



Virtual Networking with z/VM Guest LANs and the z/VM Virtual Switch

Session 9125

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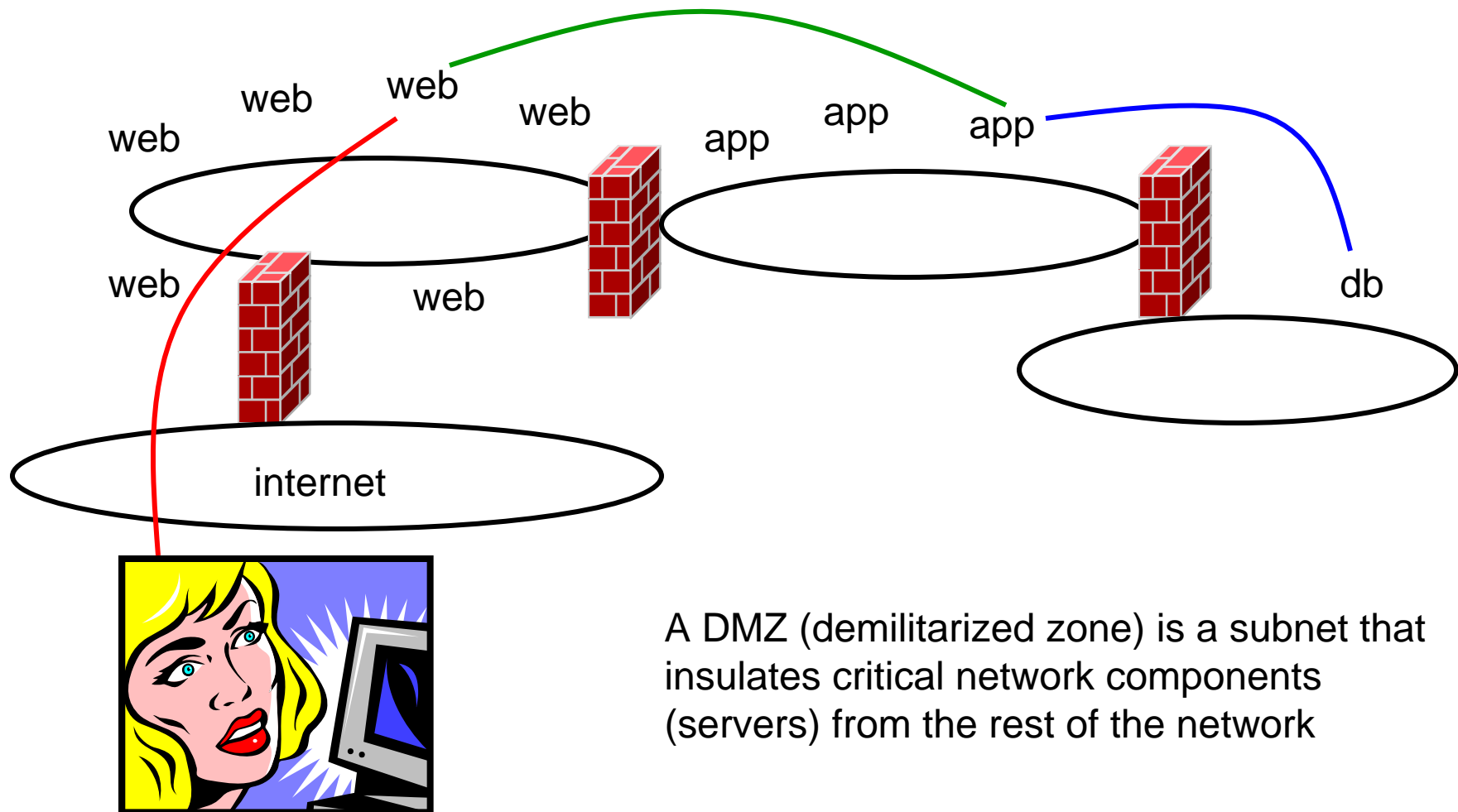
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Topics

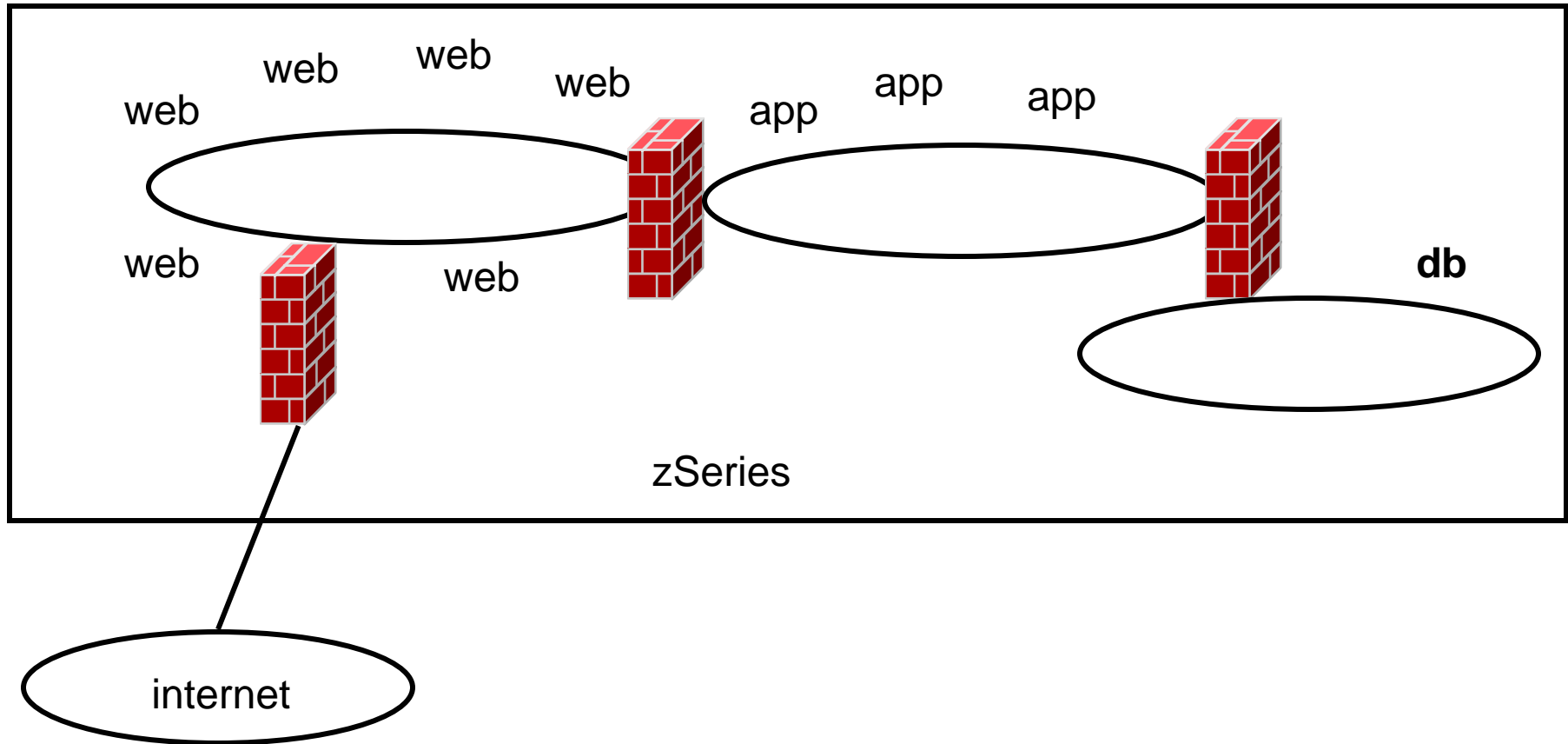
- Overview
- Guest LANs
- Virtual Network Interface Card
- Virtual Switch
- What's new in z/VM Version 5.1 and 5.2

