

MODULE – 5

VIRTUALIZED DATA CENTER – NETWORKING

Module 5: Virtualized Data Center – Networking

Upon completion of this module, you should be able to:

- Describe network virtualization in VDC
- Describe VDC network infrastructure and components
- Describe Virtual LAN (VLAN) and Virtual SAN (VSAN) and their benefits
- Describe the key network traffic management techniques in VDC

Module 5: Virtualized Data Center – Networking

Lesson 1: VDC Networking Overview

Topics covered in this lesson:

- Overview of network virtualization
- Overview of network that is virtualized
- Virtualization tools that enable network virtualization
- Benefits of network virtualization

Network Virtualization

Network Virtualization

It is a process of logically segmenting or grouping physical network(s) and making them operate as single or multiple independent network(s) called “Virtual Network(s)”.

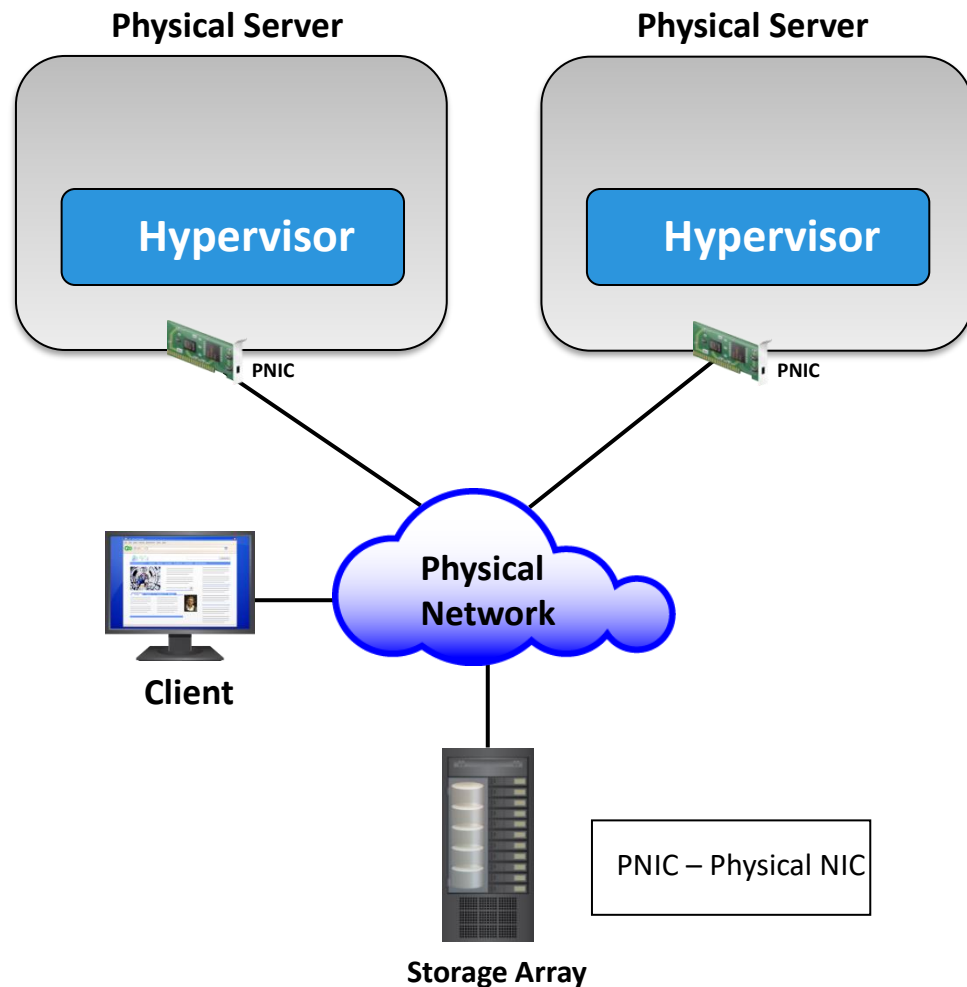
- Enables virtual networks to share network resources
- Allows communication between nodes in a virtual network without routing of frames
- Enforces routing for communication between virtual networks
- Restricts management traffic, including ‘Network Broadcast’, from propagating to other virtual network
- Enables functional grouping of nodes in a virtual network

