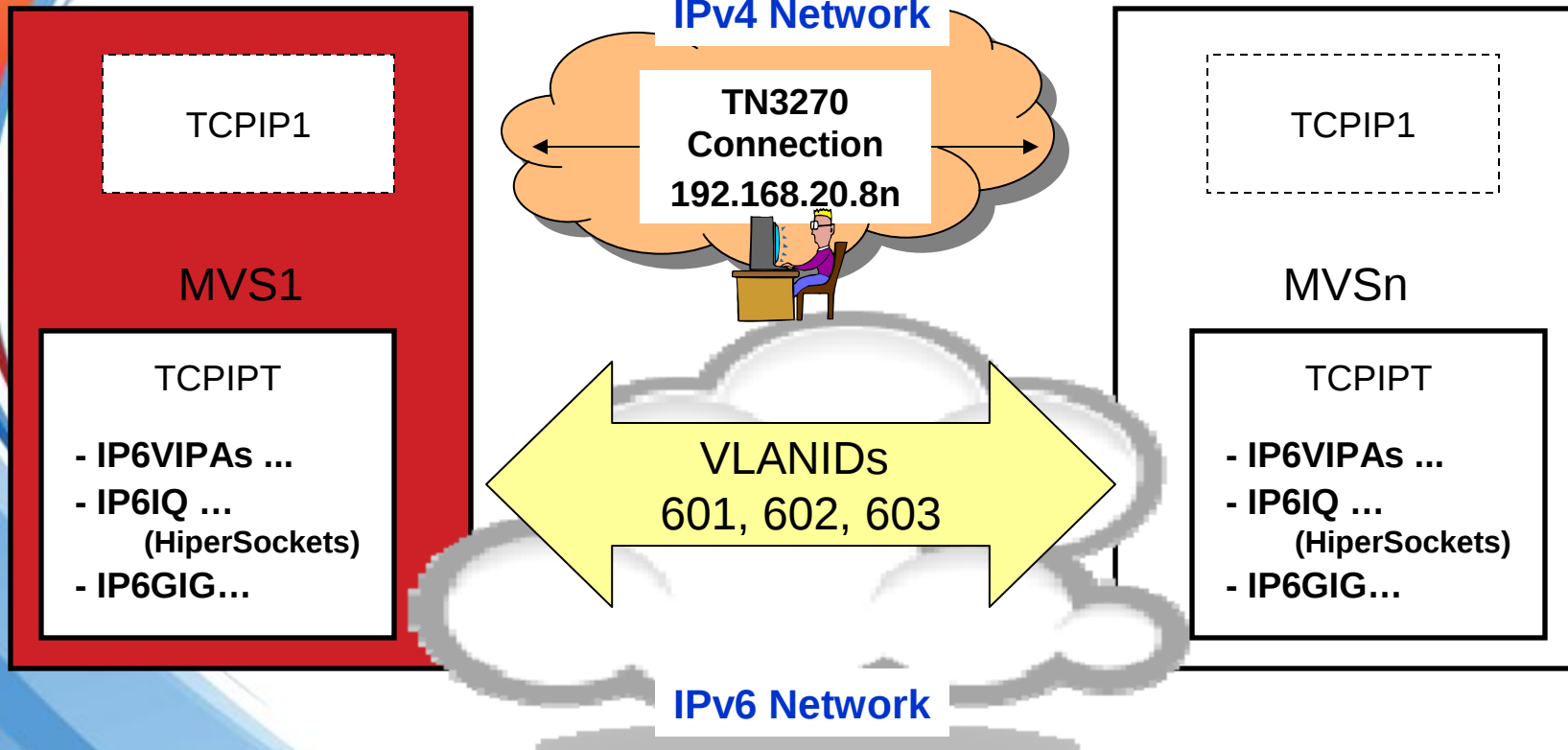
1. Telnet into Maintenance Stack (TCPIP1) at the MVS_n Guest Machine.
 - A. Edit TCP/IP configurations for Test Stack (TCPIPT) with ISPF editor under TSO
2. Initialize and Test your TCPIPT with your new profile.
3. You will test your connections against the Instructor MVS: MVS1.