Multi-DMZ Network

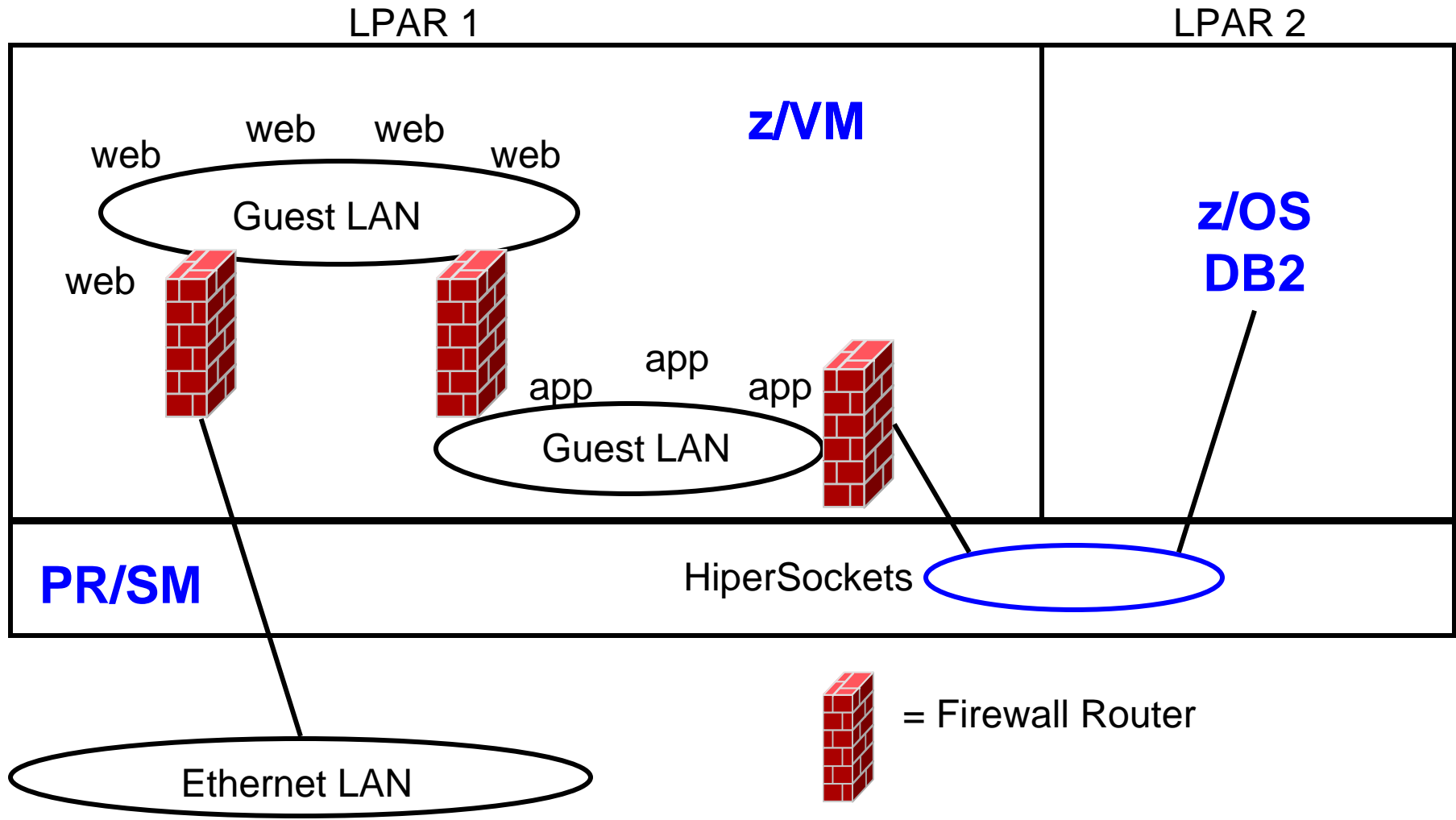


A DMZ (demilitarized zone) is a subnet that insulates critical network components (servers) from the rest of the network

Multi-DMZ Network on zSeries



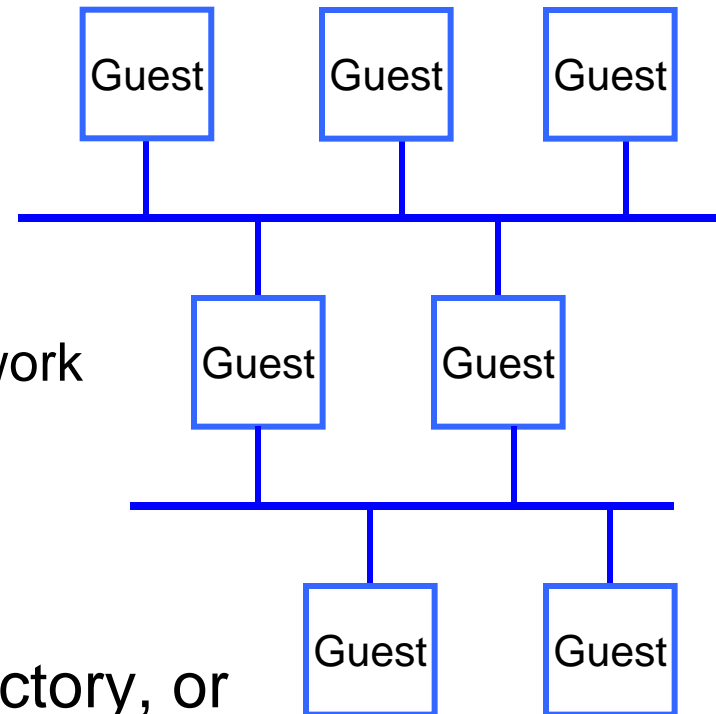
Multi-DMZ Network with Guest LANs



Guest LANs

z/VM Guest LAN

- A simulated LAN
 - ▶ Ethernet: IPv4 and IPv6
 - ▶ HiperSockets: IPv4
 - ▶ No built-in connection to outside network
- As many as you want
- Created in `SYSTEM CONFIG`, directory, or by `CP DEFINE LAN` command



Why Guest LAN instead of Dedicated Hardware ?

- Dedicated network connections may be best for some environments:
 - ▶ When intense network activity is expected and you need to guarantee network access bandwidth
 - ▶ When direct access to physical network is required

- z/VM Guest LAN may be better for other environments:
 - ▶ When network hardware is limited
 - ▶ When multiple nodes are guests in the same z/VM host image
 - ▶ When network activity must be isolated from primary network (e.g. test environments, student labs, application server access to database servers)

Primary Guest LAN Attributes

- Name & Owner
- Type
- Access list
- Maximum frame size (HiperSockets only)

- Some attributes can be changed after the LAN is defined

- There are some others not discussed here
 - ▶ Maximum number of connections
 - ▶ Accounting

LAN Name and Owner

- The LAN name is a simple 1-8 character token
- The LAN owner is a VM user ID or “SYSTEM”
- (name, owner) is unique within the system
- A Class G LAN owner can
 - ▶ modify the LAN access list
 - ▶ delete the LAN
- A Class B user can create, modify, or detach any LAN

HiperSockets or Ethernet

TYPE HIPERsockets | QDIO [IP | ETHERNET]

- HiperSockets
 - ▶ Synchronous
 - ▶ Low latency
 - ▶ Slightly smaller path length in CP (less CP time)

- QDIO
 - ▶ OSA-Express in QDIO mode
 - ▶ Asynchronous
 - ▶ Higher latency than HiperSockets
 - ▶ Higher CPU cost
 - ▶ IP = Layer 3, ETHERNET = Layer 2

Access list

■ Unrestricted

- ▶ Any user can connect (couple) to this LAN
- ▶ Hint: CP QUERY LAN can show you who is connected

■ Restricted

- ▶ Only users in the access list can connect (couple) to this LAN
- ▶ LAN owner uses CP SET LAN to GRANT or REVOKE access
- ▶ CP QUERY LAN can show you the current access list
- ▶ CP QUERY LAN can show you who is connected

■ External Security Manager

- ▶ RACF/VM support for new VMLAN objects

Maximum Frame Size (HiperSockets only)

MFS 16K | 24K | 40K | 64K

- Simulates CHPID OS=*value* specification in IOCDs for HiperSockets (TYPE=IQD) chpids
 - ▶ Does not apply to QDIO

- Largest MTU specification = (MFS - 8K)

- Hints:
 - ▶ If guest LAN is isolated, use large MFS and large MTU
 - ▶ If LAN has external gateway, use MFS 16K and match external MTU (e.g. 1492)
 - ▶ Jumbo frame (MTU 8992) gateway needs 24K MFS

Persistent vs. Transient LAN

- Persistent / Transient is inferred from other attributes
 - ▶ Any LAN owned by user “SYSTEM” is *persistent*
 - ▶ Any LAN created by SYSTEM CONFIG is *persistent*
 - ▶ All other LANs are *transient*
- A *persistent* LAN must be explicitly deleted by CP DETACH LAN
- A *transient* LAN is automatically deleted when the last user uncouples from the LAN

Setting Guest LAN 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 020000-02FFFF
VMLAN MACIDRANGE SYSTEM x-y [USER a-b]
```

- VMLAN LIMIT TRANSIENT 0 prevents dynamic definition
- Use SET VMLAN to change dynamically



Virtual MAC Addresses

- Each instance of CP should have a unique VMLAN MACPREFIX
- Virtual MAC = MACPREFIX || MACID
- VMLAN MACIDRANGE
 - ▶ SYSTEM – The range of MACIDs from which CP will select a dynamically defined MAC
 - ▶ USER – The range of MACIDs reserved by CP for NICDEF. All MACIDs on NICDEFs must be in this range.
 - ▶ USER is a subset of SYSTEM

Create a Guest LAN

- DEFINE LAN in SYSTEM CONFIG

```
DEFINE LAN name [OWNERid ownerid]  
              [TYPE HIPERsockets|QDIO]  
              [MAXCONN INFinite|nnnn]  
              [MFS 16K|24K|40K|64K]  
              [ACCOUNTing ON|OFF]  
              [UNRESTRicted|RESTRicted]  
              [GRANT userlist]
```

Examples:

```
DEFINE LAN QDIO5 OWNER SYSTEM TYPE QDIO
```

- CP DEFINE LAN to create dynamically

```
DEFINE LAN NET9 OWNER SYSTEM RESTRICTED TYPE QDIO
```

Grant Guest LAN Access

- DEFINE LAN and MODIFY LAN in SYSTEM CONFIG

```
MODIFY LAN  name
             [OWNERid ownerid / OWNERID SYSTEM]
             [GRANT userid]
```

Example:

```
DEFINE LAN HIPER1 OWNER SYSTEM RESTRICTED
MODIFY LAN HIPER1 OWNER SYSTEM GRANT LINUX01
MODIFY LAN HIPER1 OWNER SYSTEM GRANT LINUX02
```

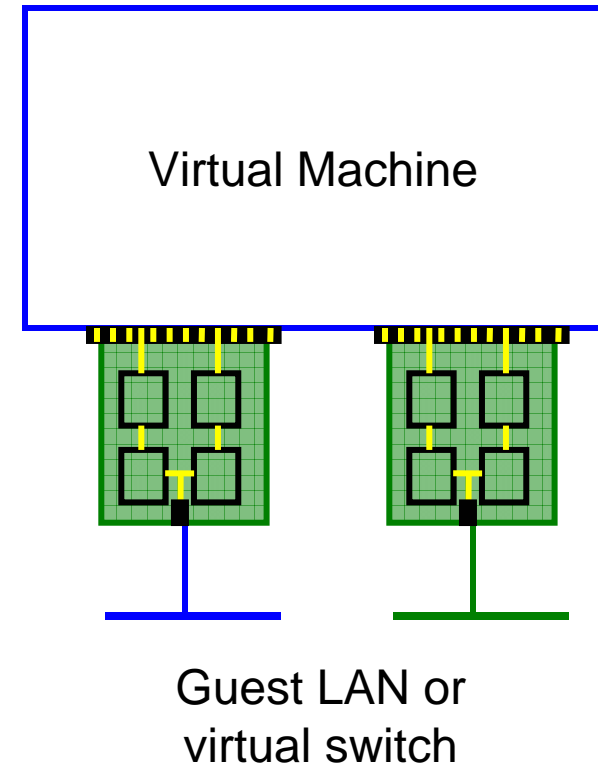
- CP SET LAN to change dynamically

```
CP SET LAN HIPER1 OWNER SYSTEM GRANT LINUX03
```

Virtual Network Interface Card

Virtual Network Interface Card (NIC)

- A simulated network adapter
 - ▶ OSA-Express QDIO
 - ▶ HiperSockets
 - ▶ Must match LAN type
- 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 directory or CP DEFINE NIC command



Virtual NIC - User Directory

- May be automated with USER DIRECT file:

```
NICDEF vdev [TYPE HIPERS | QDIO]
             [LAN owner name]
             [DEVICES nn]
             [CHPID xx]
             [MACID xyyyzz]          Combined with VMLAN
                                     MACPREFIX to create
                                     virtual MAC
```

Example:

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

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 CSC201
```

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 guest because HiperSockets are managed by CHPID number

- **This is a virtual CHPID number**

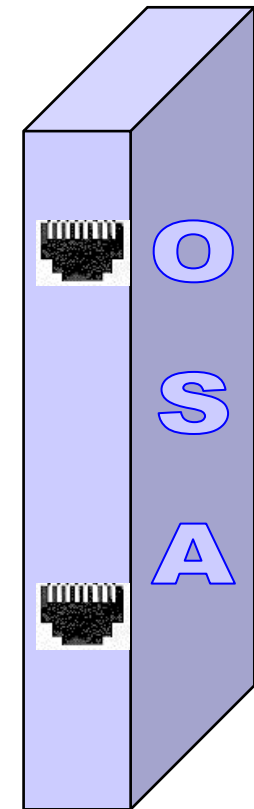
Virtual Switch

What's a 'switch' anyway?

