

*TOMORROW starts here.*



Cisco *live!*

# Hypervisors Networking: Best Practices for Interconnecting with Cisco Switches

BRKVIR-2019

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# Thong?



# What is this Session About?

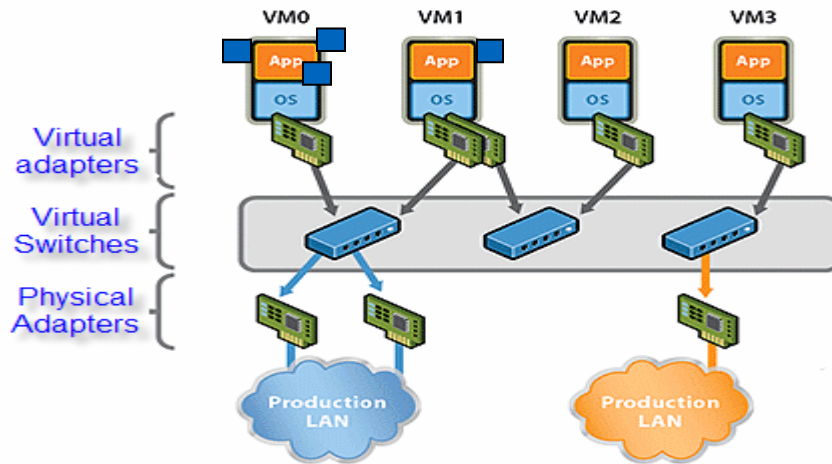
- Networking Virtualisation Concepts
- Hypervisor Overview
  - VMware vSphere ESXi 5.5
  - Microsoft Windows Server 2012 R2 (Hyper-V 3.0)
  - Citrix XenServer 6.2
- Topology Overview
- Nexus 1000v



# Networking Virtualisation Concepts

# Hypervisor Networking Virtualisation

- VM-to-VM and VM-to physical-host, traffic handled via software switch that lives in the hypervisor



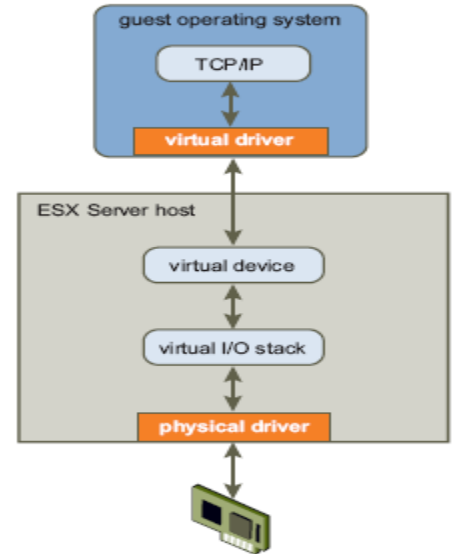
VM-to-VM:  
memory transfer

VM-to-physical:  
physical adapter

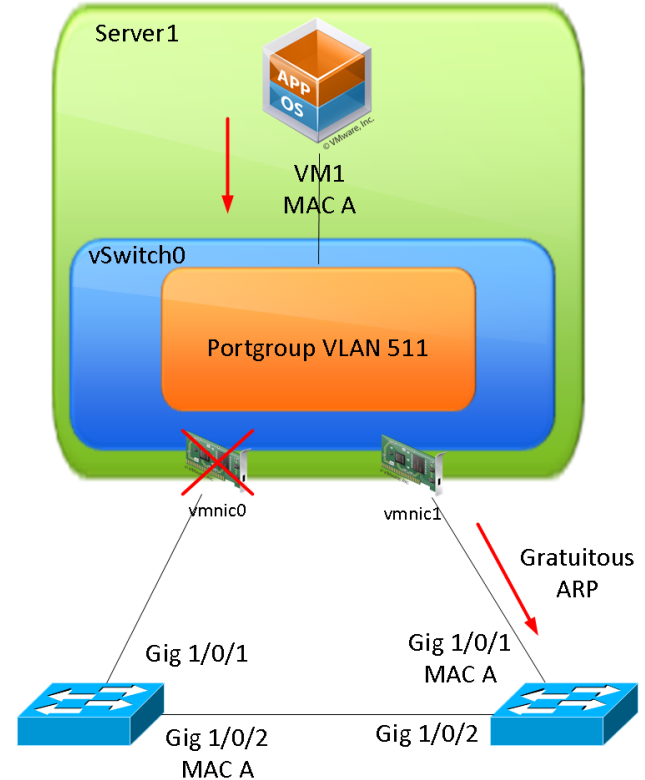
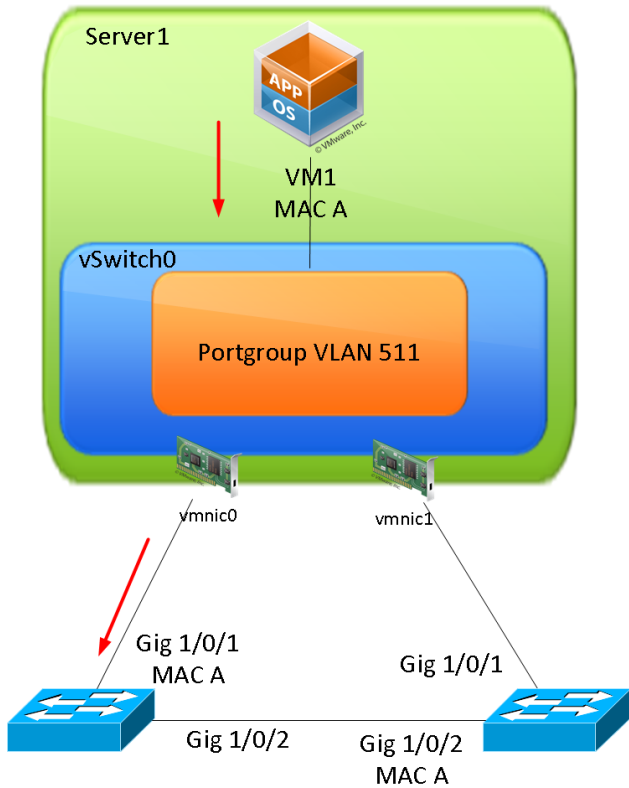
# Hypervisor Networking Virtualisation

## VMware vSphere ESXi example

- VMs don't directly control networking hardware
  - x86 hw designed to be handled by only one device driver!
- When a VM communicates with the outside world, it:
  - ... passes the packet to its local device driver ...
  - ... which in turns hands it to the hypervisor...
  - ... which in turns passes it to the physical NIC
- ESX gives VMs several device driver options:
  - Strict emulation of Intel's e1000 / e1000e
  - VMware vmxnet/vmxnet3: paravirtualised!
- VMs have MAC addresses that appear on the wire

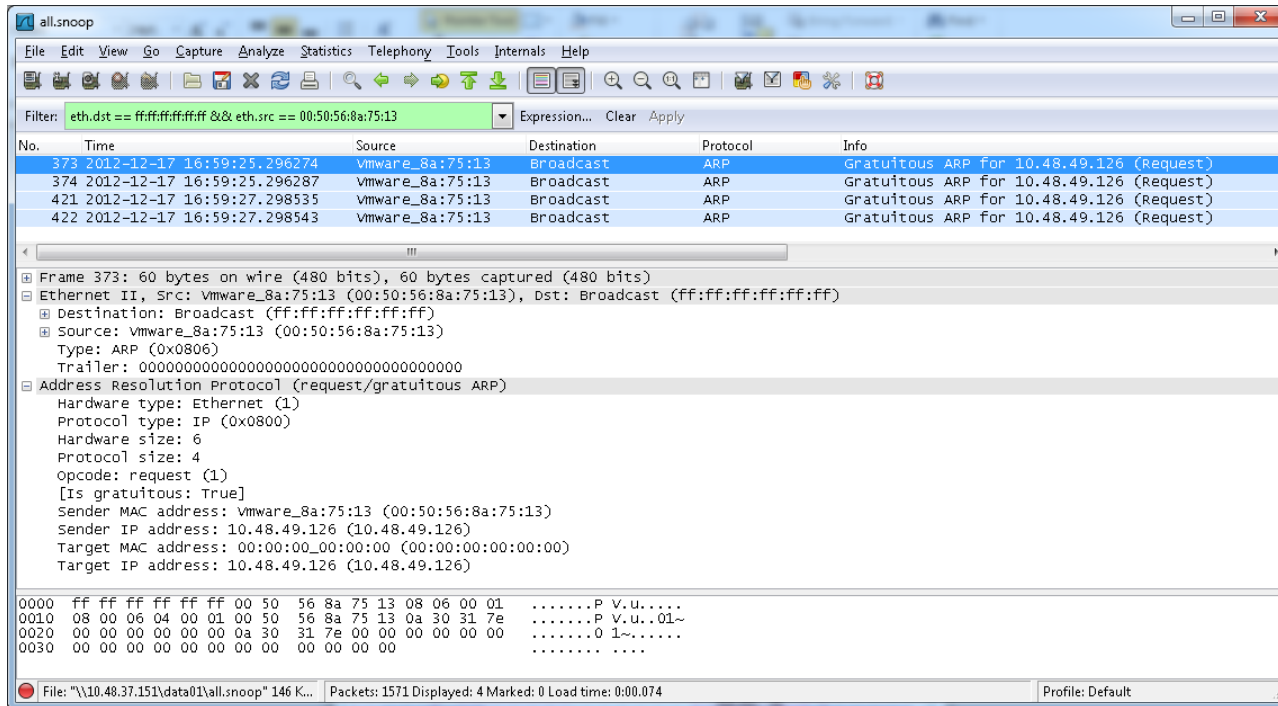


# Gratuitous ARP





# Gratuitous ARP



The image shows a Wireshark capture window titled "all.snoop". The filter bar contains the expression "eth.dst == ff:ff:ff:ff:ff:ff && eth.src == 00:50:56:8a:75:13". The packet list pane shows four packets (No. 373, 374, 421, 422) all of type ARP, with the info column indicating they are "Gratuitous ARP for 10.48.49.126 (Request)".

No.	Time	Source	Destination	Protocol	Info
373	2012-12-17 16:59:25.296274	vmware_8a:75:13	Broadcast	ARP	Gratuitous ARP for 10.48.49.126 (Request)
374	2012-12-17 16:59:25.296287	vmware_8a:75:13	Broadcast	ARP	Gratuitous ARP for 10.48.49.126 (Request)
421	2012-12-17 16:59:27.298535	vmware_8a:75:13	Broadcast	ARP	Gratuitous ARP for 10.48.49.126 (Request)
422	2012-12-17 16:59:27.298543	vmware_8a:75:13	Broadcast	ARP	Gratuitous ARP for 10.48.49.126 (Request)

The packet details pane for packet 373 shows:

- Frame 373: 60 bytes on wire (480 bits), 60 bytes captured (480 bits)
- Ethernet II, Src: vmware\_8a:75:13 (00:50:56:8a:75:13), Dst: Broadcast (ff:ff:ff:ff:ff:ff)
  - Destination: Broadcast (ff:ff:ff:ff:ff:ff)
  - Source: vmware\_8a:75:13 (00:50:56:8a:75:13)
    - Type: ARP (0x0806)
    - Trailer: 00000000000000000000000000000000
- Address Resolution Protocol (request/gratuitous ARP)
  - Hardware type: Ethernet (1)
  - Protocol type: IP (0x0800)
  - Hardware size: 6
  - Protocol size: 4
  - Opcode: request (1)
  - [Is gratuitous: True]
  - Sender MAC address: vmware\_8a:75:13 (00:50:56:8a:75:13)
  - Sender IP address: 10.48.49.126 (10.48.49.126)
  - Target MAC address: 00:00:00\_00:00:00 (00:00:00:00:00:00)
  - Target IP address: 10.48.49.126 (10.48.49.126)

The packet bytes pane shows the raw data in hexadecimal and ASCII:

```
0000 ff ff ff ff ff ff 00 50 56 8a 75 13 08 06 00 01 .....P V.u.....
0010 08 00 06 04 00 01 00 50 56 8a 75 13 0a 30 31 7e .....P V.u..01~
0020 00 00 00 00 00 00 0a 30 31 7e 00 00 00 00 00 00 .....0 1~.....
0030 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ..... .....
```

The status bar at the bottom indicates: File: "\\10.48.37.151\data01\all.snoop" 146 K... Packets: 1571 Displayed: 4 Marked: 0 Load time: 0:00.074 Profile: Default

# Spanning-Tree?

- Disable Spanning-tree
  - NX-OS: spanning-tree port type edge [ trunk ]
  - IOS: spanning-tree portfast
- Link flap with spanning-tree enabled = 30s network outage

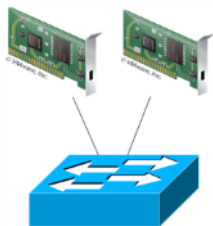
# Link Aggregation Demystified

Port-channel, Etherchannel, LACP, 802.3ad, 802.1ax, LAG, Teaming, Bonding

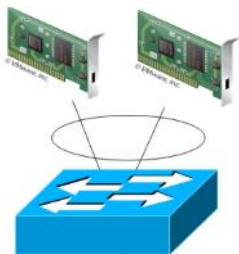
- IEEE 802.3ad predecessor to 802.1AX
- 802.1AX defines Link Aggregation Group (LAG)
- LAG can be static or dynamic
- Link Aggregation Control Protocol (LACP) is part of 802.1AX

# Switch Independent / Dependent

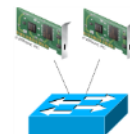
- Independent - no specific switch protocol / configuration is required



- Dependent - specific switch configuration is required (port-channel)



# Switch Independent Configuration Options (NX-OS)



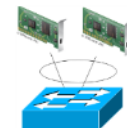
## Access

```
interface Ethernet101/1/31
  switchport mode access
  switchport access vlan 511
  spanning-tree port type edge trunk
```

## Trunk

```
interface Ethernet101/1/31
  switchport mode trunk
  switchport trunk allowed vlan 511
  spanning-tree port type edge trunk
```

# Switch Dependent Configuration Options (NX-OS)



## Static

```
interface Ethernet101/1/31-32
  switchport mode trunk
  switchport trunk allowed vlan 511
  spanning-tree port type edge trunk
  channel-group 300
```

## LACP

```
interface Ethernet101/1/31-32
  switchport mode trunk
  switchport trunk allowed vlan 511
  spanning-tree port type edge trunk
  channel-group 300 mode active
```

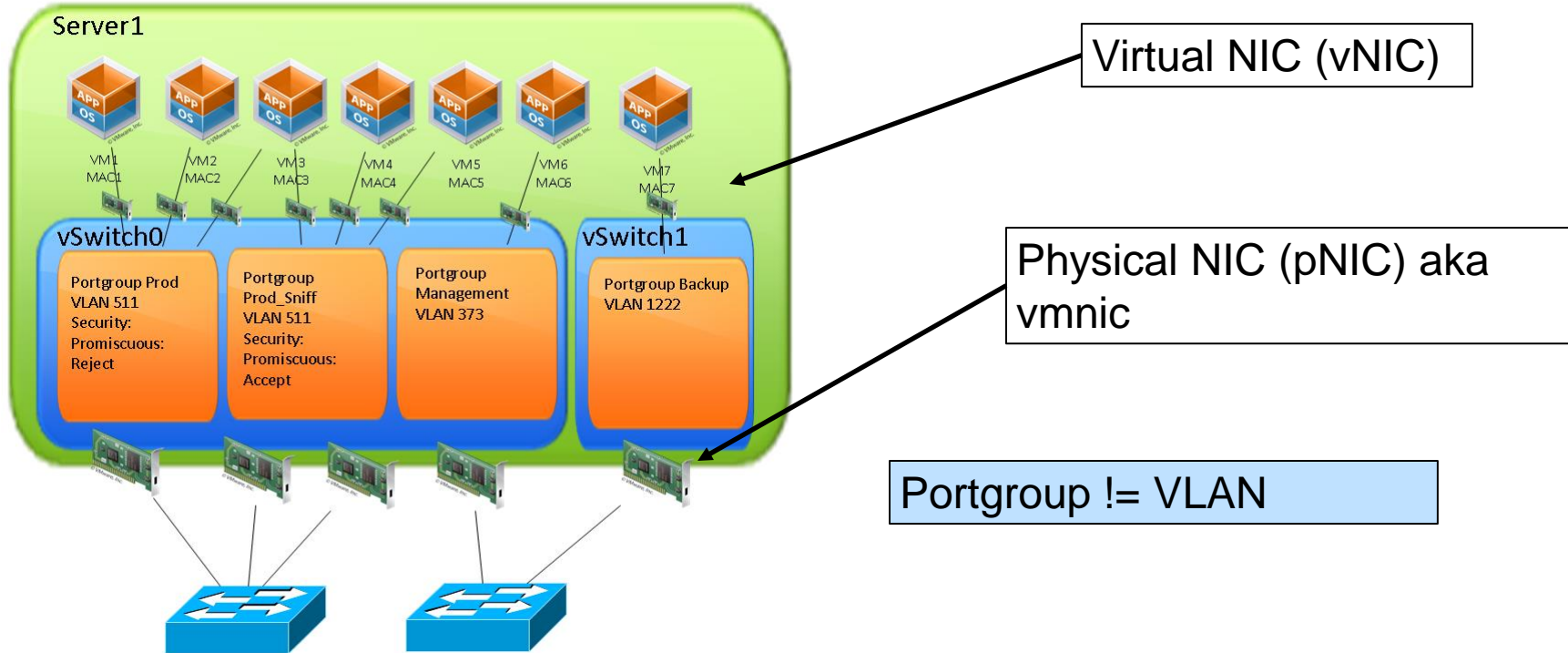
```
interface Port-Channel300
  switchport mode trunk
  switchport trunk allowed vlan 511
```