Diagram of Interfaces between MVS1 & Student MVS_n



Instructor MVS

Student MVS₂ – MVS₇



- Convert your MVS to support Dual-Mode Stacks (IPv4 + IPv6 sockets)
- Create IPv6 Interfaces for VLANs (VIPAs, HiperSockets, QDIO LAN)
 - See pages 9 - 15 of this handout.
- Change Resolver to Use IPNodes Files to manage IPv6 Addresses

Lab Flow

- Review Diagram with IPv6 addresses for HiperSockets and for OSA QDIO ports
 - See pages 9 - 15 of this handout.
- Issue Netstat to see IPv4 format
- Issue Netstat CONFIG to see what entries are there prior to migration ...
- Change BPXPRM to support IPv6
- Recycle TCP/IP stack
- Issue Netstat to see IPv6 format
- Add IPV6 Statements to TCPIPT stack:
 - IPCONFIG6
 - IPV6 VIPAs, HiperSockets, QDIO Adapters
- Create IPNODES file with IPv6 addresses
- Create static routing table with REPL to reach VIPA over HiperSockets
- Test IPNodes and BEGINRoutes with PINGs
 - Connection to IPv6
 - Connection to IPv4
- OPTIONAL: Test IPNodes and BEGINRoutes with FTP
- OPTIONAL: Modify OMPROUTE for IPv6
- OPTIONAL: Test with PING and FTP
 - Connection to IPv6
 - Connection to IPv4

Unique IPv6 Local Address Prefix Calculation with bitace.com/ipv6calc



Private subnet / Unique Local IPv6 Unicast Addresses

A private subnet is akin to the IPv4 private networks 10.0.0.0/8, 172.16.0.0/12 and 192.168.0.0/16.

To address the problem of everyone using one of just three choices for private network, the IPv6 standard defines a 40 bit random part of the address range reserved for private use.

It has been defined by [RFC 4193](http://tools.ietf.org/html/rfc4193)

This tool will calculate a 40 bit random part and display a subnet ready for use.

Your private subnet is: fd49:dc08:87bd::/48

[Calculate IPv6 private subnet](#)

Unicast-Prefix-based IPv6 Multicast Addresses

Your IPv6 subnet can be converted to a multicast subnet. You can use a subnet assigned by your ISP, a private subnet generated by the above calculator or even a tunnel address. Do not use a link local address.

This method is defined by [RFC 3306](http://tools.ietf.org/html/rfc3306)

Please remember to specify the prefix length. Prefix length must be in the interval [1 ; 64]. If you omit the prefix, 64 is assumed.

Your multicast subnet is: ff38:30:fd49:dc08:87bd::/96

Enter IPv6 subnet:

- ☐ node-local scope
- ☐ link-local scope
- ☐ site-local scope
- ☒ organization-local scope
- ☐ global scope

[calculate](#)

NOTE: You will find several IPv6 address calculators on the Internet. The one that we used for this lab is at bitace.com/ipv6calc.



Addresses for MVS1 – MVS7

IPv6

MVS1 Addresses (Instructor MVS)

At Control TCPIP1:

- Telnet Address is 192.168.20.81

At Customizable TCPIPT:

INTFNAME: IP6VIP1A

ADDRESS: FD49:DC08:87BD:A814::1
TYPE: GLOBAL

INTFNAME: IP6VIP1B

ADDRESS: FD49:DC08:87BD:A815::91
TYPE: GLOBAL

INTFNAME: IP6VIP1C

ADDRESS: FD49:DC08:87BD:A816::191
TYPE: GLOBAL

INTFNAME: IP6VIP1X

ADDRESS: FD49:DC08:87BD:A888::101
TYPE: GLOBAL

- **INTFNAME: IP6GIG1A (QDIO LAN – VLAN 601)**

ADDRESS: FD49:DC08:87BD:A814:0:1:2:601
TYPE: GLOBAL

ADDRESS: FE80::1:2:601

TYPE: LINK_LOCAL

FLAGS: AUTOCONFIGURED

- **INTFNAME: IP6GIG1B (QDIO LAN – VLAN 602)**

ADDRESS: FD49:DC08:87BD:A815:0:5FF:FE77:9FF7
TYPE: GLOBAL

ADDRESS: FE80::5FF:FE77:9FF7

TYPE: LINK_LOCAL

FLAGS: AUTOCONFIGURED

- **INTFNAME: IP6IQ1DE (HiperSockets, CHPID DE, – VLAN 603)**

ADDRESS: FD49:DC08:87BD:A816:0:1:2:603
TYPE: GLOBAL

ADDRESS: FE80::1:2:603

TYPE: LINK_LOCAL

FLAGS: AUTOCONFIGURED

- **INTFNAME: LOOPBACK6**

- ADDRESS: ::1

- TYPE: LOOPBACK

MVS2 Addresses (Student MVS)

At Control TCPIP1:

- Telnet Address is 192.168.20.82

At Customizable TCPIPT:

INTFNAME: IP6VIP2A

ADDRESS: FD49:DC08:87BD:A814::2
TYPE: GLOBAL

INTFNAME: IP6VIP2B

ADDRESS: FD49:DC08:87BD:A815::92
TYPE: GLOBAL

INTFNAME: IP6VIP2C

ADDRESS: FD49:DC08:87BD:A816::192
TYPE: GLOBAL

- Student USERID = USER21
- TSO Password = gbguser
- UNIX Subdirectory = /u/user21
- Telnet to 192.168.20.82
- Alternate USERID = USER22

- **INTFNAME: IP6GIG2A (QDIO LAN – VLAN 601)**
ADDRESS: FD49:DC08:87BD:A814:0:2:2:601
TYPE: GLOBAL

ADDRESS: FE80::2:2:601
TYPE: LINK_LOCAL
FLAGS: AUTOCONFIGURED

- **INTFNAME: IP6GIG2B (QDIO LAN – VLAN 602)**
ADDRESS: FD49:DC08:87BD:A815:0:xxxx:yyyy:zzzz
TYPE: GLOBAL

ADDRESS: FE80::5FF:FE77:9FF7
TYPE: LINK_LOCAL
FLAGS: AUTOCONFIGURED

- **INTFNAME: IP6IQ2DE (HiperSockets, CHPID DE, – VLAN 603)**
ADDRESS: FD49:DC08:87BD:A816:0:2:2:603
TYPE: GLOBAL

ADDRESS: FE80::2:2:603
TYPE: LINK_LOCAL
FLAGS: AUTOCONFIGURED

- **INTFNAME: LOOPBACK6**
- ADDRESS: ::1
- TYPE: LOOPBACK

MVS3 Addresses (Student MVS)

At Control TCPIP1:

- Telnet Address is 192.168.20.83

At Customizable TCPIPT:

INTFNAME: IP6VIP3A

ADDRESS: FD49:DC08:87BD:A814::3
TYPE: GLOBAL

INTFNAME: IP6VIP3B

ADDRESS: FD49:DC08:87BD:A815::93
TYPE: GLOBAL

INTFNAME: IP6VIP3C

ADDRESS: FD49:DC08:87BD:A816::193
TYPE: GLOBAL

- Student USERID = USER31
- TSO Password = gbguser
- UNIX Subdirectory = /u/user31
- Telnet to 192.168.20.83
- Alternate USERID = USER32

INTFNAME: IP6GIG3A (QDIO LAN – VLAN 601)

ADDRESS: FD49:DC08:87BD:A814:0:3:2:601
TYPE: GLOBAL

ADDRESS: FE80::3:2:601

TYPE: LINK_LOCAL

FLAGS: AUTOCONFIGURED

INTFNAME: IP6GIG3B (QDIO LAN – VLAN 602)

ADDRESS: FD49:DC08:87BD:A815:0:xxxx:yyyy:zzzz
TYPE: GLOBAL

ADDRESS: FE80::5FF:FE77:9FF7

TYPE: LINK_LOCAL

FLAGS: AUTOCONFIGURED

INTFNAME: IP6IQ3DE (HiperSockets, CHPID DE, – VLAN 603)

