z/VM Virtual Switch
Part 2: Advanced Topics

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Notes

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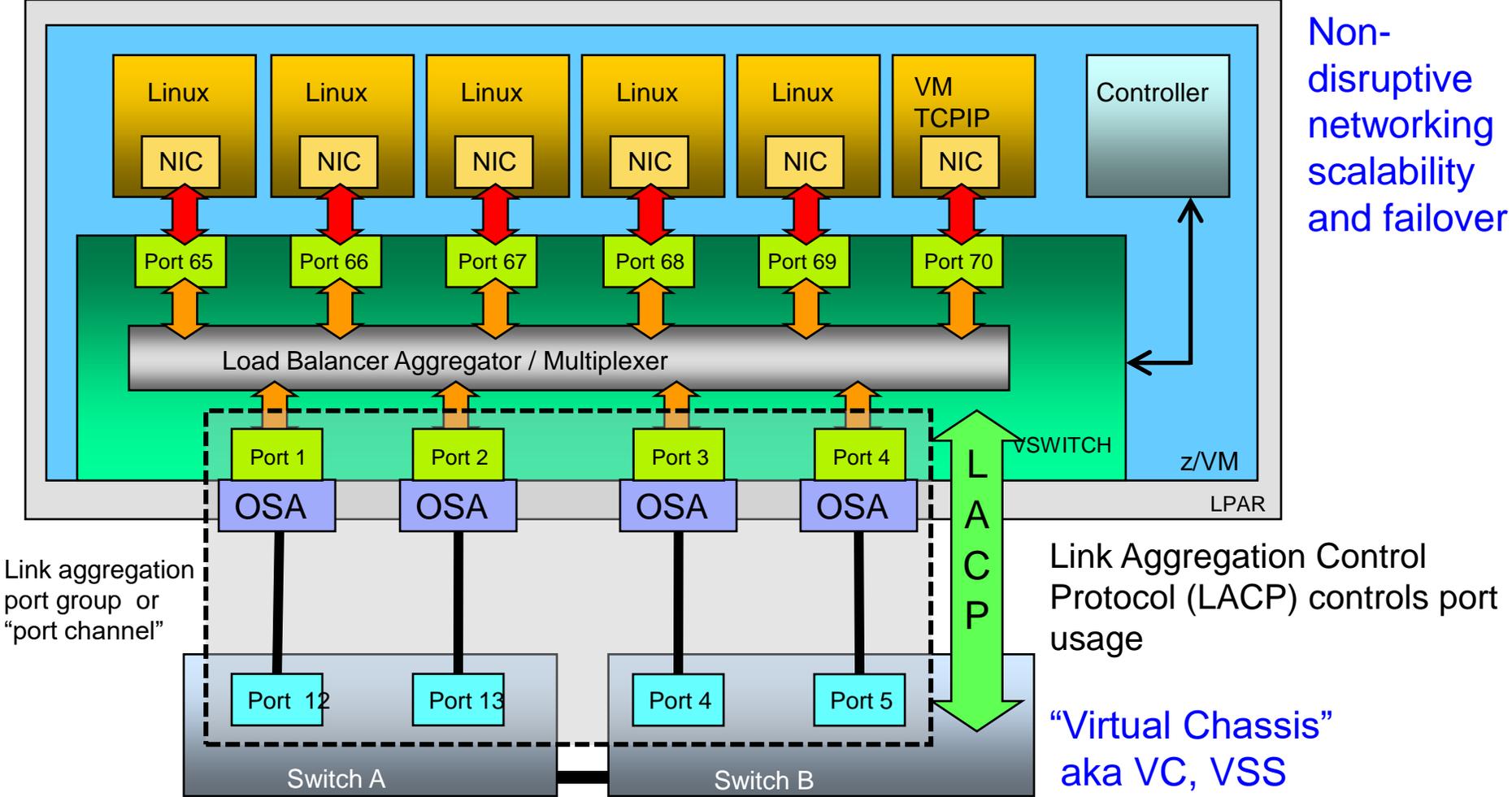
Agenda

— Link aggregation (channel bonding)