# Hypervisor Overview

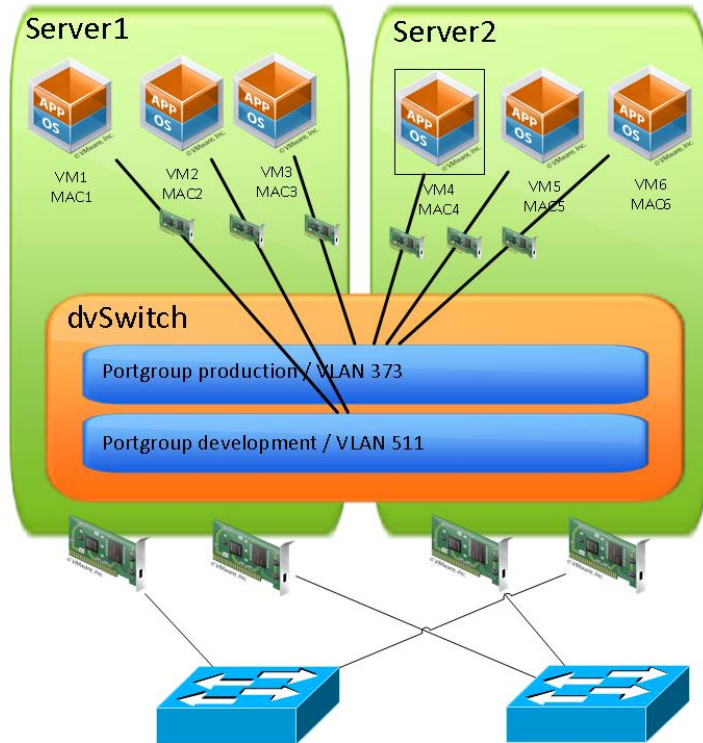
## VMware vSphere ESXi

# vSphere Standard Switch (vSS)





# vSphere Distributed Switch (vDS)



- Spans multiple servers
- Enterprise Plus license required

# VMware vSphere ESXi

- Route based on originating virtual port
- Route based on source MAC hash
- Use explicit failover order
- Route based on physical NIC load (vDS)
- Route based on IP hash
- Route based on IP hash + LACP (vDS)

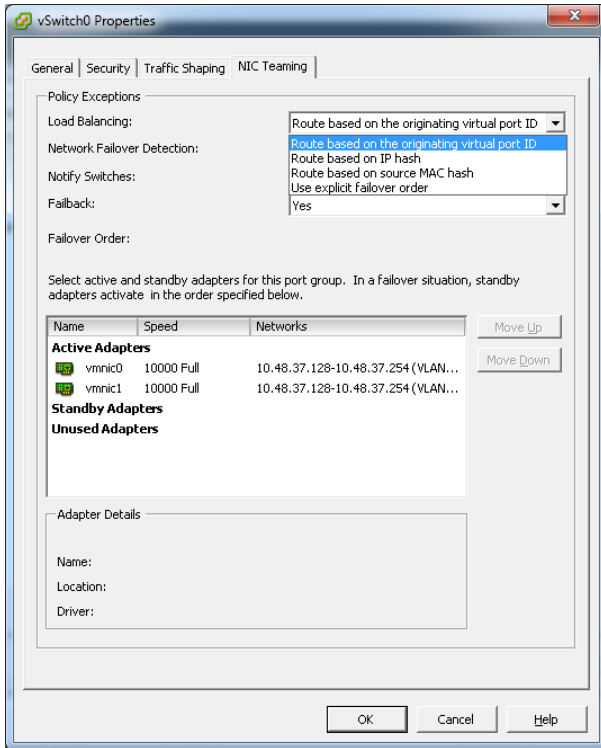


Switch Independent

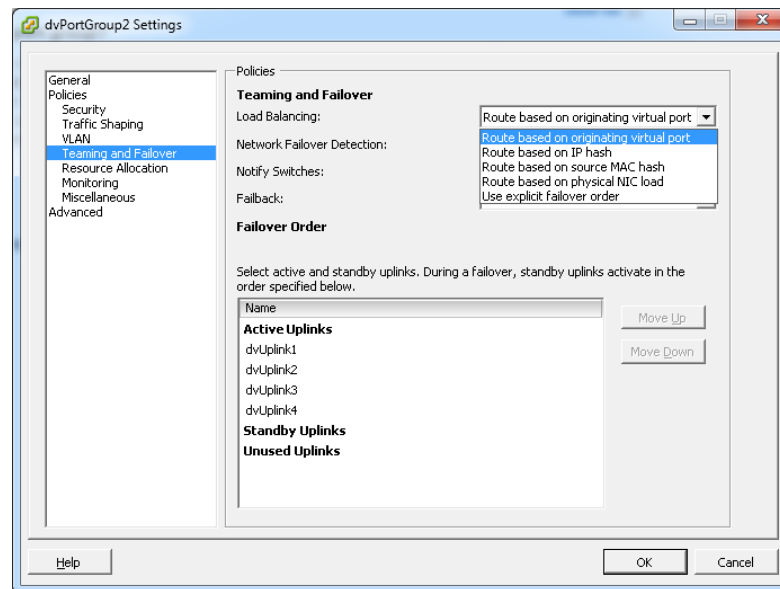
Switch Dependent

# Uplink Options

## vSphere Standard Switch



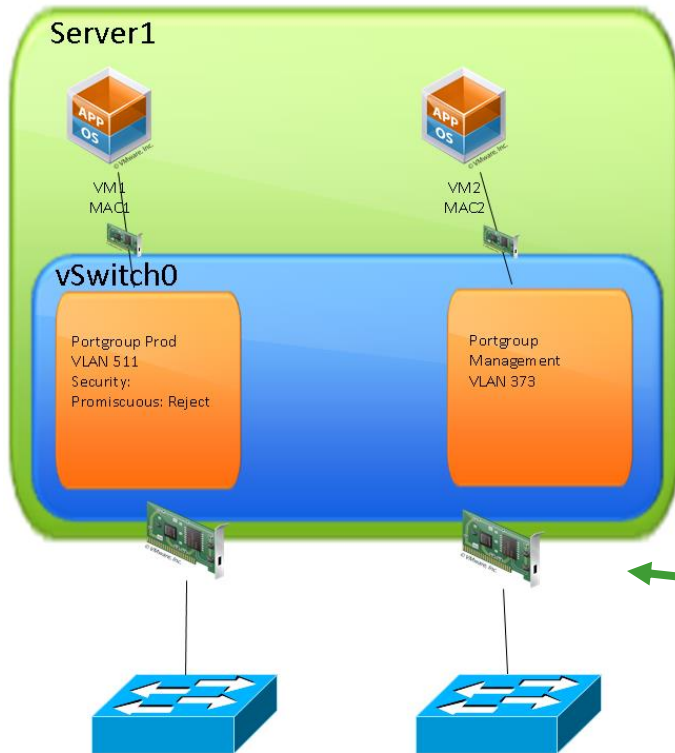
## vSphere Distributed Switch (vDS)



### vDS (extra):

- Route based on physical NIC load
- Route based on IP hash + LACP

# Load Balancing



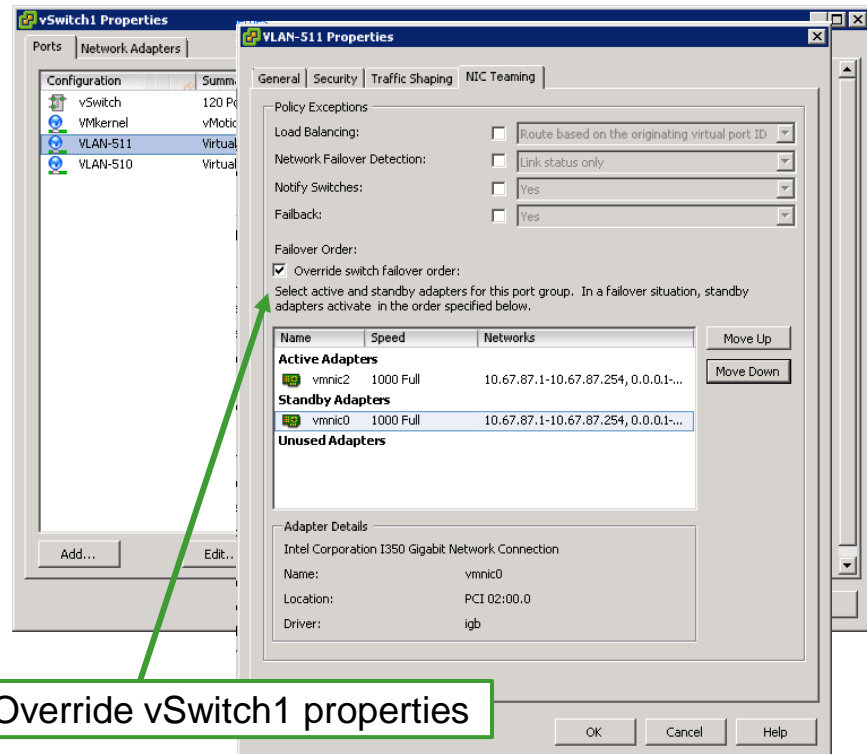
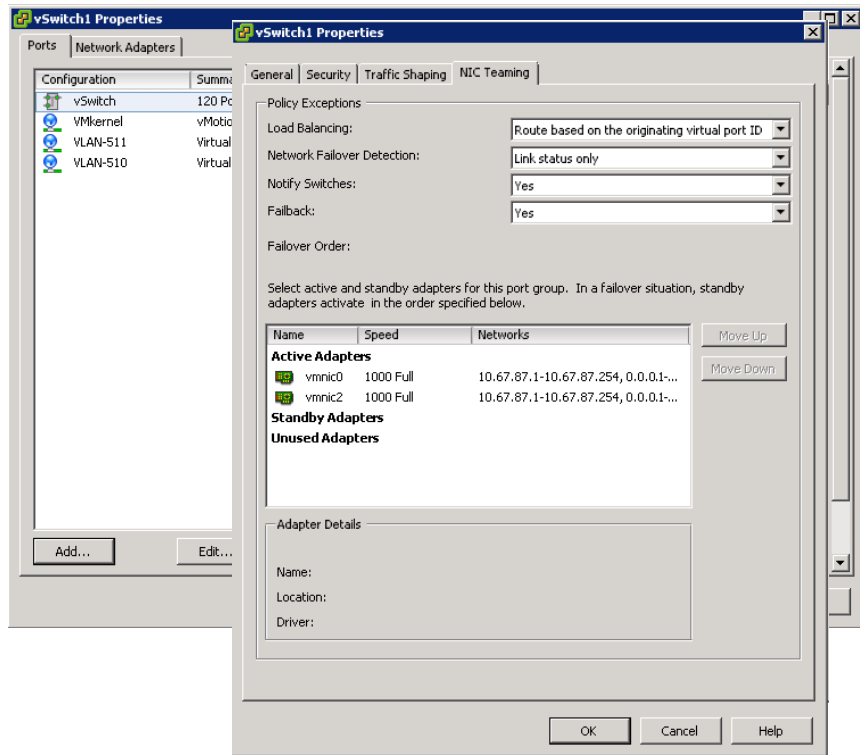
## Per portgroup:

- Route based on originating virtual port
- Route based on IP hash
- Route based on source MAC hash
- Route based on physical NIC load (vDS)
- Use explicit failover order

## Per DVUplink:

- Route based on IP hash + LACP (vDS)

# Load Balancing: VMware Standard Switch



Override vSwitch1 properties

# Load Balancing: VMware Distributed Switch

The image shows two configuration windows from VMware vSphere. The background window is 'dvSwitch-DVUplinks-19 Settings'. In the 'Policies' section, under 'Teaming and Failover', the 'Load Balancing' dropdown is set to 'Route based on originating virtual port'. A green callout box with an arrow points to this dropdown, containing the text: 'Not configurable on the DVUplinks'. The foreground window is 'VLAN-511 Settings'. In its 'Policies' section, the 'Load Balancing' dropdown is open, showing several options: 'Route based on physical NIC load', 'Route based on originating virtual port', 'Route based on IP hash', 'Route based on source MAC hash', 'Route based on physical NIC load', and 'Use explicit failover order'. The 'Route based on physical NIC load' option is currently selected.

# Active / Standby / Unused

**vSwitch1 Properties**

General Security Traffic Shaping NIC Teaming

Policy Exceptions

Load Balancing: Route based on the originating virtual port ID

Network Failover Detection: Link status only

Notify Switches: Yes

Failback: Yes

Failover Order:

Select active and standby adapters for this port group. In a failover situation, standby adapters activate in the order specified below.

Name	Speed	Networks
<b>Active Adapters</b>		
vmnic0	1000 Full	10.67.87.1-10.67.87.254, 0.0.0.1-...
<b>Standby Adapters</b>		
vmnic1	1000 Full	10.67.87.1-10.67.87.254, 0.0.0.1-...
<b>Unused Adapters</b>		
vmnic2	1000 Full	10.67.87.1-10.67.87.254, 0.0.0.1-...

