The z/VM Virtual Switch
Advancing the Art of Virtual Networking
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Topics

- Overview
- Multi-zone Networks
- Virtual Switch
- Virtual NIC
Multi-Zone Network
Multi-zone Network on System z
Multi-zone Network with Guest LANs

LPAR 1

web
web
web

Guest LAN

web

web

LPAR 2

z/VM

z/OS
DB2

app
app
app

Guest LAN

HiperSockets

= Firewall Router

PR/SM

Ethernet LAN
Multi-DMZ Network on zSeries with outboard firewall
Multi-DMZ Network with two VSWITCHes

LPAR 1

web
web
web
web
VSWITCH 1

LPAR 2

z/VM

app
app
app

VSWITCH 2

z/OS
DB2
Multi-DMZ Network with VSWITCH (B)

With 1 VSWITCH, 3 VLANs, and a multi-domain firewall
**Guest LAN vs. Virtual Switch**

- **Guest LAN**
  - Virtual router is required
  - Different subnet
  - External router awareness
  - Guest-managed failover

- **Virtual Switch**
  - No virtual router
  - Same subnet
  - Transparent bridge
  - CP-managed failover
Setting Guest LAN and VSWITCH defaults and limits

- Set global guest LAN attributes in the SYSTEM CONFIG file:

  - `VMLAN LIMIT PERSISTENT INFINITE|maxcount`
  - `VMLAN LIMIT TRANSIENT INFINITE|maxcount`
  - `VMLAN ACNT|ACCOUNTING SYSTEM ON|OFF`
  - `VMLAN ACNT|ACCOUNTING USER ON|OFF`
  - `VMLAN MACPREFIX 020000–02FFFFFF`
  - `VMLAN MACIDRANGE SYSTEM x–y [USER a–b]`

- `VMLAN LIMIT TRANSIENT 0` prevents dynamic definition of Guest LANs by class G users
Virtual MAC Addresses

- Each instance of CP should have a unique MACPREFIX
  - VMLAN MACPREFIX 020001
  - Reserve 020000 (the default) to recognize a misconfigured system

- Use MACIDRANGE to identify static vs. dynamic MAC addresses
  - VMLAN MACIDRANGE SYSTEM 000001-002FFF
    USER 002000-002FFF
  - USER range is a subset of SYSTEM range
  - Static MAC ids must come from USER range

- Virtual MAC = MACPREFIX || MACID
  - 02 00 01 00 01 23
What’s a ‘switch’ anyway?

It creates LANs and routes traffic

- Turn ports on and off
- Assign a port to a LAN segment
- Provides LAN sniffer ports
IEEE VLANs

- If you run out of ports, you don’t throw it away, you daisy chain (“trunk”) it to another switch.
z/VM Virtual Switch – VLAN unaware
Sees only a single LAN segment

Virtual Switch Guest LAN

Linux  VM TCP/IP  z/VSE  z/OS

CP

OSA-Express

Ethernet LAN

Access port

Virtual QDIO adapter

Same LAN segment and subnet
z/VM Virtual Switch – VLAN aware
Sees all authorized LAN segments

Virtual Switch Guest LAN

Virtual QDIO adapter

IEEE 802.1q transparent bridge
4 LANs
Trunk Port vs. Access Port

- Trunk port carries traffic from all VLANs
- Every frame is tagged with the VLAN id
- Access port carries traffic for a single VLAN
- Host not aware of VLANs
Physical Switch to Virtual Switch

- Trunk port carries traffic between CP and switch
- Each guest can be in a different VLAN
A VLAN-aware switch: An inside look
Virtual Switch Attributes

- 1-8 character name
- Associated OSAs or Port group
- A controller virtual machine
  - DTCVSW1 and DTCVSW2
  - Starts, stops, and monitors OSAs
  - Not involved in data transfer
  - Do not ATTACH or DEDICATE devices
- Access list
Create a Virtual Switch

- SYSTEM CONFIG or CP command:

```plaintext
DEFINE VSWITCH name
    [RDEV NONE | cuu [cuu [cuu]] ]
    [NONROUTER | PRIROUTER]

    [VLAN UNAWARE | VLAN default_vid]
    [NATIVE 1 | native_vid]
    [GROUP group_name]

    [IP | ETHERNET]

    [CONNECT | DISCONNECT]
    [PORTTYPE ACCESS | PORTTYPE TRUNK]
    [CONTROLLER * | CONTROLLER userid]

Example:

DEFINE VSWITCH SWITCH12 RDEV 1E00 1F04
```
ETHERNET vs. IP

- **ETHERNET = “Layer 2”**
  - Each guest has a unique MAC address
  - Guest sends ethernet frame to NIC
  - OSA and CP have MAC address awareness

- **IP = “Layer 3”**
  - All guests have the same MAC address
  - Guest sends IP packets to NIC
  - OSA adds frame
  - OSA and CP have IP address awareness
Access list

- Only users in the access list can connect (couple) to this LAN or VSWITCH

- CP SET LAN or SET VSWITCH to GRANT or REVOKE access
  - RACF can control and audit access

- CP QUERY LAN or VSWITCH can show you the current access list and who is connected
  - Look at the DETAILS option
Vs. Guest LAN

- DEFINE LAN, SET LAN, QUERY LAN
- Owned by users or SYSTEM
- Class G can create (by default)
- Persistent vs. Transient
- Standalone LAN segment
- No connection to external network
  - Virtual router
  - Each Guest LAN needs its own subnet
Change the Virtual Switch access list