— Shared Link Aggregation port groups

— HiperSocket Bridge

— Virtual Ethernet Port Aggregator (VEPA)

— SNMP MIB

— Diagnostics

IEEE 802.3ad Link Aggregation

Non-disruptive networking scalability and failover

Link Aggregation Control Protocol (LACP) controls port usage

"Virtual Chassis" aka VC, VSS

Link aggregation port group or "port channel"

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 bandwidth
  - Provides seamless failover in the event of a failed OSA, switch port, cable, or switch
  - Only supported for ETHERNET VSWITCHes
  - Virtual NIC is still limited to bandwidth of single OSA
  - Also called a **port channel**

— 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 PCHNL01 JOIN F100 F200.P1`

— Create a VSWITCH that references to group
- `DEFINE VSWITCH … ETHERNET GROUP PCHNL01`

— Note: OSA ports cannot be shared with other VSWITCHes or LPARs unless using **shared port groups**

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

Shared Link Aggregation Port Groups

— Every link aggregation port group uses at least two OSA ports per port group
  - A four-member SSI cluster will use at least 8 ports.
  - Four clusters (dev, test, prod, sandbox) will use 32 ports
  - Large capital investment: OSAs, switch ports, cables, connectors (SFPs)
  - Limit of 48 OSD channel paths

— New OSA Express capability on **IBM z13 and later** provides ability to share OSA ports in link aggregation mode to be shared across **z/VM** LPARs

Shared Link Aggregation Port Groups

— Multiple VSWITCHes can share a single OSA link aggregation port group.

- Same or different LPAR

— Two new system constructs

- **Inter-VSWITCH Link** (IVL) - Provides management and data communications between participating members of a Global VSWITCH.
  - Data communication only if LPAR loses connection to OSA still operable from another sharing LPAR (rare)

- **Global VSWITCH** - Provides the mechanism for a Virtual Switch to span multiple z/VM LPARs within a CPC.

Shared Link Aggregation Port Groups

— VSWITCHes are in communication with each other using a registered multicast group (not IP)

— 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

— z/VM equivalent of "virtual chassis"

IVL Domain

— Provides control and error recovery functions for all global VSWITCHes in the domain
  - All z/VM hypervisors sharing the same physical port group must be members of the same IVL domain

— The IVL domain is established through an IVL VSWITCH
  - Global VSWITCH definition is deferred until domain is established

— In rare cases, may be required to forward guest traffic to another LPAR

IVL VSWITCH

— **DEFINE VSWITCH *name* TYPE IVL DOMAIN *d* [VLAN *vid*]**
  - DOMAIN A through H (max 8 domains per CPC)
  - Identify VLAN

— Maximum 16 z/VM LPARs in an IVL domain
  - A z/VM LPAR can be in only one IVL domain

— Conventional RDEV list or exclusive port GROUP
  - Remember to provide OSA port redundancy!
  - **No, you cannot use the same OSAs that the global VSWITCHes are using!**

IVL Dynamic 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

— CP will select the device numbers to be used on the target adapter.

— CP propagates changes to the port group configuration to all active members of the IVL domain

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

— 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).