Adapter Details

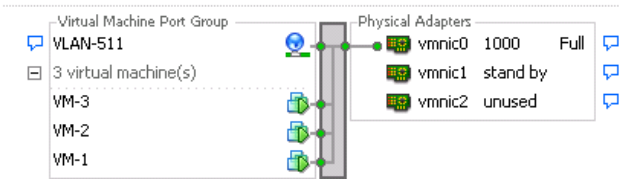
Name:

Location:

Driver:

OK Cancel Help

Standard Switch: vSwitch1



vmnic0

Ethernet101/1/31 is up

vmnic1

Ethernet101/1/31 is up

vmnic2

Ethernet101/1/32 is up

Cisco Discovery Protocol

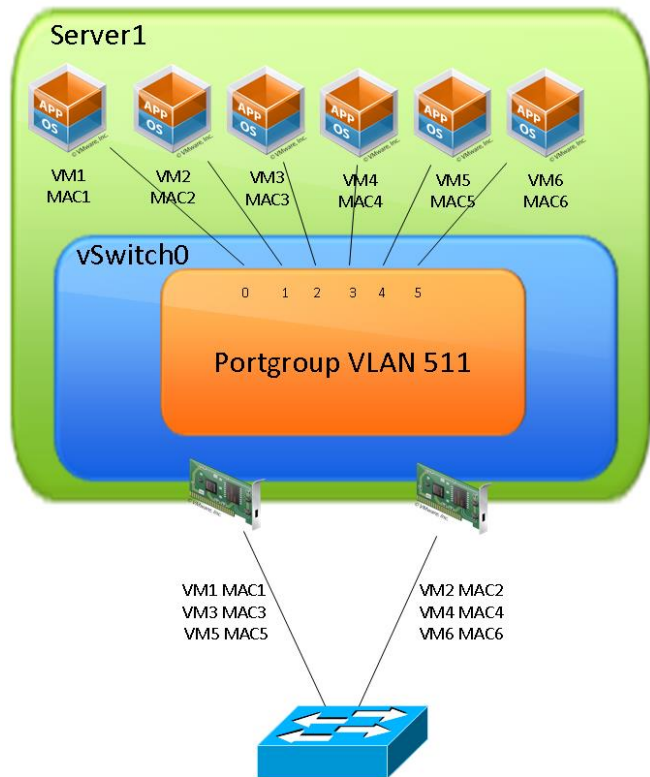
**Properties**

Version:	2
Timeout:	0
Time to live:	175
Samples:	253
Device ID:	SV-5K-1(FOX1726GPAC)
IP Address:	10.67.86.4
Port ID:	Ethernet101/1/31
Software Version:	Cisco Nexus Operating System (...)
Hardware Platform:	NSK-C5596UP
IP Prefix:	0.0.0.0
IP Prefix Length:	0
VLAN:	511
Full Duplex:	Enabled
MTU:	1500
System Name:	SV-5K-1
System OID:	1.3.6.1.4.1.9.12.3.1.3.1038
Management Address:	10.67.83.198
Location:	snmplocation

**Peer Device Capability Enabled**

Router:	No
Transparent Bridge:	No
Source Route Bridge:	No
Network Switch:	Yes
Host:	No
IGMP:	Yes
Repeater:	No

# Route Based on Originating Virtual Port



- Default configuration
- Even distribution of traffic if number of vNICs > physical adapters
- vNIC pinned to single physical NIC
- Can go to one or multiple switches



# Route Based on Originating Virtual Port

VC-01 - vSphere Client

File Edit View Inventory Administration Plug-ins Help

Home Inventory Networking

VC-01

- CiscoLive
  - VM Network
    - dvSwitch
      - dvSwitch-DVUplinks
        - VLAN-511

VLAN-511

Getting Started Summary Ports Virtual Machines Hosts Tasks & Events

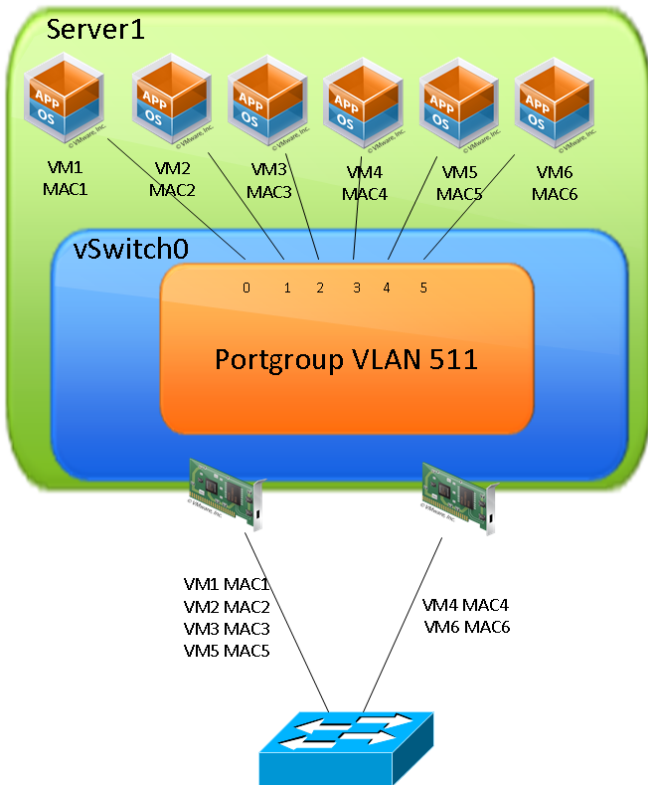
Time since last refresh: 01:44

9:49:58am up 1:44, 567 worlds, 4 VMs, 5 vCPUs; CPU load average: 0.01, 0.01,

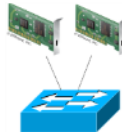
```
SV-5K-1# show mac address-table | grep aaa
* 511      aaaa.cafe.0001    dynamic 0          F   F   Eth101/1/31
* 511      aaaa.face.0002    dynamic 0          F   F   Eth101/1/31
* 511      aaaa.feed.0003    dynamic 0          F   F   Eth101/1/32
SV-5K-1#
```

Port ID	Connectee	Runtime MAC address	PORT-ID	USED-BY	TEAM-PNIC	DNAME	PKT/s	Mb/s
132	VM-1	aa:aa:ca:fe:00:01	33554433	Management	n/a	vSwitch0	0.00	0.00
133	VM-2	aa:aa:fa:ce:00:02	33554434	vmnic3	-	vSwitch0	53.10	1.52
134	VM-3	aa:aa:fe:ed:00:03	33554435	Shadow of vmnic3	n/a	vSwitch0	0.00	0.00
135	--	--	33554436	vmk0	vmnic3	vSwitch0	53.10	1.52
			33554438	36042:VMware vCenter	vmnic3	vSwitch0	0.00	0.00
			50331649	Management	n/a	DvsPortset-0	0.00	0.00
			50331650	vmnic0	-	DvsPortset-0	2.16	0.00
			50331651	Shadow of vmnic0	n/a	DvsPortset-0	0.00	0.00
			50331656	46658:VM-1.eth0	vmnic0	DvsPortset-0	0.98	0.00
			50331657	46777:VM-2.eth0	vmnic0	DvsPortset-0	1.18	0.00
			50331658	48692:VM-3.eth0	vmnic2	DvsPortset-0	1.18	0.00
			50331659	vmnic2	-	DvsPortset-0	1.18	0.00
			50331660	Shadow of vmnic2	n/a	DvsPortset-0	0.00	0.00

# Route Based on Source MAC Hash



- vNIC pinning based on src MAC hash
- vNIC pinned to single physical NIC
- Even distribution of traffic if random MAC addresses
- Be careful with manual MAC address assignments
- Can go to one or multiple switches



# Route Based on Source MAC Hash

```
11:20:03am up 3:15, 567 worlds, 4 VMs, 5 vCPUs; CPU load average: 0.01, 0.01, 0
```

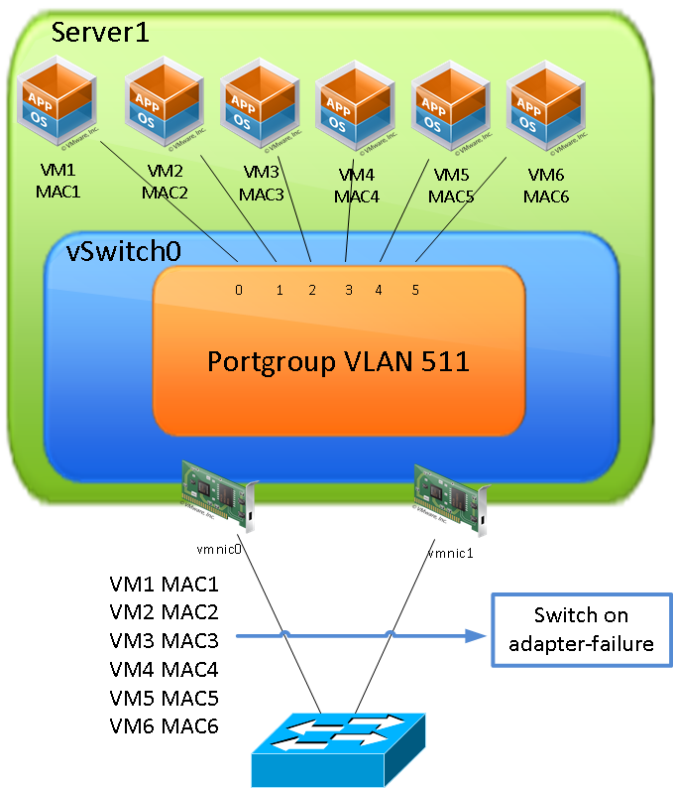
PORT-ID	USED-BY	TEAM-PNIC	DNAME	PKTTX/s	MbTX/s
33554433	Management	n/a	vSwitch0	0.00	0.00
33554434	vmnic3	-	vSwitch0	54.72	2.68
33554435	Shadow of vmnic3	n/a	vSwitch0	0.00	0.00
33554436	vmk0	vmnic3	vSwitch0	54.92	2.68
33554438	36042:VMware vCenter	vmnic3	vSwitch0	0.00	0.00
50331649	Management	n/a	DvsPortset-0	0.00	0.00
50331650	vmnic0	-	DvsPortset-0	1.18	0.00
50331651	Shadow of vmnic0	n/a	DvsPortset-0	0.00	0.00
50331659	vmnic2	-	DvsPortset-0	2.17	0.00
50331660	Shadow of vmnic2	n/a	DvsPortset-0	0.00	0.00
50331661	46658:VM-1.eth0	vmnic2*	DvsPortset-0	1.18	0.00
50331662	46777:VM-2.eth0	vmnic0*	DvsPortset-0	1.18	0.00
50331663	48692:VM-3.eth0	vmnic2*	DvsPortset-0	0.98	0.00

```
SV-5K-1# show mac address-table | grep aaa
```

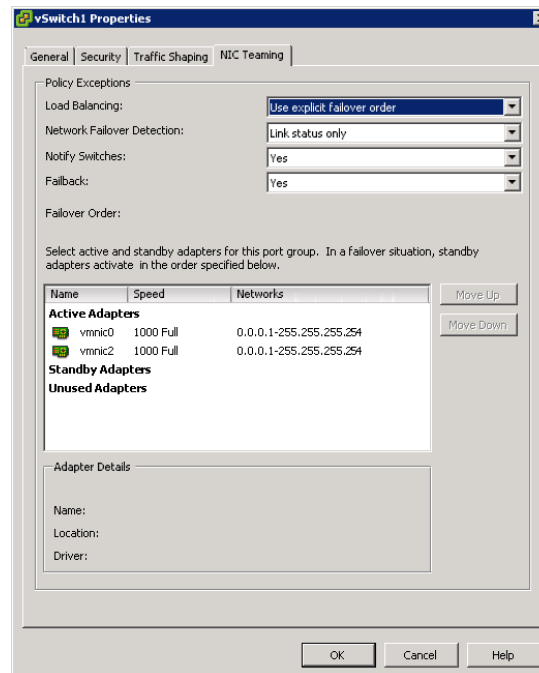
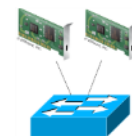
```
* 511      aaaa.cafe.0001    dynamic 0      F      F      Eth101/1/32
* 511      aaaa.face.0002    dynamic 0      F      F      Eth101/1/31
* 511      aaaa.feed.0003    dynamic 0      F      F      Eth101/1/32
```

```
SV-5K-1#
```

# Use Explicit Failover Order



- Highest order uplink from the list of active adapters
- Can go to one or multiple switches



# Use Explicit Failover Order

11:54:41am up 3:49, 567 worlds, 4 VMs, 5 vCPUs; CPU load average: 0.01, 0.01,

PORT-ID	USED-BY	TEAM-PNIC	DNAME	PKTTX/s	MbTX/s
33554433	Management	n/a	vSwitch0	0.00	0.00
33554434	vmnic3	-	vSwitch0	17.13	0.34
33554435	Shadow of vmnic3	n/a	vSwitch0	0.00	0.00
33554436	vmk0	vmnic3	vSwitch0	17.13	0.34
33554438	36042:VMware vCenter	vmnic3	vSwitch0	0.00	0.00
50331649	Management	n/a	DvsPortset-0	0.00	0.00
67108865	Management	n/a	vSwitch1	0.00	0.00
67108868	vmnic0	-	vSwitch1	4.33	0.00
67108869	Shadow of vmnic0	n/a	vSwitch1	0.00	0.00
67108870	vmnic2	-	vSwitch1	0.00	0.00
67108871	Shadow of vmnic2	n/a	vSwitch1	0.00	0.00
67108872	46658:VM-1	vmnic0	vSwitch1	0.98	0.00
67108873	46777:VM-2	vmnic0	vSwitch1	2.36	0.00
67108874	48692:VM-3	vmnic0	vSwitch1	0.98	0.00

All MACs on single port

```
SV-5K-1# show int e101/1/31-32 | grep "is up"
```

```
Ethernet101/1/31 is up
Ethernet101/1/32 is up
```

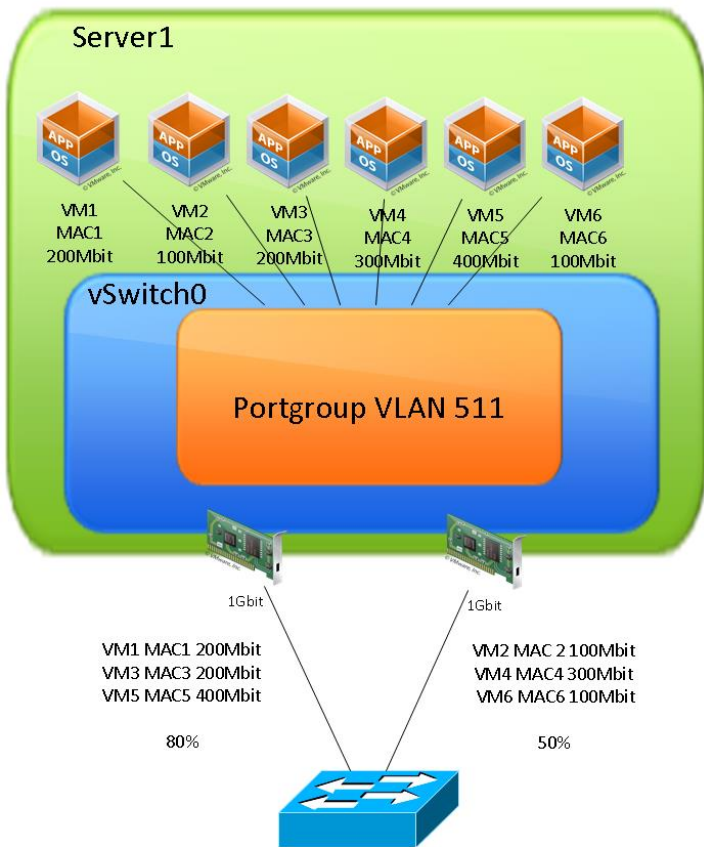
```
SV-5K-1# show mac address-table | grep aaa
```

```
* 511      aaa.cafe.0001      dynamic 10          F      F      Eth101/1/31
* 511      aaa.face.0002      dynamic 10          F      F      Eth101/1/31
* 511      aaa.feed.0003      dynamic 10          F      F      Eth101/1/31
```

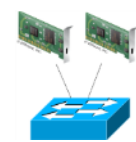
```
SV-5K-1# show mac address-table interface e101/1/32
```

```
SV-5K-1#
```

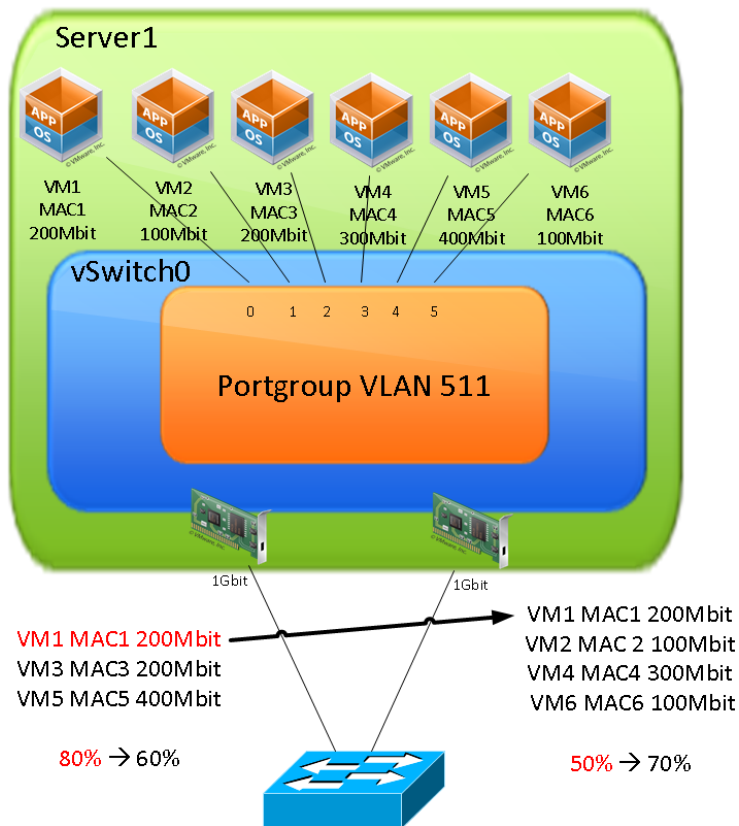
# Route Based on Physical NIC Load (vDS)



