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Security and Virtualization in the Data Center

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Speaker information

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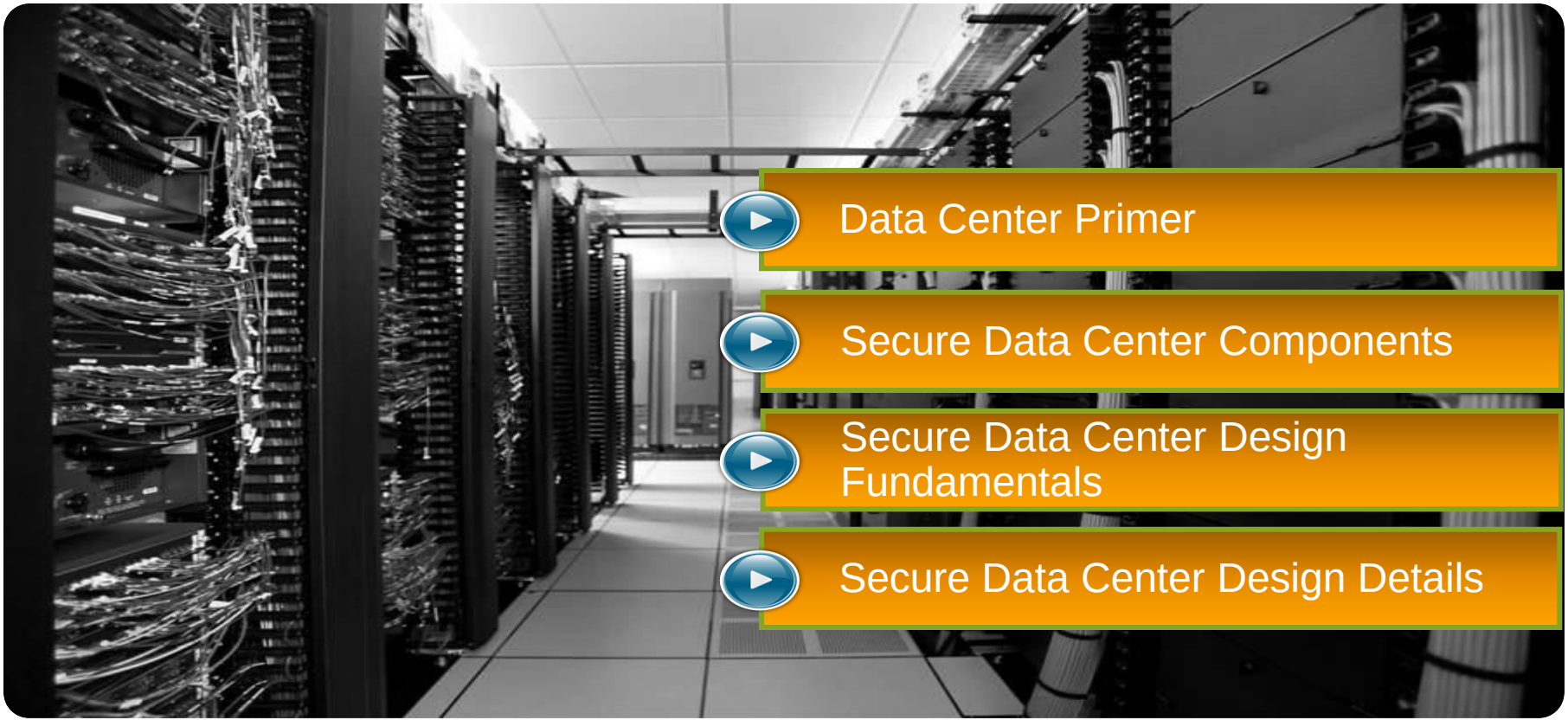
- Focus areas:
  - Data Center Security
  - Virtualization
  - Secure Mobility
  - Security Design
  - Compliance (PCI, Federal)

Takeaways

- To effectively integrate security must understand the core data center fabric technologies and features: VDC, vPC, VRF, server virtualization, traffic flows
- Security as part of the core design
- Designs to enforce microsegmentation in the data center
- Enforce separation of duties in virtualized and cloud environments
- Security to enforce continuous compliance

Secure Data Center



Data Center Primer: Terms and Technology

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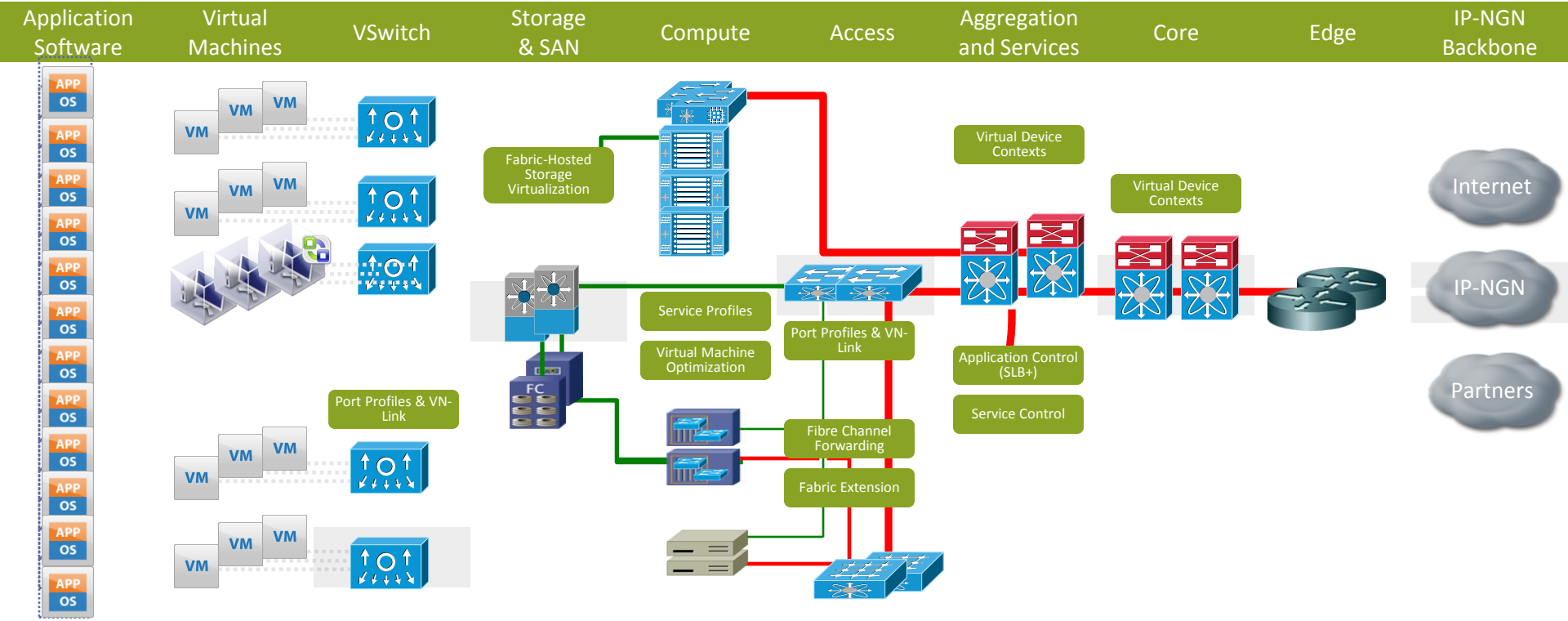
Cisco Datacenter Terms Primer

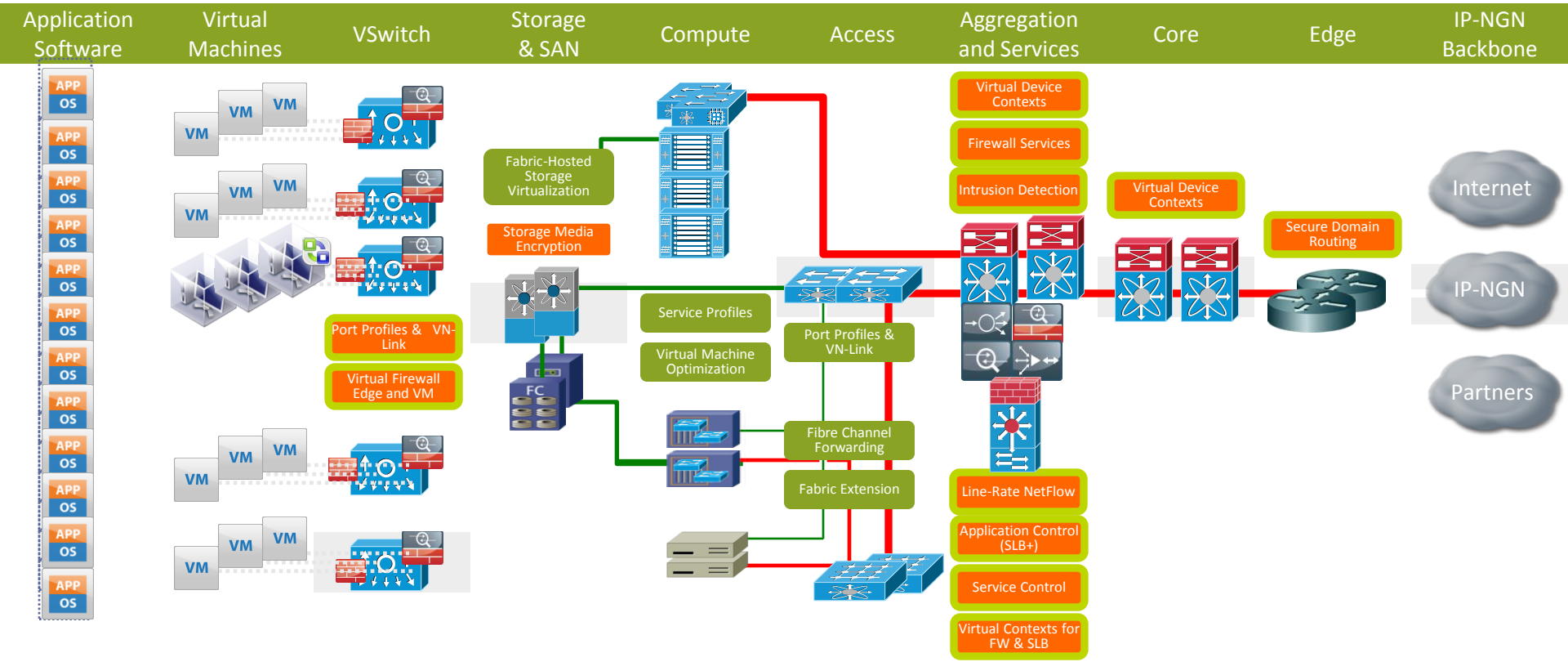
Know the lingo

- VDC – Virtual Device Context
- VPC – Virtual Port Channel
- VSS & MEC – Virtual Switching System & Multi-chassis Ether-channel
- VSL & Peer Link – Virtual Switch Link
- ECMP – Equal cost Multi-Path
- VSD – Virtual Service Domain
- VBS – Virtual Blade Switching
- VRF – Virtual Routing & Forwarding
- FabricPath

Data Center Architecture



Secure Data Center Architecture



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Data Center Security Challenges

Security Threats & Considerations

- Denial of Service i.e. (Google, Twitter, Facebook)
- APT – Targeted Attacks / Nation State Attacks
- Data Protection for Privacy and Data Compliance
- Application Exploits (SQL Injection)
- Malware / Botnets
- Mobile Malicious Code
- *Virtualization Concerns*

Secure the Platform

Network security best practices

- Network device hardening
- Defense in Depth
- AAA
- NetFlow
- Separation of duties and least privileges

Virtualization specifics

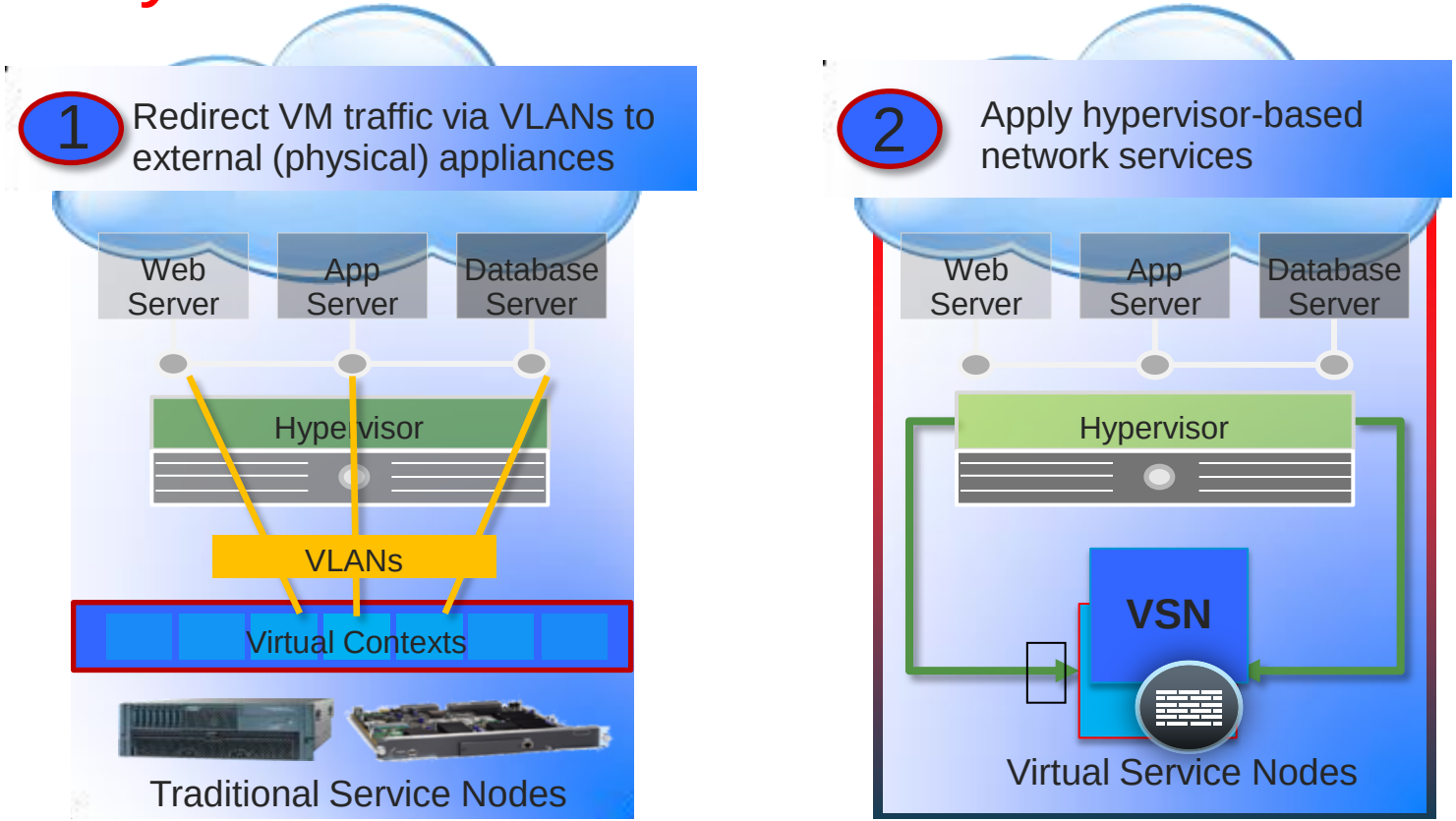
- Follow hypervisor hardening recommendations
- Access Controls (production vs. management)
- Secure and harden Guest OS
- Segmentation