- Specify after DEFINE VSWITCH statement in SYSTEM CONFIG to add users to access list

```
MODIFY VSWITCH name GRANT userid
SET [VLAN vid1 vid2 vid3 vid4]
[PORTTYPE ACCESS | TRUNK]
[PROmiscuous | NOPROmiscuous]

SET VSWITCH name REVOKE userid
```

Examples:
```
MODIFY VSWITCH SWITCH12 GRANT LNX01 VLAN 3
CP SET VSWITCH SWITCH12 GRANT LNX02 PORTTYPE TRUNK
  VLAN 4 20-22 29 302

CP SET VSWITCH SWITCH12 GRANT LNX02 PROMISCIOUS
```
IEEE 802.3ad Link Aggregation

Non-disruptive networking scalability and failover
IEEE 802.3ad Link Aggregation

- **System z9 and later**
- **Groups available OSA-Express2/3 ports for use by the z/VM Virtual Switch**
  - Up to 8 ports per virtual switch
  - Increases Virtual Switch bandwidth and provides near seamless failover in the event of a failed controller, link or switch
  - Only supported for Layer 2 switches
- **Includes support to recover from a failed external switch**
IEEE 802.3ad Link Aggregation

- Define an OSA port group
  - SET PORT GROUP *name* JOIN E100 E200.P1

- DEFINE VSWITCH … ETHERNET GROUP *name*

- OSAs *cannot* be shared
z/VM Virtual Switch SNMP MIB

- Integrates VSWITCH into standards-based switch management and monitoring tools
- SNMP subagent provides Bridge MIB data
  - Defined by RFC 1493
Virtual Switch Uplink Ports
“It’s not your grandfather’s VSWITCH!”

- All traffic sent to defined uplink guest
- Uplink can route it or forward it
- Great for firewalls
Additional security controls

- Virtual Sniffers
  - Guest must be authorized via SET VSWITCH or security server
  - Guest enables promiscuous mode using CP SET NIC or via device driver controls
    - E.g. tcpdump -P
  - Guest receives copies of all frames sent or received for authorized VLANs

- Port Isolation
  - Stop guests from talking to each other, even when in same VLAN
  - Shut off OSA “short circuit” to other users of the same OSA port
Virtual Network Interface Card
Virtual Network Interface Card (NIC)

- A simulated network adapter
- 3 or more devices per NIC
  - More than 3 to simulate port sharing on 2nd-level system or for multiple data channels
- Provides access to Guest LAN or Virtual Switch
- Created by NICDEF or CP DEFINE NIC command
Virtual NIC - User Directory

- One per interface in USER DIRECT file:

```plaintext
NICDEF vdev [TYPE HIPERS | QDIO] 
[LAN owner name] 
[DEVICES nn] 
[CHPID xx] 
[MACID xxyyzz] 

Example:

NICDEF 1100 LAN SYSTEM SWITCH1 CHPID B1 MACID B10006
```

- This is the only way to pre-assign the MAC address!
Virtual NIC - CP Command

- May be interactive with CP DEFINE NIC and COUPLE commands:

```
CP DEFINE NIC vdev
    [[TYPE] HIPERsockets|QDIO]
    [DEVices devs]
    [CHPID xx]

CP COUPLE vdev [TO] owner name

Example:

CP DEFINE NIC 1200 TYPE QDIO
CP COUPLE 1200 TO SYSTEM SWITCH12
```
NIC CHPID parameter

CHPID xx

- Specifies the Channel Path ID number (in hex) to use for this NIC
  - Default is any available unused real CHPID number

- Needed for z/OS guests only when connecting to HiperSockets Guest LAN

- This is a virtual CHPID number
Some Final Thoughts...
Network Configuration

- Guest LANs require a new subnet and the use of a virtual router
  - Can use a Disconnected VSWITCH instead

- A Virtual SWITCH extends the subnets you already have

- By having virtual and real configurations be the same, you can easily test network configuration before deployment with real hardware
Built-in Diagnostics

- **CP QUERY VMLAN**
  - to get global VM LAN information (e.g. limits)
  - to find out what service has been applied

- **CP QUERY LAN ACTIVE**
  - to find out which users are coupled
  - to find out which IP addresses are active

- **CP QUERY NIC DETAILS**
  - to find out if your adapter is coupled
  - to find out if your adapter is initialized
  - to find out if your IP addresses have been registered
  - to find out how many bytes/packets sent/received
## Support Summary

<table>
<thead>
<tr>
<th>z/VM Version</th>
<th>Features</th>
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<tbody>
<tr>
<td>z/VM 6.1</td>
<td>Uplink port can be OSA or guest</td>
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</tbody>
</table>
| z/VM 5.4     | Port isolation  
Native VLAN id defaults to 1  
z/VM TCP/IP support for Layer 2 |
| z/VM V5.3    | Link aggregation  
Separation of default VLAN id from native VLAN id  
SNMP monitor |
| z/VM V5.2    | Virtual SPAN ports for sniffers |
| z/VM V5.1    | Virtual trunk and access port controls  
Removal of VLAN ANY  
Layer 2 (MAC) frame transport  
Improved virtual switch error detection & recovery  
External security manager access control |
| z/VM V4      | IPv4 Virtual Switch with IEEE VLANs  
IPv4 HiperSocket Guest LAN  
IPv4 and IPv6 QDIO Guest LAN |
References

- **Publications:**
  - z/VM CP Planning and Administration
  - z/VM CP Command and Utility Reference
  - z/VM TCP/IP Planning and Customization
  - z/VM Connectivity

- **Links:**
  - [http://www.linuxvm.org/](http://www.linuxvm.org/)
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