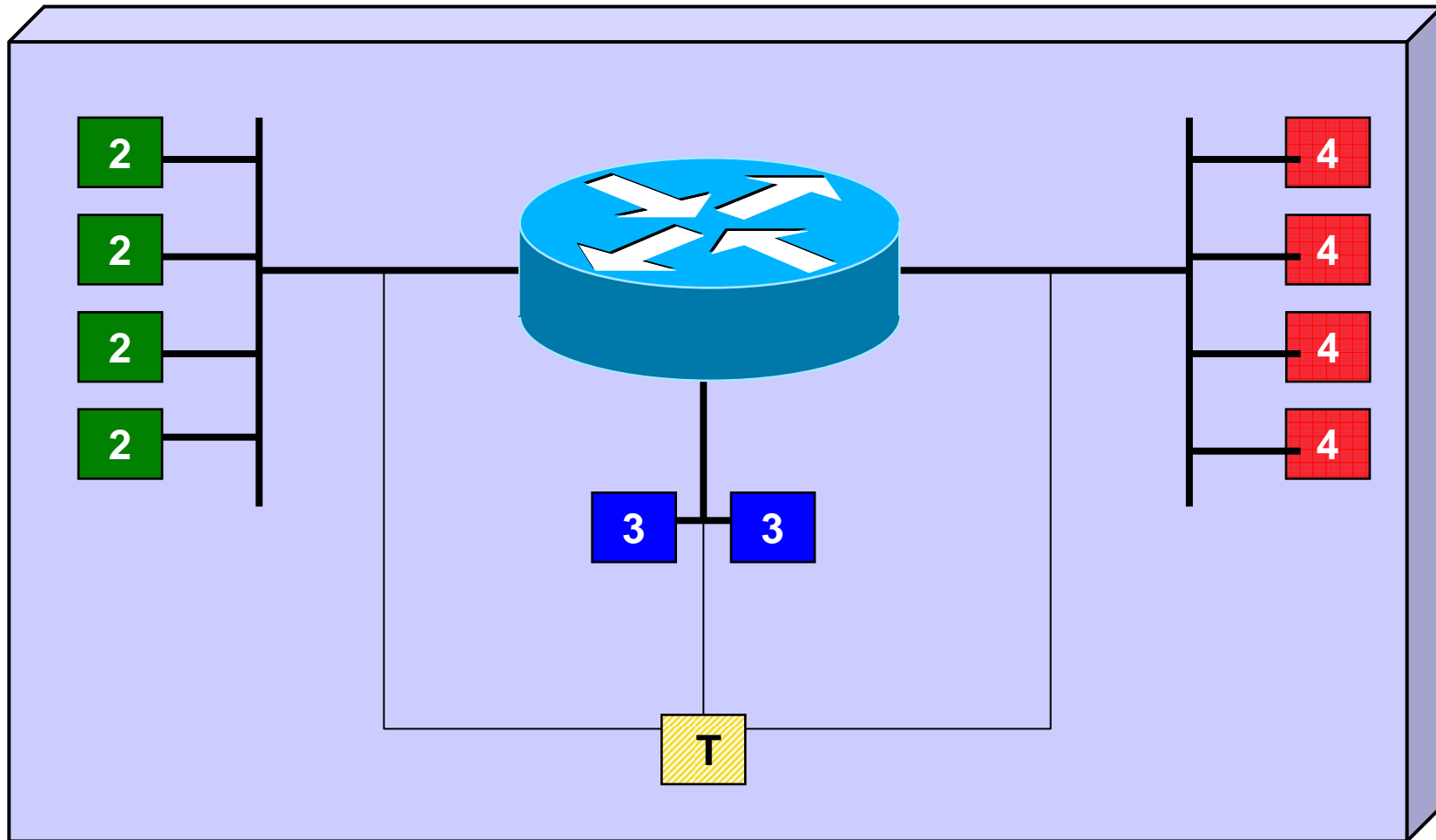


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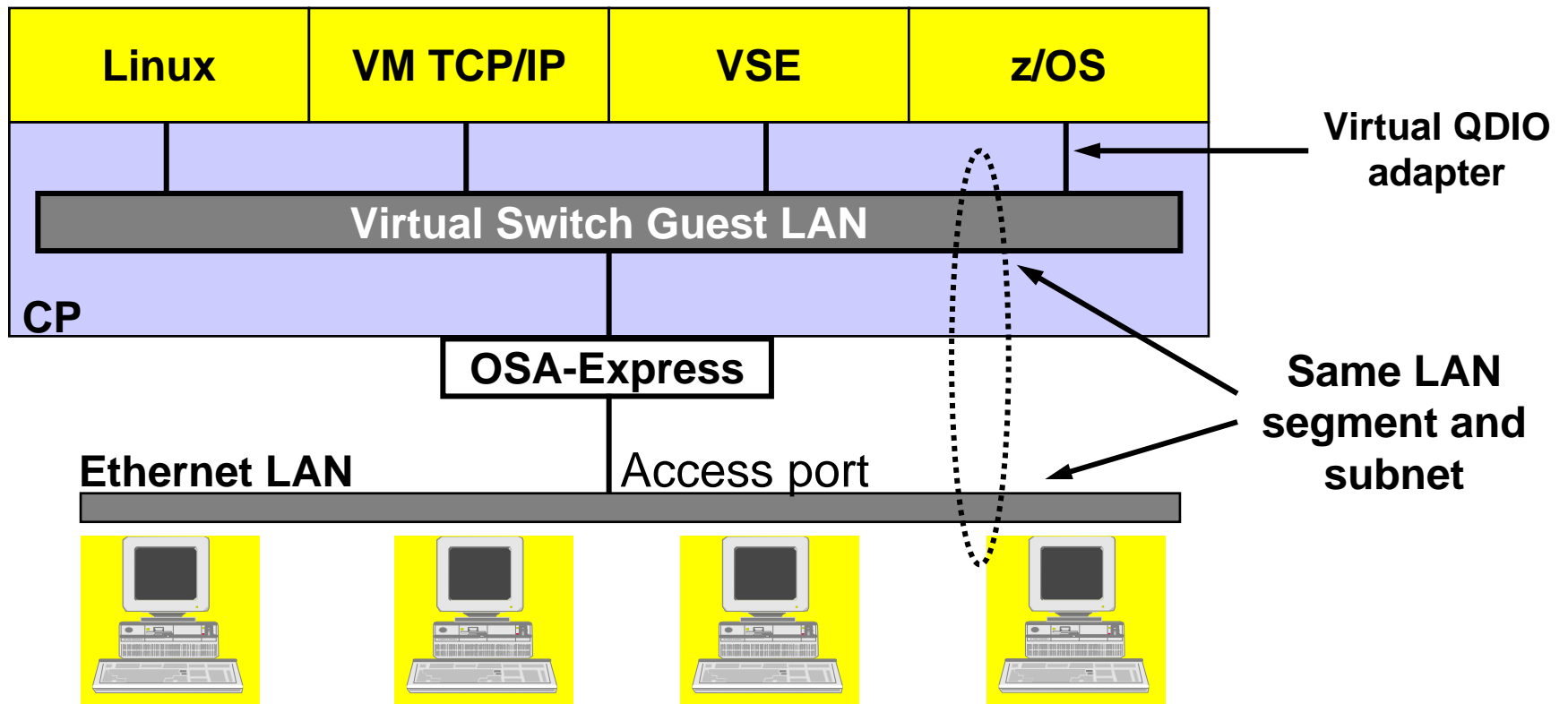
- ▶ A box that creates a LAN
- ▶ It can be remotely configured
 - ▶ E.g. Turn ports on and off
- ▶ Similar to a home router