Add Security Services

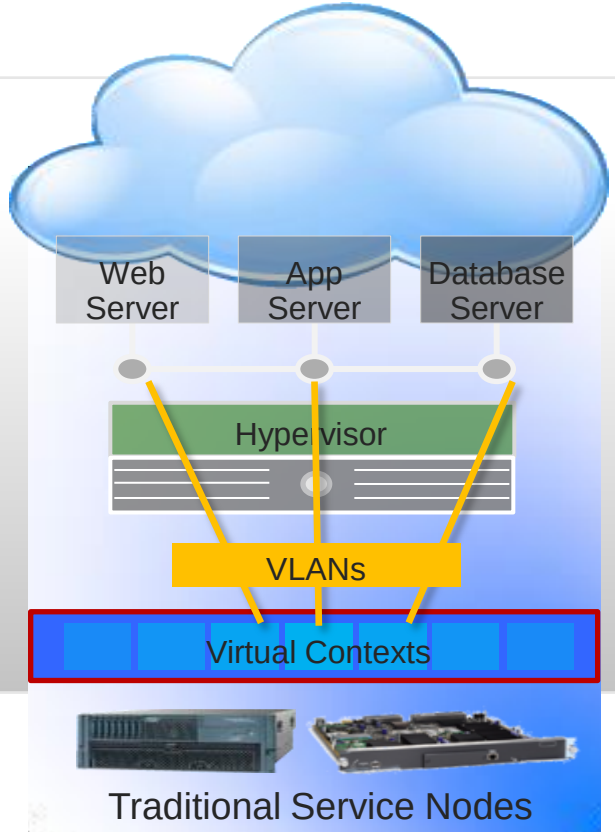
- VRF, VLAN, Access control Lists
- Stateful Network Firewalls
- Intrusion Detection and Prevention
- Web firewalls
- Load Balancers
- SSL Offloading
- Virtual security appliances
- Management and Visibility tools

Data Center Security Components: What's in our toolbox

Physical and Virtual Service Nodes



Physical Firewalls



ASA Services Module

ASA 5585 Appliance

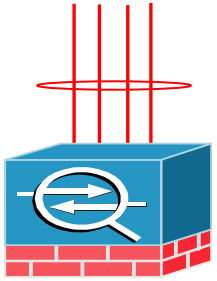
Features in ASA Firewalls

EtherChannel

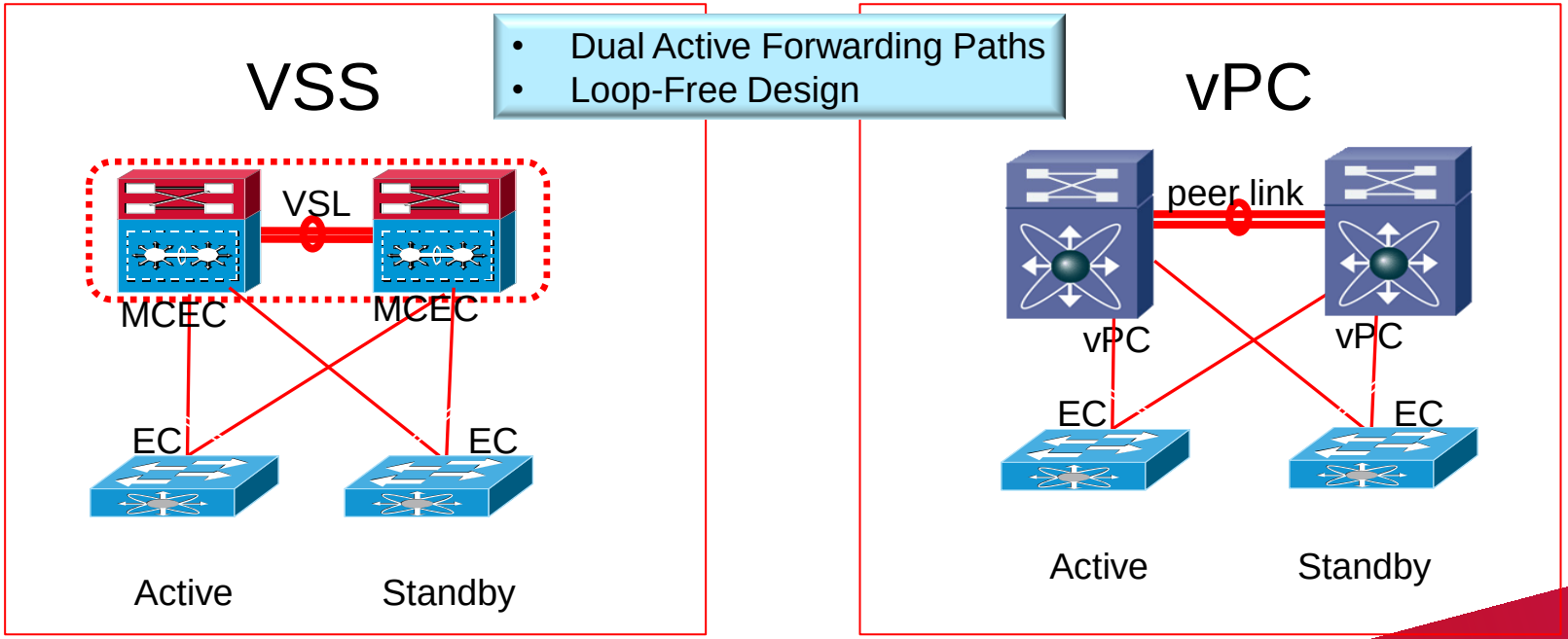
- ASA supports Link Aggregation Control Protocol (LACP), an IEEE 802.3ad standard
- Each port-channel supports up to 8 active and 8 standby links
- Supported methods of aggregation: Active, Passive & On
- EtherChannel ports are treated just like physical and logical interfaces on ASA
- ASA can tie-in directly to vPC (Nexus 7000) or VSS (6500) enabled switch

Up to 32 interfaces per Virtual Context (formerly 2)

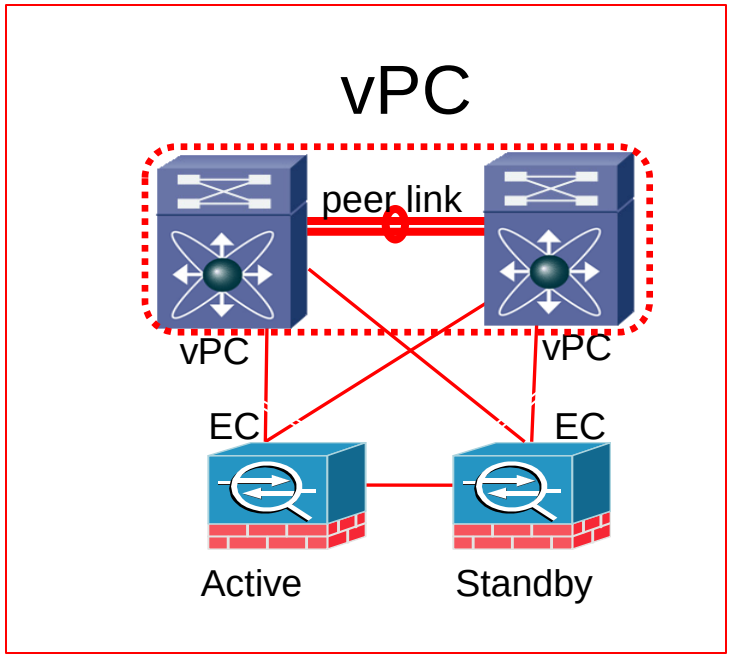
  - - 4 Interfaces per bridge group 8 bridge groups per Virtual Context

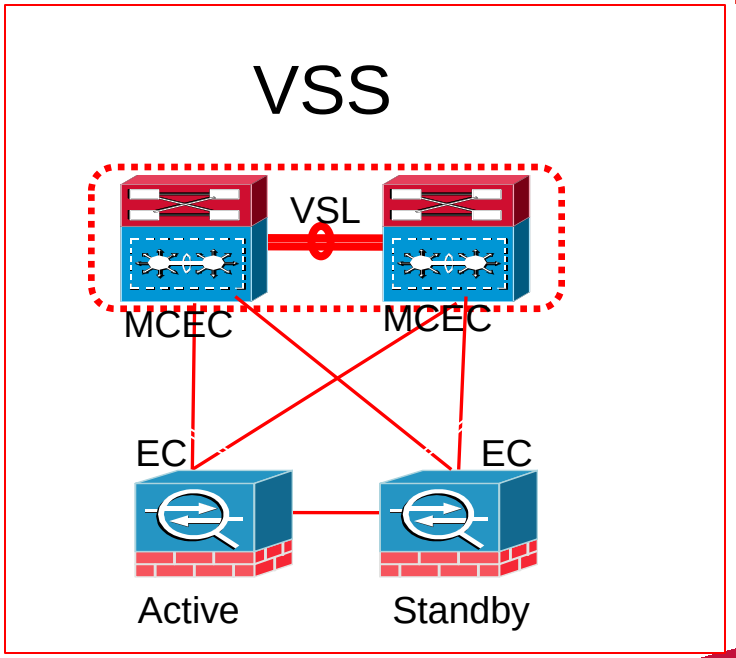


Catalyst 6500 VSS and Nexus 7000 vPC



ASA Integration with vPC & VSS



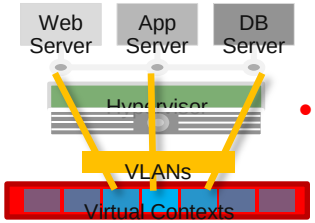


Virtualization Concerns

- Policy Enforcement
  - –Applied at physical server—not the individual VM
  - –Impossible to enforce policy for VMs in motion

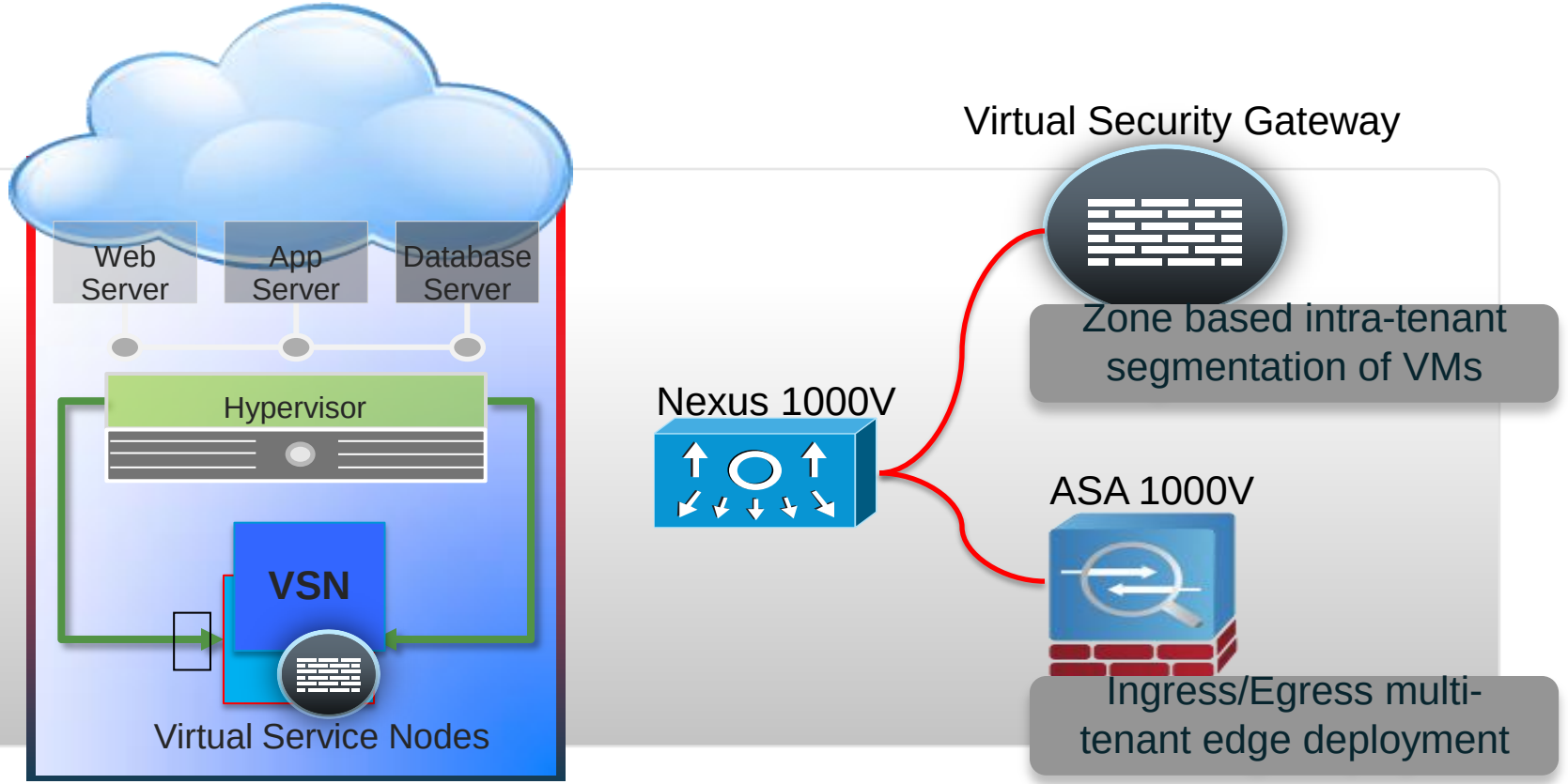
- Operations and Management
  - –Lack of VM visibility, accountability, and consistency
  - –Difficult management model and inability to effectively troubleshoot