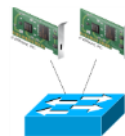
- Initial vNIC placement uses “Route based on originating virtual port”
- If pNIC RX or TX > 75% → rebalance
- VMkernel checks load every 30s
- MAC moves on switch layer
- Can go to single or multiple switches



# Route Based on Physical NIC Load (vDS)



- Initial vNIC placement uses “Route based on originating virtual port”
- If pNIC RX or TX > 75% → rebalance
- VMkernel checks load every 30s
- MAC moves on switch layer
- Can go to single or multiple switches



# Route Based on Physical NIC Load (vDS)

11:27:00am up 3:21, 565 worlds, 4 VMs, 5 vCPUs; CPU load average: 0.01, 0.01, 0.01

PORT-ID	USED-BY	TEAM-PNIC	DNAME	PKTTX/s	MbTX/s	PKTRX/s	MbRX/s
33554433	Management	n/a	vSwitch0	0.00	0.00	0.00	0.00
33554434	vmnic3	-	vSwitch0	309.68	51.35	2405.21	1.26
33554435	Shadow of vmnic3	n/a	vSwitch0	0.00	0.00	0.00	0.00
33554436	vmk0	vmnic3	vSwitch0	309.68	51.35	2368.92	1.21
33554438	36042:VMware vCenter	vmnic3	vSwitch0	0.00	0.00	8.28	0.01
50331649	Management	n/a	DvsPortset-0	0.00	0.00	0.00	0.00
50331650	vmnic0	-	DvsPortset-0	1894.74	0.87	8030.26	84.93
50331651	Shadow of vmnic0	n/a	DvsPortset-0	0.00	0.00	0.00	0.00
50331659	vmnic2	-	DvsPortset-0	1.97	0.00	35.11	0.05
50331660	Shadow of vmnic2	n/a	DvsPortset-0	0.00	0.00	0.00	0.00
50331661	46658:VM-1.eth0	vmnic0	DvsPortset-0	1894.74	0.78	8005.60	84.90
50331662	46777:VM-2.eth0	vmnic2	DvsPortset-0	0.99	0.00	9.27	0.01
50331663	48692:VM-3.eth0	vmnic2	DvsPortset-0	0.99	0.00	9.27	0.01

```
SV-5K-1# show mac address-table | grep aaa
```

```
* 511      aaaa.cafe.0001      dynamic  0          F      F      Eth101/1/31
* 511      aaaa.face.0002      dynamic  0          F      F      Eth101/1/32
* 511      aaaa.feed.0003      dynamic  0          F      F      Eth101/1/32
```

```
SV-5K-1#
```



# VMware Switch Independent

## Switch Configuration

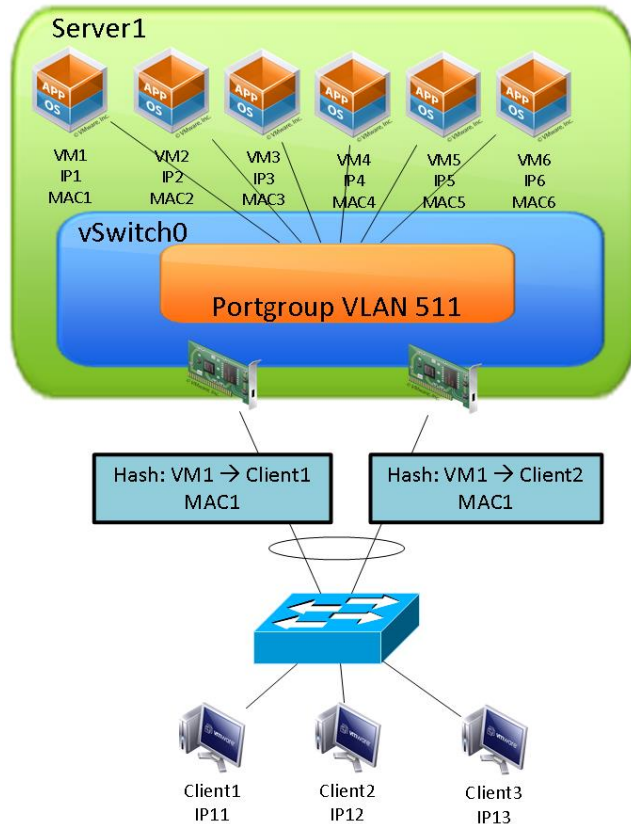


```
interface Ethernet101/1/31-32
  switchport mode trunk
  switchport trunk allowed vlan 511
  spanning-tree port type edge trunk
```

Used for:

- Route based on originating virtual port
- Route based on source MAC hash
- Use explicit failover order
- Route based on physical NIC load (vDS)

# Route Based on IP Hash



- IP source and destination hash
- Evenness of traffic distribution depends on TCP/IP attributes of flows
- Requires static 802.3ad port-channel (mode on)
- Connects to single port-channel

# Route Based on IP Hash

## Misconfiguration Example

```
SV-5K-1# show logging | grep mac
2014 Jan 3 13:38:46 SV-5K-1 %FWM-2-STM_LOOP_DETECT: Loops detected in the network for mac aaaa.cafe.0001 among ports Eth101/1/32 and Eth101/1/31 vlan 511
2014 Jan 3 13:42:07 SV-5K-1 %FWM-2-STM_LOOP_DETECT: Loops detected in the network for mac aaaa.cafe.0001 among ports Eth101/1/32 and Eth101/1/31 vlan 511
2014 Jan 3 13:45:27 SV-5K-1 %FWM-2-STM_LOOP_DETECT: Loops detected in the network for mac aaaa.cafe.0001 among ports Eth101/1/31 and Eth101/1/32 vlan 511
2014 Jan 3 13:48:37 SV-5K-1 %FWM-2-STM_LOOP_DETECT: Loops detected in the network for mac aaaa.cafe.0001 among ports Eth101/1/32 and Eth101/1/31 vlan 511
2014 Jan 3 13:51:53 SV-5K-1 %FWM-2-STM_LOOP_DETECT: Loops detected in the network for mac aaaa.cafe.0001 among ports Eth101/1/31 and Eth101/1/32 vlan 511
2014 Jan 3 13:54:54 SV-5K-1 %FWM-2-STM_LOOP_DETECT: Loops detected in the network for mac aaaa.cafe.0001 among ports Eth101/1/32 and Eth101/1/31 vlan 511
2014 Jan 3 13:58:01 SV-5K-1 %FWM-2-STM_LOOP_DETECT: Loops detected in the network for mac aaaa.cafe.0001 among ports Eth101/1/32 and Eth101/1/31 vlan 511
2014 Jan 3 14:01:03 SV-5K-1 %FWM-2-STM_LOOP_DETECT: Loops detected in the network for mac aaaa.cafe.0001 among ports Eth101/1/31 and Eth101/1/32 vlan 511
SV-5K-1#
```

```
SV-5K-1# show mac address-table | grep aaaa.cafe.0001
* 511      aaaa.cafe.0001    dynamic 0      F    F    Eth101/1/31
SV-5K-1# show mac address-table | grep aaaa.cafe.0001
* 511      aaaa.cafe.0001    dynamic 0      F    F    Eth101/1/32
SV-5K-1# show mac address-table | grep aaaa.cafe.0001
* 511      aaaa.cafe.0001    dynamic 0      F    F    Eth101/1/31
SV-5K-1# show mac address-table | grep aaaa.cafe.0001
* 511      aaaa.cafe.0001    dynamic 10     F    F    Eth101/1/32
SV-5K-1# show mac address-table | grep aaaa.cafe.0001
* 511      aaaa.cafe.0001    dynamic 0      F    F    Eth101/1/32
SV-5K-1# show mac address-table | grep aaaa.cafe.0001
* 511      aaaa.cafe.0001    dynamic 0      F    F    Eth101/1/31
```

# VMware Switch Dependent

## Route Based on IP Hash – Switch Configuration

```
interface Ethernet101/1/31-32
  switchport mode trunk
  switchport trunk allowed vlan 511
  spanning-tree port type edge trunk
  channel-group 300
```

```
interface Port-Channel300
  switchport mode trunk
  switchport trunk allowed vlan 511
```

```
SV-5K-1(config-if)# channel-group 300 mode ?
  active   Set channeling mode to ACTIVE
  on       Set channeling mode to ON
  passive  Set channeling mode to PASSIVE
```

```
SV-5K-1(config-if)# channel-group 300 mode
```

# Route Based on IP Hash

```
11:01:40am up 2:56, 567 worlds, 4 VMs, 5 vCPUs; CPU load average: 0.01, 0.01,
```

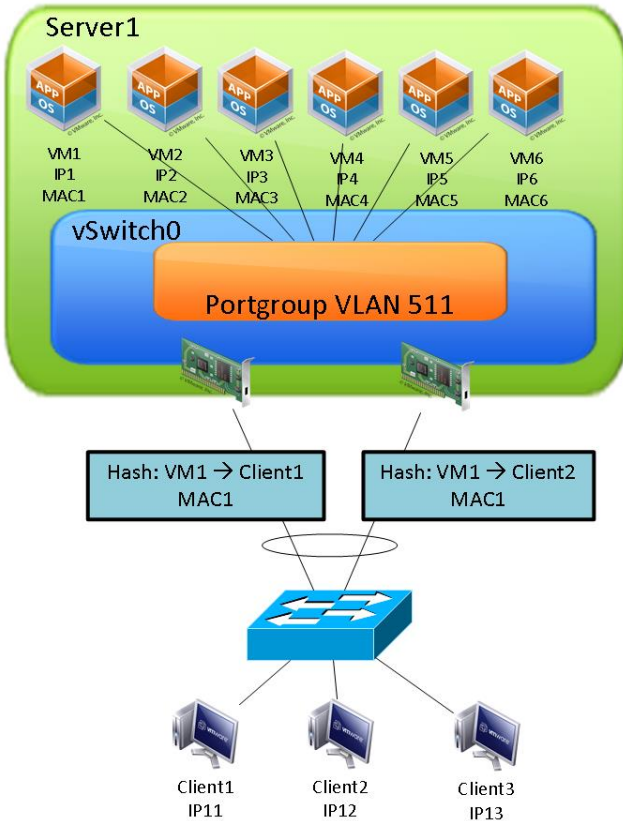
PORT-ID	USED-BY	TEAM-PNIC	DNAME	PKT/s	Mb/s
33554433	Management	n/a	vSwitch0	0.00	0.00
33554434	vmnic3	-	vSwitch0	12.59	0.15
33554435	Shadow of vmnic3	n/a	vSwitch0	0.00	0.00
33554436	vmk0	vmnic3	vSwitch0	12.59	0.15
33554438	36042:VMware vCenter	vmnic3	vSwitch0	0.00	0.00
50331649	Management	n/a	DvsPortset-0	0.00	0.00
50331650	vmnic0	-	DvsPortset-0	127.26	0.12
50331651	Shadow of vmnic0	n/a	DvsPortset-0	0.00	0.00
50331659	vmnic2	-	DvsPortset-0	65.89	0.07
50331660	Shadow of vmnic2	n/a	DvsPortset-0	0.00	0.00
50331661	46658:VM-1.eth0	all(2)	DvsPortset-0	191.58	0.18
50331662	46777:VM-2.eth0	all(2)	DvsPortset-0	1.38	0.00
50331663	48692:VM-3.eth0	all(2)	DvsPortset-0	1.77	0.00

```
SV-5K-1# show mac address-table | grep aaaa.cafe.0001
```

```
* 511 aaaa.cafe.0001 dynamic 0 F F Po301
SV-5K-1#
```

Group	Port-Channel	Type	Protocol	Member Ports
301	Po301(SU)	Eth	NONE	Eth101/1/31(P) Eth101/1/32(P)
SV-5K-1#				

# Route Based on IP Hash + LACP (vDS)



- IP source and destination hash
- Evenness of traffic distribution depends on TCP/IP attributes of flows
- Requires dynamic 802.3ad port-channel (mode active/passive)

# Route Based on IP Hash + LACP (vDS)

The screenshot displays two configuration windows. The top window, 'dvPortGroup2 - Edit Settings', has the 'Teaming and failover' tab selected. The 'Load balancing' dropdown is set to 'Route based on IP hash', indicated by a green arrow. The 'Network failure detection' is set to 'Link status only', 'Notify switches' to 'Yes', and 'Failback' to 'Yes'. The bottom window, 'dvSwitch2-DVUplinks-721 - Edit Settings', has the 'LACP' tab selected. The 'Status' dropdown is set to 'Enabled' and the 'Mode' dropdown is set to 'Active', both indicated by green arrows. A tooltip is visible over the 'Mode' dropdown, stating: 'To properly enable LACP, all uplinks backed by this uplink port group must have their load balancing policy set to IP hash and all uplinks set to active.' The 'Active uplinks' list on the left shows four uplinks (dvUplink1-4) with green status icons.

**Active** – The port is in an active negotiating state, in which the port initiates negotiations with remote ports by sending LACP packets.

**Passive** – The port is in a passive negotiating state, in which the port responds to LACP packets it receives but does not initiate LACP negotiation.

# Route Based on IP Hash + LACP (vDS)

```
11:12:31am up 3:07, 565 worlds, 4 VMs, 5 vCPUs; CPU load average: 0.01, 0.01,
```

PORT-ID	USED-BY	TEAM-PNIC	DNAME	PKTTX/s	MbTX/s
33554433	Management	n/a	vSwitch0	0.00	0.00
33554434	vmnic3	-	vSwitch0	36.21	2.12
33554435	Shadow of vmnic3	n/a	vSwitch0	0.00	0.00
33554436	vmk0	vmnic3	vSwitch0	36.21	2.12
33554438	36042:VMware vCenter	vmnic3	vSwitch0	0.00	0.00
50331649	Management	n/a	DvsPortset-0	0.00	0.00
50331650	vmnic0	-	DvsPortset-0	2.36	0.00
50331651	Shadow of vmnic0	n/a	DvsPortset-0	0.00	0.00
50331659	vmnic2	-	DvsPortset-0	0.98	0.00
50331660	Shadow of vmnic2	n/a	DvsPortset-0	0.00	0.00
50331661	46658:VM-1.eth0	all(2)	DvsPortset-0	1.18	0.00
50331662	46777:VM-2.eth0	all(2)	DvsPortset-0	0.98	0.00
50331663	48692:VM-3.eth0	all(2)	DvsPortset-0	1.18	0.00
50331664	LACP_MgmtPort	n/a	DvsPortset-0	0.00	0.00

Extra LACP\_MgmtPort

```
SV-5K-1# show mac address-table | grep aaa
```

```
* 511      aaaa.cafe.0001      dynamic  0          F    F    Po300
* 511      aaaa.face.0002      dynamic  0          F    F    Po300
* 511      aaaa.feed.0003      dynamic  0          F    F    Po300
```

```
SV-5K-1#
```

```
-----
Group Port-      Type      Protocol  Member Ports
  Channel
300   Po300(SU)  Eth      LACP      Eth101/1/31(P) Eth101/1/32(P)
SV-5K-1#
```



# VMware Switch Dependent

## Route based on IP hash + LACP (vDS) – Switch Configuration

```
interface Ethernet101/1/31-32
  switchport mode trunk
  switchport trunk allowed vlan 511
  spanning-tree port type edge trunk
  channel-group 300 mode active
```

```
interface Port-Channel300
  switchport mode trunk
  switchport trunk allowed vlan 511
```

```
SV-5K-1(config-if)# channel-group 300 mode ?
```

```
active  Set channeling mode to ACTIVE
```

```
on      Set channeling mode to ON
```

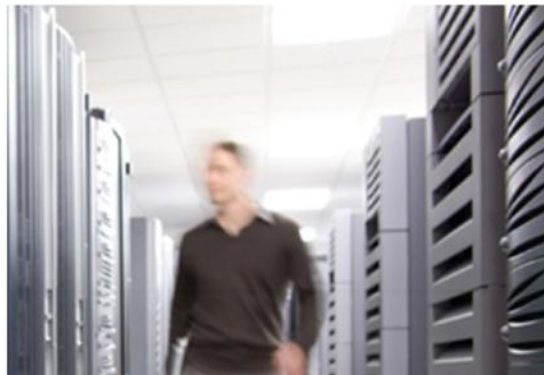
```
passive Set channeling mode to PASSIVE
```

```
SV-5K-1(config-if)# channel-group 300 mode
```

	ESXi	Active	Passive
Switch			
Active		Yes	Yes
Passive		Yes	No

# VMware Conclusion

- vSphere Standard Switch (vSS)
  - Switch independent
    - Route based on originating virtual port
  - Switch dependent
    - Route based on IP hash
  
- vSphere Distributed Switch (vDS)
  - Switch independent
    - Route based on physical NIC load
  - Switch dependent
    - Route based on IP hash + LACP



# Hypervisor Overview

## Microsoft Hyper-V 3.0

### Windows 2012 R2

# Uplink Options

- Single physical NIC or Teaming

NIC Teaming

New team

Team name:  
Po1

Member adapters:

In Team	Adapter	Speed	State	Reason
<input checked="" type="checkbox"/>	Ethernet	1 Gbps		
<input type="checkbox"/>	Ethernet 2	1 Gbps		
<input checked="" type="checkbox"/>	Ethernet 3	1 Gbps		
<input type="checkbox"/>	Ethernet 4	1 Gbps		

Additional properties

Teaming mode: Switch Independent

Load balancing mode: Static Teaming

Standby adapter: LACP

Primary team interface: Po1: Default VLAN

OK Cancel

NIC Teaming

New team

Team name:  
Po1

Member adapters:

In Team	Adapter	Speed	State	Reason
<input checked="" type="checkbox"/>	Ethernet	1 Gbps		
<input type="checkbox"/>	Ethernet 2	1 Gbps		
<input checked="" type="checkbox"/>	Ethernet 3	1 Gbps		
<input type="checkbox"/>	Ethernet 4	1 Gbps		

Additional properties

Teaming mode: Switch Independent

Load balancing mode: Dynamic

Standby adapter: Address Hash

Primary team interface: Dynamic

OK Cancel

# Enabling NIC Teaming

- Pre-Windows 2012 - Teaming provided by vendor device drivers
- Windows 2012 - Native teaming support

The screenshot shows the Windows Server Manager interface for a local server named 'bdsol-cl-hyperv-01'. The 'PROPERTIES' window is open, displaying various system settings. A red arrow points to the 'NIC Teaming' property, which is currently set to 'Disabled'. Other properties shown include Computer name, Workgroup, Windows Firewall, Remote management, Remote Desktop, Ethernet adapters, Windows Error Reporting, Customer Experience Improvement Program, IE Enhanced Security Configuration, Time zone, and Product ID.