Define a Global VSWITCH

— `SET PORT GROUP PCHNL032 LACP ACTIVE SHARED`
`SET PORT GROUP PCHNL032 JOIN 6100 6200`
`DEFINE VSWITCH VSW1 GLOBAL ETHERNET GROUP PCHNL032`
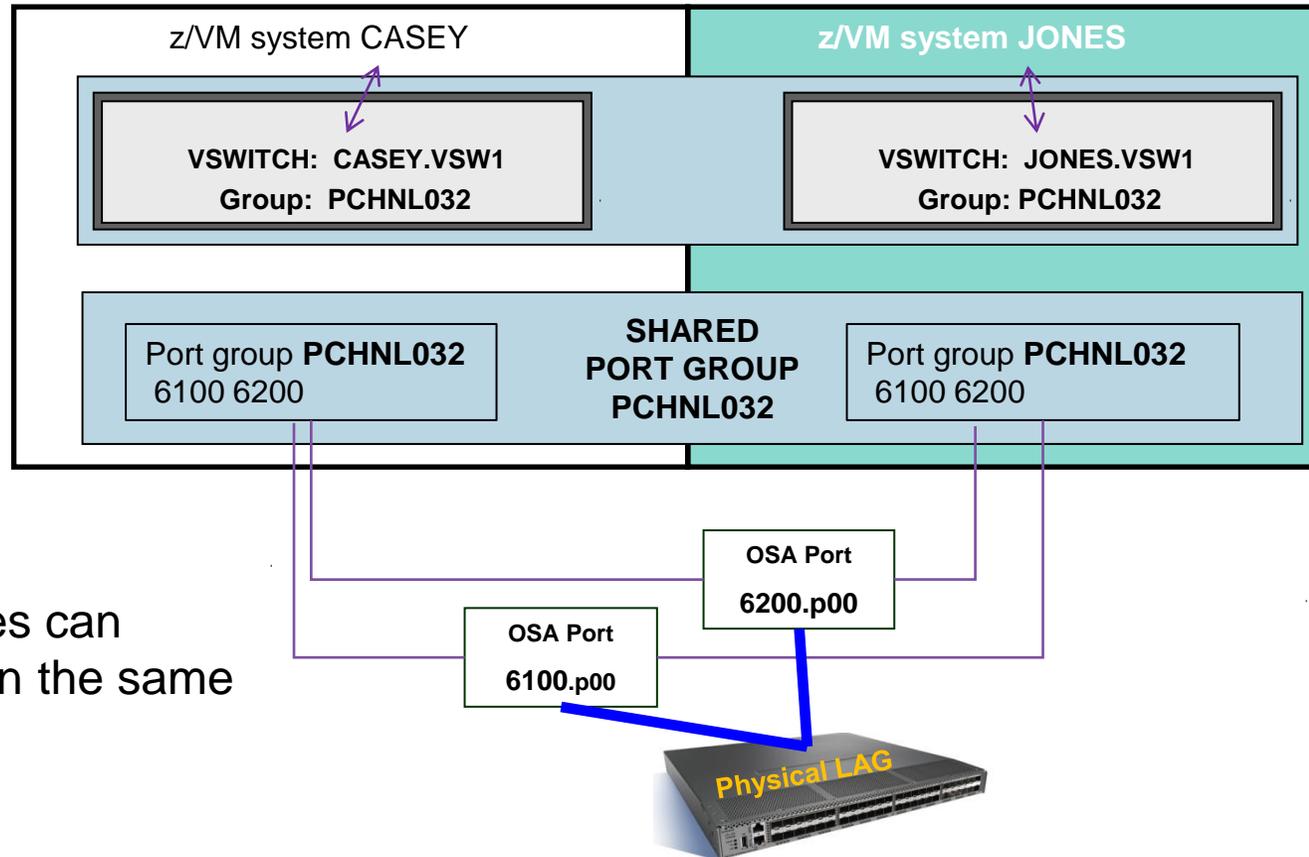
Up to 4 VSWITCHes can share a group within the same LPAR

Asynchronous Global VSWITCH Initialization

— Guests cannot connect to a VSWITCH until it is defined

— A Global VSWITCH cannot be defined until port group has been formed

— Port group cannot form until IVL is up and has discovered other members of the IVL domain

— **Placing in SYSTEM CONFIG is not sufficient!**
  - If you bring guests up before your global VSWITCH is defined, guests will get NIC errors
  - Defer guest startup to automation (e.g. IBM Operations Manager) which waits for CP messages
    - Or add polling logic to AUTOLOG1 that delays dependent guests until Global VSWITCH is up.