- Roles and Responsibilities
  - –Muddled ownership as server admin must configure virtual network
  - –Organizational redundancy creates compliance challenges

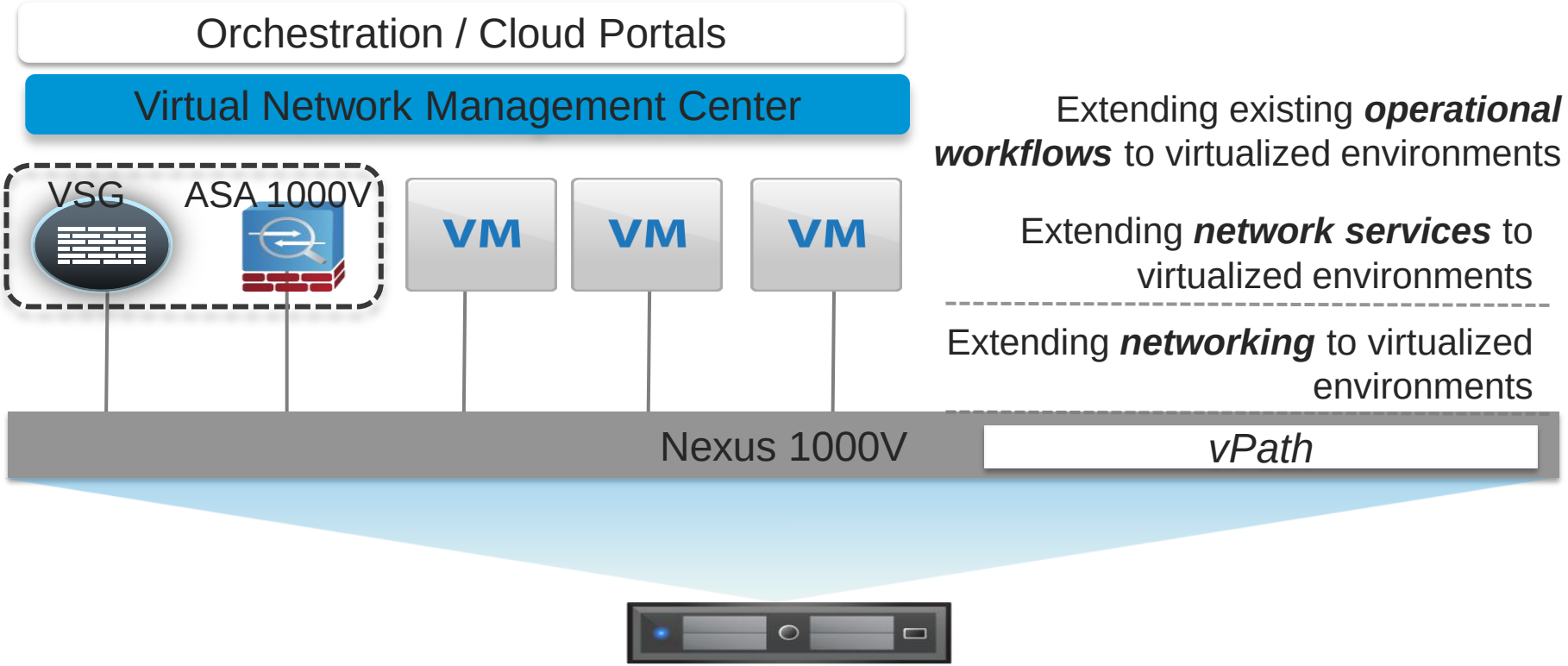


- Machine Segmentation
  - –Server and application isolation on same physical server
  - –No separation between compliant and non-compliant systems…

Virtualization & Virtual Service Nodes



Cisco's Virtual Security Architecture



Extending existing ***operational workflows*** to virtualized environments

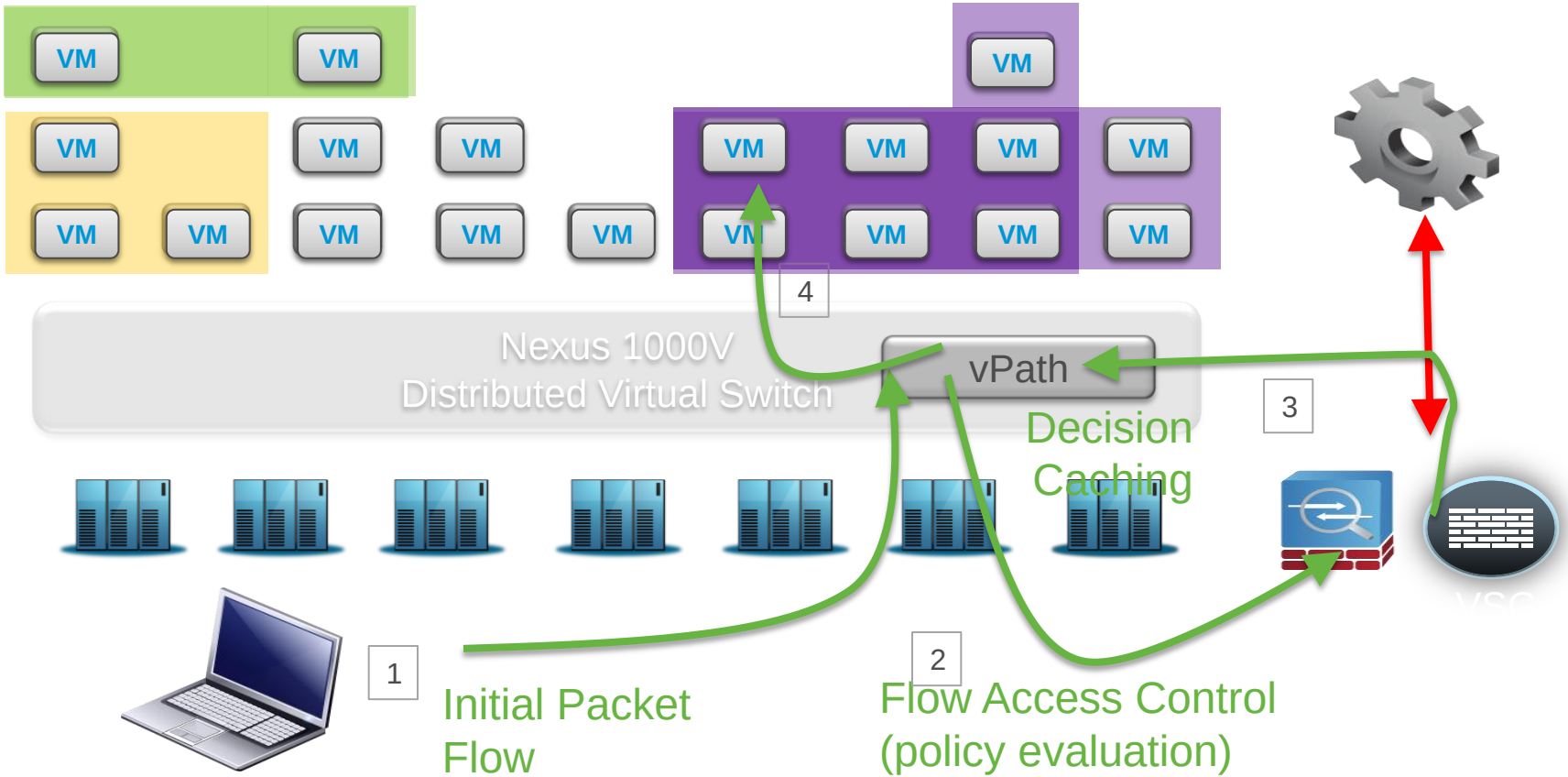
Extending ***network services*** to virtualized environments

Extending ***networking*** to virtualized environments

vPath— The intelligent virtual network

- vPath is intelligence build into Virtual Ethernet Module (VEM) of Nexus 1000V (1.4 and above)
- vPath has two main functions:
    a. Intelligent Traffic Steering
    b. Offload processing via Fastpath from virtual Service Nodes to VEM
- Dynamic Security Policy Provisioning (via security profile)
- Leveraging vPath enhances the service performance by moving the processing to Hypervisor

vPath: Fast Path Switching for Virtualization



Cisco Virtual Security Gateway

Virtual Security Gateway (VSG)

Context aware Security	VM context aware rules
Zone based Controls	Establish zones of trust
Dynamic, Agile	Policies follow vMotion
Best-in-class Architecture	Efficient, Fast, Scale-out SW

Virtual Network Management Center (VNMC)

Non-Disruptive Operations	Security team manages security
Policy Based Administration	Central mgmt, scalable deployment, multi-tenancy
Designed for Automation	XML API, security profiles

Virtual Security Gateway

Context based rule engine, where ACLs can be expressed using any combination of network (5-tuple), **custom** and **VM attributes**. It's extensible so other types of context/attributes can be added in future

No need to deploy on every physical server (this is due to 1000V vPath intelligence)

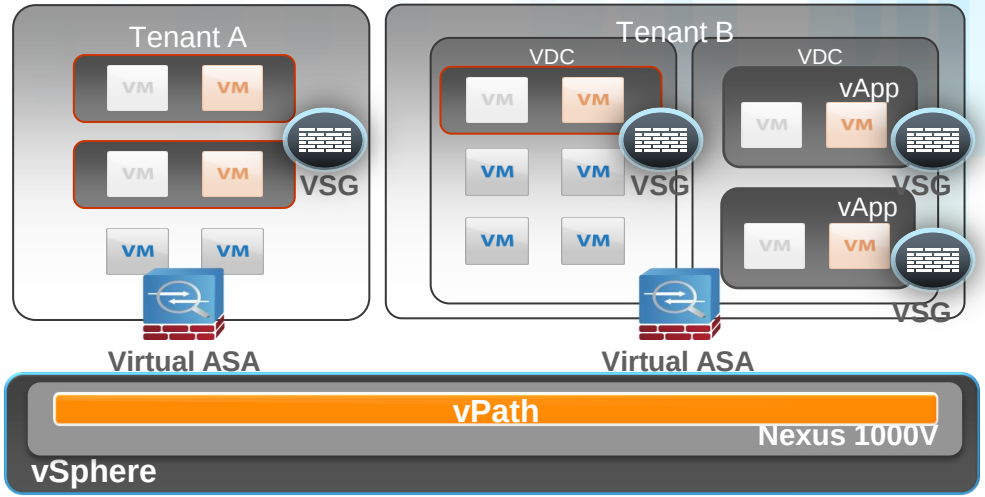
Hence can be deployed on a dedicated server, or hosted on a Nexus 1010 appliance

Performance optimization via enforcement off-load to 1000V vPath

High availability

ASA 1000v

- Runs same OS as ASA appliance and blade
- Maintains ASA Stateful Inspection Engines
- IPSEC site-to-site VPN
- Collaborative Security Model
  - VSG for intra-tenant secure zones
  - Virtual ASA for tenant edge controls
- Integration with Nexus 1000V & vPath