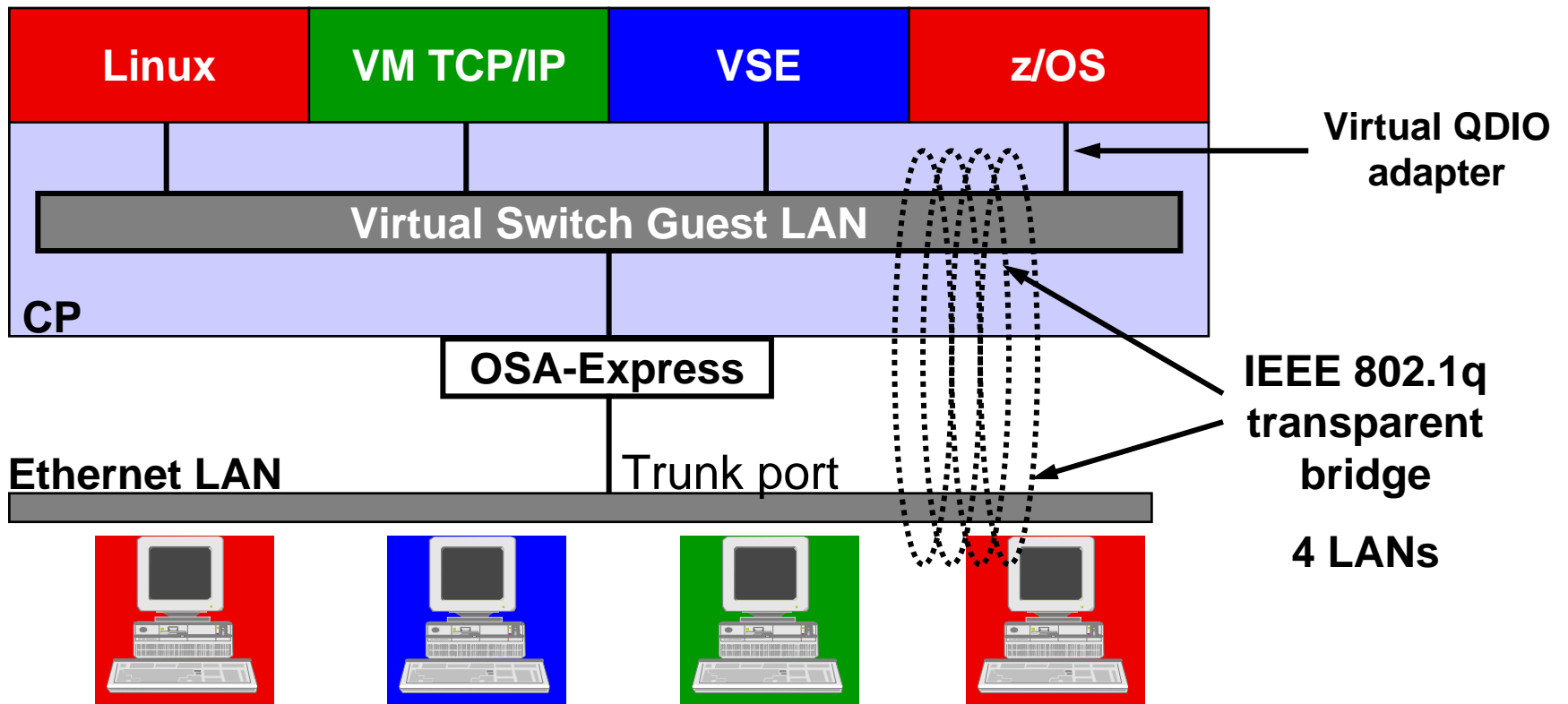
A VLAN-aware switch: An inside look



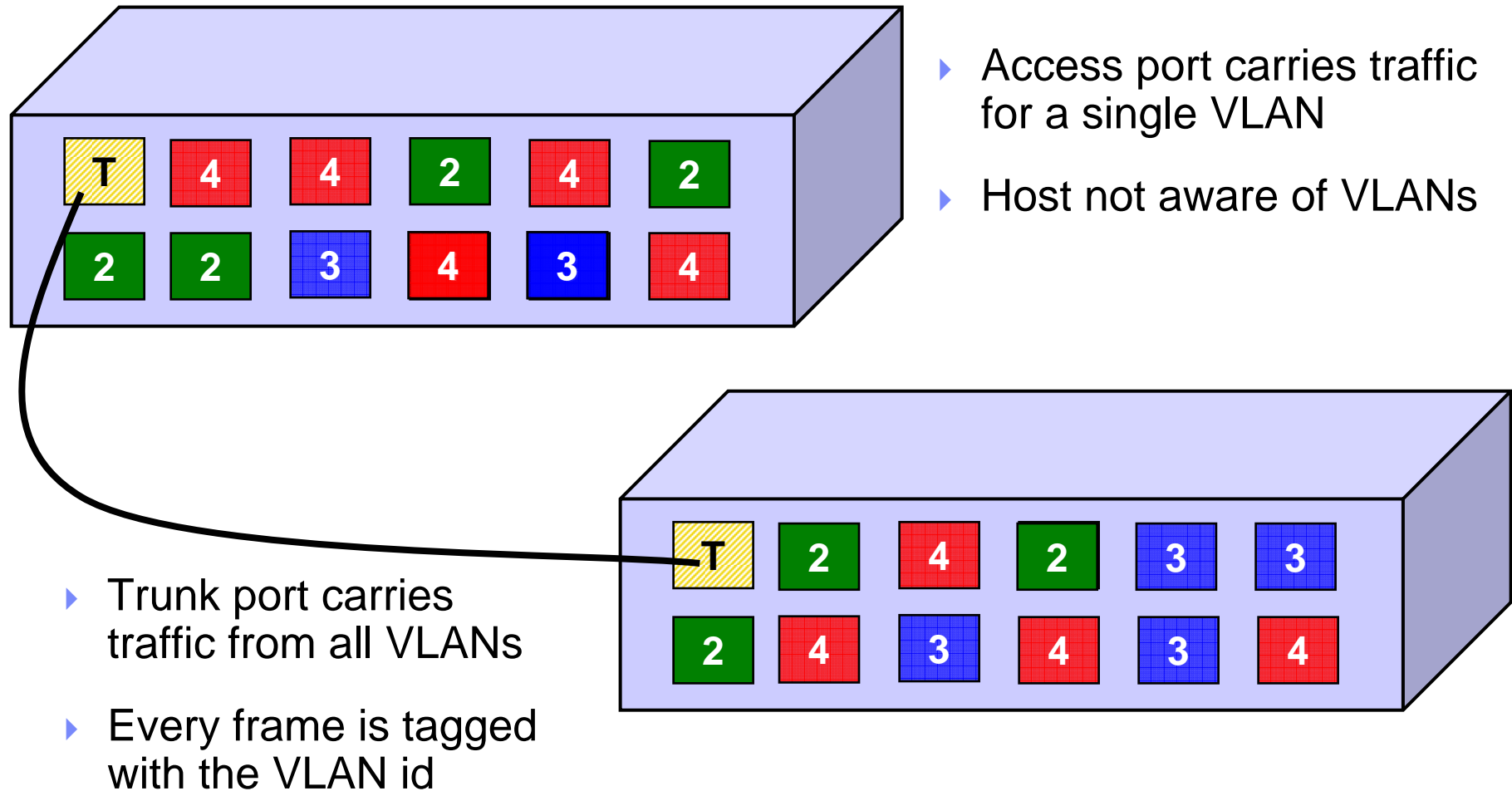
z/VM Virtual Switch – VLAN unaware



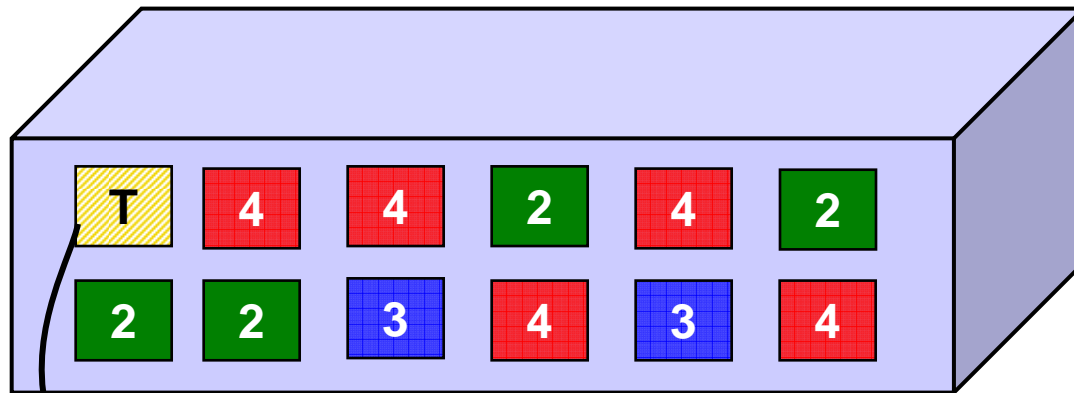
z/VM Virtual Switch – VLAN aware



Trunk Port vs. Access Port

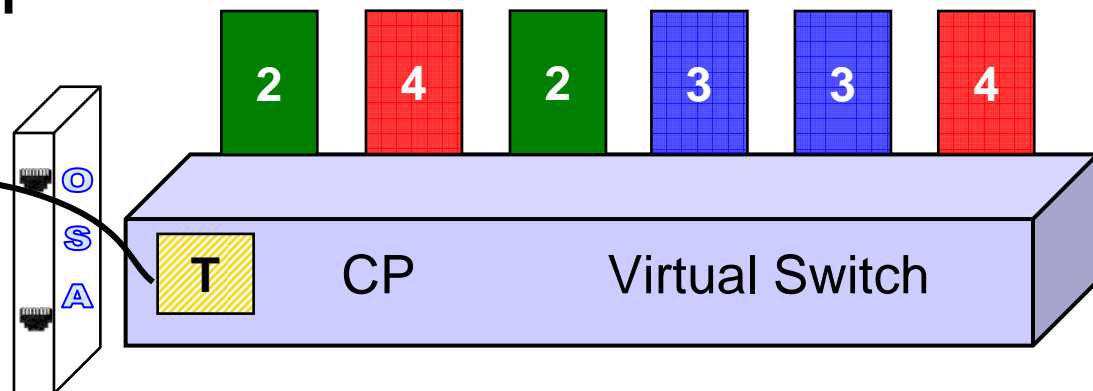


Physical Switch to Virtual Switch



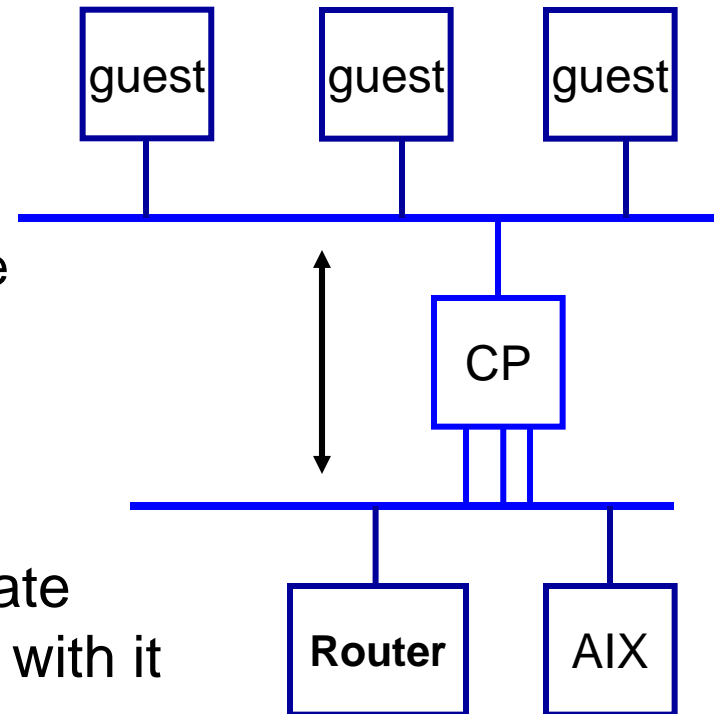
▶ Trunk port carries traffic between CP and switch

▶ Each guest can be in a different VLAN



z/VM Virtual Switch

- A special-purpose Guest LAN
 - ▶ Ethernet IPv4
 - ▶ Built-in IEEE 802.1q bridge to outside network
 - ▶ IEEE VLAN capable
- Each Virtual Switch has up to 3 separate OSA-Express connections associated with it
- Created in `SYSTEM CONFIG` or by `CP DEFINE VSWITCH` command



Virtual Switch Attributes

- Name
- Associated OSAs (maximum 3)