ADDRESS: FD49:DC08:87BD:A816:0:3:2:603
TYPE: GLOBAL

ADDRESS: FE80::3:2:603

TYPE: LINK_LOCAL

FLAGS: AUTOCONFIGURED

INTFNAME: LOOPBACK6

• ADDRESS: ::1

• TYPE: LOOPBACK

MVS4 Addresses (Student MVS)

At Control TCPIP1:

- Telnet Address is 192.168.20.84

At Customizable TCPIPT:

INTFNAME: IP6VIP4A

ADDRESS: FD49:DC08:87BD:A814::4
TYPE: GLOBAL

INTFNAME: IP6VIP4B

ADDRESS: FD49:DC08:87BD:A815::94
TYPE: GLOBAL

INTFNAME: IP6VIP4C

ADDRESS: FD49:DC08:87BD:A816::194
TYPE: GLOBAL

- Student USERID = USER41
- TSO Password = gbguser
- UNIX Subdirectory = /u/user41
- Telnet to 192.168.20.84
- Alternate USERID = USER42

- **INTFNAME: IP6GIG4A (QDIO LAN – VLAN 601)**
ADDRESS: FD49:DC08:87BD:A814:0:4:2:601
TYPE: GLOBAL

ADDRESS: FE80::4:2:601
TYPE: LINK_LOCAL
FLAGS: AUTOCONFIGURED

- **INTFNAME: IP6GIG4B (QDIO LAN – VLAN 602)**
ADDRESS: FD49:DC08:87BD:A815:0:xxxx:yyyy:zzzz
TYPE: GLOBAL

ADDRESS: FE80::5FF:FE77:9FF7
TYPE: LINK_LOCAL
FLAGS: AUTOCONFIGURED

- **INTFNAME: IP6IQ4DE (HiperSockets, CHPID DE, – VLAN 603)**
ADDRESS: FD49:DC08:87BD:A816:0:4:2:603
TYPE: GLOBAL

ADDRESS: FE80::4:2:603
TYPE: LINK_LOCAL
FLAGS: AUTOCONFIGURED

- **INTFNAME: LOOPBACK6**
- ADDRESS: ::1
- TYPE: LOOPBACK

MVS5 Addresses (Student MVS)

At Control TCPIP1:

- Telnet Address is 192.168.20.85

At Customizable TCPIPT:

INTFNAME: IP6VIP5A

ADDRESS: FD49:DC08:87BD:A814::5
TYPE: GLOBAL

INTFNAME: IP6VIP5B

ADDRESS: FD49:DC08:87BD:A815::95
TYPE: GLOBAL

INTFNAME: IP6VIP5C

ADDRESS: FD49:DC08:87BD:A816::195
TYPE: GLOBAL

- Student USERID = USER51
- TSO Password = gbguser
- UNIX Subdirectory = /u/user51
- Telnet to 192.168.20.85
- Alternate USERID = USER52

- **INTFNAME: IP6GIG5A (QDIO LAN – VLAN 601)**
ADDRESS: FD49:DC08:87BD:A814:0:5:2:601
TYPE: GLOBAL

ADDRESS: FE80::5:2:601
TYPE: LINK_LOCAL
FLAGS: AUTOCONFIGURED

- **INTFNAME: IP6GIG5B (QDIO LAN – VLAN 602)**
ADDRESS: FD49:DC08:87BD:A815:0:xxxx:yyyy:zzzz
TYPE: GLOBAL

ADDRESS: FE80::5FF:FE77:9FF7
TYPE: LINK_LOCAL
FLAGS: AUTOCONFIGURED

- **INTFNAME: IP6IQ5DE (HiperSockets, CHPID DE, – VLAN 603)**
ADDRESS: FD49:DC08:87BD:A816:0:5:2:603
TYPE: GLOBAL

ADDRESS: FE80::5:2:603
TYPE: LINK_LOCAL
FLAGS: AUTOCONFIGURED

- **INTFNAME: LOOPBACK6**
- ADDRESS: ::1
- TYPE: LOOPBACK

MVS6 Addresses (Student MVS)

At Control TCPIP1:

- Telnet Address is 192.168.20.86

At Customizable TCPIPT:

INTFNAME: IP6VIP6A

ADDRESS: FD49:DC08:87BD:A814::6
TYPE: GLOBAL

INTFNAME: IP6VIP6B

ADDRESS: FD49:DC08:87BD:A815::96
TYPE: GLOBAL

INTFNAME: IP6VIP6C

ADDRESS: FD49:DC08:87BD:A816::196
TYPE: GLOBAL

- Student USERID = USER61
- TSO Password = gbguser
- UNIX Subdirectory = /u/user61
- Telnet to 192.168.20.86
- Alternate USERID = USER62

- **INTFNAME: IP6GIG6A (QDIO LAN – VLAN 601)**

ADDRESS: FD49:DC08:87BD:A814:0:6:2:601
TYPE: GLOBAL

ADDRESS: FE80::6:2:601

TYPE: LINK_LOCAL

FLAGS: AUTOCONFIGURED

- **INTFNAME: IP6GIG6B (QDIO LAN – VLAN 602)**

ADDRESS: FD49:DC08:87BD:A815:0:xxxx:yyyy:zzzz
TYPE: GLOBAL

ADDRESS: FE80::5FF:FE77:9FF7

TYPE: LINK_LOCAL

FLAGS: AUTOCONFIGURED

- **INTFNAME: IP6IQ6DE (HiperSockets, CHPID DE, – VLAN 603)**

ADDRESS: FD49:DC08:87BD:A816:0:6:2:603
TYPE: GLOBAL

ADDRESS: FE80::6:2:603

TYPE: LINK_LOCAL

FLAGS: AUTOCONFIGURED

- **INTFNAME: LOOPBACK6**

- ADDRESS: ::1

- TYPE: LOOPBACK

MVS7 Addresses (Student MVS)

At Control TCPIP1:

- Telnet Address is 192.168.20.87

At Customizable TCPIPT:

INTFNAME: IP6VIP7A

ADDRESS: FD49:DC08:87BD:A814::7
TYPE: GLOBAL

INTFNAME: IP6VIP7B

ADDRESS: FD49:DC08:87BD:A815::97
TYPE: GLOBAL

INTFNAME: IP6VIP7C

ADDRESS: FD49:DC08:87BD:A816::197
TYPE: GLOBAL

- Student USERID = USER71
- TSO Password = gbguser
- UNIX Subdirectory = /u/user71
- Telnet to 192.168.20.87
- Alternate USERID = USER72

INTFNAME: IP6GIG7A (QDIO LAN – VLAN 601)

ADDRESS: FD49:DC08:87BD:A814:0:7:2:601
TYPE: GLOBAL

ADDRESS: FE80::7:2:601

TYPE: LINK_LOCAL

FLAGS: AUTOCONFIGURED

INTFNAME: IP6GIG7B (QDIO LAN – VLAN 602)

ADDRESS: FD49:DC08:87BD:A815:0:xxxx:yyyy:zzzz
TYPE: GLOBAL

ADDRESS: FE80::5FF:FE77:9FF7

TYPE: LINK_LOCAL

FLAGS: AUTOCONFIGURED

INTFNAME: IP6IQ7DE (HiperSockets, CHPID DE, – VLAN 603)