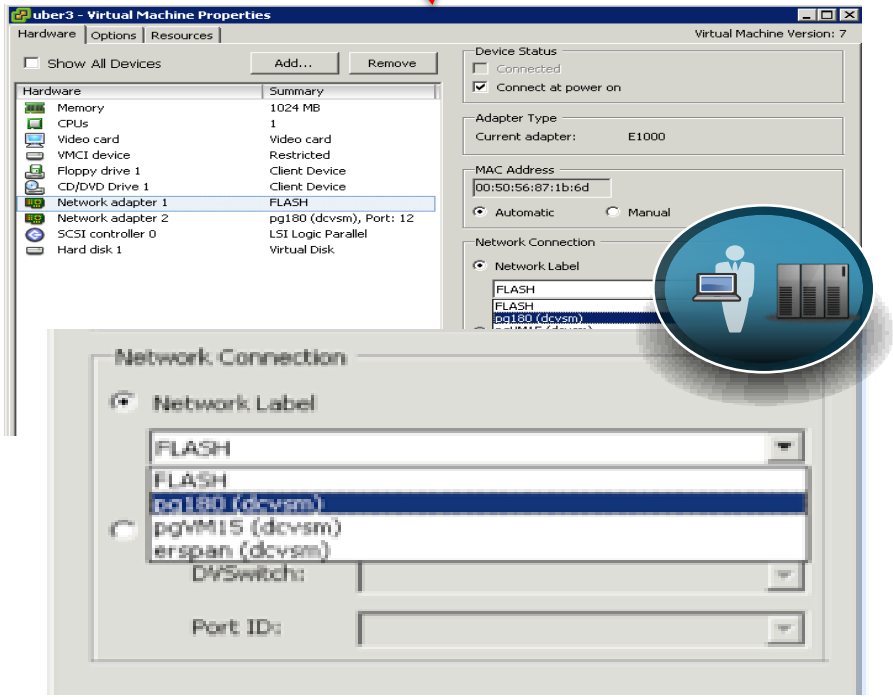


Nexus 1000V Port Profiles

Port Profile –> Port Group

vCenter API

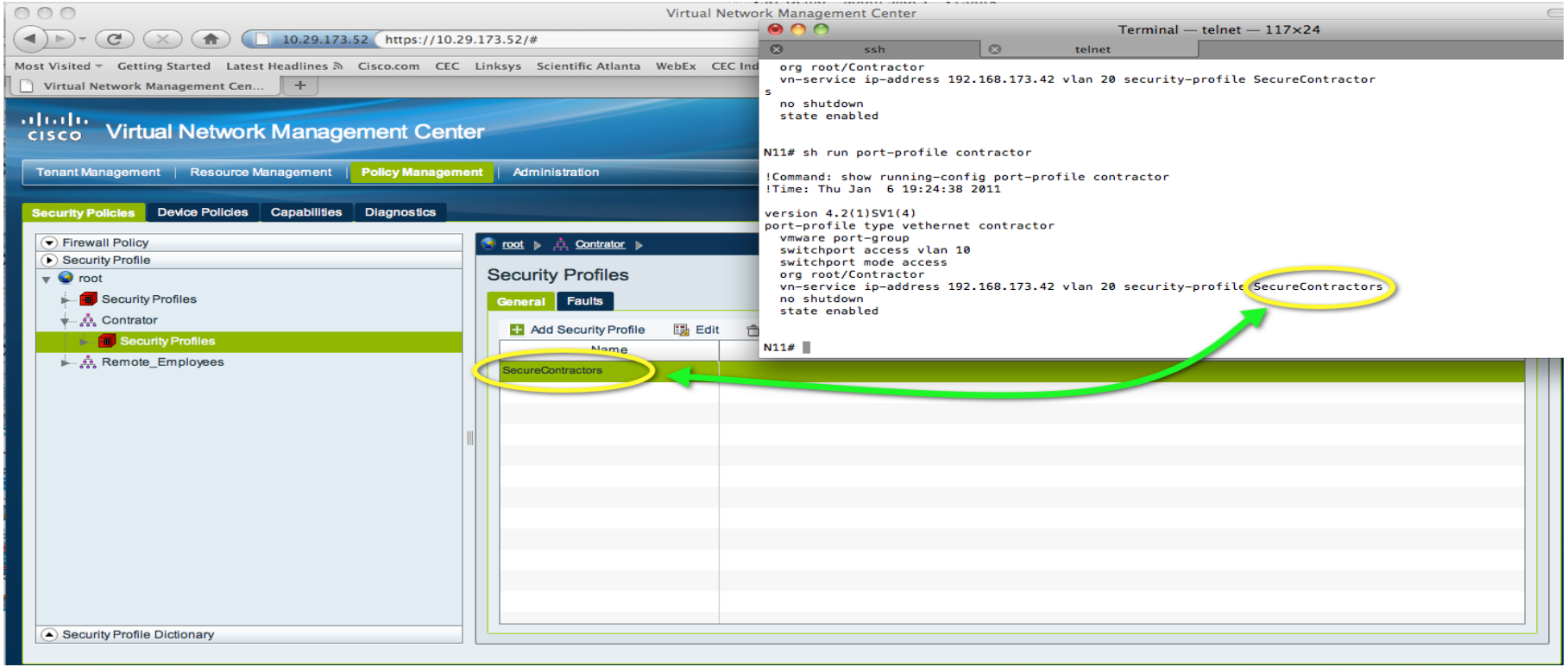
```
port-profile vm180
  vmware port-group pg180
  switchport mode access
  switchport access vlan 180
  ip flow monitor ESE-flow input
  ip flow monitor ESE-flow output
  no shutdown
  state enabled

interface Vethernet9
  inherit port-profile vm180

interface Vethernet10
  inherit port-profile vm180
```



Support Commands Include:

- ✓ Port management
- ✓ VLAN
- ✓ PVLAN
- ✓ Port Security
- ✓ QoS
- ✓ Port-channel
- ✓ ACL
- ✓ Netflow

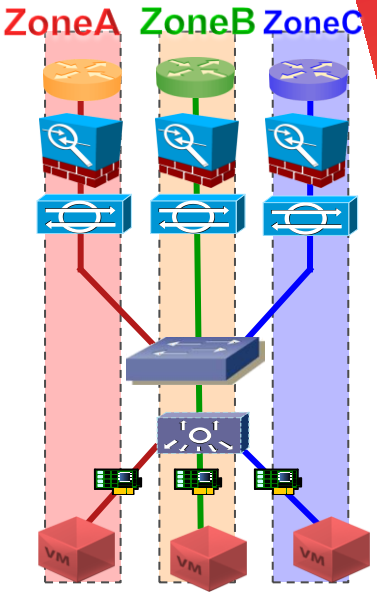
Security Policy to Port Profile

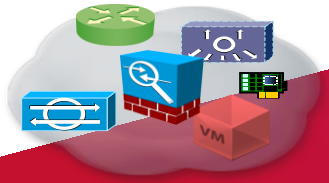


Design Fundamentals

Secure Data Center

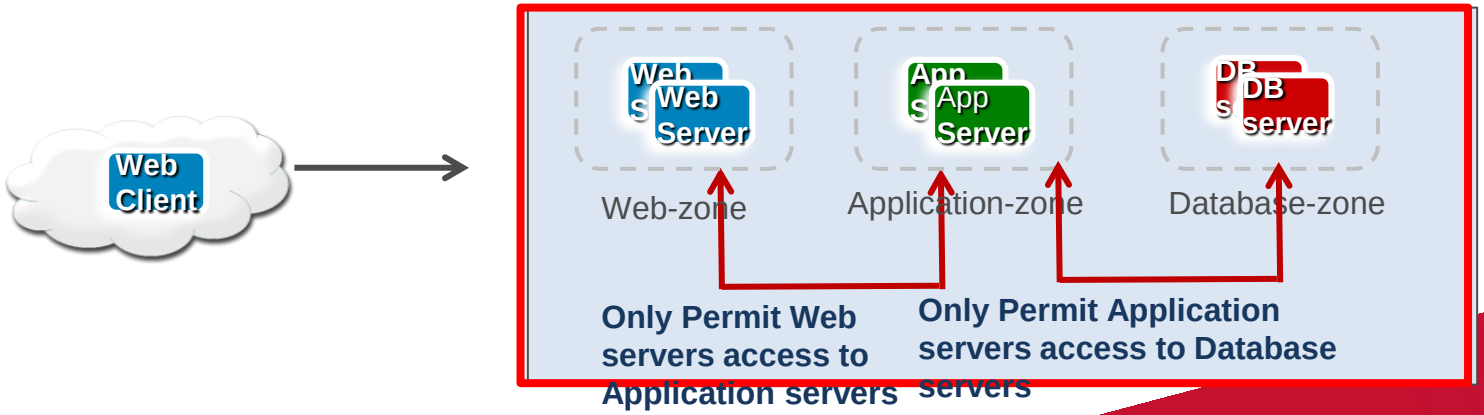
- Network security can be mapped and applied to both the physical and virtual DC networks
- Zones can be used to provide data centric security policy enforcement
- Steer VM traffic to Firewall Context
- Segment pools of blade resources per Zone
- Segment Network traffic w/in the Zone
  - –System Traffic
  - –VM Traffic
  - –Management Traffic
- Lockdown elements w/in a Zone
- Unique policies and traffic decisions can be applied to each zone creating very flexible designs
- Foundation for secure private cloud





Understand Network and Application Flows

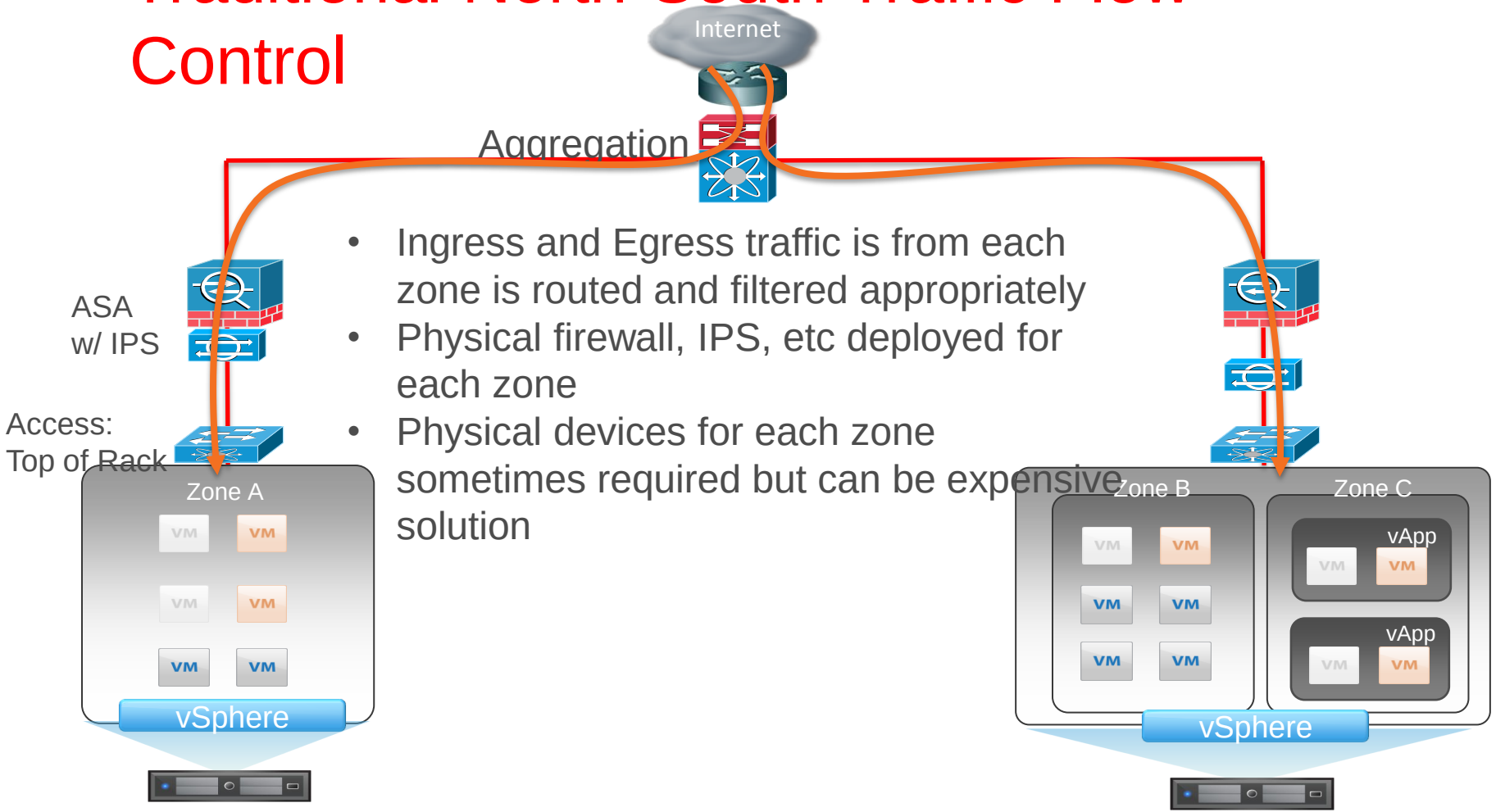
- Understand how the applications are deployed and accessed both internally and externally
- Understand the North-South, East-West flow patterns
- Adjacency of services to servers is important. Adding services to existing flow patterns minimizes packet gymnastics!
- Again, design with the maximum amount of high availability: know your failover and failback times, traffic paths during failover scenarios



Important

- Careful attention should be given to where the server's default gateway resides
- Can be disruptive to introduce changes to where the gateway resides. Non-greenfield designs require flexibility for deploying new services. Ex. From switch to service appliance
- Service introduction ie. Firewall, Web security, load balancing, can all have an impact on data center traffic flows
- Design with the maximum amount of high availability: know your failover and failback times, traffic paths during failover scenarios
- Multicast support considerations for L2 vs L3 services

