Session 17525

z/VM Virtual Switch: Advanced Topics

Alan Altmark
Senior Managing z/VM Consultant
IBM Systems Lab Services
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Agenda

• Port-based authorization

• Link aggregation (channel bonding)

• Shared Link Aggregation port groups

• HiperSocket Bridge

• Virtual Ethernet Port Aggregator (VEPA)

• SNMP MIB
Port-based VSWITCH access list

- Explicit port definitions
  - Admin-assigned port number
  - Each is associated with one or more VLAN ids
  - Each is reserved for a specific user ID
  - Port type
  - SET VSWITCH GRANT not used

- If user has more than one reserved port, must select via PORTNUM on COUPLE command

```
<table>
<thead>
<tr>
<th>VLAN 100</th>
<th>VLAN 200</th>
</tr>
</thead>
<tbody>
<tr>
<td>LinuxB</td>
<td>LinuxC</td>
</tr>
<tr>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>trunk port</td>
<td></td>
</tr>
</tbody>
</table>

LinuxA

1
2

access ports

No vconfig

No vconfig

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Port-based VSWITCH access list

define vswitch vsw1 portbased vlan aware native none
set vswitch vsw1 portnumber 1 userid LINUXA
set vswitch vsw1 portnumber 2 userid LINUXA
set vswitch vsw1 portnumber 3 userid LINUXC
set vswitch vsw1 portnumber 4 userid LINUXB porttype TRUNK
set vswitch vsw1 vlanid 100 add 1 4
set vswitch vsw1 vlanid 200 add 2 3 4

LINUXA:  NICDEF 4E0 TYPE QDIO
NICDEF 5E0 TYPE QDIO
COMMAND COUPLE 4E0 TO SYSTEM VSW1 PORTNUM 1
COMMAND COUPLE 5E0 TO SYSTEM VSW1 PORTNUM 2

LINUXB:  NICDEF 4E0 TYPE QDIO LAN SYSTEM VSW1
          + vconfig eth0.100
          + vconfig eth0.200

LINUXC:  NICDEF 4E0 TYPE QDIO LAN SYSTEM VSW1
IEEE 802.3ad Link Aggregation

Non-disruptive networking scalability and failover

Load Balancer Aggregator / Multiplexer

LACP (Link Aggregation Control Protocol)

Switch A

Switch B

System z LPAR

z/VM

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

• Binds multiple OSA-Express ports into a single pipe
  – Up to 8 OSA ports per virtual switch
  – Increases Virtual Switch total bandwidth
  – Provides seamless failover in the event of a failed OSA, switch port, cable, or switch
  – Only supported for Layer 2 VSWITCHes
  – Virtual NIC is limited to bandwidth of single OSA

• With “virtual chassis” support from switch vendor, can even handle physical switch outage
IEEE 802.3ad Link Aggregation

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

- DEFINE VSWITCH … ETHERNET GROUP name

- OSA ports cannot be shared with other VSWITCHes or LPARs unless using IBM z13 and z/VM 6.3
Multi-VSWITCH Link Aggregation Port Groups

- IBM z13 exclusive!

- Provides a single point of control for OSA Port management across multiple VSWITCHes sharing the same physical port group.

- Requires two new system constructs
  - Global VSWITCH - Provides the mechanism for a Virtual Switch to span multiple z/VM LPARs within a CPC.
  - Inter-VSWITCH Link (IVL) - Provides management and data communications between Global VSWITCHes within the same or other z/VM instances.
Shared Link Aggregation Port Groups

- VSWITCHes are in communication with each other using a registered multicast group

- Port group can be used by different VSWITCHes

- Configuration changes are propagated to all z/VM systems sharing the port group

- You can manage the port group from any z/VM system connected to it

- Systems cooperate to balance traffic flow
The IVL Domain

- An IVL domain is a group of up to 16 z/VM LPARs on a CPC

- All z/VM Hypervisors sharing the same physical port group must be members of the same IVL domain

- A z/VM LPAR can be a member of exactly one IVL domain

- The IVL domain is established through an IVL VSWITCH – One per z/VM LPAR

- Up to 8 IVL Domains can share a single LAN segment

- The bandwidth required by the IVL is minor, consisting of management and LAG data recovery communications.