- A controlling virtual machine (minimal VM TCP/IP stack server)
 - ▶ Controller not involved in data transfer
 - ▶ Do not ATTACH or DEDICATE
 - ▶ User needs IUCV *VSWITCH authorization
 - ▶ User needs VSWITCH CONTROLLER statement in PROFILE TCPIP
- Similar to Guest LAN
 - ▶ Owner SYSTEM
 - ▶ Type QDIO
 - ▶ Persistent
 - ▶ Restricted

Create a Virtual Switch

- SYSTEM CONFIG or CP command:

```
DEFINE VSWITCH name
    [RDEV NONE | cuu [cuu [cuu]] ]
    [CONNECT | DISCONNECT]
    [CONTROLLER * | userid]
    [NONROUTER | PRIROUTER]

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

    [PORTTYPE ACCESS | PORTTYPE TRUNK]
```

z/VM 5.3

Example:

```
DEFINE VSWITCH SWITCH12 RDEV 1E00 1F04 CONNECT
```

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
```

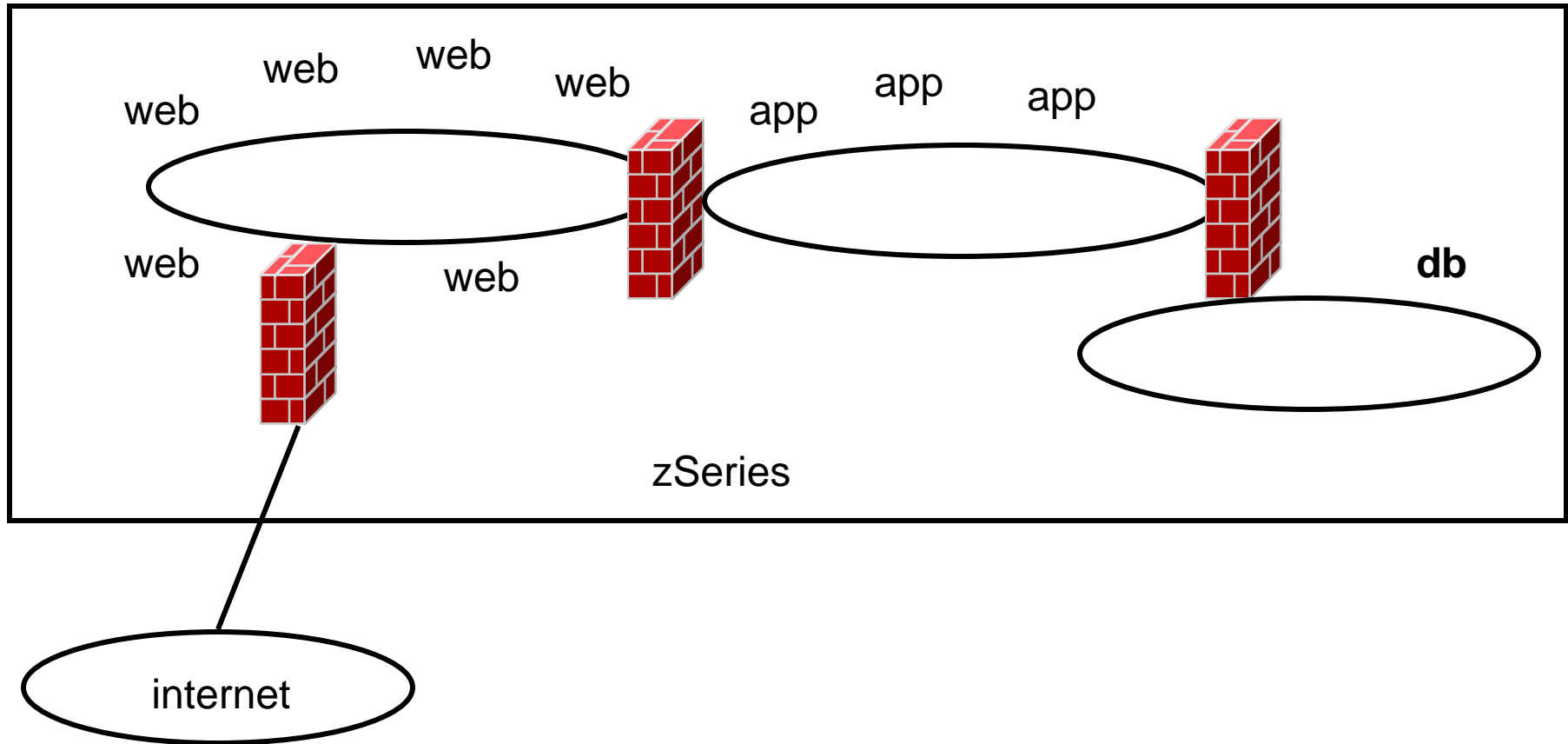
Examples:

```
MODIFY VSWITCH SWITCH12 GRANT LNX01 VLAN 3 7 105
CP SET VSWITCH SWITCH12 GRANT LNX02 PORTTYPE TRUNK
VLAN 4 20-22 29 302
```

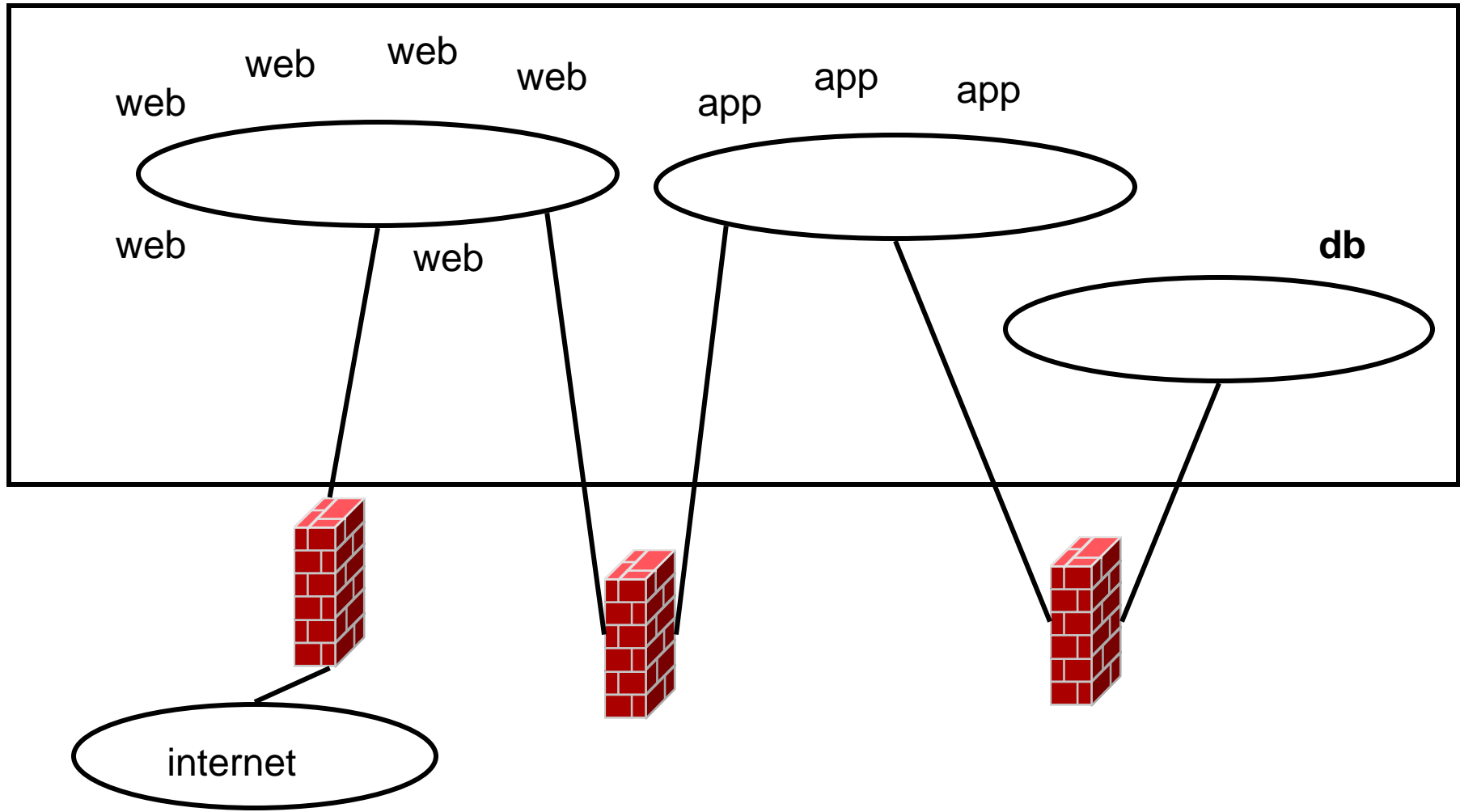
```
CP SET VSWITCH SWITCH12 GRANT LNX02 PROMISCUOUS
```

- z/VM 4.4 supports “VLAN ANY”, but it’s removed in z/VM5.1!

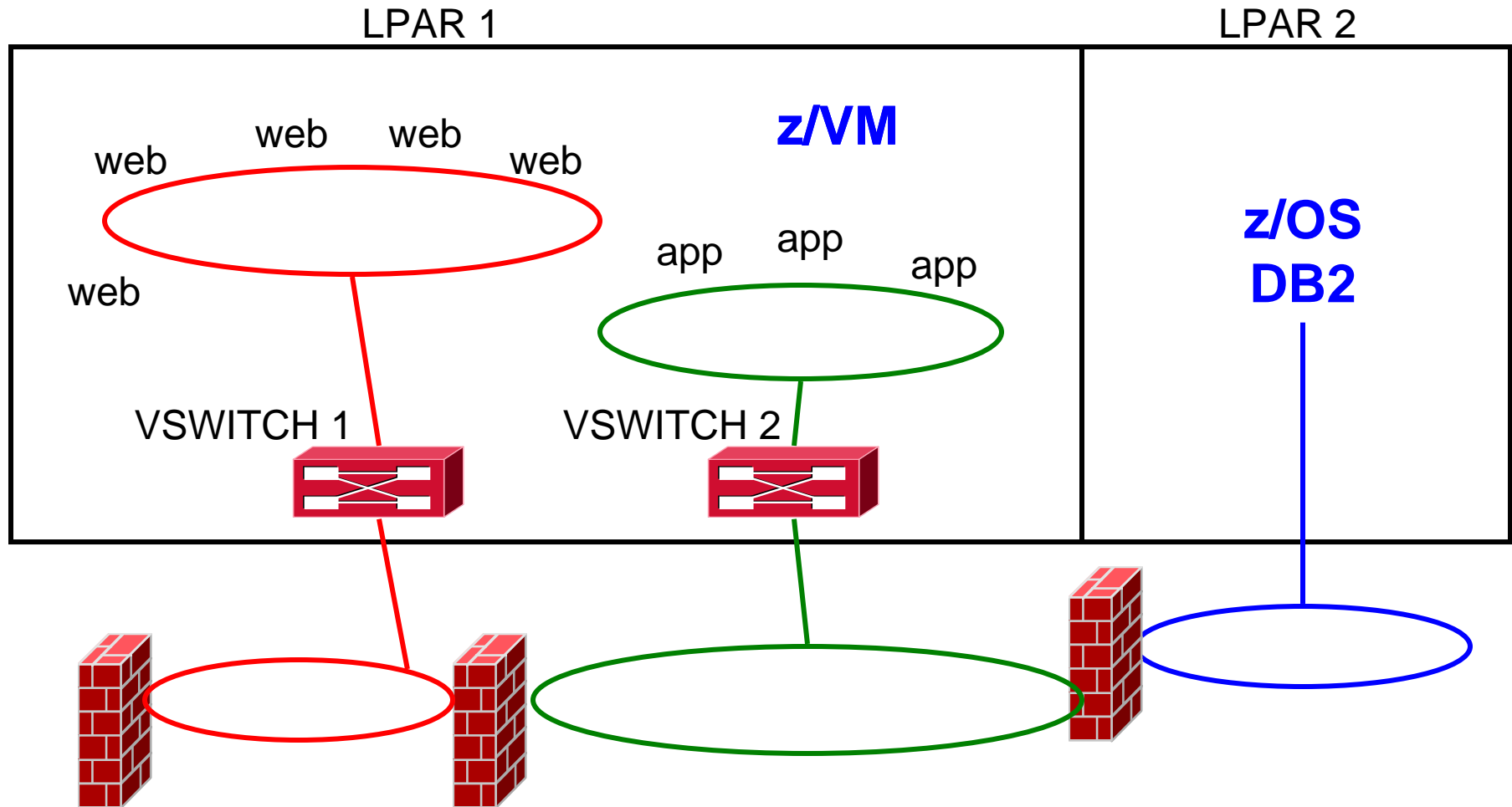
Multi-DMZ Network on zSeries - Reloaded



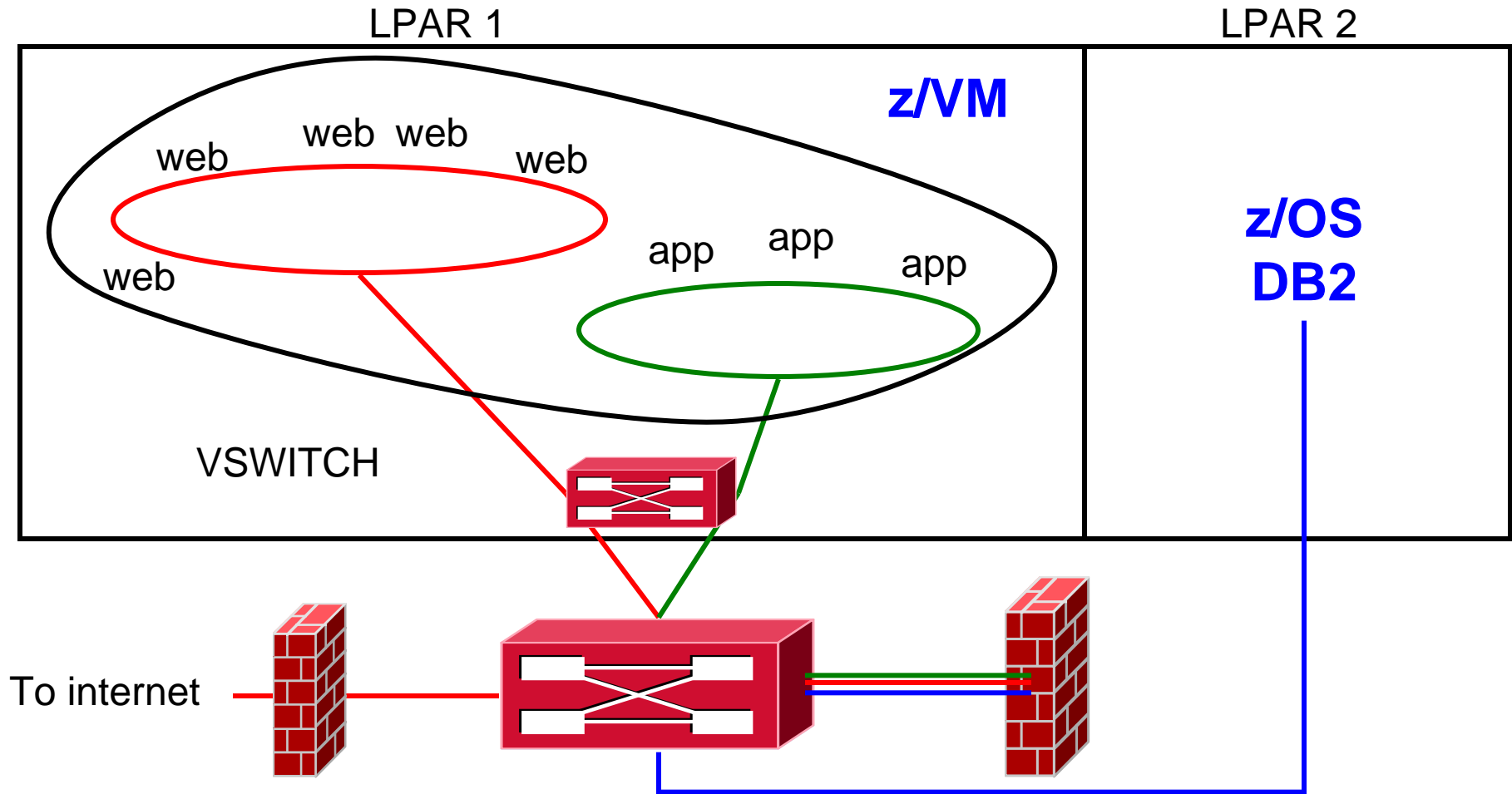
Multi-DMZ Network on zSeries with outboard firewall



Multi-DMZ Network with VSWITCH (A)



Multi-DMZ Network with VSWITCH (B)



With 1 VSWITCH, 3 VLANs, and a multi-domain firewall

What's new?

New in z/VM 5.3

- OSA link aggregation
 - ▶ IEEE 802.1ad
 - ▶ Hyperchannel
 - ▶ Channel Bonding

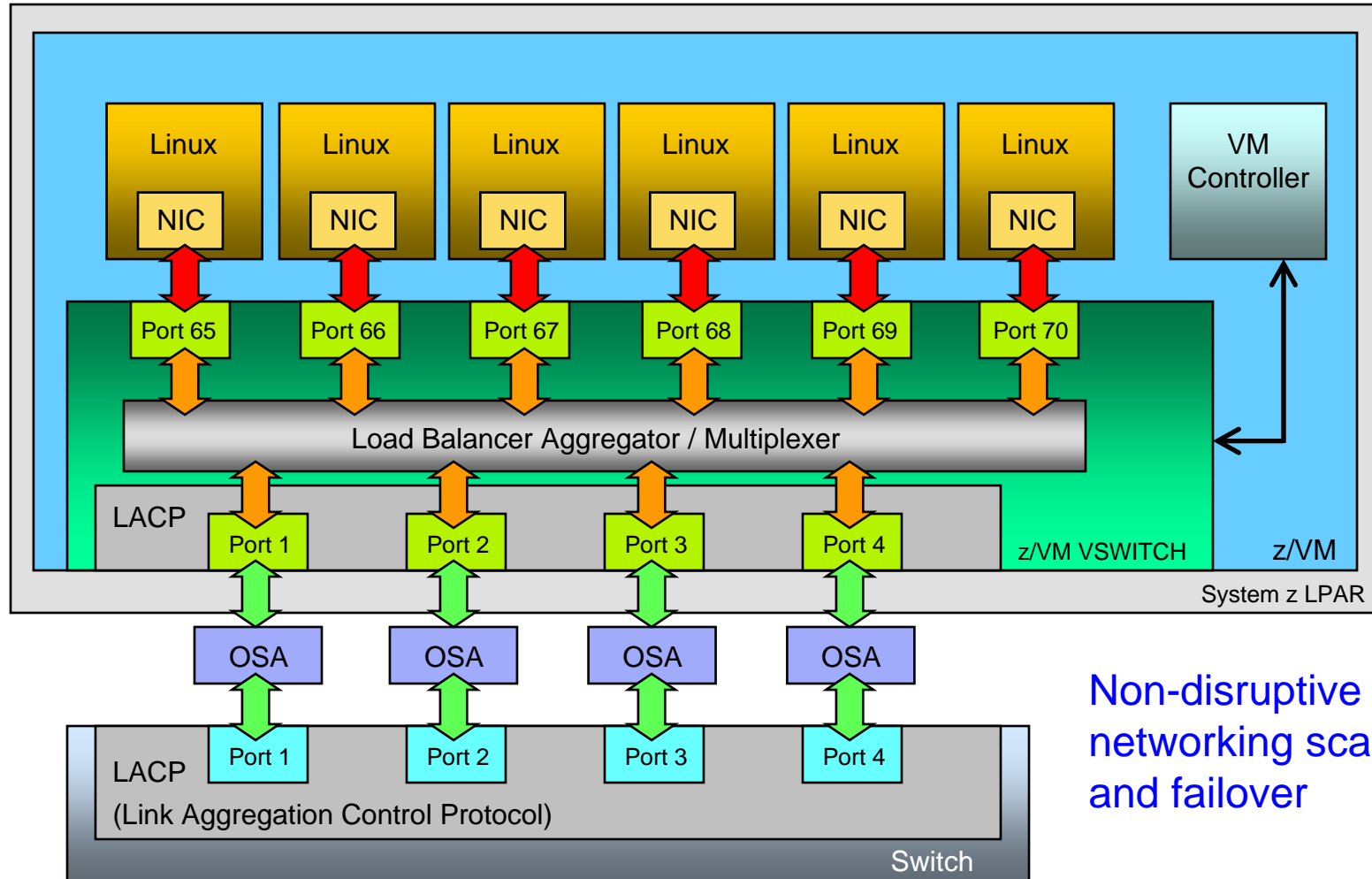
- SNMP virtual switch monitor

OSA-Express2 Link Aggregation Support

- **z/VM support for IEEE 802.3ad Link Aggregation**
- **Requires associated OSA-Express2 support announced on April 18, 2007 for IBM System z9 servers**
- **Groups available OSA-Express2 adapters for use by the z/VM Virtual Switch**
 - Up to 8 adapters can be aggregated 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
- **Enables increased scalability for virtual network I/O**
- **Includes support to recover from a failed external switch**
- **Enhances support for business continuance**

z/VM VSWITCH Link Aggregation Support

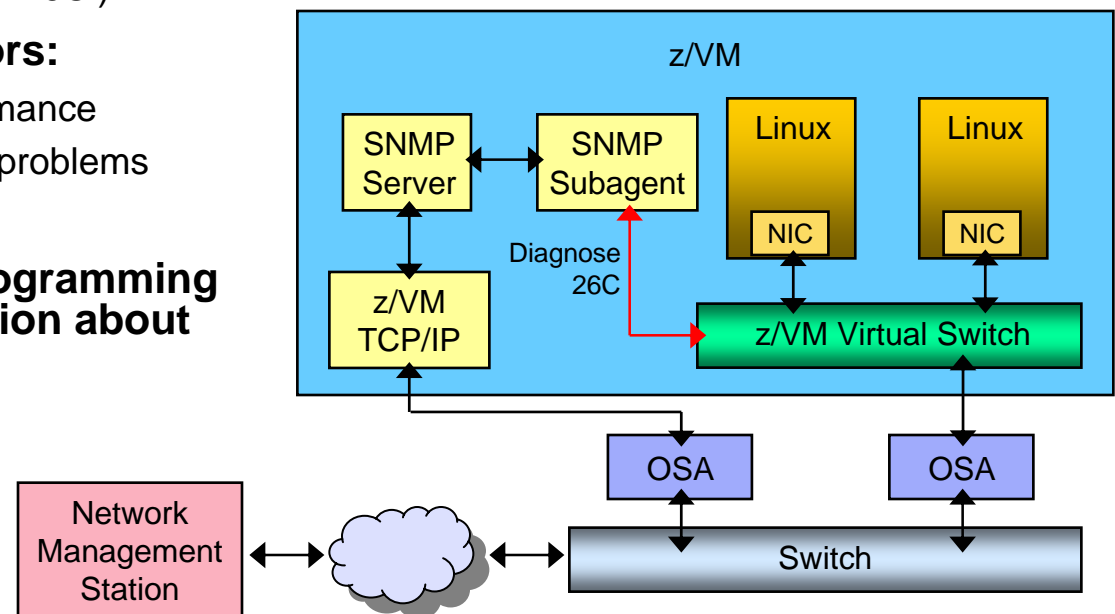
Enhanced Networking Bandwidth and Business Continuance



Non-disruptive
networking scalability
and failover

z/VM Virtual Switch SNMP Support

- **Helps enhance virtual network management with additional support for Simple Network Management Protocol (SNMP)**
- **Provides an SNMP subagent that will return Bridge MIB (Management Information Base) data for the z/VM Virtual Switch**
 - MIB data returned is defined by RFC 1493
 - The subagent acquires the information using a Control Program Diagnose interface (Diagnose x'26C')
- **Helps network administrators:**
 - Manage virtual network performance
 - Find and solve virtual network problems
 - Plan virtual network growth
- **Support also provides a programming interface to obtain information about virtual networks**



New in z/VM 5.2...

■ Support for LAN Sniffers

- ▶ CP command or device driver control (“promiscuous mode”)
 - SET VSWITCH GRANT, SET LAN GRANT, SET NIC
- ▶ External security manager
 - RACF/VM CONTROL access to VMLAN profile
- ▶ Guest receives copies of all frames sent or received