Traditional North-South Traffic Flow Control

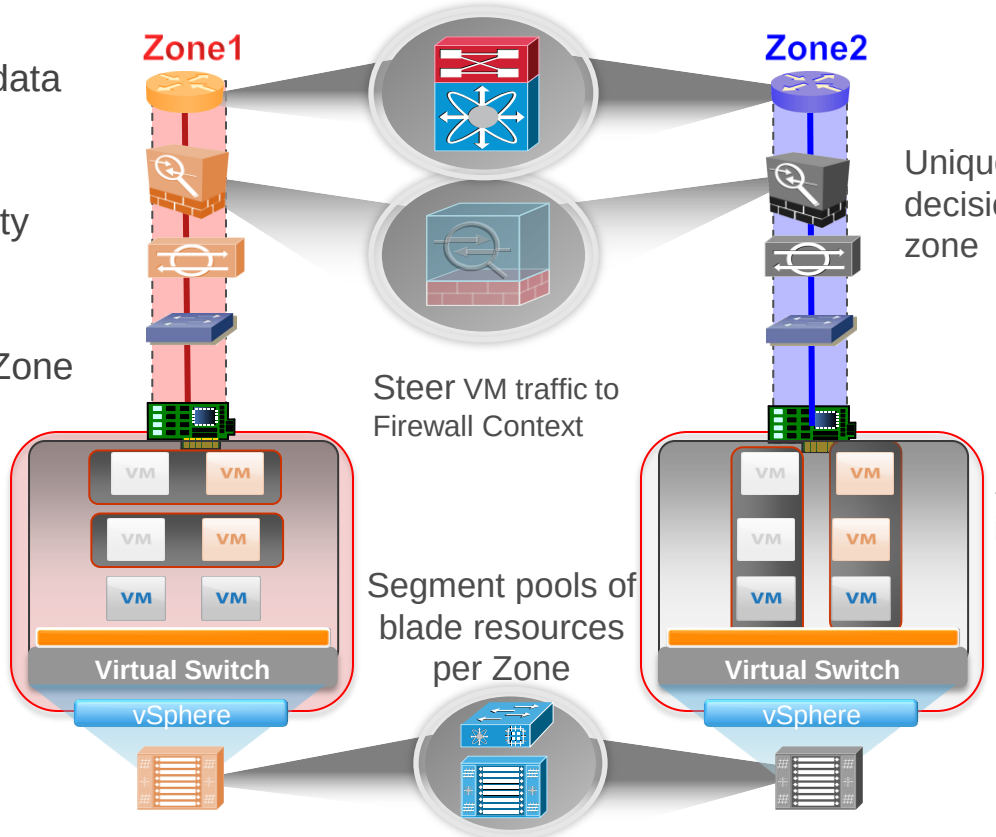


- Ingress and Egress traffic is from each zone is routed and filtered appropriately
- Physical firewall, IPS, etc deployed for each zone
- Physical devices for each zone sometimes required but can be expensive solution

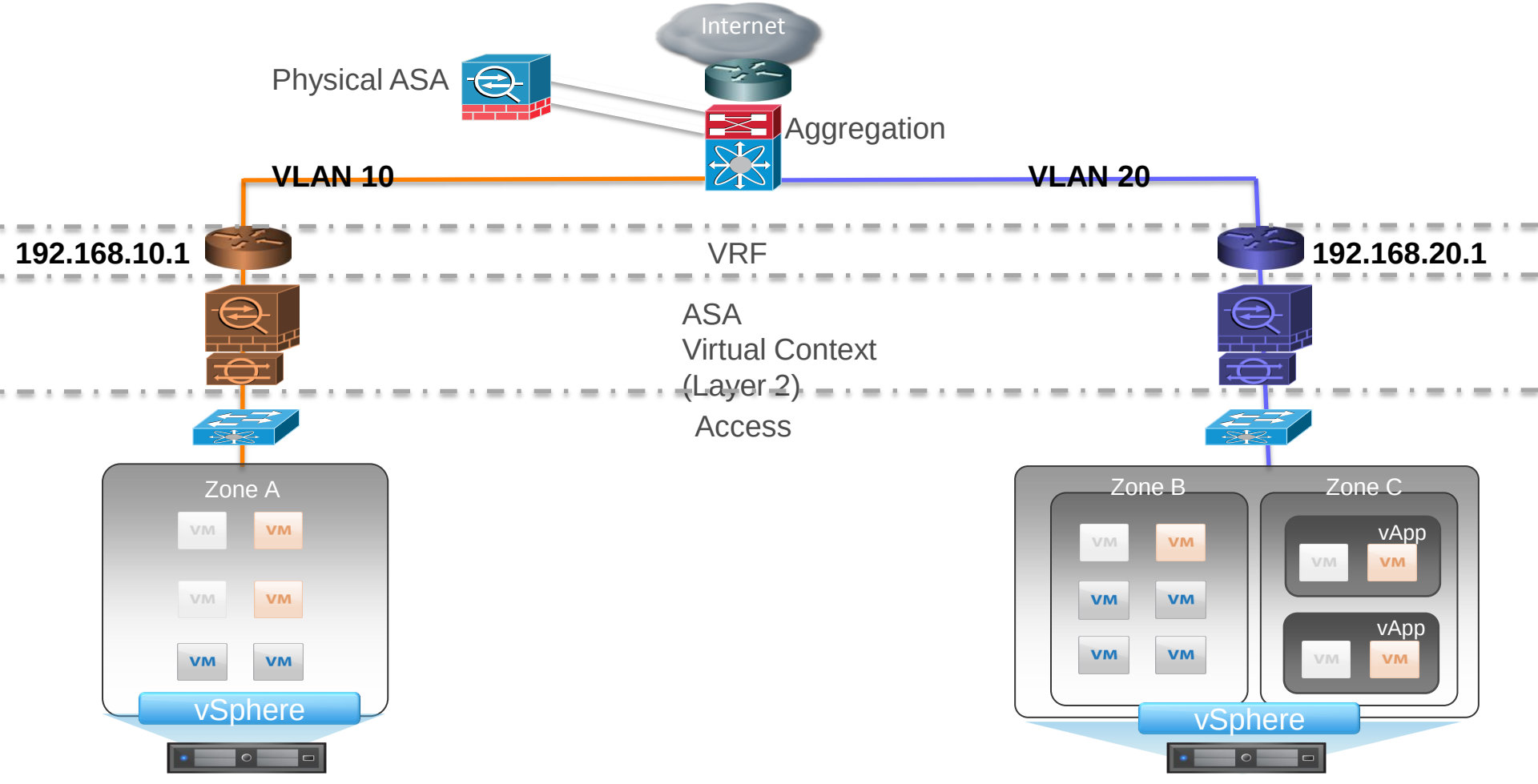
Network Virtualization and Zones

Acme Co. - Control Traffic and Apply Policy per Zone

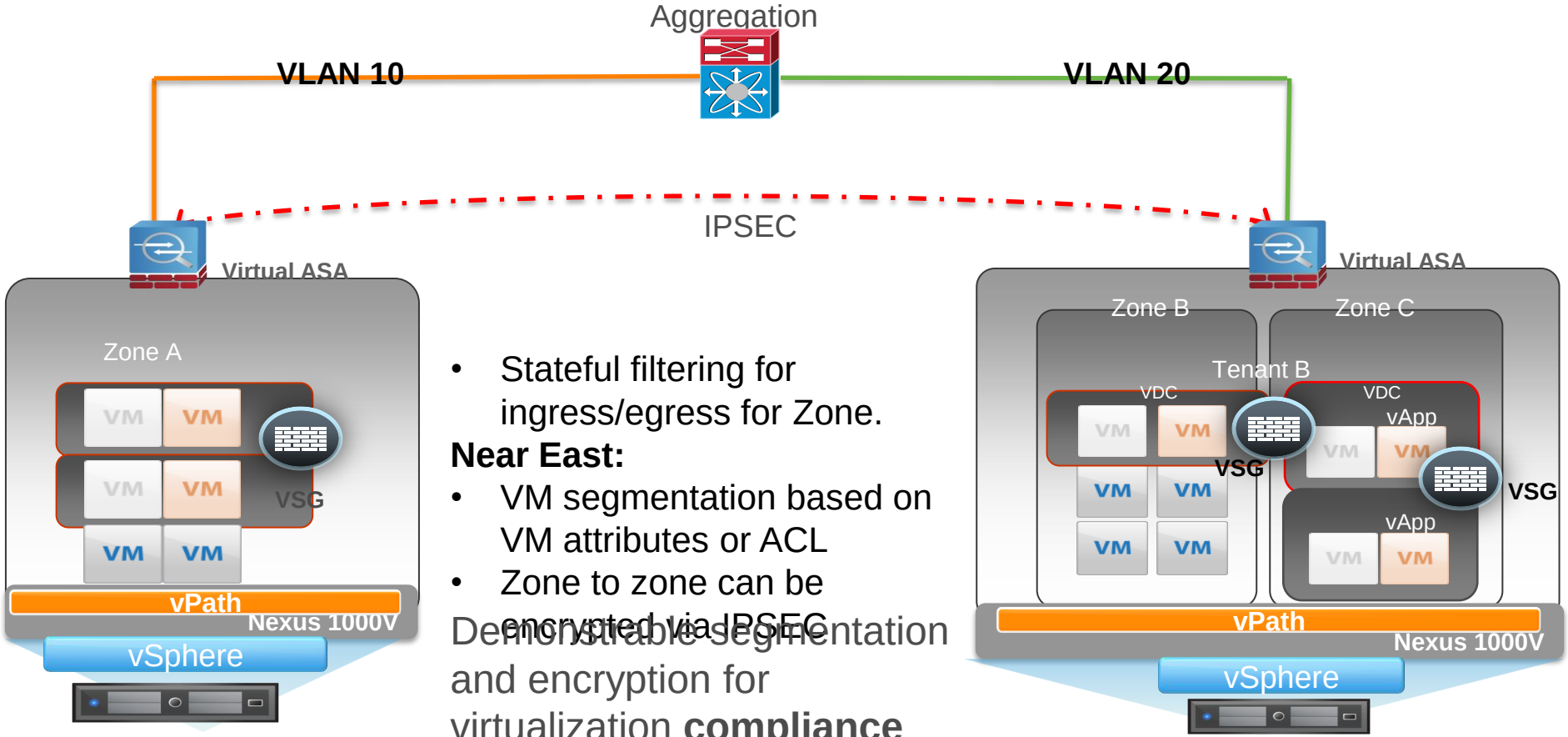
- Zones used to provide data centric security policy enforcement
- Physical network security mapped per zone
  - VRF, Virtual Context
- Lockdown elements in Zone



North-South Traffic with Network Virtualization



Microsegmenation:
Per Zone, Per VM, Per vNIC



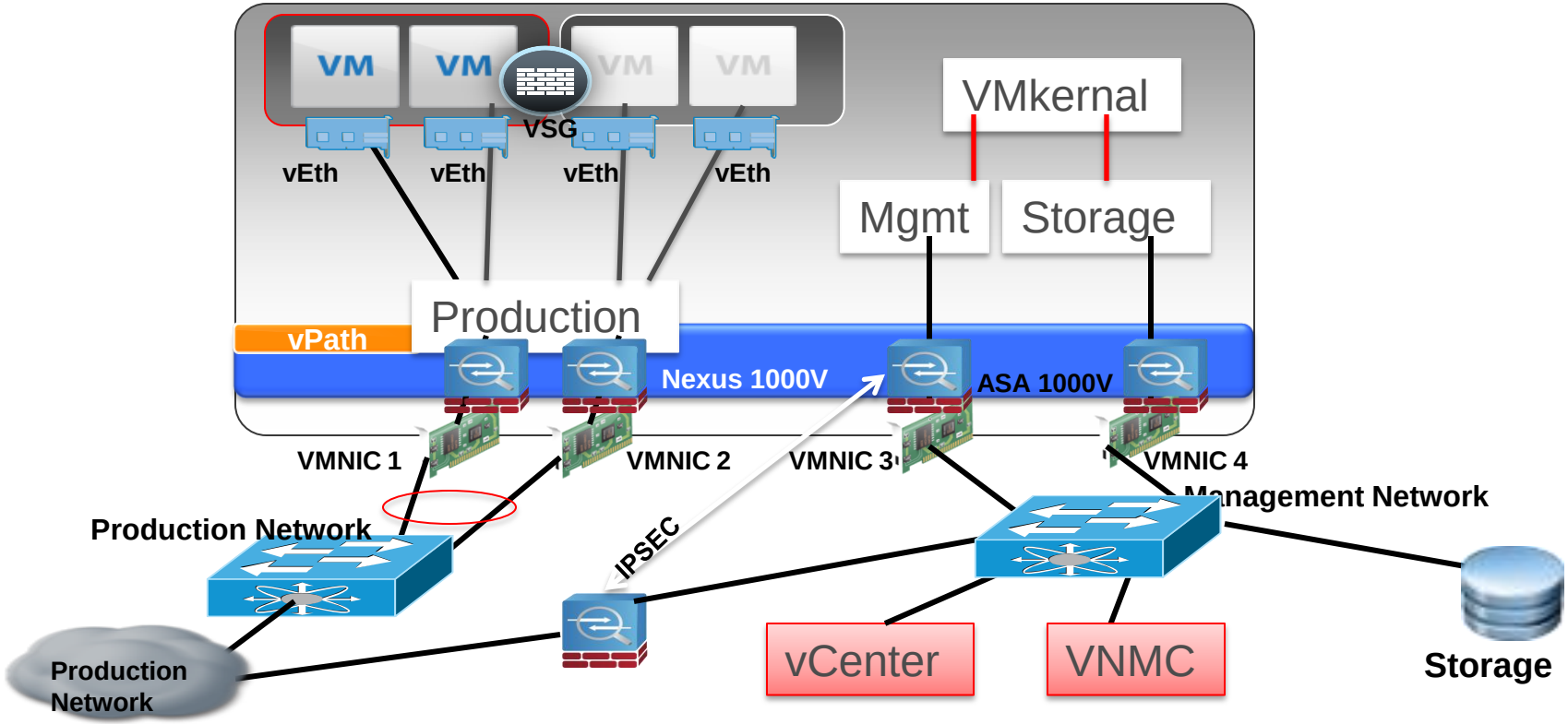
- Stateful filtering for ingress/egress for Zone.