Network Virtualization in VDC

- Involves virtualizing physical and VM networks

Physical Network

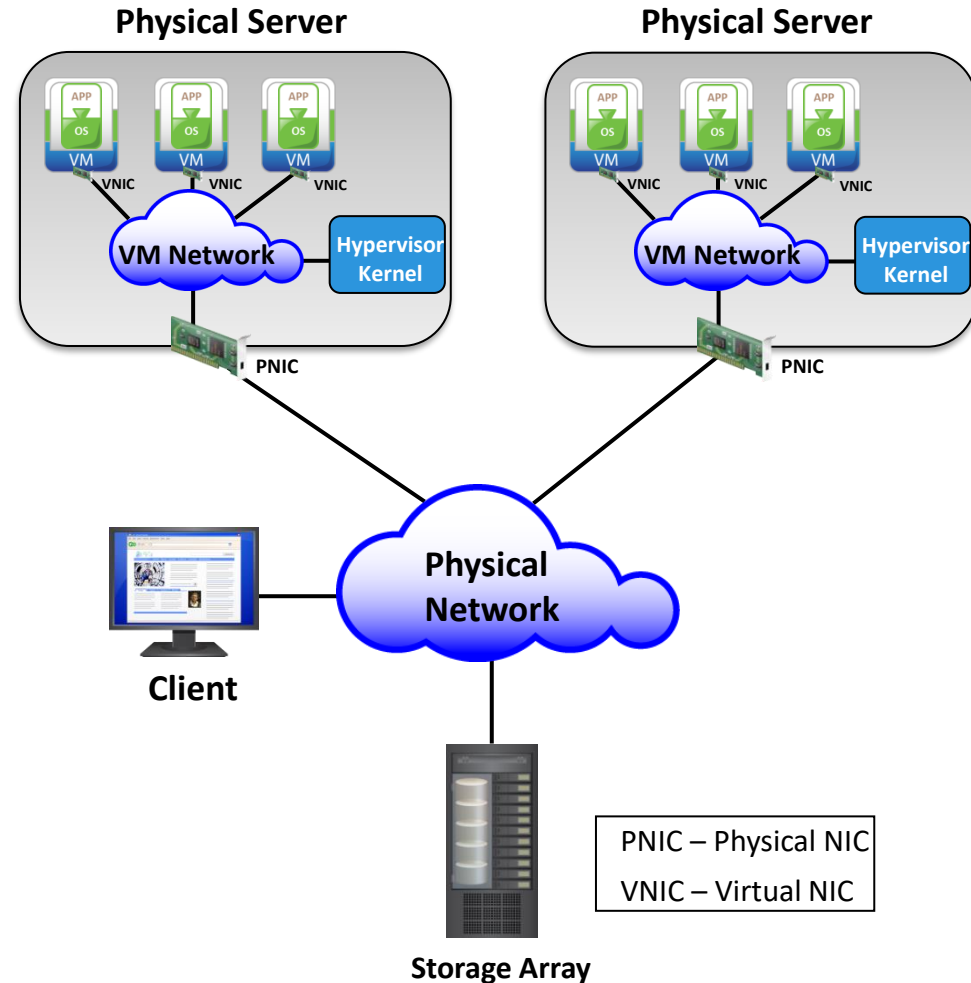
- Consists of following physical components:
 - ▶ Network adapters, switches, routers, bridges, repeaters, and hubs
- Provides connectivity
 - ▶ Among physical servers running hypervisor
 - ▶ Between physical servers and clients
 - ▶ Between physical servers and storage systems



Network Virtualization in VDC (contd.)

VM Network

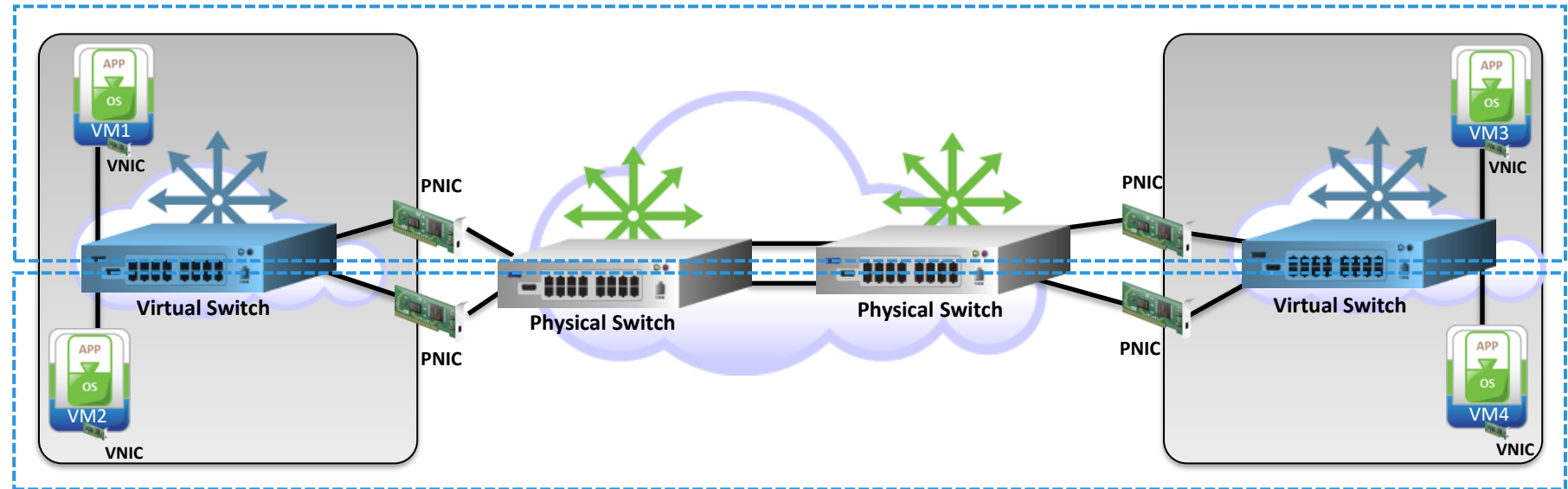
- Resides inside physical server
- Consists of logical switches called “virtual switches”
- Provides connectivity among VMs inside a physical server
- Provides connectivity to Hypervisor kernel
- Connects to physical network



Network Virtualization in VDC (contd.)