IVL VSWITCH

- DEFINE VSWITCH name {options}
  - TYPE IVL
  - DOMAIN A through P
  - VLAN vid
  - Conventional RDEV list or exclusive port GROUP

- Remember to provide OSA port redundancy for IVL!
IVL Network Configuration Domain B VLAN 8

- z/VM Hypervisor Casey
  - IVL VSwitch: IVL
    - IVL NIC Port
    - Uplink Port 7286.P00 to Uplink Port 7289.P01

- z/VM Hypervisor Jones
  - IVL VSwitch: IVL
    - IVL NIC Port
    - Uplink Port 7286.P00 to Uplink Port 7289.P01

- Alternate OSA Adapters
- Physical IVL Network to allow for VSwitch Failover

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IVL Controls

- **SET VSWITCH name IVLPORT {option}**
  - VLAN - Change the VLAN ID associated with the IVL
  - RESET - Terminate and recreate the IVL port connection
  - PING - Tests connectivity between z/VM hypervisors in the same IVL domain
    - **SET VSWITCH IVL IVLPORT PING ALL**
  - HEARTBEAT TIMEOUT - Adjusts how often the local z/VM system confirms connectivity with the other domain members
Create the Shared Port Group

- SET PORT GROUP name LACP ACTIVE SHARED
- SET PORT GROUP name JOIN rdev1.port  rdev2.port

- Device numbers can be any device number on the chpid

- The z/VM Control Program will select the device numbers to be used on the target adapter.

- z/VM will automatically propagate Shared Port Group information to all active IVL Members in the same IVL domain (B, in this example)
Port Group Verification

- **ALL**
  - Return all active port groups defined in the system
- **ACTIVE**
  - Return only those port groups associated with a virtual switch
- **INACTIVE**
  - Return only those port groups NOT associated with a virtual switch
- **GROUP** `groupname`
  - Return only the specified port group
- **GROUP** `groupname.instance`
  - Return only the specified port group instance
- **RDEV** `rdev`
  - Return only information for the specified real device
- **DETAILS**
  - Return additional information
Define a Global VSWITCH

- DEFINE VSWITCH name GLOBAL ETHERNET GROUP group

- A Global VSWITCH is a virtual switch which can span multiple z/VM instances through the IVL Network and which shares the same physical port group.

- Must be defined with the same name in all sharing LPARs

- A Global ID (systemid.vsw_name) is generated by the control program

- Multiple Global VSWITCHes can be defined per z/VM LPAR

- An instance of a Shared Port Group is created when it is configured to a virtual switch (group.0).
Multi-VSwitch LAG Configuration

- **Logical Partition A**
  - z/VM Hypervisor: CASEY
  - VSwitch: CASEY.NETWORK
    - Group: LAG
  - OSA Port: 7210.P01

- **Logical Partition B**
  - z/VM Hypervisor: JONES
  - VSwitch: JONES.NETWORK
    - Group: LAG
  - OSA Port: 7220.P00

- **Shared Port Group LAG**

- **Global VSwitch**

- **Physical LAG**

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CEC
Sharing A LAG within the Same z/VM Hypervisor

- DEFINE VSWITCH NETWORK2
  GLOBAL ETHERNET GROUP LAG

- LAG.0 is the base instance of a Shared Port Group and is the only instance propagated to other IVL Members within the same domain.

- A second instance of the shared Port Group is created (LAG.1) when it is configured to a second vswitch. It remains local to the defining system.

- Up to four port group instances can be defined within an LPAR.

- The only difference between the base and its other instances are the device numbers allocated for each adapter within the LAG.

- z/VM will automatically allocate an OSA triplet for each adapter within in the group from the available devices in the LPAR.
Best Practices for Link Aggregation

• Use a pair of switches that support “virtual chassis”
  – Provides cross-switch link aggregation port group
  – Plug each switch into separate power source

• Use two OSA ports on different PCHIDs
  – Each one plugged into one of the two switches