OSA Priority Queuing

— OSA Express enables the host to provide an ordered set of outbound data queues that OSA will service in order, but without queue starvation.
  - Fair share

— CP creates four queues (in order):
  - System
  - High priority guest
  - Normal priority guest (default)
  - Low priority guest

— You assign a virtual NIC to a queue

OSA Priority Queuing

— I/O configuration controls the availability of priority queuing in the OSA
- Enabled by default
- Use CHPARM to disable – see IOCP book

— You must turn on priority queuing in your VSWITCHes

DEFINE VSWITCH ... UPLINK PRIQUEUING ON
SET VSWITCH ... UPLINK PRIQUEING ON

- SET requires that VSWITCH be DISCONNECTed

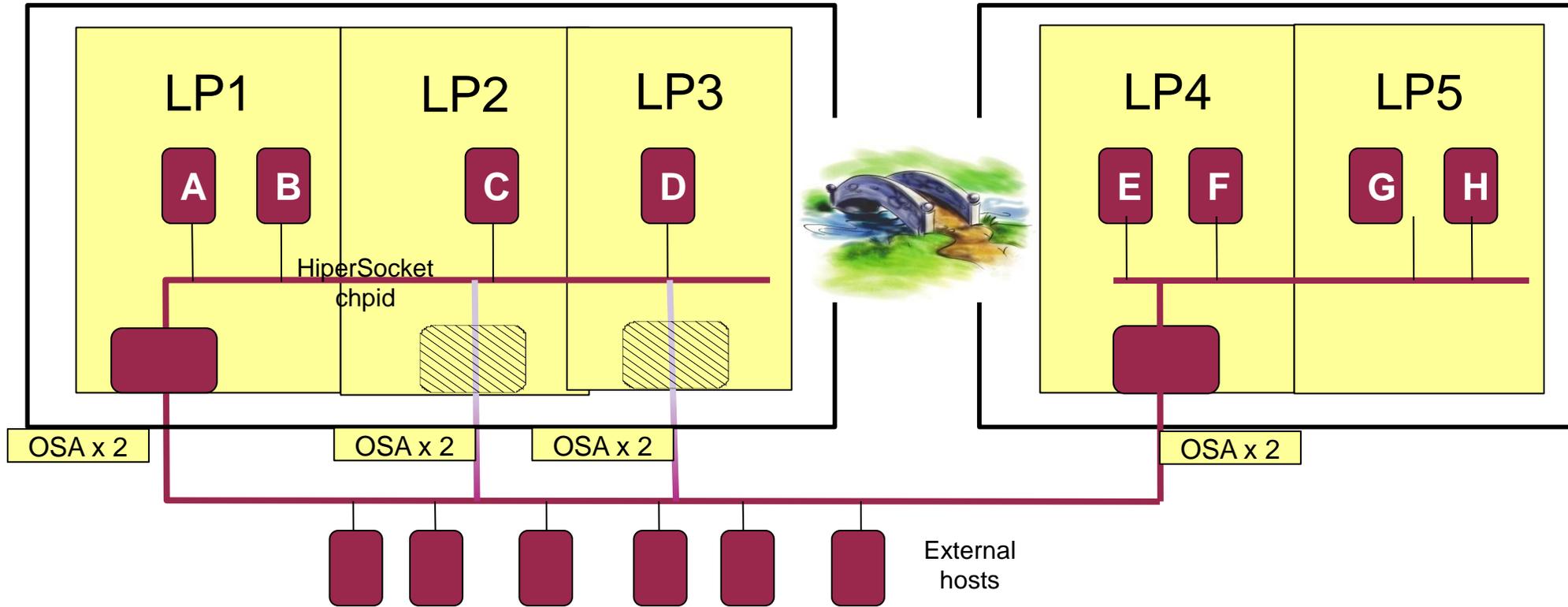— IVLs will automatically use priority queuing, if available

OSA Priority Queuing

— By default, a virtual NIC is "normal" priority

— Applies only to guest outbound transmissions

— Use NICDEF to specify priority

  NICDEF 800 .... PQUPLINKTX LOW | NORMAL | HIGH

  • Can also use SET VSWITCH GRANT, but stick with NICDEF!

HiperSocket Virtual Switch Bridge

— One active bridge per LPAR

— Path MTU discovery support
  • Large frames inside
  • Smaller frames outside

HiperSocket VSWITCH 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)

— Enables cross-CPC Live Guest Relocation
  - Does not work with z/OS LPARs!