Property	Value
Computer name	bdsol-cl-hyperv-01
Workgroup	WORKGROUP
Windows Firewall	Public: On
Remote management	Enabled
Remote Desktop	Enabled
NIC Teaming	Disabled
Ethernet	IPv4 address assigned by DHCP, IPv6 enabled
Ethernet 2	10.48.49.68
Ethernet 3	IPv4 address assigned by DHCP, IPv6 enabled
Ethernet 4	IPv4 address assigned by DHCP, IPv6 enabled
Last installed updates	Never
Windows Update	Not co
Last checked for updates	Never
Windows Error Reporting	Off
Customer Experience Improvement Program	Not pa
IE Enhanced Security Configuration	On
Time zone	(UTC+
Product ID	Not ac

# Microsoft Network Adapter Multiplexor Driver

The screenshot displays three overlapping windows from a Windows Server environment:

- NIC Teaming**: A window showing server status. Under the **TEAMS** section, it lists:
 

Team	Status	Teaming Mode
MLOM	OK	Switch Independent
P81E	OK	Switch Independent
- Network Connections**: A window showing a list of network adapters:
 

Name	Status	Manufacturer
Ethernet	Enabled	Intel(R) 82576 Gigabit Dual Port N...
Ethernet 2	Enabled	Intel(R) 82576 Gigabit Dual Port N...
Ethernet 3	Enabled	Cisco VIC Ethernet Interface
Ethernet 4	Enabled	Cisco VIC Ethernet Interface #2
MLOM	Enabled	Microsoft Network Adapter Multi...
P81E	Enabled	Microsoft Network Adapter Multi...
- P81E Properties**: A dialog box for the selected P81E adapter.
  - Networking** tab is active.
  - Connect using:** Microsoft Network Adapter Multiplexor Driver #2
  - This connection uses the following items:**
    - Client for Microsoft Networks
    - Windows Network Virtualization Filter driver
    - Microsoft Load Balancing/Failover Provider
    - Microsoft MAC Bridge
    - QoS Packet Scheduler
    - File and Printer Sharing for Microsoft Networks
    - Hyper-V Extensible Virtual Switch
  - Description:** Allows your computer to access resources on a Microsoft network.

# Microsoft Network Adapter Multiplexor Driver

The screenshot shows the 'Virtual Switch Manager for BDSOL-CL-H-01' window. The 'Virtual Switches' pane on the left shows a tree view with 'External VLAN49' selected. The 'Virtual Switch Properties' pane on the right is open, showing the following configuration:

- Name:** External VLAN49
- Notes:** (Empty)
- Connection type:** External network (Selected)
- What do you want to connect this virtual switch to?**
  - External network:
    - Microsoft Network Adapter Multiplexor Driver (Selected)
    - Cisco VIC Ethernet Interface
    - Cisco VIC Ethernet Interface #2
    - Intel(R) 82576 Gigabit Dual Port Network Connection
    - Intel(R) 82576 Gigabit Dual Port Network Connection #2
    - Microsoft Network Adapter Multiplexor Driver
    - Microsoft Network Adapter Multiplexor Driver #2
    - Private network
  - Private network
- VLAN ID:**
  - Enable virtual LAN identification for management operating system
  - The VLAN identifier specifies the virtual LAN that the management operating system will use for all network communications through this network adapter. This setting does not affect virtual machine networking.
  - VLAN ID: 2
  - Remove

At the bottom of the window, there is an information icon and the text: "SR-IOV can only be configured when the virtual switch is created. An external virtual switch with SR-IOV enabled cannot be converted to an internal or private switch." Buttons for 'OK', 'Cancel', and 'Apply' are at the bottom right.

On the left side of the screenshot, a 'NIC Teaming' window is partially visible, showing a list of servers and teams. The 'SERVERS' section shows 'BDSOL-CL-H-01' selected. The 'TEAMS' section shows 'MLOM' and 'P81E' with 'OK' status and 'Switch Indepe' (likely Independent) status.

On the right side, a 'Properties' dialog box is partially visible, showing 'Multiplexor Driver #2' and a 'Configure...' button.

# Standby Adapter

NIC Teaming

Team properties

Team name: MLOM

Member adapters:

In Team	Adapter	Speed	State	Reason
<input checked="" type="checkbox"/>	Ethernet 1	1 Gbps	Standby	
<input checked="" type="checkbox"/>	Ethernet 2	1 Gbps	Active	
<input type="checkbox"/>	Ethernet 3	Disabled		
<input type="checkbox"/>	Ethernet 4	10 Gbps		

Additional properties

Teaming mode: Switch Independent

Load balancing mode: Address Hash

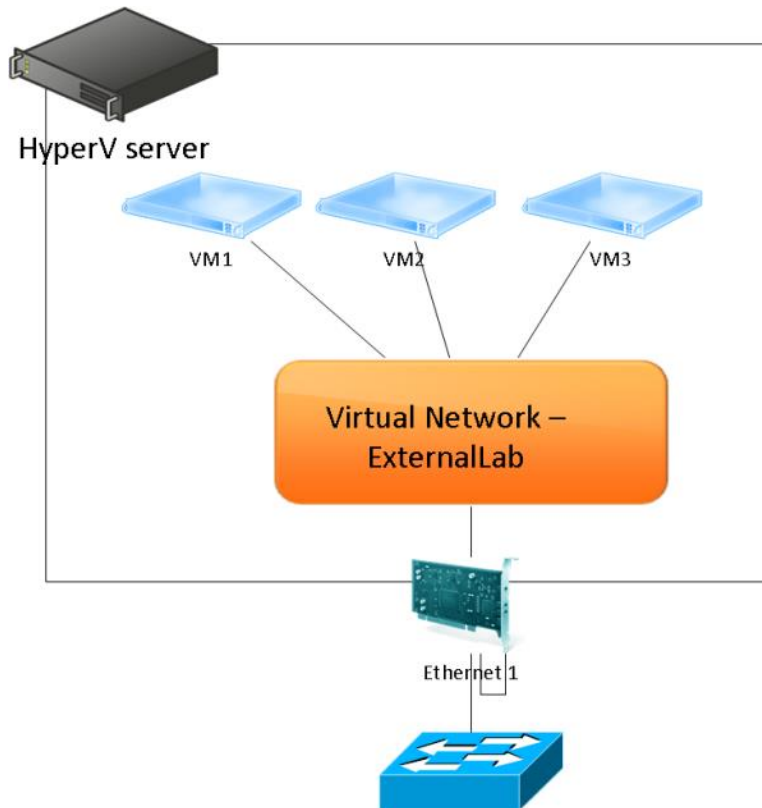
Standby adapter: Ethernet

OK Cancel Apply

```
SV-5K-1# show int e101/1/31-32 | grep "is up"
Ethernet101/1/31 is up
Ethernet101/1/32 is up
SV-5K-1# show mac address-table | grep aaa
* 511      aaa.cafe.0001    dynamic  10      F      F      Eth101/1/31
* 511      aaa.face.0002    dynamic  10      F      F      Eth101/1/31
* 511      aaa.feed.0003    dynamic  10      F      F      Eth101/1/31
SV-5K-1# show mac address-table interface e101/1/32
SV-5K-1#
```

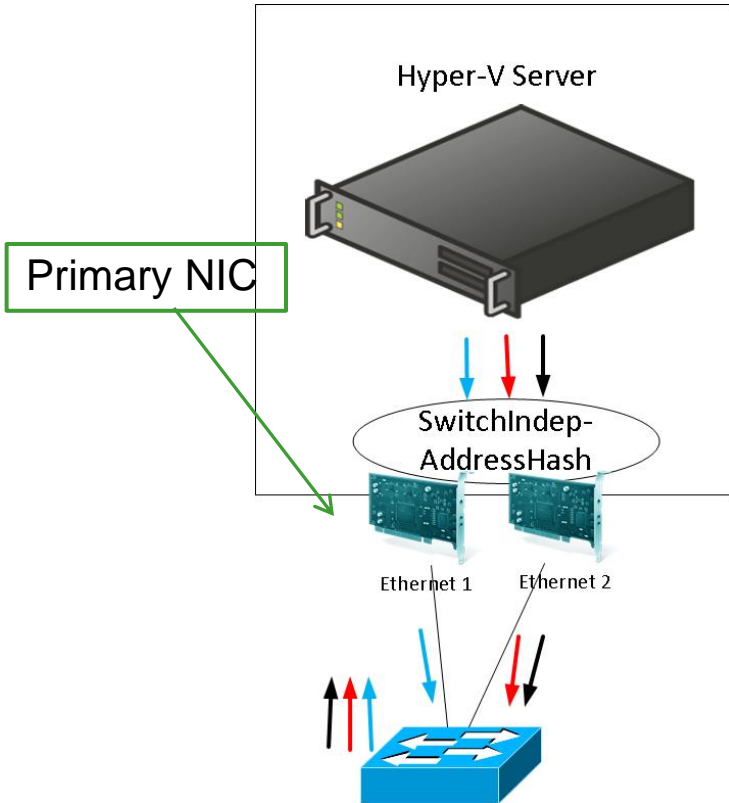
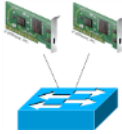


# Single Physical NIC



- Normal server connection
- Access or trunk interface
- Multiple MACs on switch port

# Switch Independent – Address Hash



- MAC/IP/Port hash for outbound traffic
- Outbound frame uses src MAC of egress NIC
- ARP replies contain MAC of primary NIC
- Primary NIC receives inbound traffic
- Can go to single or multiple switches

# Switch Independent – Address Hash

NIC Teaming

Team properties

Team name: SwitchIndependent-AddressHash

Member adapters:

In Team	Adapter	Speed	State	Reason
<input checked="" type="checkbox"/>	Ethernet	1 Gbps	Active	
<input checked="" type="checkbox"/>	Ethernet 2	1 Gbps	Active	
<input type="checkbox"/>	vEthernet (Hyper-V Switch 1)	10 Gbps		

Additional properties

Teaming mode: Switch Independent

Load balancing mode: Address Hash

Standby adapter: None (all adapters Active)

OK Cancel Apply

```
SV-5K-2# show mac address-table vlan 511 | egrep Eth101/1/31|Eth101/1/32
* 511 503d.e59d.32ed dynamic 10 F F Eth101/1/31
* 511 503d.e59d.32ef dynamic 10 F F Eth101/1/32
SV-5K-2#
```

```
Ethernet adapter SwitchIndependent-AddressHash:
Connection-specific DNS Suffix . : 
Description . . . . . : Microsoft Network Adapter
Physical Address. . . . . : 50-3D-E5-9D-32-ED
DHCP Enabled. . . . . : No
Autoconfiguration Enabled . . . . . : Yes
IPv4 Address. . . . . : 10.67.87.158(Preferred)
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 10.67.87.1
DNS Servers . . . . . : 64.104.123.245
NetBIOS over Tcpi . . . . . : Enabled
```

# Switch Independent – Address Hash

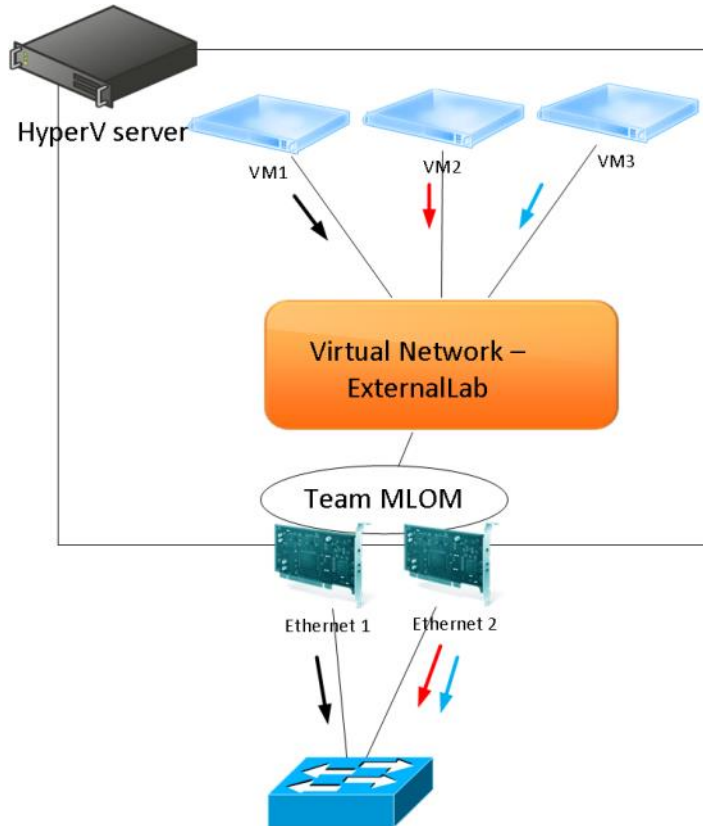
hyperv-si-addresshash.pcapng [Wireshark 1.10.4 (SVN Rev 54184 from /trunk-1.10)]

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

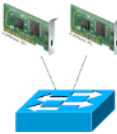
Filter: `ip.addr==10.67.87.158` Expression... Clear Apply Save

Source	src mac	Destination	dst mac	Protocol
10.67.87.158	Cisco_9d:32:ef	10.67.87.150	Vmware_a4:65:c9	TCP
10.67.87.158	Cisco_9d:32:ef	10.67.87.150	Vmware_a4:65:c9	TCP
10.67.87.158	Cisco_9d:32:ef	10.67.87.150	Vmware_a4:65:c9	TCP
10.67.87.158	Cisco_9d:32:ef	10.67.87.150	Vmware_a4:65:c9	TCP
10.67.87.150	Vmware_a4:65:c9	10.67.87.158	Cisco_9d:32:ed	TCP
10.67.87.158	Cisco_9d:32:ef	10.67.87.150	Vmware_a4:65:c9	TCP
10.67.87.158	Cisco_9d:32:ef	10.67.87.150	Vmware_a4:65:c9	TCP
10.67.87.158	Cisco_9d:32:ef	10.67.87.150	Vmware_a4:65:c9	TCP
10.67.87.158	Cisco_9d:32:ef	10.67.87.150	Vmware_a4:65:c9	TCP
10.67.87.158	Cisco_9d:32:ef	10.67.87.150	Vmware_a4:65:c9	TCP