- VM and physical networks are virtualized to create virtual networks; for example: virtual LAN, virtual SAN

Virtual Network 1



Virtual Network 2

Network Virtualization Tools

- Physical switch Operating System (OS)
 - ▶ OS must have network virtualization functionality
- Hypervisor
 - ▶ Uses built-in networking and network virtualization functionalities
 - ▶▶ To create virtual switch and configuring virtual networks on it
 - ▶ Or, uses third-party software for providing networking and network virtualization functionalities
 - ▶▶ Third-party software is installed onto the hypervisor
 - ▶▶ Third-party software replaces the native networking functionality of the hypervisor

Benefits of Network Virtualization

Benefit	Description
Enhances security	<ul style="list-style-type: none">• Restricts access to nodes in a virtual network from another virtual network• Isolates sensitive data from one virtual network to another
Enhances performance	<ul style="list-style-type: none">• Restricts network broadcast and improves virtual network performance
Improves manageability	<ul style="list-style-type: none">• Allows configuring virtual networks from a centralized management workstation using management software• Eases grouping and regrouping of nodes
Improves utilization and reduces CAPEX	<ul style="list-style-type: none">• Enables multiple virtual networks to share the same physical network, which improves utilization of network resource• Reduces the requirement to setup separate physical networks for different node groups

Module 5: Virtualized Data Center – Networking

Lesson 2: VDC Network Infrastructure

Topics covered in this lesson:

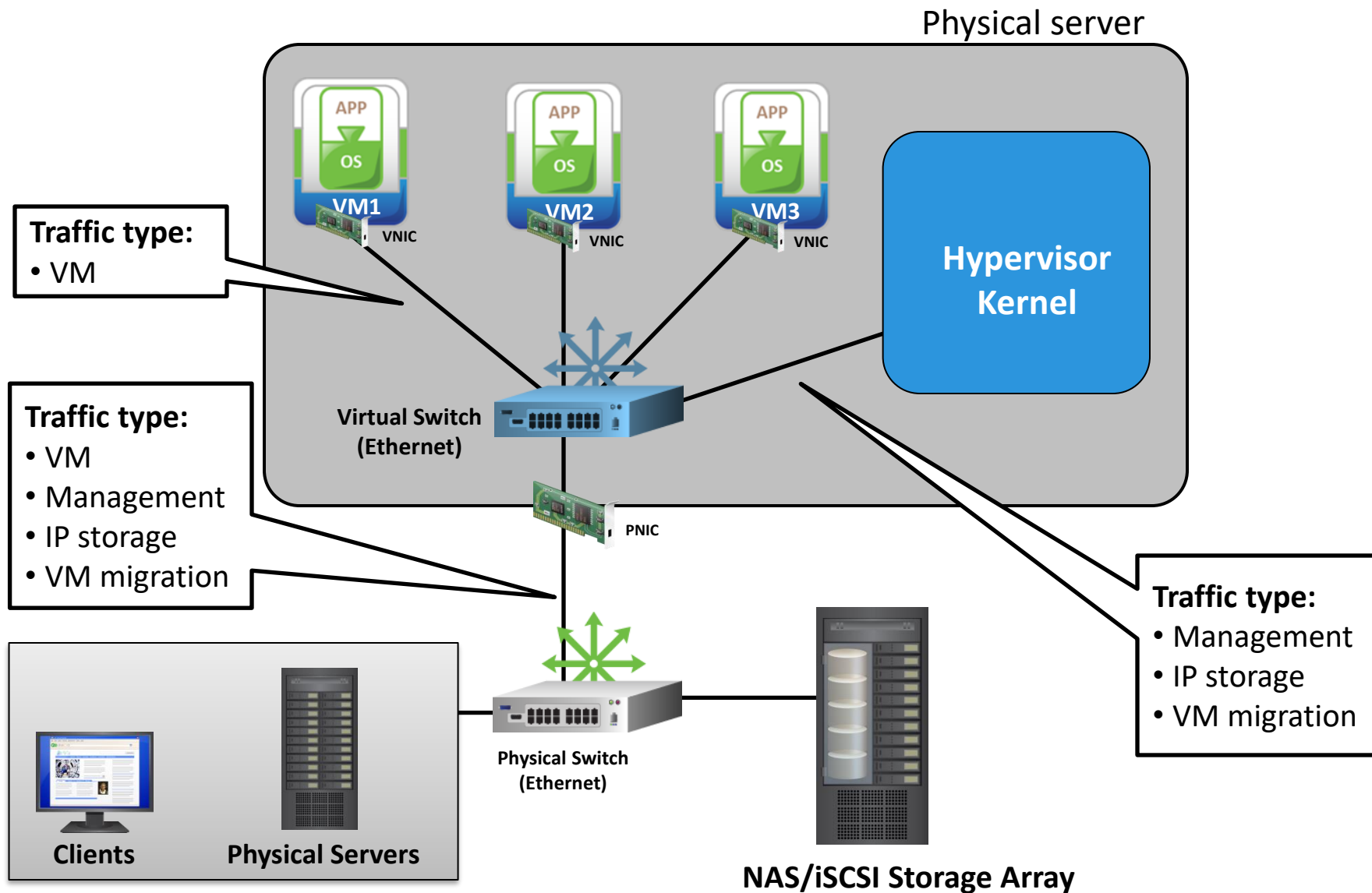
- Network infrastructure and components
- Network connectivity and traffic flow
- Features and functions of network components