HiperSocket VSWITCH Bridge

— **DEFINE VSWITCH**
  - all the traditional keywords
  - ETHERNET BRIDGEPORT RDEV hs_devaddr [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

VEPA - Virtual Ethernet Port Aggregator

— 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

— SET VSWITCH ... VEPA ON | OFF
  - VEPA and ISOLATE are mutually exclusive
    - VEPA implies isolation
  - VSWITCH will verify external switch support
  - Negotiated use - no hardware configuration required

z/VM Virtual Switch SNMP MIB

— Integrates VSWITCH into standards-based switch management and monitoring tools
- NetCool
- Nagios

— SNMP subagent provides bridge MIB data
- Defined by RFC 1493
- Version 1
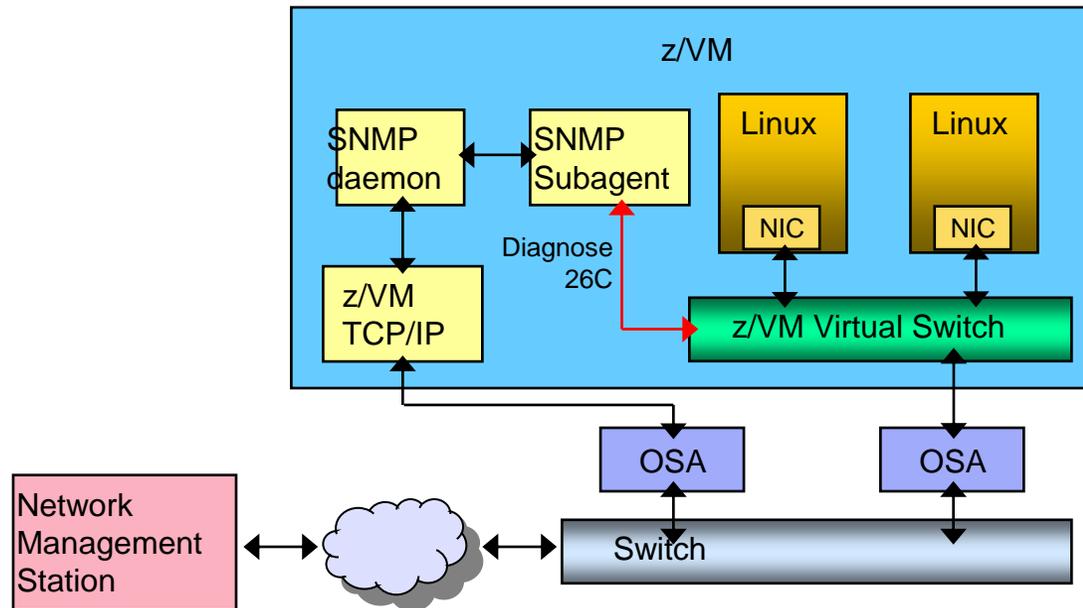
Diagnostics

— 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: Discard Counters

Discard Counter	Uplink: QUERY VSWITCH ACTIVE	Guest NIC: QUERY NIC USER userid vdev
RX > 0 inbound	VSWITCH definition mismatch • Unused VLAN ID • VLAN UNAWARE on trunk	Packets are arriving faster than the guest can consume them
TX > 0 outbound	Overrun on the physical OSA. • Link is too slow compared to guests • Use faster OSA or link aggregation	• Unauthorized VLAN ID on virtual trunk port • Untagged frame on virtual trunk with NATIVE NONE • Guest configured as VLAN-aware with virtual access port • Overrun target guest
To reset	CP SET VSWITCH COUNTERS CLEAR	Resets when NIC is detached

Support Timeline

z/VM 7.1 2019	• Priority queuing
z/VM 6.4 2017	• Unified VSWITCH with NICDEF controls CP (VM65925), DIRMAINT (VM65926), RACF(VM65931)
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 • VLAN UNAWARE, NATIVE NONE
z/VM V5	• Virtual and physical port isolation • z/VM TCP/IP support for Layer 2 • Link aggregation • SNMP monitor • Virtual SPAN ports for sniffers • Virtual trunk and access port controls • Layer 2 (MAC) frame transport • External security manager access control
z/VM V4 2001	• 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

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