ADDRESS: FD49:DC08:87BD:A816:0:7:2:603
TYPE: GLOBAL

ADDRESS: FE80::7:2:603

TYPE: LINK_LOCAL

FLAGS: AUTOCONFIGURED

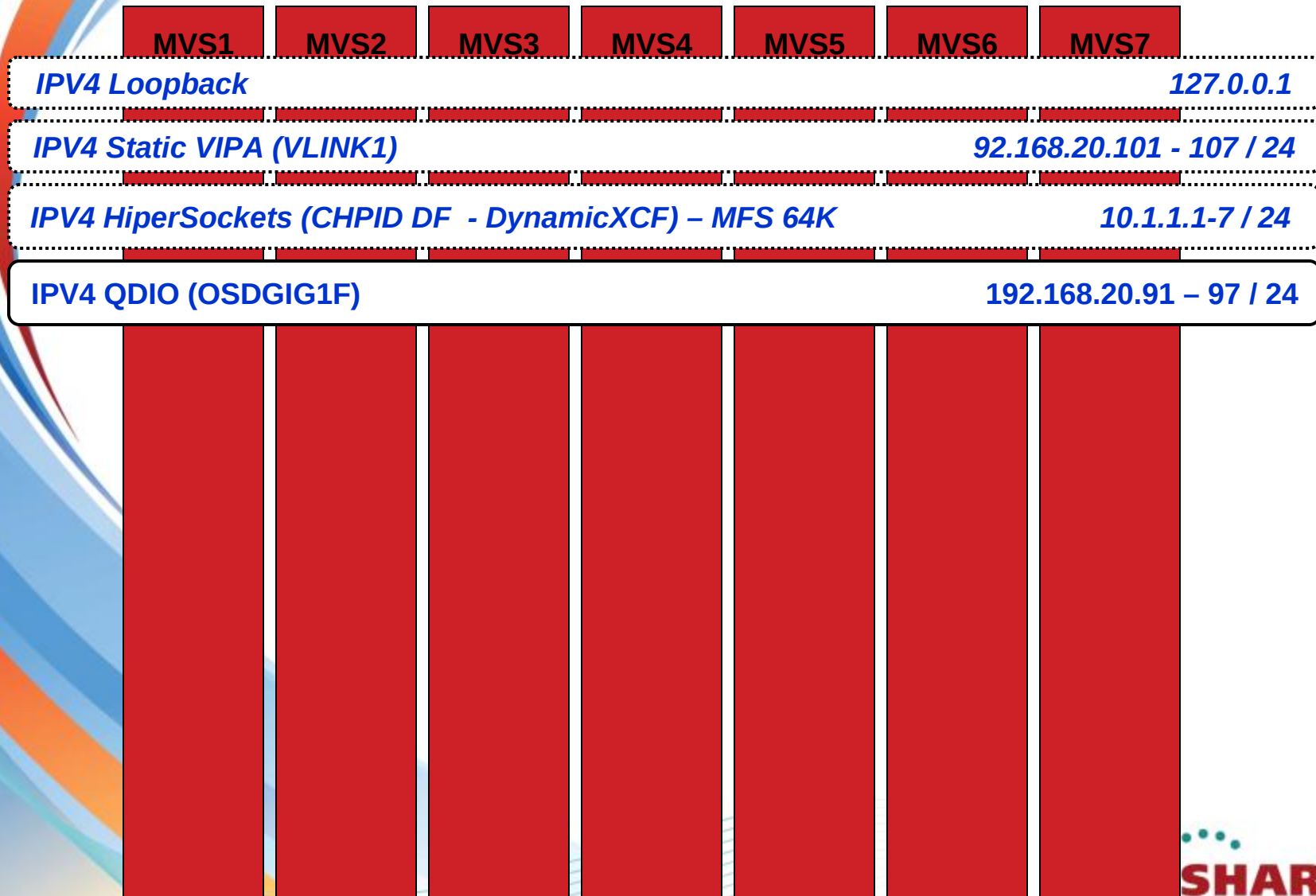
INTFNAME: LOOPBACK6

- ADDRESS: ::1
- TYPE: LOOPBACK

Appendices to Understand IPv6 Address Structure

MVS1-MVS7

TCPIPT Dual-Mode Stack: Structure of TCPIPT IPv4 Addresses in Labs



TCPIPT Dual-Mode Stack: Structure of TCPIPT IPv6 Address in Labs

MVS1	MVS2	MVS3	MVS4	MVS5	MVS6	MVS7
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Full IPV6 Address Example: FD49:DC08:87BD:A814:0: 1: 2: 601

Computed ULA Prefix: FD49:DC08:87BD:

Assigned Subnets in 4th Field:

Static VIPA6:	<u>A814</u>
and QDIO6 OSA:	<u>A814 (VLANID 601)</u>
Static VIPA6:	<u>A815</u>
and QDIO6 OSA:	<u>A815 (VLANID 602)</u>
Static VIPA6:	<u>A816</u>
and HiperSockets6:	<u>A816 (VLANID 603)</u>
Static VIPA6 (MVS1):	<u>A888</u>