Near East:

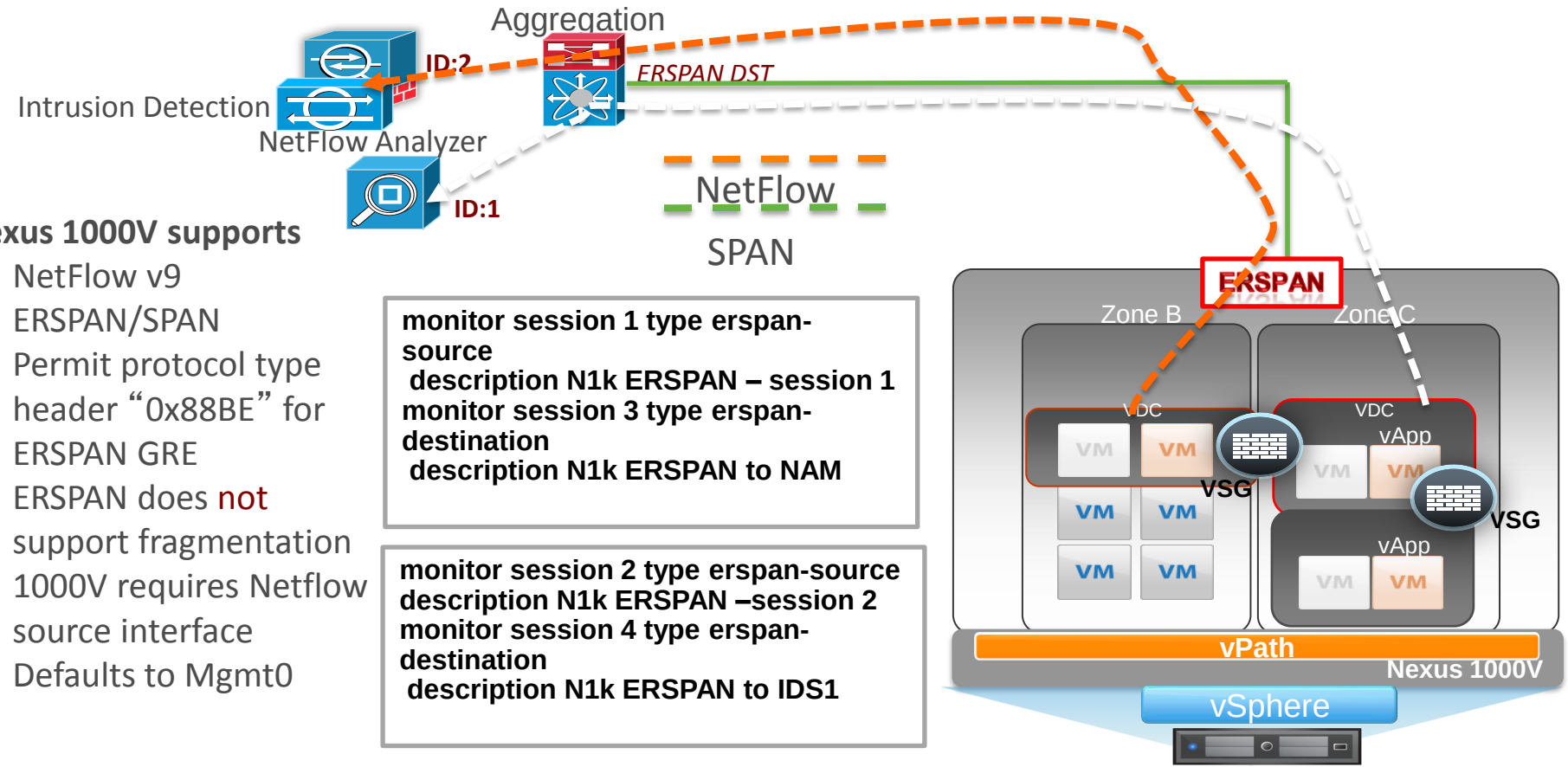
- VM segmentation based on VM attributes or ACL
- Zone to zone can be encrypted via IPSEC

Demonstrable segmentation and encryption for virtualization **compliance**

Segmentation of Production and Non-Production Traffic



Visibility: Monitor VM to VM Traffic



Nexus 1000V supports

- NetFlow v9
- ERSPAN/SPAN
- Permit protocol type header “0x88BE” for ERSPAN GRE
- ERSPAN does not support fragmentation
- 1000V requires Netflow source interface Defaults to Mgmt0

```
monitor session 1 type erspan-source
 description N1k ERSPAN – session 1
monitor session 3 type erspan-destination
 description N1k ERSPAN to NAM
```

```
monitor session 2 type erspan-source
description N1k ERSPAN –session 2
monitor session 4 type erspan-destination
 description N1k ERSPAN to IDS1
```

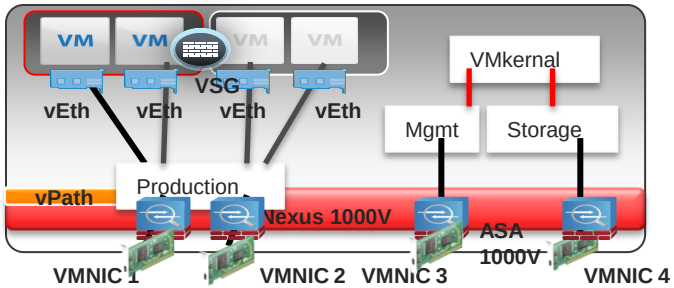
Virtualization & Compliance: PCI DSS 2.0

- PCI security requirements apply to all ‘system components.’
- System components are defined as:
  - Any network component, server, or application that is included in or connected to the cardholder data environment.
  - Virtualization components such as virtual machines, virtual switches/routers, virtual appliances, virtual applications/desktops, and hypervisors.
- The cardholder data environment is that part of the network that possesses cardholder data or sensitive authentication data.
- Adequate network segmentation, which isolates systems that store, process, or transmit cardholder data from those that do not, may reduce the scope of the cardholder data environment.

Source PCI DSS 2.0

Guidance

- All virtual components in scope
- All virtual communications and data flows must be identified and documented
- Virtualized environment must maintain proper segmentation
- Must meet intent of all 12 PCI requirements



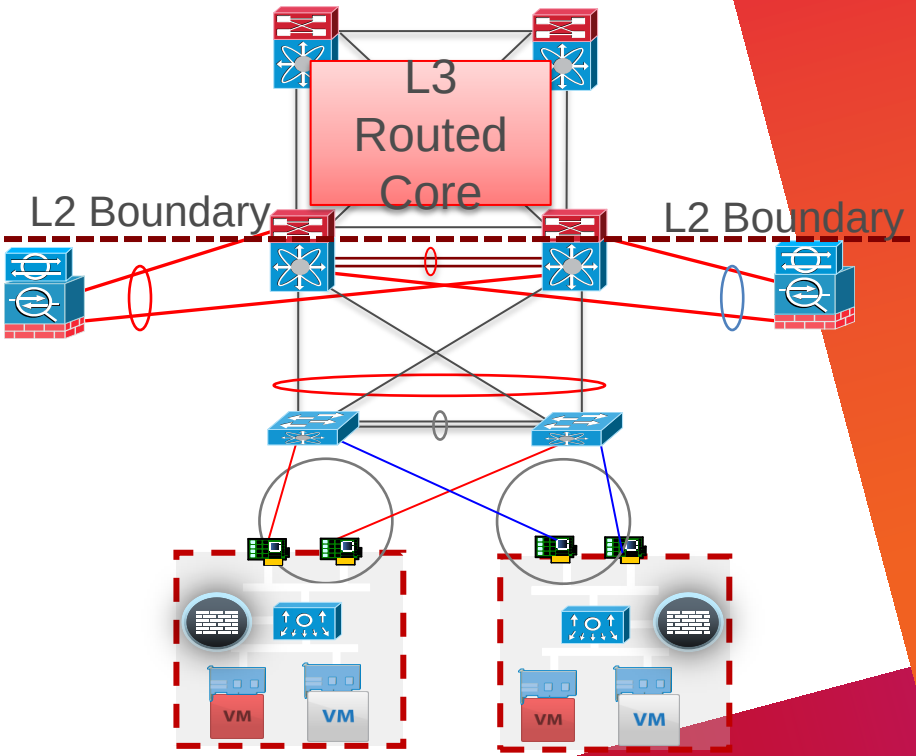
Design Details

Secure Data Center Reference Architecture

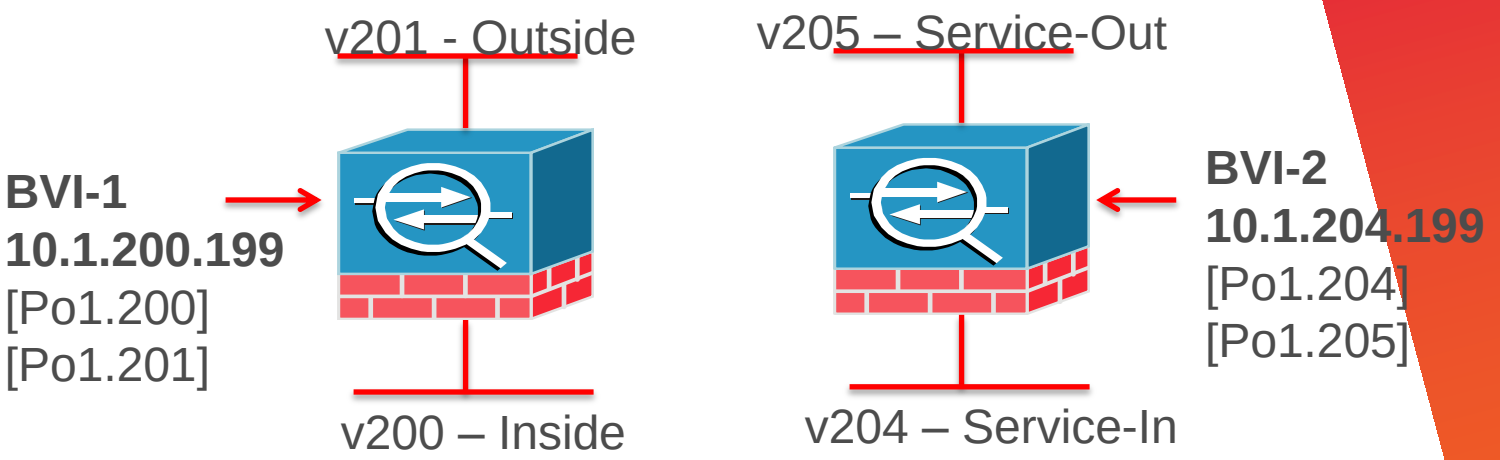
- 2x Nexus 7010s with VDCs (Core and Aggregation) (NX-OS 5.1(3))
- 2x Nexus 5Ks for top of rack
- 2x ASA 5585-60 with IPS
- 2x 6500-E with ASA-SMs
- 2x Virtual Security Gateway (VSG) in HA mode
- 2x Nexus 1000V with redundant VSMs
- Identity Services Engine (ISE) for 802.1x user AAA
- Standard VMWare ESXi Infrastructure with multiple service domains (Active Directory, DNS, VDI, etc)

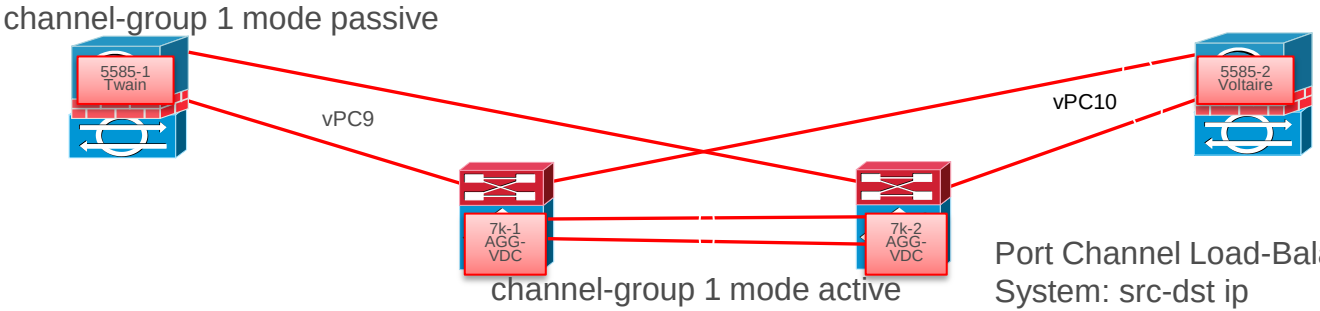
Traditional Model

- Services are Aggregated at the Distribution Layer
- Single or Multi-Tenant zone based segmentation
- Virtual Context create security zones from the DC edge to the Virtual Machine
- VRF->Firewall->VLAN->Virtual Switch->Virtual Firewall->vNIC->VM
- EtherChannel and vPC provide loop-free Layer 2 environment
- Visibility and control for vm-to-vm flows