Components of VDC Network Infrastructure

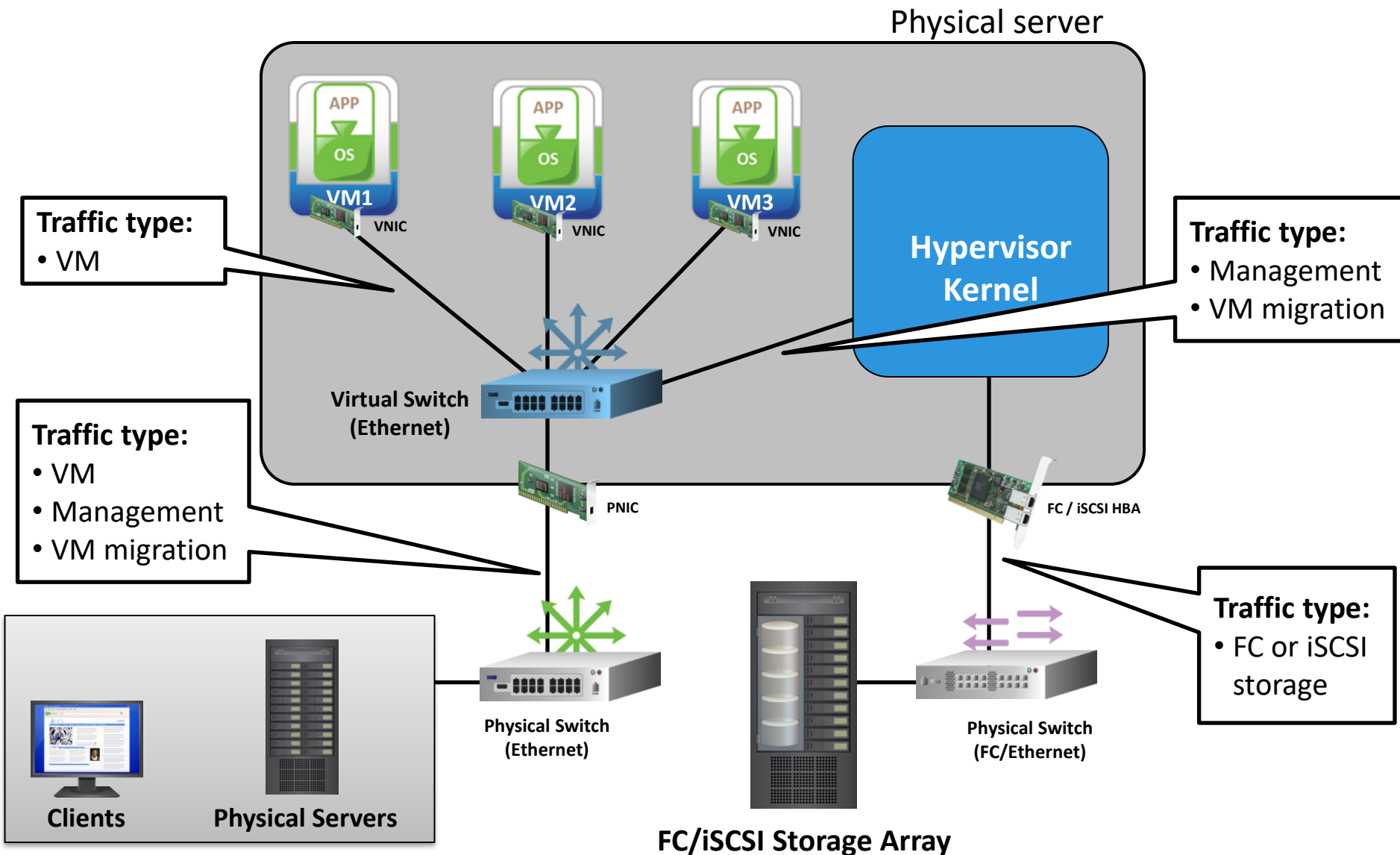
- VDC network infrastructure includes both virtual and physical network components
 - ▶ Components are connected to each other to enable network traffic flow