■ Pre-defined VSWITCH controllers

- ▶ DTCVSW1 and DTCVSW2
- ▶ Same as shown in Getting Started with Linux
 - Add them to AUTOLOG1
 - Remove “VSWITCH CONTROLLER ON” from PROFILE TCPIP in your production stacks

New in z/VM 5.1...

- ESM control for all guest LANs and VSWITCHes, including VLAN ID control
 - ▶ RACF: Class VMLAN, Profile owner.laname or owner.laname.vid
 - ▶ All Guest LANs and VSwitches can be controlled

- Layer 2 (MAC) communications
 - ▶ Fulfillment of Statement of Direction
 - ▶ All types of traffic, not just IP
 - ▶ Virtual NIC MAC appears on network
 - ▶ VMLAN updates to allow specification of ranges used for automatic and static MAC address assignments

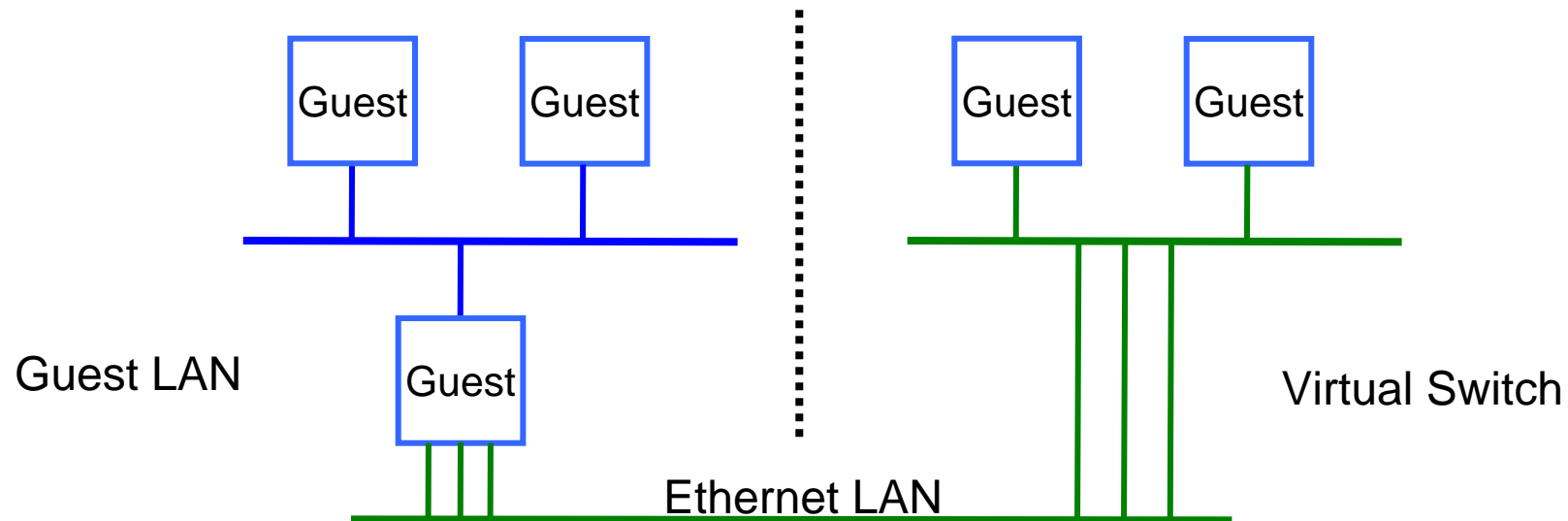
- Better VSWITCH stall detection, error reporting, and error recovery.

New in z/VM 5.1...

- IEEE 802.1q compliance changes
 - ▶ VLAN ANY is gone
 - ▶ VSWITCH can be defined as VLAN-aware (or not). Default is “not”.
 - ▶ When a NIC couples to a VLAN-aware VSWITCH, it will be assigned a PORTTYPE attribute
 - ACCESS: VLAN tags not given to or accepted from guest
 - TRUNK: VLAN tags are given to and expected from guest
 - ▶ Default PORTTYPE comes from DEFINE VSWITCH
 - Can be overridden by MODIFY VSWITCH GRANT
 - ▶ Some configurations require migration effort

Some Final Thoughts...

Guest LAN vs. Virtual Switch



- Virtual router is required
- Different subnet
- External router awareness
- Guest-managed failover
- No virtual router
- Same subnet
- Transparent bridge
- CP-managed failover

Network Configuration

- Guest LANs require a new subnet and the use of a virtual router
- 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

Thanks for Listening!

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

z/VM V5.3	<ul style="list-style-type: none">▪ Link aggregation▪ Separation of default VLAN id from native VLAN id▪ SNMP monitor
z/VM V5.2	<ul style="list-style-type: none">▪ Virtual SPAN ports for sniffers
z/VM V5.1	<ul style="list-style-type: none">▪ 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	<ul style="list-style-type: none">▪ 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 Planning, Administration and Operation

- Links:
 - ▶ <http://www.ibm.com/servers/eserver/zseries/os/linux/>
 - ▶ <http://www.linuxvm.org/>

Contact Information

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`LINUX-390@vm.marist.edu`

<http://ibm.com/vm/techinfo/listserv.html>