  – Separate back-planes to ensure separate power supply

• Provides continuous operation in case of
  – Single-source power failure
  – Switch reboot (e.g. maintenance)
  – Switch port failure
  – OSA port failure
  – OSA firmware upgrade
  – Cable failure
HiperSocket Virtual Switch Bridge

• Connect HiperSocket LAN to ethernet LAN without a router
  – Same subnet as ethernet LAN

• Full redundancy
  – Up to 5 bridges per CPC (CEC)
  – Automatic failover with optional failback
  – Each bridge can have more than one OSA uplink (typical)
HiperSocket Virtual Switch Bridge

- One active bridge per LPAR
- Path MTU discovery support
  - Large frames inside
  - Smaller frames outside
HiperSocket Virtual Switch Bridge

- DEFINE VSWITCH switch
- (all the traditional keywords)
- ETHERNET
  BRIDGEPORT RDEV hipersocket_rdev [PRIMARY]

- The HiperSocket device must be on a CHPID defined in the IOCP with CHPARM=x4

- CP DEFINE CHPID …. EXTERNAL_BRIDGED is available for dynamic I/O
IEEE 802.1Qbg relaxes prohibition on packet reflection
- Frames now allowed to be "reflected" back to the origin port
- Physical switch receives all guest-to-guest traffic
- Enables use of external packet filtering and monitoring
- No hardware configuration required

SET VSWITCH ... VEPA ON | OFF
- VEPA and ISOLATE are mutually exclusive
  - VEPA implies isolation
- VSWITCH will verify external switch support
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
Diagnostics

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

• CP QUERY VSWITCH 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
Diagnostics – Discarded packets

• Uplink port (CP’s perspective)
  – QUERY VSWITCH ACTIVE
  – RX: VSWITCH definition does not match physical port definition (trunk vs, access)
  – TX: Overrun on the OSA. Link is too slow. Use faster OSA or link aggregation.

• Virtual NIC (guest perspective)
  – QUERY NIC USER <userid> <vdev>
  – RX: Packets are arriving faster than the guest can consume them
  – TX: Packet cannot be delivered to destination
    • Unauthorized VLAN ID on virtual trunk port
    • Untagged frame on virtual trunk with NATIVE NONE
    • Guest configured as VLAN-aware (vconfig), but has virtual access port
    • Overrun target guest
Summary

• Use IEEE VLANs to simplify configuration

• Use Link Aggregation for best availability

• Integrate into SNMP-based monitoring solutions

• Port-based or User-based configuration style

• The latest technologies
## Support Timeline

<table>
<thead>
<tr>
<th>Version</th>
<th>Features</th>
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| z/VM 6.3 | - Shared link aggregation port groups  
| | - VEPA  
| | - SET VSWITCH SWITCHOVER |
| z/VM 6.2 | - Port-based configuration provides separate VLAN per virtual access port  
| | - HiperSocket bridge |
| z/VM 6.1 | - Uplink port can be OSA or guest  
| | - zEnterprise Ensemble (IEDN and INMN)  
| | - VLAN UNAWARE, NATIVE NONE |
| z/VM 5  | - Virtual and physical port isolation  
| | - z/VM TCP/IP support for Layer 2  
| | - Link aggregation  
| | - SNMP monitor  
| | - Virtual SPAN ports for sniffer  
| | - Virtual trunk and access port controls  
| | - Layer 2 (MAC) frame transport  
| | - External security manager access control |
| z/VM 4  | - Layer 3 (IPv4 only) Virtual Switch with IEEE VLANs  
| | - Guest LAN with OSA and HiperSocket simulation |
References

- Publications:
  - z/VM CP Planning and Administration
  - z/VM CP Command and Utility Reference
  - z/VM Connectivity
Contact Information

IBM
1701 North Street
Endicott, NY  13760

Mobile 607 321 7556
Fax 607 429 3323
Email: alan_altmark@us.ibm.com

Alan C. Altmark
Senior Managing z/VM Consultant
z Systems Delivery Practice
IBM Systems Lab Services

Mailing lists:  IBMTCP-L@vm.marist.edu
IBMVM@listserv.uark.edu
LINUX-390@vm.marist.edu

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stglis@us.ibm.com