Convention for predefined INTFID: :00:<MVS #>:<TCPStack #>:<VLANID>:

Convention for predefined INTFID: :00:<MVS #>:<TCPStack #>:<VLANID>:

Full IPV6 Address Example: FD49:DC08:87BD:A814:0: 1: 2: 601

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TCPIPT Dual-Mode Stack: Profile IP6PRO1a – IP6PRO7a



IPV4 Loopback 127.0.0.1

IPV4 Static VIPA (VLINK1) 92.168.20.101 - 107 / 24

IPV4 HiperSockets (CHPID DF - DynamicXCF) – MFS 64K 10.1.1.1-7 / 24

IPV4 QDIO (OSDGIG1F) 192.168.20.91 – 97 / 24

IPV6 Loopback ::1

IPV6 Static VIPA (IP6VIP1a – IP6VIP7a) fd49:dc08:87bd:A814::1 – 7 / 64

IPV6 Static VIPA (IP6VIP1b – IP6VIP7b) fd49:dc08:87bd:A815::91 – 97 / 64

IPV6 Static VIPA (IP6VIP1c – IP6VIP7c) fd49:dc08:87bd:A816::191 – 197 / 64

MVS1 ONLY: IPV6 Static VIPA (IP6VIP1x) fd49:dc08:87bd:A888::101 / 64

IPV6 HS (CHPID DE – IP6IQ1DE – IP6IQ7DE) – MFS 64K
fd49:dc08:87bd:A816:0:1:2:603 / 64 **VLAN ID 603**

IPV6 QDIO (IP6GIG1a – IP6GIG7a) fd49:dc08:87bd:A814:<defined INTFID>:601 / 64 **VLAN ID 601**

IPV6 QDIO (IP6GIG1b – IP6GIG7b) fd49:dc08:87bd:A815:<generated INTFID>:91 – 97 / 64 **VLAN ID 602**

Convention for predefined INTFID: :00:<MVS #>:<TCPStack #>:<VLANID>:

Full IPV6 Address Example: FD49:DC08:87BD:A814:0: 1: 2: 601

Instructor-run Jobs Prior to Lab

At MVS1:

- SYS1.CS.CNTL(RACFPSEC) -- against shared RACF Database from one system
- SYS1.CS.CNTL(RACFSIZE) -- against shared RACF Database "*****"
- SYS1.CS.CNTL(EMPTY6PR) -- against shared PARMLIB for all MVS2-MVS7
- NOTE: Your instructor will already have initialized the following procedures at MVS1 – the system against which you will be testing:
 - /SET OMVS=I6 ('sys1.parmlib(bpxprmi6)')
 - /F CCLRSLVR,REFRESH,SETUP='/BACKUP/CSPOLICY/IPV6/setuptch'
 - /S TCPIPT,PROF=IP6PRO1A,CS=SYS1
 - /S OMPRT,CS=SYS1,ENV=OENV6T1
 - /S ftpt
 - //FTPT PROC
MODULE='FTPD',CS=SYS1,DATA=DAT&CL1.A,FDAT=FTPSEC,PARMS=""
 - /S tn3270t
 - TN3270T PROC PARMS='CTRACE(CTIEZBTN)',PROF=TN&CL1.A,CS=SYS1,
DATA=DAT&CL1.A
- At UNIX: ./usscleanip6.sh and ./usscopyip6.sh (takes care of ALL STUDENT MVS systems)

On Your MVS:

- 1) Your instructor will also have run one script to clear out the student directories from a previous lab offering.
 - 1) EMPTY6IP (copies skeletons into student datasets on unique volumes)
 - 2) At UNIX:
 - 1) F CCLRSLVR,REFRESH,SETUP='/BACKUP/CSPOLICY/IPV6/setuptch'

IPv6 Configuration on z/OS

Hands-on Lab

End of Lab

SHARE San Francisco 2013

Session 12861

End of LAB IPv6 Configuration on z/OS Hands-on Lab Introduction



Speaker:

Gwendolyn J. Dente (gdente@us.ibm.com)
IBM Advanced Technical Support (ATS)
Gaithersburg, Maryland (USA)

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