ASA Details

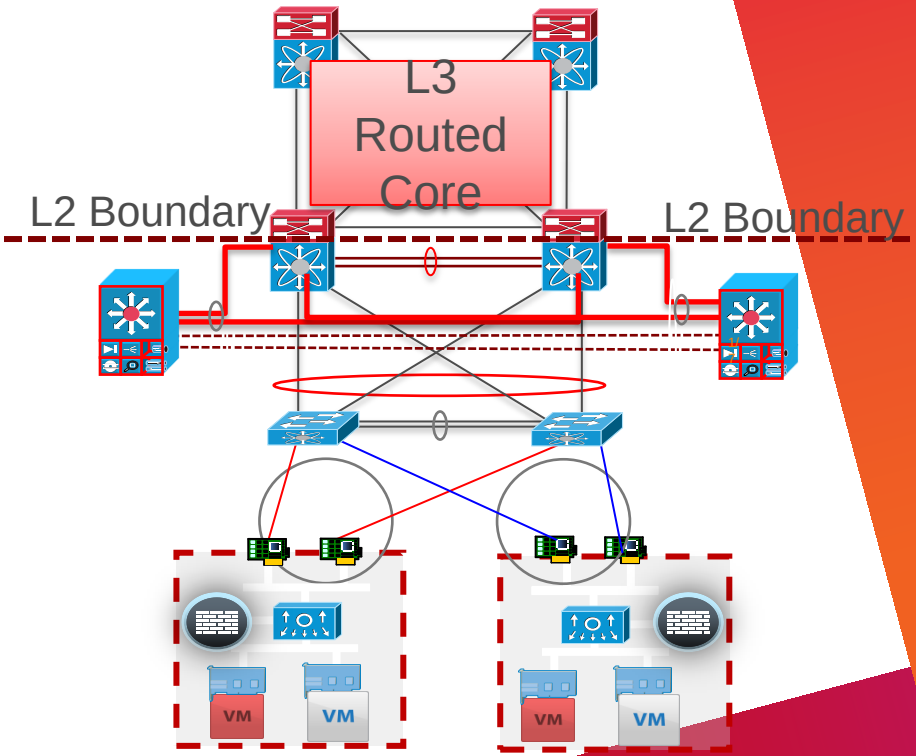




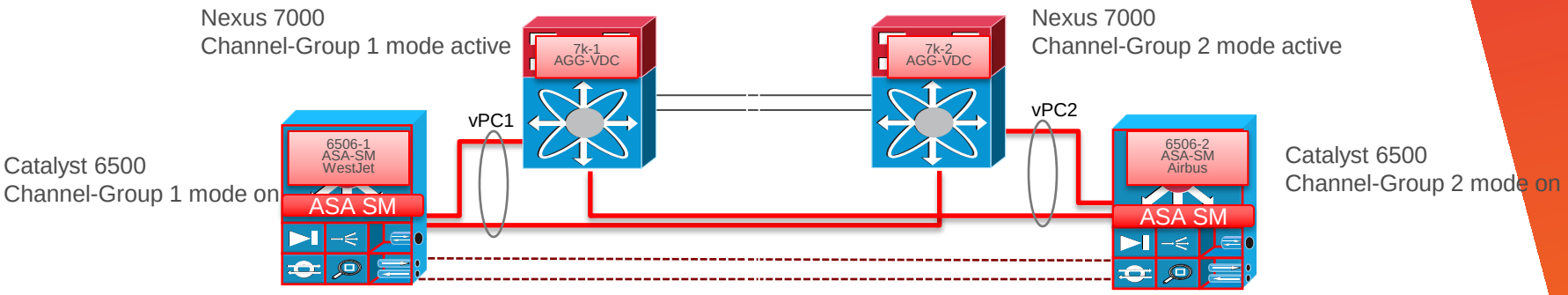
Port Channel Load-Balancing Configuration:
System: src-dst ip

Secure Service Pod Model

- Services Pod centralizes security services
- Traffic forwarded via service-specific VLANs
- Modules (Cat 6500) and appliances supported
- Highly scalable module design
- Single or Multi-Tenant zone based segmentation
- Security zones from the DC edge to the Virtual Machine

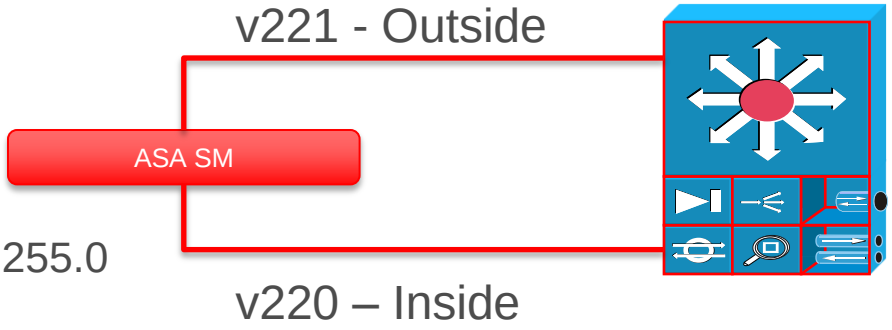


Nexus 7000 & Cat 6500 Channel Group Modes



ASA SM Layer 2 and 3

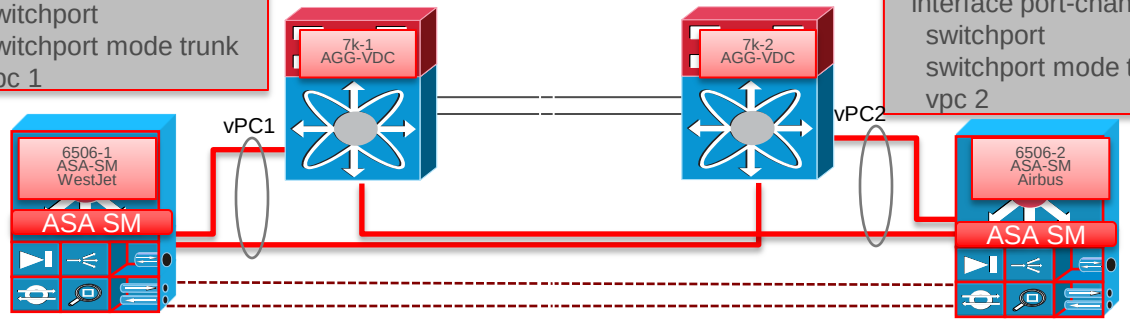
interface BVI2
 description bvi for 221 and 220
 ip address 10.1.221.199 255.255.255.0



ASA SM Details

```
interface Vlan221
  mac-address
b414.89e1.2222
  ip address
10.1.221.252/24
  hsrp 21
    preempt
    priority 105
    ip 10.1.221.254
 interface port-channel1
  switchport
  switchport mode trunk
  vpc 1
```

```
interface Vlan221
  mac-address
b414.89e1.3333
  ip address
10.1.221.253/24
  hsrp 21
    preempt
    priority 100
    ip 10.1.221.254
 interface port-channel2
  switchport
  switchport mode trunk
  vpc 2
```

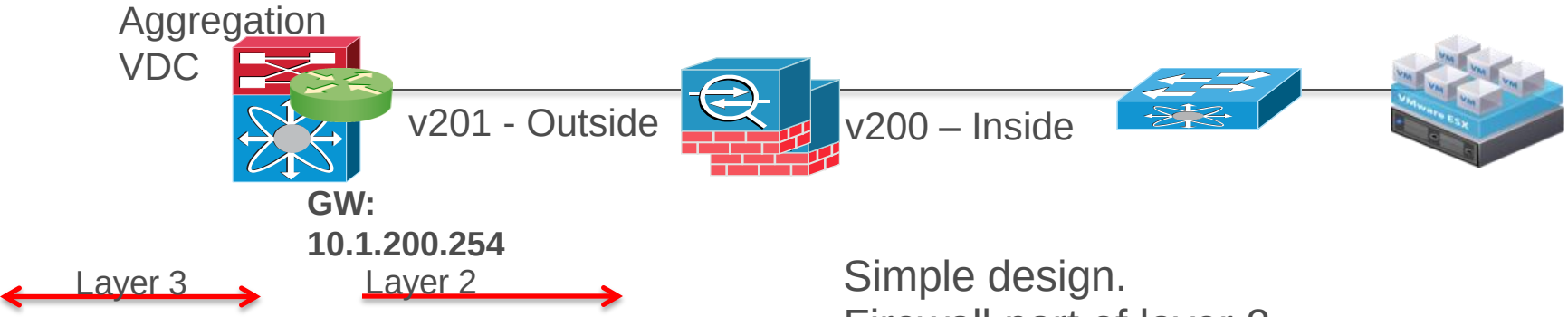



```
 BVI2
  ip address
  10.1.221.199
interface Vlan220
 nameif inside
 bridge-group 2
 security-level 100
!
interface Vlan221
 nameif outside
 bridge-group 2
 security-level 0
```

```
failover lan interface Failover Vlan44
failover link State Vlan45
failover interface ip Failover 10.90.44.1 255.255.255.0 standby 10.90.44.2
failover interface ip State 10.90.45.1 255.255.255.0 standby 10.90.45.2199
```

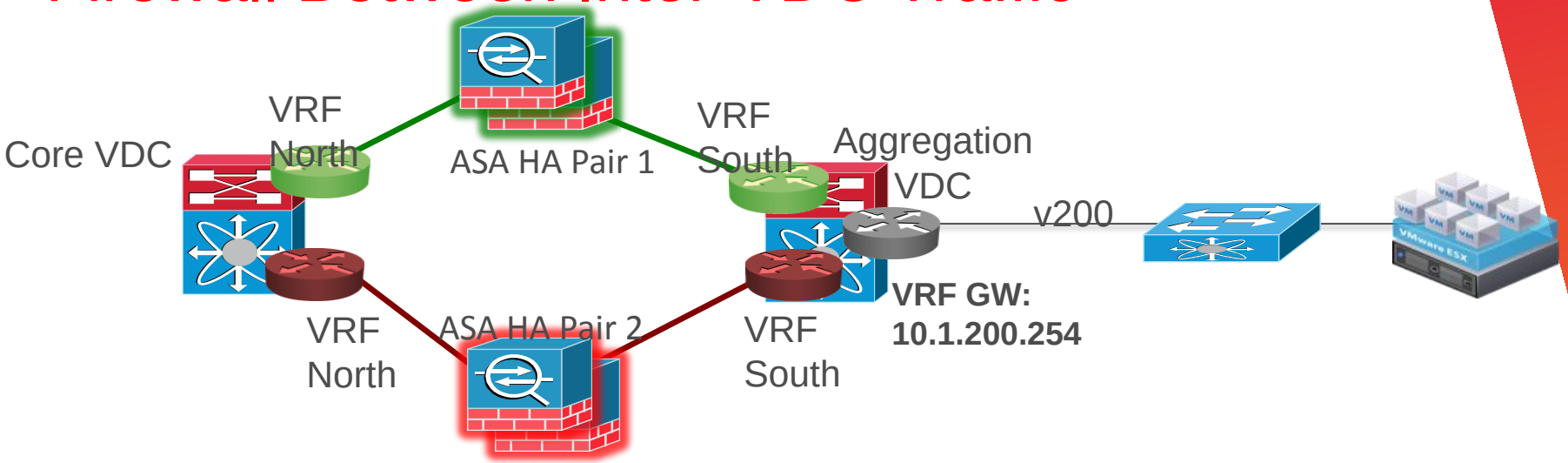
Server Gateway Outside of Firewall: Design #1

ASA HA pair in transparent mode with SVI on Aggregation VDC. Server gateway on outside of firewall



Simple design.
Firewall part of layer 2 failure domain.

ASA in the Data Center: Design #2 Firewall Between Inter-VDC Traffic



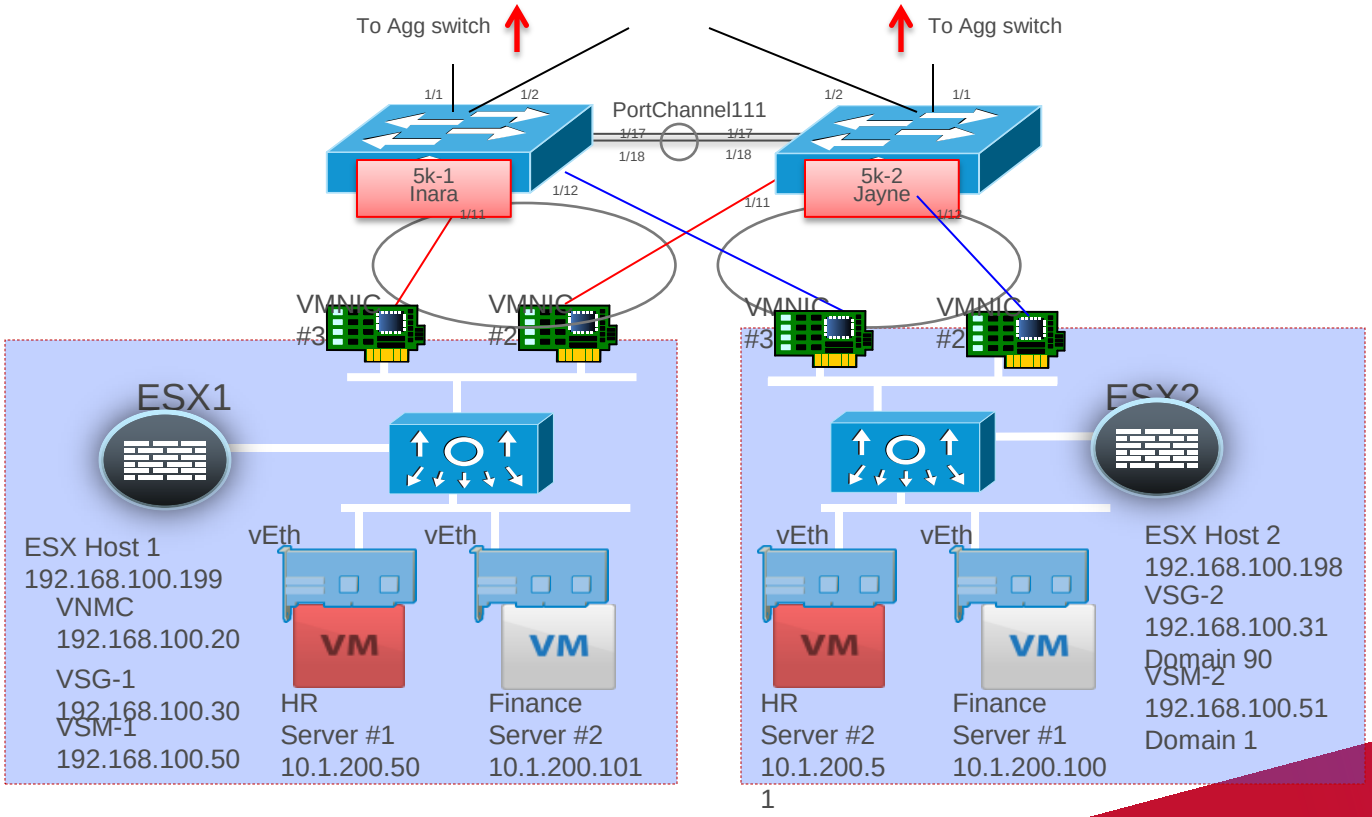
- Transparent (L2) firewall services are “sandwiched” between Nexus VDCs
- Allows for other services (IPS, LB, etc) to be layered in as needed
- ASAs can be virtualized to for 1x1 mapping to VRFs