Component	Description
Virtual NIC	<ul style="list-style-type: none">• Connects VMs to the VM network• Sends/receives VM traffic to/from VM network
Virtual HBA	<ul style="list-style-type: none">• Enables a VM to access FC RDM disk/LUN assigned to the VM
Virtual switch	<ul style="list-style-type: none">• Is an Ethernet switch that forms VM network• Provides connection to virtual NICs and forwards VM traffic• Provides connection to hypervisor kernel and directs hypervisor traffic: management, storage, VM migration
Physical adapter: NIC, HBA, CNA	<ul style="list-style-type: none">• Connects physical servers to physical network• Forwards VM and hypervisor traffic to/from physical network
Physical switch, router	<ul style="list-style-type: none">• Forms physical network that supports Ethernet/FC/iSCSI/FCoE• Provides connections among physical servers, between physical servers and storage systems, and between physical servers and clients

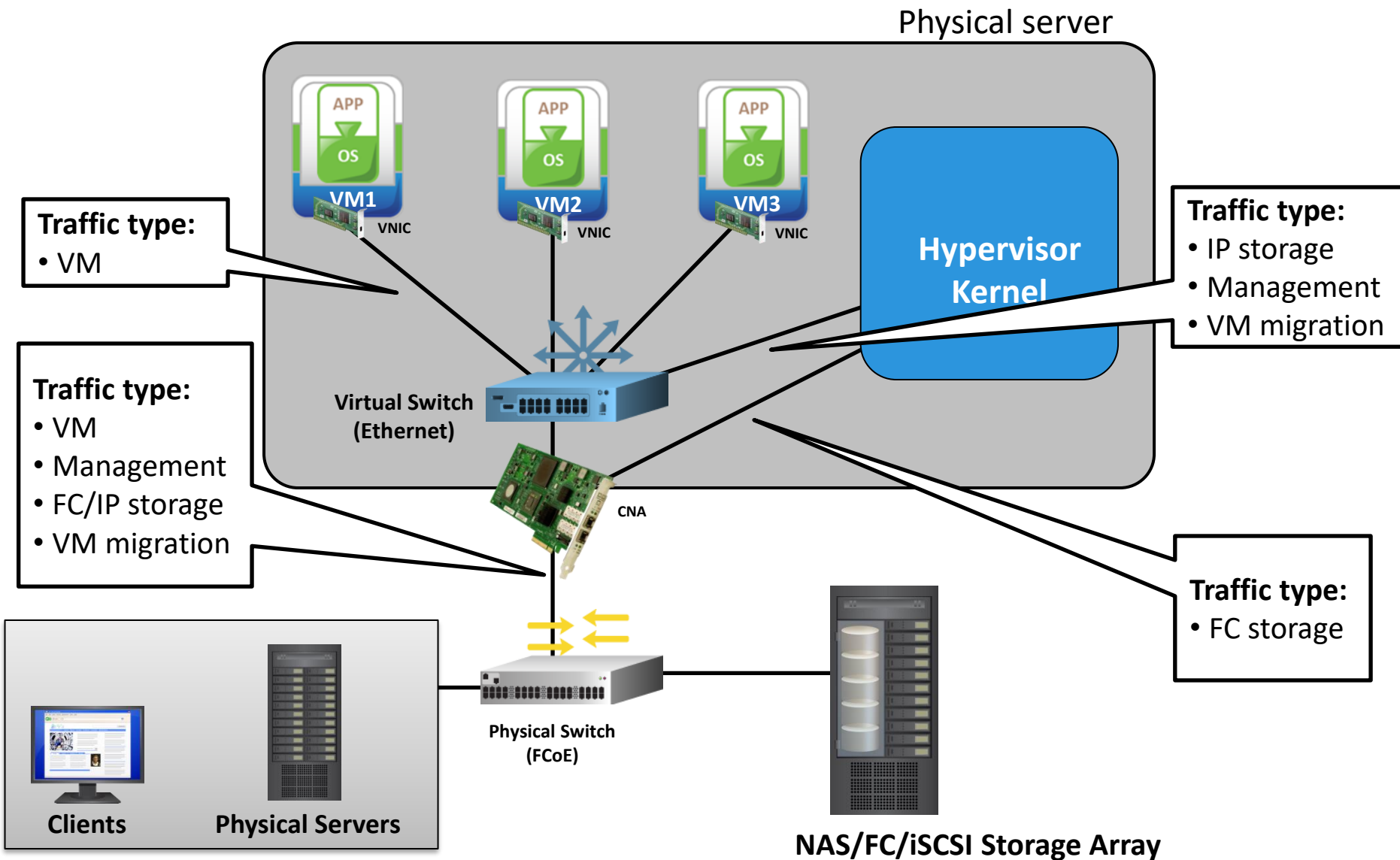
Network Connectivity and Traffic Flow: Example 1