# Switch Independent - Hyper-V Port



- vNICs are pinned to single team member
- vNICs pinned in round robin
- Can go to single or multiple switches



# Switch Independent - Hyper-V Port

NIC Teaming

Team properties

Team name:  
MLOM

Member adapters:

In Team	Adapter	Speed	State	Reason
<input checked="" type="checkbox"/>	Ethernet 1	1 Gbps	Active	
<input checked="" type="checkbox"/>	Ethernet 2	1 Gbps	Active	
<input type="checkbox"/>	Ethernet 3	Disabled		
<input type="checkbox"/>	Ethernet 4	10 Gbps		

^ Additional properties

Teaming mode: Switch Independent

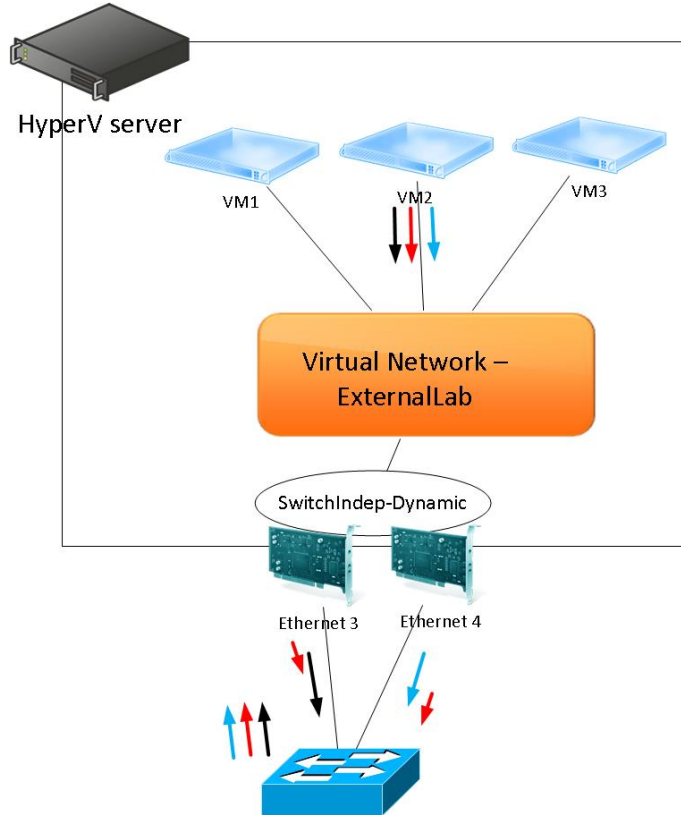
Load balancing mode: Hyper-V Port

Standby adapter: None (all adapters Active)

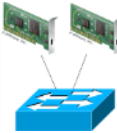
OK Cancel Apply

```
SV-5K-1# show mac address-table | grep aaa
* 511      aaaa.cafe.0001   dynamic  0          F    F    Eth101/1/31
* 511      aaaa.face.0002   dynamic  0          F    F    Eth101/1/31
* 511      aaaa.feed.0003   dynamic  0          F    F    Eth101/1/32
SV-5K-1#
```

# Switch Independent - Dynamic



- Outbound flows redistributed to optimise pNIC bandwidth utilisation
- Algorithm can move flows between pNICs w/o packet reordering (flowlets)
- Inbound traffic works like Hyper-V Port mode
- Can go to single or multiple switches



# Switch Independent - Dynamic

NIC Teaming

Team properties

Team name: SwitchIndependentDynamic

Member adapters:

In Team	Adapter	Speed	State	Reason
<input checked="" type="checkbox"/>	Ethernet 3	1 Gbps	Active	
<input checked="" type="checkbox"/>	Ethernet 4	1 Gbps	Active	
<input type="checkbox"/>	vEthernet (Hyper-V Switch 1)	10 Gbps		

Additional properties

Teaming mode: Switch Independent

Load balancing mode: Dynamic

Standby adapter: None (all adapters Active)

OK Cancel Apply

```
SV-5K-1# show mac address-table | egrep Eth101/1/31|Eth101/1/32
* 511      503d.e59d.32ec    dynamic 180      F   F   Eth101/1/31
* 511      503d.e59d.32ee    dynamic 10       F   F   Eth101/1/32
* 511      aaaa.cafe.0001    dynamic 0        F   F   Eth101/1/31
* 511      aaaa.face.0002    dynamic 0        F   F   Eth101/1/31
* 511      aaaa.feed.0003    dynamic 0        F   F   Eth101/1/32
SV-5K-1#
```

```
[240] 5.0- 6.0 sec 5.59 MBytes 46.9 Mbites/sec
[232] 5.0- 6.0 sec 4.06 MBytes 34.1 Mbites/sec
[224] 5.0- 6.0 sec 32.8 MBytes 275 Mbites/sec
[216] 5.0- 6.0 sec 34.8 MBytes 292 Mbites/sec
[208] 5.0- 6.0 sec 10.7 MBytes 89.6 Mbites/sec
[200] 5.0- 6.0 sec 86.9 MBytes 729 Mbites/sec
[192] 5.0- 6.0 sec 36.0 MBytes 302 Mbites/sec
[248] 5.0- 6.0 sec 6.41 MBytes 53.7 Mbites/sec
SUM 5.0- 6.0 sec 217 MBytes 1.82 Gbites/sec
```



# Switch Independent - Dynamic

hv-si-dynamic.pcap [Wireshark 1.10.4 (SVN Rev 54184 from /trunk-1.10)]

File Edit View Go Capture Analyze Statistics Telephony Tools Internals Help

Filter:  Expression... Clear Apply Save

Source	src mac	Destination	dst mac	Protocol	Info
10.67.87.153	Cisco_9d:32:ee	10.67.87.150	Vmware_a4:65:c9	TCP	49314 > compl
10.67.87.153	Cisco_9d:32:ee	10.67.87.150	Vmware_a4:65:c9	TCP	49314 > compl
10.67.87.153	Cisco_9d:32:ee	10.67.87.150	Vmware_a4:65:c9	TCP	49314 > compl
10.67.87.153	Cisco_9d:32:ee	10.67.87.150	Vmware_a4:65:c9	TCP	49314 > compl
10.67.87.153	aa:aa:fa:ce:00:02	10.67.87.150	Vmware_a4:65:c9	TCP	49313 > compl
10.67.87.153	aa:aa:fa:ce:00:02	10.67.87.150	Vmware_a4:65:c9	TCP	49313 > compl
10.67.87.153	aa:aa:fa:ce:00:02	10.67.87.150	Vmware_a4:65:c9	TCP	49313 > compl
10.67.87.153	aa:aa:fa:ce:00:02	10.67.87.150	Vmware_a4:65:c9	TCP	49313 > compl
10.67.87.153	aa:aa:fa:ce:00:02	10.67.87.150	Vmware_a4:65:c9	TCP	49313 > compl
10.67.87.153	aa:aa:fa:ce:00:02	10.67.87.150	Vmware_a4:65:c9	TCP	49313 > compl
10.67.87.153	aa:aa:fa:ce:00:02	10.67.87.150	Vmware_a4:65:c9	TCP	49313 > compl
10.67.87.153	aa:aa:fa:ce:00:02	10.67.87.150	Vmware_a4:65:c9	TCP	49313 > compl
10.67.87.153	aa:aa:fa:ce:00:02	10.67.87.150	Vmware_a4:65:c9	TCP	49313 > compl
10.67.87.153	aa:aa:fa:ce:00:02	10.67.87.150	Vmware_a4:65:c9	TCP	49313 > compl
10.67.87.150	Vmware_a4:65:c9	10.67.87.153	aa:aa:fa:ce:00:02	TCP	complex-link
10.67.87.150	Vmware_a4:65:c9	10.67.87.153	aa:aa:fa:ce:00:02	TCP	complex-link
10.67.87.153	Cisco_9d:32:ee	10.67.87.150	Vmware_a4:65:c9	TCP	49314 > compl
10.67.87.153	Cisco_9d:32:ee	10.67.87.150	Vmware_a4:65:c9	TCP	49314 > compl
10.67.87.153	Cisco_9d:32:ee	10.67.87.150	Vmware_a4:65:c9	TCP	49314 > compl
10.67.87.153	Cisco_9d:32:ee	10.67.87.150	Vmware_a4:65:c9	TCP	49314 > compl

# Microsoft Switch Independent

## Switch Configuration



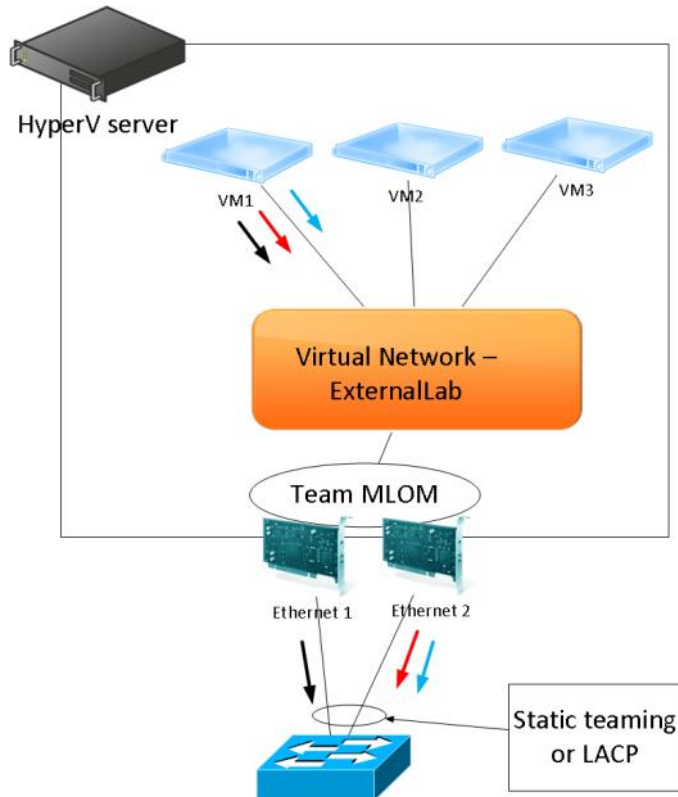
For Your  
Reference

```
interface Ethernet101/1/31-32
  switchport mode trunk
  switchport trunk allowed vlan 511
  spanning-tree port type edge trunk
```

Used for:

- **Teaming mode:** Switch Independent
- **Load balancing modes:**
  - Address Hash
  - Hyper-V Port
  - Dynamic

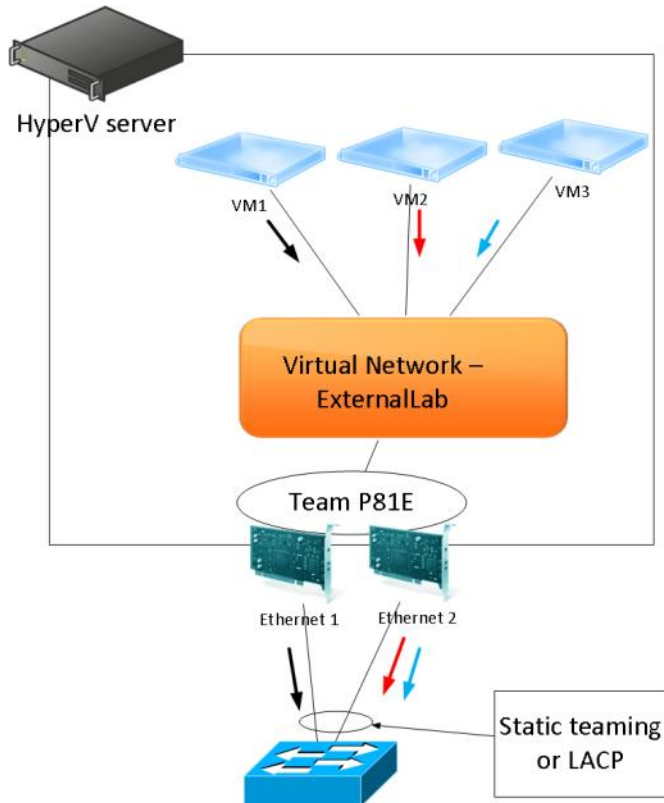
# Switch Dependent – Address Hash



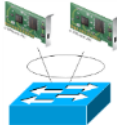
- Outbound traffic spread across all active members based on hash
- Inbound traffic distributed by switch load-balancing algorithm
- Team connects to single port-channel



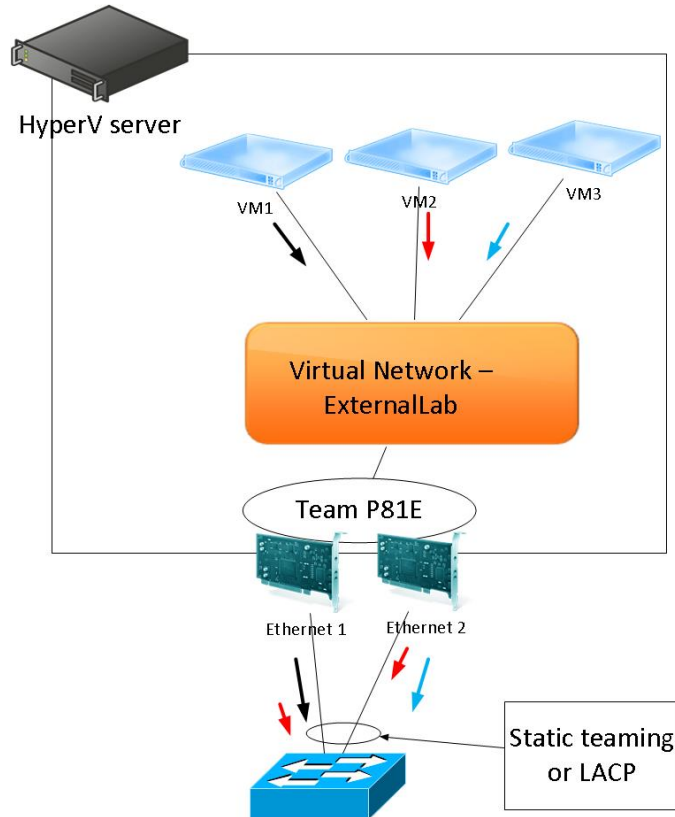
# Switch Dependent - Hyper-V Port



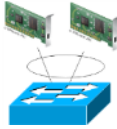
- vNICs are pinned to single team member
- vNICs pinned in round robin
- Inbound traffic distributed by switch load-balancing algorithm
- Team connects to single port-channel



# Switch Dependent - Dynamic



- Outbound flows redistributed to optimise pNIC bandwidth utilisation
- Algorithm can move flows between pNICs w/o packet reordering (flowlets)
- Inbound traffic distributed by switch load-balancing algorithm



# Switch Dependent

Load Balancing Mode: Address Hash, Hyper-V Port and Dynamic

NIC Teaming

Team properties

Team name: Team 1

Member adapters:

In Team	Adapter	Speed	State	Reason
<input type="checkbox"/>	Ethernet	1 Gbps		
<input type="checkbox"/>	Ethernet 2	1 Gbps		
<input checked="" type="checkbox"/>	Ethernet 3	1 Gbps	Active	
<input checked="" type="checkbox"/>	Ethernet 4	1 Gbps	Active	
<input type="checkbox"/>	vEthernet (Hyper-V Switch 1)	10 Gbps		

Additional properties

Teaming mode: Static Teaming

Load balancing mode: Hyper-V Port

Standby adapter: Hyper-V Port

OK Cancel Apply

NIC Teaming

Team properties

Team name: Team 1

Member adapters:

In Team	Adapter	Speed	State	Reason
<input type="checkbox"/>	Ethernet	1 Gbps		
<input type="checkbox"/>	Ethernet 2	1 Gbps		
<input checked="" type="checkbox"/>	Ethernet 3	1 Gbps	Active	
<input checked="" type="checkbox"/>	Ethernet 4	1 Gbps	Active	
<input type="checkbox"/>	vEthernet (Hyper-V Switch 1)	10 Gbps		

Additional properties

Teaming mode: LACP

Load balancing mode: Hyper-V Port

Standby adapter: Hyper-V Port

OK Cancel Apply

# Switch Dependent

Load Balancing Mode: Address Hash, Hyper-V Port and Dynamic

NIC Teaming

Team properties

Team name: Team 1

Member adapters:

In Team	Adapter	Speed	State	Reason
<input type="checkbox"/>	Ethernet	1 Gbps		
<input type="checkbox"/>	Ethernet 2	1 Gbps		
<input checked="" type="checkbox"/>	Ethernet 3	1 Gbps	Active	
<input checked="" type="checkbox"/>	Ethernet 4	1 Gbps	Active	
<input type="checkbox"/>	vEthernet (Hyper-V Switch 1)	10 Gbps		

Additional properties

Teaming mode: Static Teaming

Load balancing mode: Hyper-V Port

Standby adapter:

Address Hash
Hyper-V Port
Dynamic

OK Cancel Apply

NIC Teaming

Team properties

Team name: Team 1

Member adapters:

In Team	Adapter	Speed	State	Reason
<input type="checkbox"/>	Ethernet	1 Gbps		
<input type="checkbox"/>	Ethernet 2	1 Gbps		
<input checked="" type="checkbox"/>	Ethernet 3	1 Gbps	Active	
<input checked="" type="checkbox"/>	Ethernet 4	1 Gbps	Active	

Standby adapter:

Address Hash
Hyper-V Port
Dynamic

OK Cancel Apply

```
SV-5K-1# show mac address-table | grep aaa
* 511      aaaa.cafe.0001    dynamic    0         F        F        Po300
* 511      aaaa.face.0002   dynamic    0         F        F        Po300
* 511      aaaa.feed.0003   dynamic    0         F        F        Po300
SV-5K-1#
```

# Microsoft Switch Dependent

## Teaming Mode: Static Teaming – Switch Configuration

```
interface Ethernet101/1/31-32
  switchport mode trunk
  switchport trunk allowed vlan 511
  spanning-tree port type edge trunk
  channel-group 300
```

```
interface Port-Channel300
  switchport mode trunk
  switchport trunk allowed vlan 511
```

```
SV-5K-1(config-if)# channel-group 300 mode ?
  active   Set channeling mode to ACTIVE
  on       Set channeling mode to ON
  passive  Set channeling mode to PASSIVE
```

```
SV-5K-1(config-if)# channel-group 300 mode
```

- Used with all Load Balancing modes



# Microsoft Switch Dependent

## Teaming Mode: LACP – Switch Configuration

```
interface Ethernet101/1/31-32
  switchport mode trunk
  switchport trunk allowed vlan 511
  spanning-tree port type edge trunk
  channel-group 300 mode active
```

```
interface Port-Channel300
  switchport mode trunk
  switchport trunk allowed vlan 511
```

```
SV-5K-1(config-if)# channel-group 300 mode ?
```

```
active Set channeling mode to ACTIVE
```

```
on Set channeling mode to ON
```

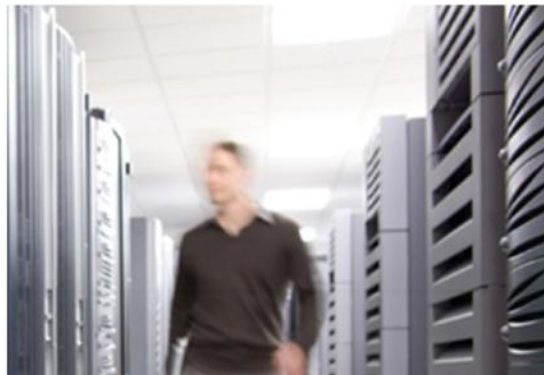
```
passive Set channeling mode to PASSIVE
```

```
SV-5K-1(config-if)# channel-group 300 mode
```

- Used with all Load Balancing modes

# Hyper-V Conclusion

- Switch independent
  - Switch Independent – Dynamic
- Switch dependent
  - Switch Dependent - Dynamic



# Hypervisor Overview

## Citrix XenServer 6.2

# Uplink Options

Single physical NIC or Bonding  
LACP as of XenServer 6.1

Select members for the new bonded network

Select the NICs you would like to use in this bond and the bond settings, and confirm whether this network should be added to new VMs.

NIC	MAC	Link Status	Speed	Duplex	Vendor	Device
<input checked="" type="checkbox"/> NIC 0	70:ca:9b:ce:ef:02	Connected	1000 Mbit/s	Full	Intel Corporation	82576 Gigabit Ne
<input type="checkbox"/> NIC 1	70:ca:9b:ce:ef:03	Connected	1000 Mbit/s	Full	Intel Corporation	82576 Gigabit Ne
<input type="checkbox"/> NIC 2	fc:f7:55:ab:31:24	Connected	10000 Mbit/s	Full	Cisco Systems Inc	VIC Ethernet NIC
<input type="checkbox"/> NIC 3	fc:f7:55:ab:31:25	Connected	10000 Mbit/s	Full	Cisco Systems Inc	VIC Ethernet NIC

Bond mode

- Active-active
- Active-passive
- LACP with load balancing based on IP and port of source and destination
- LACP with load balancing based on source MAC address

MTU: 1500

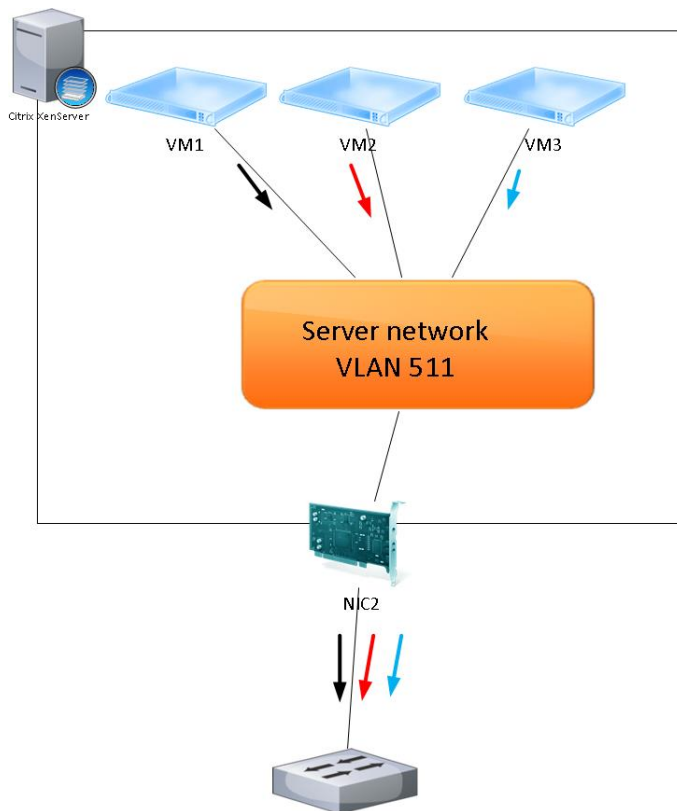
Automatically add this network to new virtual machines

< Previous Finish Cancel

Switch Independent

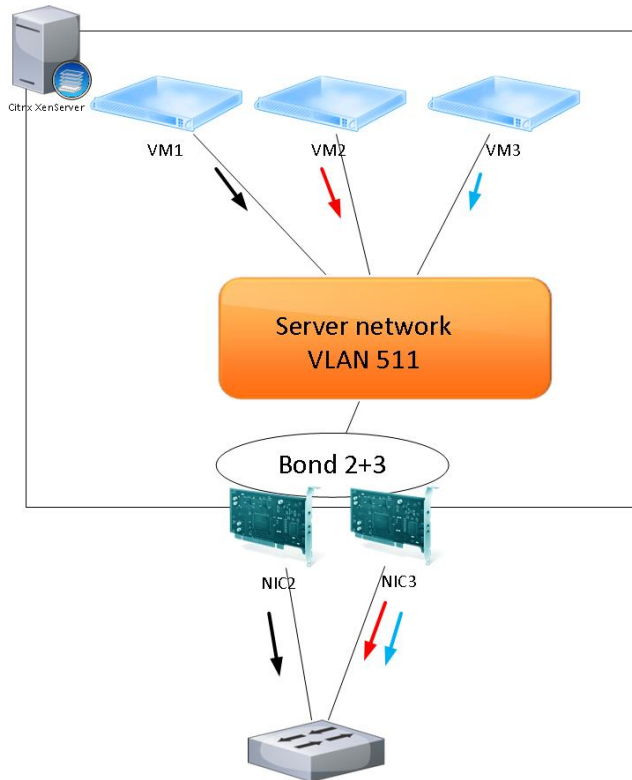
Switch Dependent

# Single Physical NIC

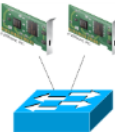


- Normal server connection
- Access or trunk
- Multiple MACs on one switch port

# Active-Active



- Balance-SLB - Server Load Balancing
- vNIC pinned to single pNIC
- vNIC pinning recalculated every 10s based on pNIC load
- MAC moves
- Can go to single or multiple switches



# Active-Active

**Bond 0+1 Properties**

General  
Bond 0+1

Custom Fields  
<None>

Network Settings  
Physical device

**Network Settings**

Use the controls below to configure advanced settings for your network. If your changes will result in temporary disruption of the network you will be informed below.

Bond mode

- Active-active
- Active-passive
- LACP with load balancing based on IP and port of source and destination
- LACP with load balancing based on source MAC address

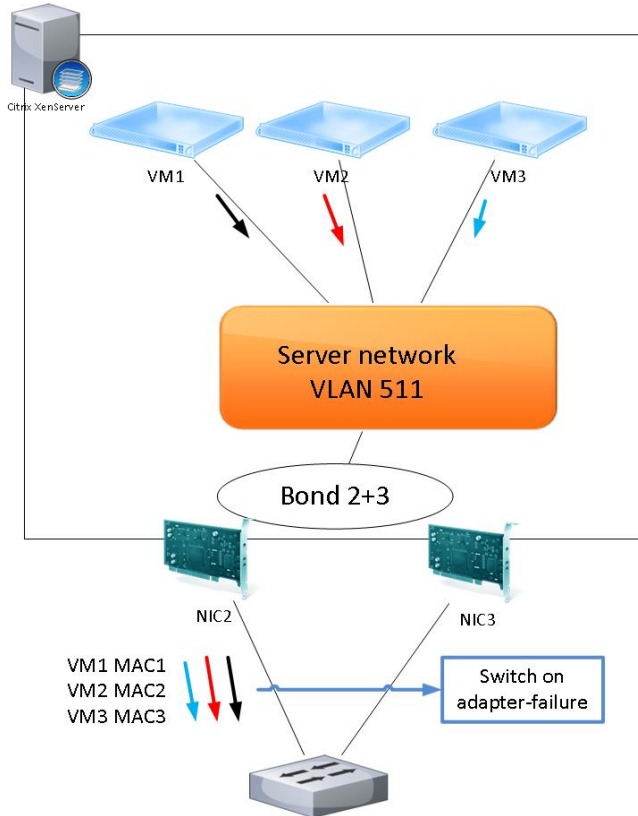
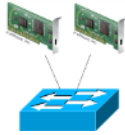
MTU: 1500

Automatically add this network to new virtual machines.

(The network's MTU cannot be changed as there are active VMs attached without tools installed)

```
SV-5K-1# show mac address-table | grep aaaa
* 511      aaaa.cafe.0001   dynamic 10      F   F   Eth101/1/31
* 511      aaaa.face.0002   dynamic 20      F   F   Eth101/1/32
* 511      aaaa.feed.0003   dynamic 0       F   F   Eth101/1/31
SV-5K-1#
```

# Active-Passive



- Single pNIC is active, all other pNICs are standby
- Can go to single or multiple switches



# Active-Passive

'Bond 0+1' Properties

General  
Bond 0+1

Custom Fields  
<None>

Network Settings  
Physical device

### Network Settings

Use the controls below to configure advanced settings for your network. If your changes will result in temporary disruption of the network you will be informed below.

Bond mode

- Active-active
- Active-passive
- LACP with load balancing based on IP and port of source and destination
- LACP with load balancing based on source MAC address

MTU: 1500

Automatically add this network to new virtual machines.

(The network's MTU cannot be changed as there are active VMs attached without tools installed)

```
SV-5K-1# show mac address-table | grep aaaa
* 511      aaaa.cafe.0001   dynamic  10      F      F      Eth101/1/32
* 511      aaaa.face.0002   dynamic  10      F      F      Eth101/1/32
* 511      aaaa.feed.0003   dynamic  10      F      F      Eth101/1/32
SV-5K-1# show int e101/1/31-32 | grep 101/1/3
Ethernet101/1/31 is up
Ethernet101/1/32 is up
SV-5K-1#
```

# Citrix Switch Independent

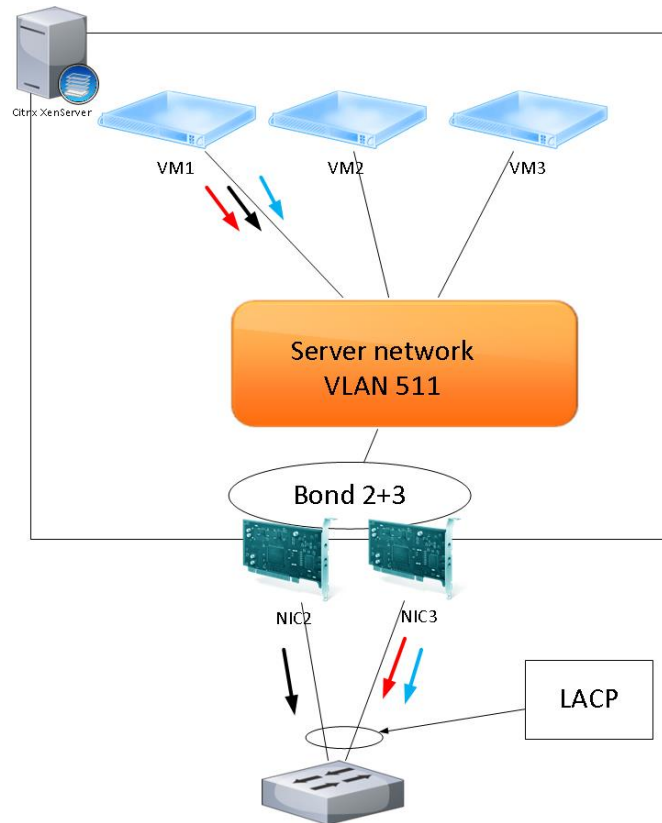
## Active/Active & Active/Passive – Switch Configuration



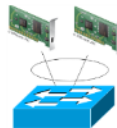
For Your  
Reference

```
interface Ethernet101/1/31-32
  switchport mode trunk
  switchport trunk allowed vlan 511
  spanning-tree port type edge trunk
```

# LACP w/ Load Balancing Based on IP & Port of SRC & DST



- Outgoing traffic will be hashed over multiple uplinks based on src/dst IP and port
- Inbound traffic distributed by switch load balancing algorithm
- Connect to single port-channel



# LACP w/ Load Balancing Based on IP & Port of SRC & DST

'Bond 0+1' Properties

General  
Bond 0+1

Custom Fields  
<None>

Network Settings  
Physical device

Network Settings

Use the controls below to configure advanced settings for your network. If your changes will result in temporary disruption of the network you will be informed below.