Network Connectivity and Traffic Flow: Example 2



Network Connectivity and Traffic Flow: Example 3

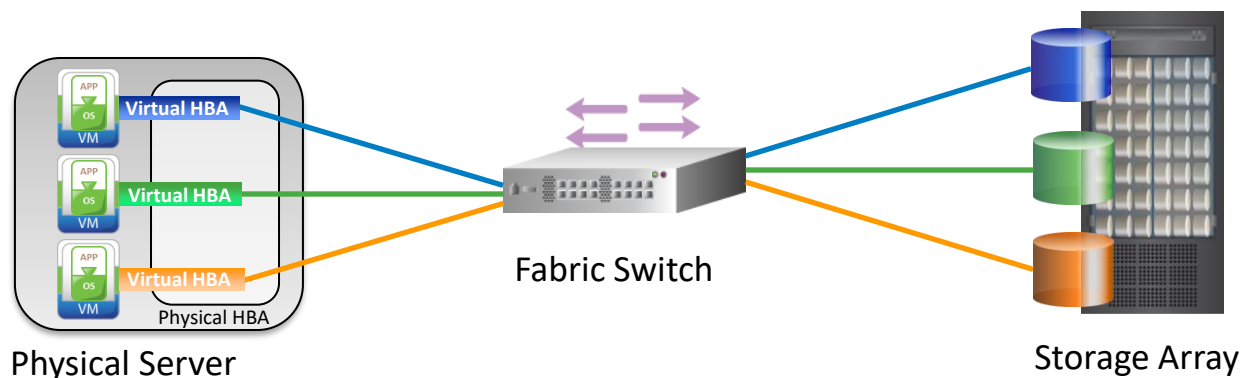


Virtual Network Component: Virtual NIC

- Connects VMs to virtual switch
- Forwards Ethernet frames to virtual switch
- Has unique MAC and IP addresses
- Supports Ethernet standards similar to physical NIC

Virtual Network Component: Virtual HBA

- Enables a VM to access FC RDM disk/LUN assigned to the VM
- Configured using N_Port ID Virtualization (NPIV) technology
 - ▶ Single physical FC HBA or CNA port (N_port) to function as multiple virtual N_ports, each with its own WWN
 - ▶ A virtual N_port acts as a virtual HBA port
- Hypervisor kernel leverages NPIV to instantiate virtual N_ports
 - ▶ Assigns the virtual N_ports to the VMs
- Enables zoning and LUN masking at VM level

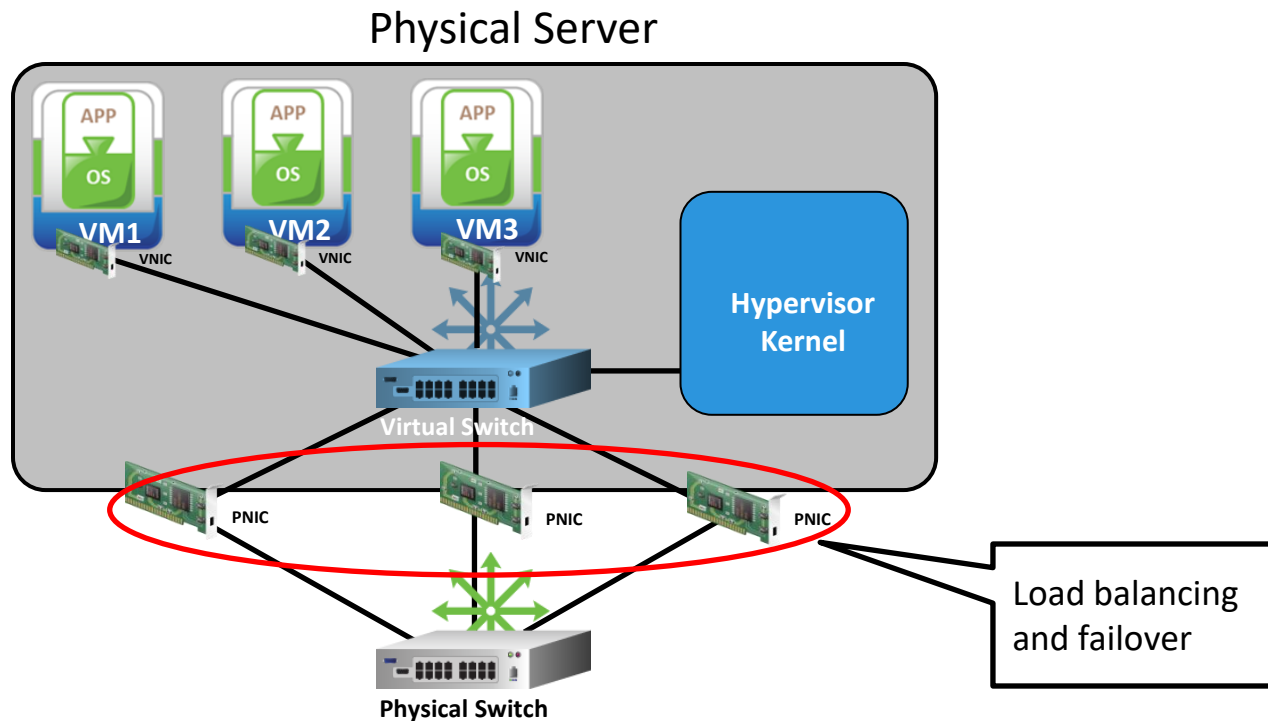


Virtual Network Component: Virtual Switch

- Is a logical OSI layer 2 switch that supports Ethernet protocol
- Resides inside a physical server
- Is created and configured using hypervisor
- Maintains MAC address table for frame forwarding
- Directs network traffic to/from VMs and hypervisor kernel
 - ▶ VM to VM within physical server
 - ▶ VM to physical network
 - ▶ Hypervisor kernel: IP storage, VM migration, and management

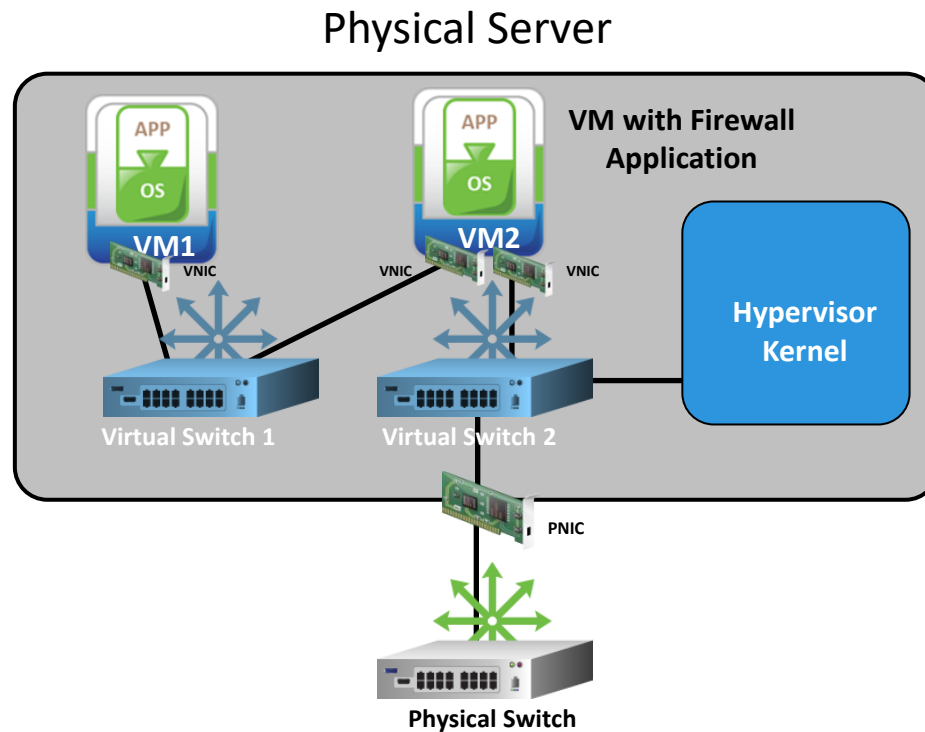
Virtual Network Component: Virtual Switch (contd.)

- May connect to multiple physical NICs
 - ▶ Connection to multiple NICs performs load balancing and failover



Virtual Network Component: Virtual Switch (contd.)

- May have no connection to any physical NIC
 - ▶ If virtual switch has no connection to physical NIC, it directs VM traffic within the physical server

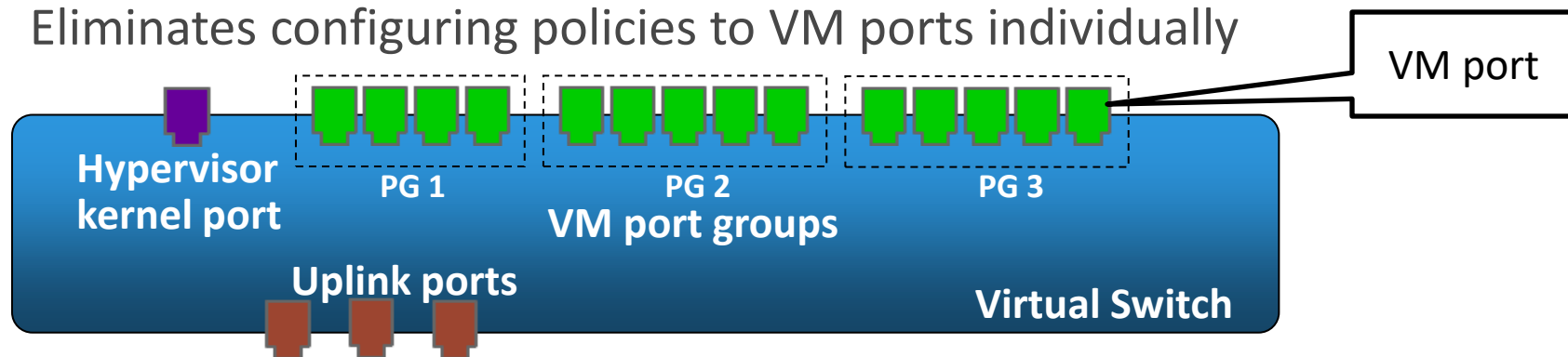


Virtual Network Component: Virtual Switch (contd.)