Bond mode

Active-active  
 Active-passive  
 LACP with load balancing based on IP and port of source and destination  
 LACP with load balancing based on source MAC address

⚠ LACP must also be configured on the switch ports

MTU: 1500

SV-5K-1# show mac address-table | grep aaa

```
* 511      aaa.cafe.0001    dynamic 0          F    F    Po301
* 511      aaa.face.0002   dynamic 0          F    F    Po301
* 511      aaa.feed.0003   dynamic 0          F    F    Po301
```

SV-5K-1#

Group	Port-Channel	Type	Protocol	Member Ports
301	Po301(SU)	Eth	LACP	Eth101/1/31(P) Eth101/1/32(P)

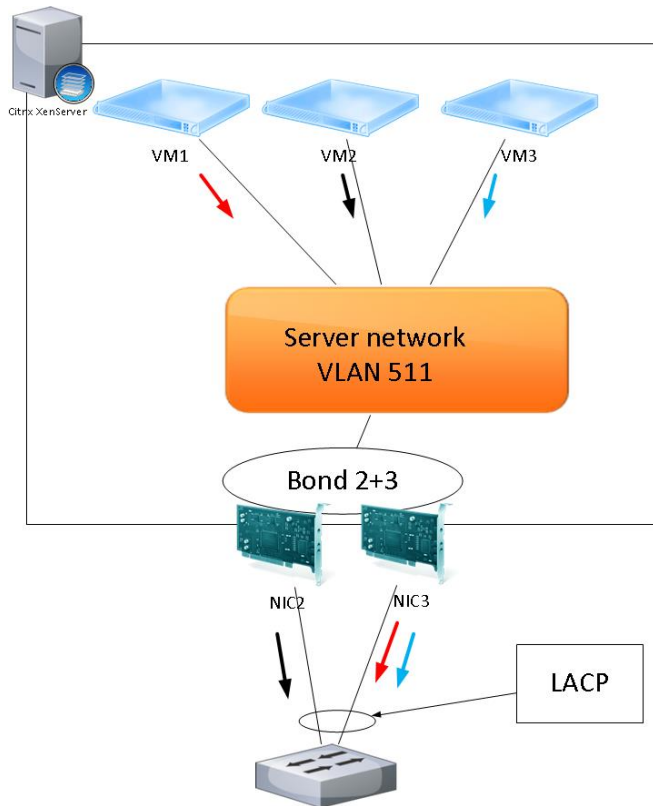
SV-5K-1#

```
[root@enserver-1 ~]# ovs-appctl bond/show bond0
bond_mode: balance-tcp
bond-hash-algorithm: balance-tcp
bond-hash-basis: 0
updelay: 31000 ms
downdelay: 200 ms
next rebalance: 1382936 ms
lACP_negotiated: true
```

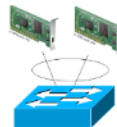
```
slave eth0: enabled
  active slave
  may_enable: true
  hash 30: 37 kB load
  hash 70: 38 kB load
  hash 72: 0 kB load
  hash 93: 0 kB load
  hash 131: 1 kB load
  hash 139: 0 kB load
  hash 212: 0 kB load
  hash 220: 0 kB load
  hash 222: 0 kB load
  hash 250: 0 kB load
```

```
slave eth2: enabled
  may_enable: true
  hash 55: 0 kB load
  hash 69: 37 kB load
  hash 83: 0 kB load
  hash 142: 0 kB load
[root@enserver-1 ~]#
```

# LACP w/ Load Balancing Based on SRC MAC Address



- vNIC is pinned to pNIC base on src MAC address hash
- Connect to single port-channel



# LACP w/ Load Balancing Based on SRC MAC Address

**Bond 0+1 Properties**

General  
Bond 0+1

Custom Fields  
<None>

Network Settings  
Physical device

**Network Settings**

Use the controls below to configure advanced settings for your network. If your changes will result in temporary disruption of the network you will be informed below.

Bond mode

- Active-active
- Active-passive
- LACP with load balancing based on IP and port of source and destination
- LACP with load balancing based on source MAC address

⚠ LACP must also be configured on the switch ports

MTU: 1500

Automatically add this network to new virtual machines

OK Cancel

SV-5K-1# **show mac address-table | grep aaa**

```
* 511      aaaa.cafe.0001    dynamic  0          F    F    Po301
* 511      aaaa.face.0002    dynamic  0          F    F    Po301
* 511      aaaa.feed.0003    dynamic  0          F    F    Po301
```

SV-5K-1#

Group	Port-Channel	Type	Protocol	Member Ports
301	Po301(SU)	Eth	LACP	Eth101/1/31(P) Eth101/1/32(P)

SV-5K-1#

```
[root@xenserver-1 ~]# ovs-appctl bond/show bond0
bond_mode: balance-slb
bond-hash-algorithm: balance-slb
bond-hash-basis: 0
updelay: 31000 ms
downdelay: 200 ms
next_rebalance: 1764448 ms
lACP_negotiated: true
```

```
slave eth0: enabled
  active slave
  may_enable: true
  hash 93: 3 kB load
  hash 115: 3 kB load
  hash 150: 3 kB load
```

```
slave eth2: enabled
  may_enable: true
[root@xenserver-1 ~]#
```

# Citrix Switch Dependent

## LACP Bonds – Switch Configuration

```
interface Ethernet101/1/31-32
  switchport mode trunk
  switchport trunk allowed vlan 511
  spanning-tree port type edge trunk
  channel-group 300 mode active
```

```
interface Port-Channel300
  switchport mode trunk
  switchport trunk allowed vlan 511
```

```
SV-5K-1(config-if)# channel-group 300 mode ?
  active   Set channeling mode to ACTIVE
  on       Set channeling mode to ON
  passive  Set channeling mode to PASSIVE
```

```
SV-5K-1(config-if)# channel-group 300 mode
```

# XenServer Conclusion

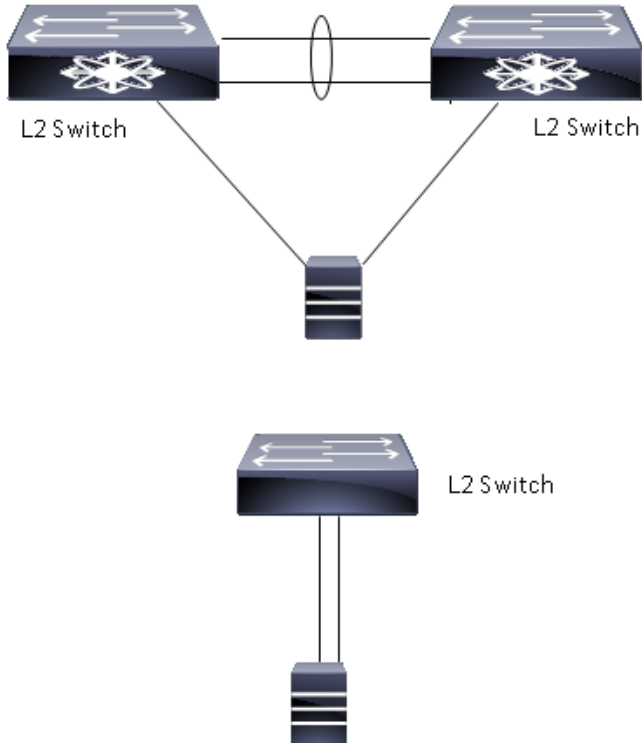
- Switch independent
  - Active-Active
- Switch dependent
  - LACP with load balancing based on source MAC address





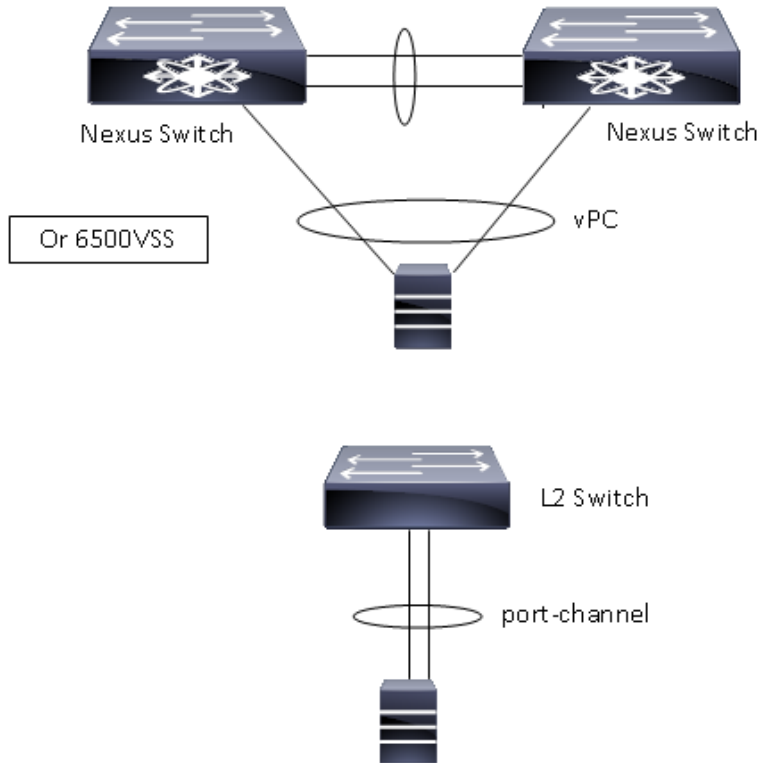
# Topology Overview

# Switch Independent



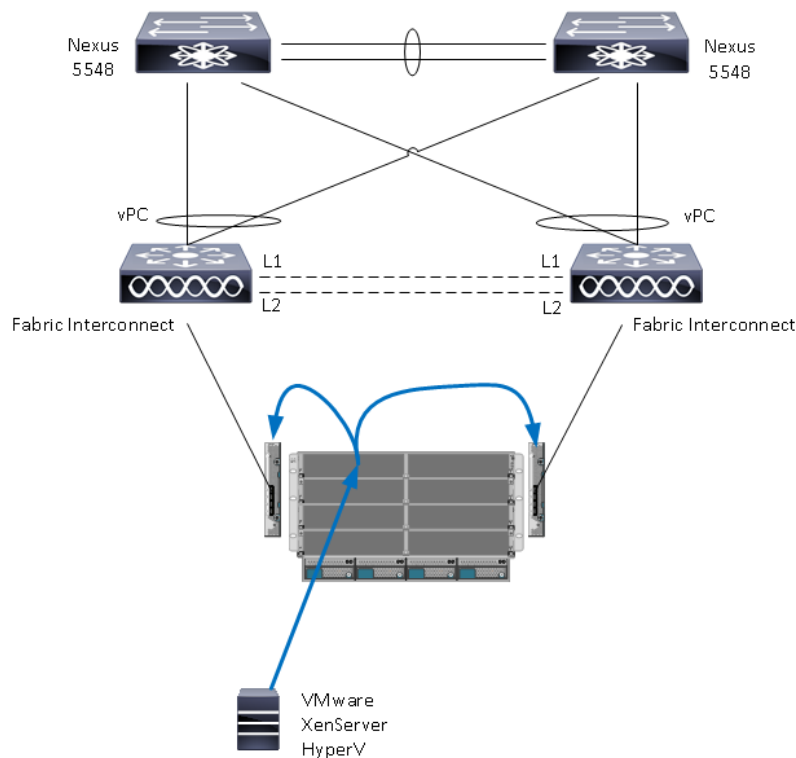
- VMware
  - Route based on originating virtual port
  - Route based on source MAC hash
  - Route based on physical NIC load (vDS)
  - Use explicit failover order
- Hyper-V
  - Switch Independent - Address hash
  - Switch Independent - Hyper-V Port mode
  - Switch Independent - Dynamic
- XenServer
  - Active-active
  - Active-passive

# Switch Dependent



- VMware
  - Route based on IP hash
  - Route based on IP hash + LACP (vDS)
- Hyper-V
  - Switch Dependent - All Address hash modes
  - Switch Dependent - Hyper-V Port mode
  - Switch Dependent - Dynamic
- XenServer
  - LACP with load balancing based on IP and port of source and destination
  - LACP with load balancing based on source MAC address

# Cisco UCS-B – Switch Independent

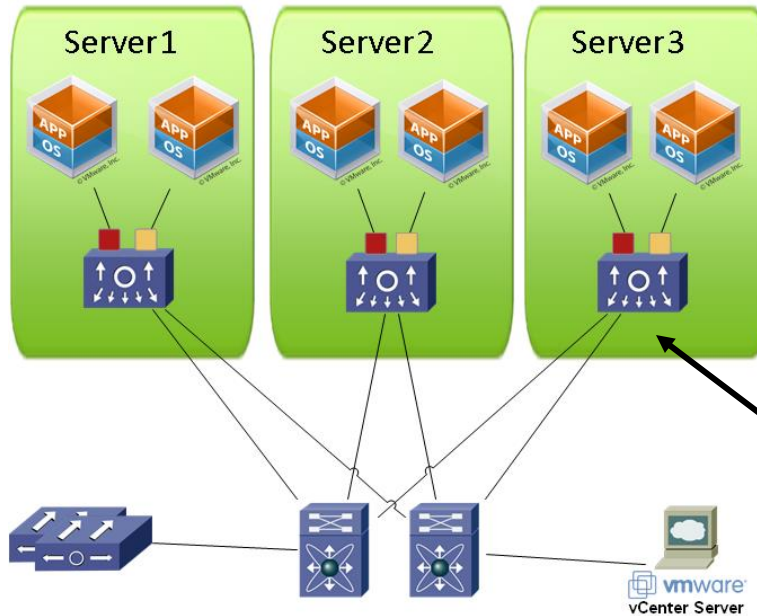


- Each Fabric Interconnect has a port-channel towards the Nexus 5000 vPC pair
- Fabric Interconnects are connected for control-plane clustering only - no data-plane traffic is exchanged
- The hypervisor running on a blade has 2 independent connections - no switch dependent protocols can be used



## Nexus 1000V

# Nexus 1000V



## Virtual Supervisor Module(VSM)

- CLI interface into the Nexus 1000V
- Leverages NX-OS
- Controls multiple VEMs as a single network device

## Virtual Ethernet Module(VEM)

- Replaces VMware's virtual switch
- Enables advanced switching capability on the hypervisor
- Provides each VM with dedicated "switch ports"

# Load Balance Options

```
Nexus1000v(config)# port-channel load-balance ethernet ?
dest-ip-port          Destination IP address and L4 port
dest-ip-port-vlan    Destination IP address, L4 port and VLAN
destination-ip-vlan  Destination IP address and VLAN
destination-mac       Destination MAC address
destination-port      Destination L4 port
source-dest-ip-port   Source & Destination IP address and L4 port
source-dest-ip-port-vlan Source & Destination IP address, L4 port and VLAN
source-dest-ip-vlan  Source & Destination IP address and VLAN
source-dest-mac      Source & Destination MAC address
source-dest-port     Source & Destination L4 port
source-ip-port        Source IP address and L4 port
source-ip-port-vlan  Source IP address, L4 port and VLAN
source-ip-vlan        Source IP address and VLAN
source-mac            Source MAC address
source-port           Source L4 port
source-virtual-port-id Source Virtual Port Id
vlan-only             VLAN only
```

```
Nexus1000v(config)#
```

# Nexus 1000V

- Multi hypervisor switch (VMware, Hyper-V\* and KVM\*)
- Layer 2 switching: VLANs, private VLANs, VXLAN, loop prevention, multicast, virtual PortChannels, LACP, ACLs
- Network management: SPAN, ERSPAN, Netflow 9, vTracker, vCenter Server Plug-in
- Enhanced QOS features
- Cisco vPath
- Security: DHCP Snooping, IP Source Guard, Dynamic ARP inspection, Cisco TrustSec SGA support
- Cisco Virtual Security Gateway
- Other virtual services (Cisco ASA 1000V, Cisco vWAAS, etc..)



# Nexus 1000V

## Sessions

- LTRVIR-2005 Deploying the Nexus 1000V on ESXi and Hyper-V
- BRKVIR-2017 The Nexus 1000V on Microsoft Hyper-V: Expanding the Virtual Edge
- BRKVIR-3013 Deploying and Troubleshooting the Nexus 1000v virtual switch
- BRKVIR-2023 Cisco Nexus 1000V InterCloud based Hybrid Cloud Architectures and Approaches

# Key Take-Aways

- Understand the hypervisor's load-balancing mechanisms
- Align the configuration on hypervisor and upstream switch
- All adapters are always up
- MAC moves are possible depending on the load balancing algorithm
- Use the correct port-channel configuration (on/active/passive)



Q & A

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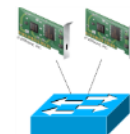


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# Appendix

# Switch Independent Configuration Options (IOS)



## Access

interface range GigabitEthernet1/0/31 - 32

switchport mode **access**

switchport access vlan 511

spanning-tree portfast

## Trunk

interface range GigabitEthernet1/0/31 - 32

switchport trunk encapsulation dot1q

switchport mode **trunk**

switchport trunk allowed vlan 511

spanning-tree portfast trunk

# Switch Dependent Configuration Options (IOS)

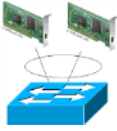
## Static

```
interface range GigabitEthernet1/0/31 - 32
  switchport trunk encapsulation dot1q
  switchport mode trunk
  switchport trunk allowed vlan 511
  spanning-tree portfast trunk
  channel-group 300 mode on
```

```
interface Port-Channel300
  switchport mode trunk
  switchport trunk allowed vlan 511
  spanning-tree portfast trunk
```

## LACP

```
interface range GigabitEthernet1/0/31 - 32
  switchport trunk encapsulation dot1q
  switchport mode trunk
  switchport trunk allowed vlan 511
  spanning-tree portfast trunk
  channel-group 300 mode active
```







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