- No direct connection between virtual switches
- Frames may be transferred between virtual switches via a VM
- Physical NICs are not shared between virtual switches

Virtual Switch: Ports and Port Group

- Types of ports
 - ▶ Hypervisor kernel port: Provides connectivity to hypervisor kernel
 - ▶ VM port: Provides connectivity to virtual NICs
 - ▶ Uplink port: Provides connectivity to physical NIC
- VM port group: Mechanism for applying uniform network policy settings to a group of VM ports
 - ▶ Policy example: Security, load balancing, and failover across PNICs
- VMs connected to a VM port group share common configuration
 - ▶ Eliminates configuring policies to VM ports individually

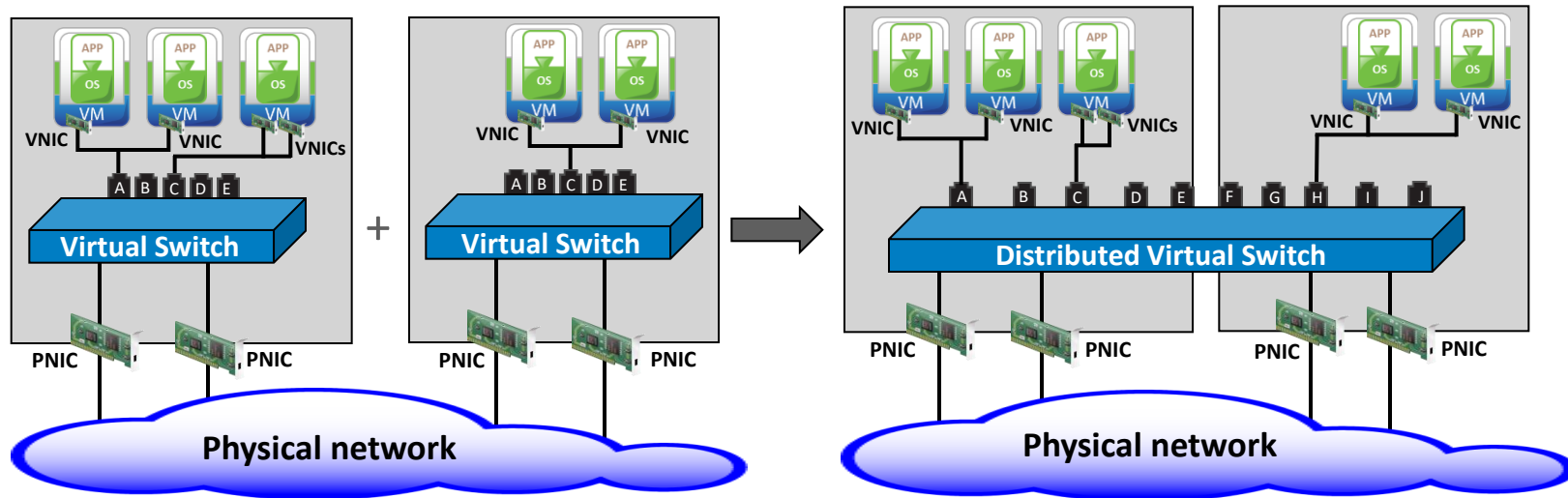


Distributed Virtual Switch

- Aggregation of multiple virtual switches distributed across multiple physical servers

Benefit

- Centralizes VM network management
- Maintains network policies during VM migration



Physical Network Component: NIC

- Physical NICs are used as inter-switch-links between virtual and physical Ethernet switches
 - ▶ Transfer VM and hypervisor kernel traffic
- Physical NICs are not addressable from network
 - ▶ IP address not assigned (prohibits OSI layer 3 access)
 - ▶ MAC addresses not available (prohibits OSI layer 2 access)
- Virtual NIC and hypervisor kernel are addressable from network
 - ▶ Have their own MAC and IP addresses
 - ▶▶ Are used as source address in Ethernet frames
- Ethernet frames are transferred through physical NICs without modification

Physical Network Component: HBA and CNA

Type of Adapter	Description
iSCSI HBA	<ul style="list-style-type: none">• Transfers hypervisor storage I/Os (SCSI I/Os) to iSCSI storage systems• Has built-in iSCSI initiator• Encapsulates SCSI I/O into iSCSI frames and then encapsulates iSCSI frames into Ethernet frames• Uses its own MAC and IP addresses for transmission of Ethernet frames over the Ethernet network• Offloads iSCSI processing (SCSI to iSCSI) from hypervisor
FC HBA	<ul style="list-style-type: none">• Transfers hypervisor storage I/Os (SCSI I/Os) to FC storage systems• Encapsulates SCSI data into FC frame• Uses its own FC address for transmission of frames over FC network
CNA	<ul style="list-style-type: none">• Hypervisor recognizes as an FC HBA and as an NIC<ul style="list-style-type: none">▶ NIC : Used as a link between virtual and physical switches▶ FC HBA : Provides hypervisor access to the FC storage