- Useful for topologies that require a FW between aggregation and core
- Downside is that most/all traffic destined for Core traverses FW; possible bottleneck, etc

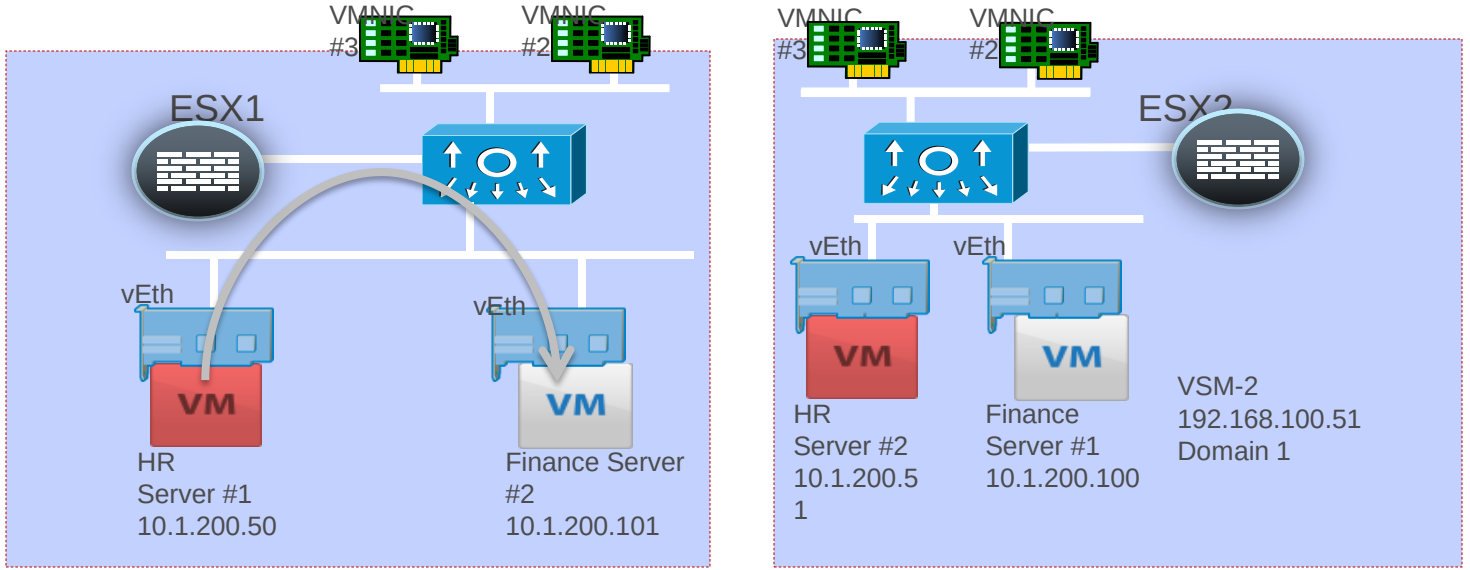
Design Details and Benefits

- Zone based differentiation, building blocks with VLANs and VRFs
  - ✓Inter-VM firewalling via VSG/ASA 1000V
  - ✓Intra-zone firewalling via both VSG/ASA 1000V and ASA/ASA-SM
  - ✓Inter-zone firewalling via ASA 1000V, ASA, or ASA-SM

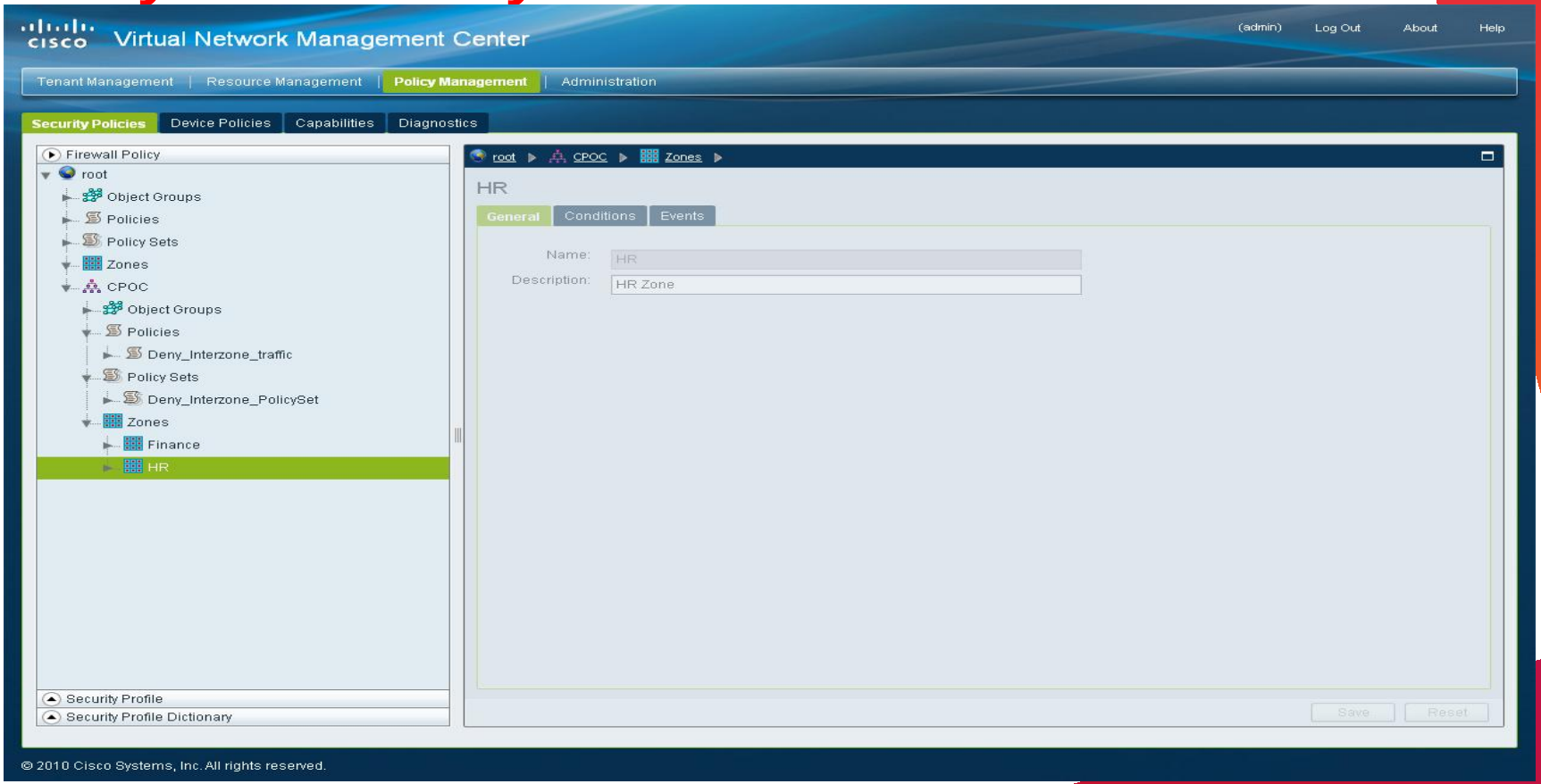
Server Access and VM Network Details



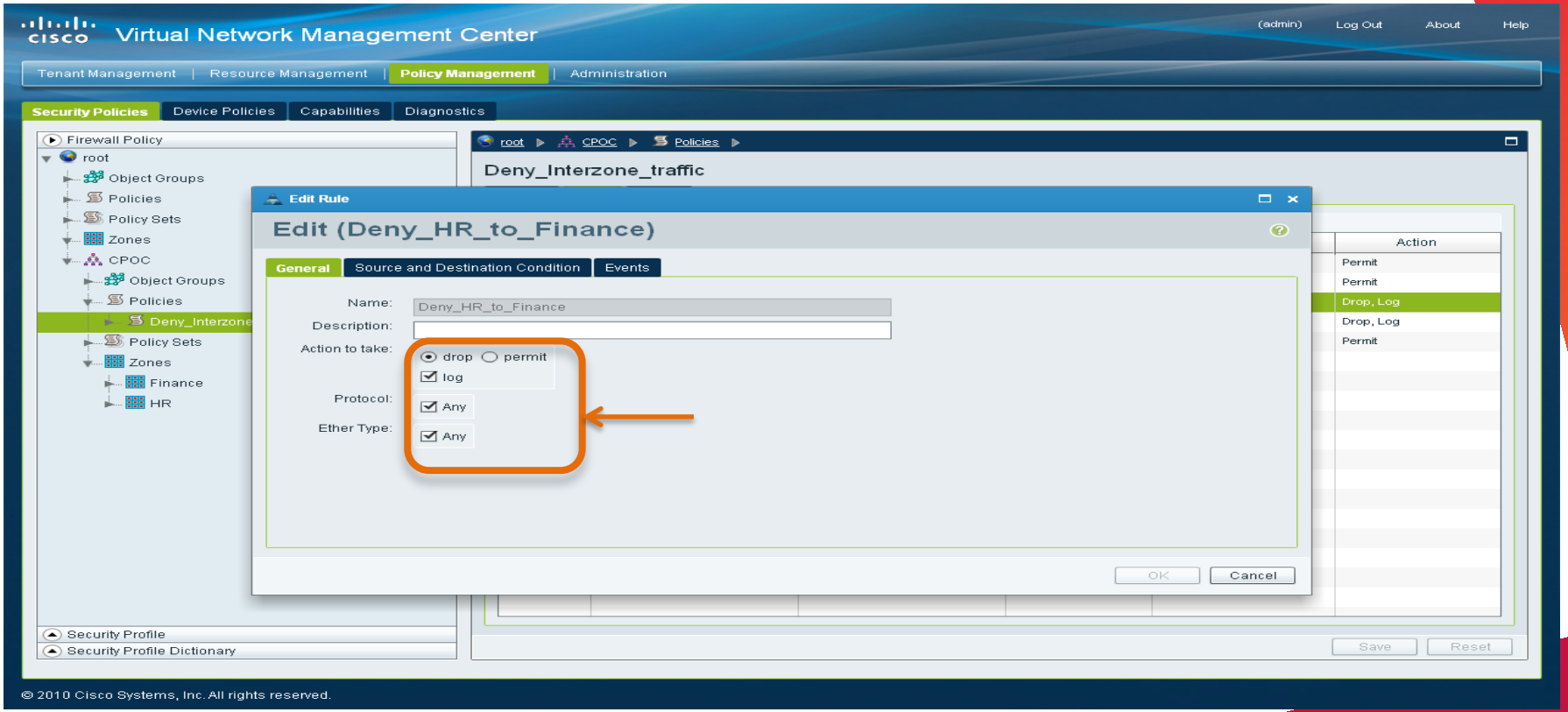
Deny HR to Finance



Policy Hierarchy



VNMC Policy: Deny HR to Finance Requests



Policy Summary on VSG

```
firewall# show running-config policy

policy default@root
  rule default/default-rule@root order 2
policy Deny_Interzone_PolicySet@root/CPOC
  rule Deny_Interzone_traffic/Permit_Finance@root/CPOC order 26
  rule Deny_Interzone_traffic/Permit_HR@root/CPOC order 51
  rule Deny_Interzone_traffic/Deny_HR_to_Finance@root/CPOC order 101
  rule Deny_Interzone_traffic/Deny_Finance_to_HR@root/CPOC order 201
  rule Deny_Interzone_traffic/Permit_All@root/CPOC order 301

firewall# show policy-engine stats

Policy Match Stats:

default@root                                    :          0
  default/default-rule@root                     :          0 (Drop)
  NOT_APPLICABLE                                :          0 (Drop)

Deny_Interzone_PolicySet@root/CPOC                                :       7703
  Deny_Interzone_traffic/Permit_Finance@root/CPOC                 :         11 (Permit)
  Deny_Interzone_traffic/Permit_HR@root/CPOC                      :          2 (Permit)
  Deny_Interzone_traffic/Deny_HR_to_Finance@root/CPOC             :          1 (Log, Drop)
  Deny_Interzone_traffic/Deny_Finance_to_HR@root/CPOC             :          2 (Log, Drop)
  Deny_Interzone_traffic/Permit_All@root/CPOC                     :       7687 (Permit)
  NOT_APPLICABLE                                                  :          0 (Drop)
```

Nexus 1000V

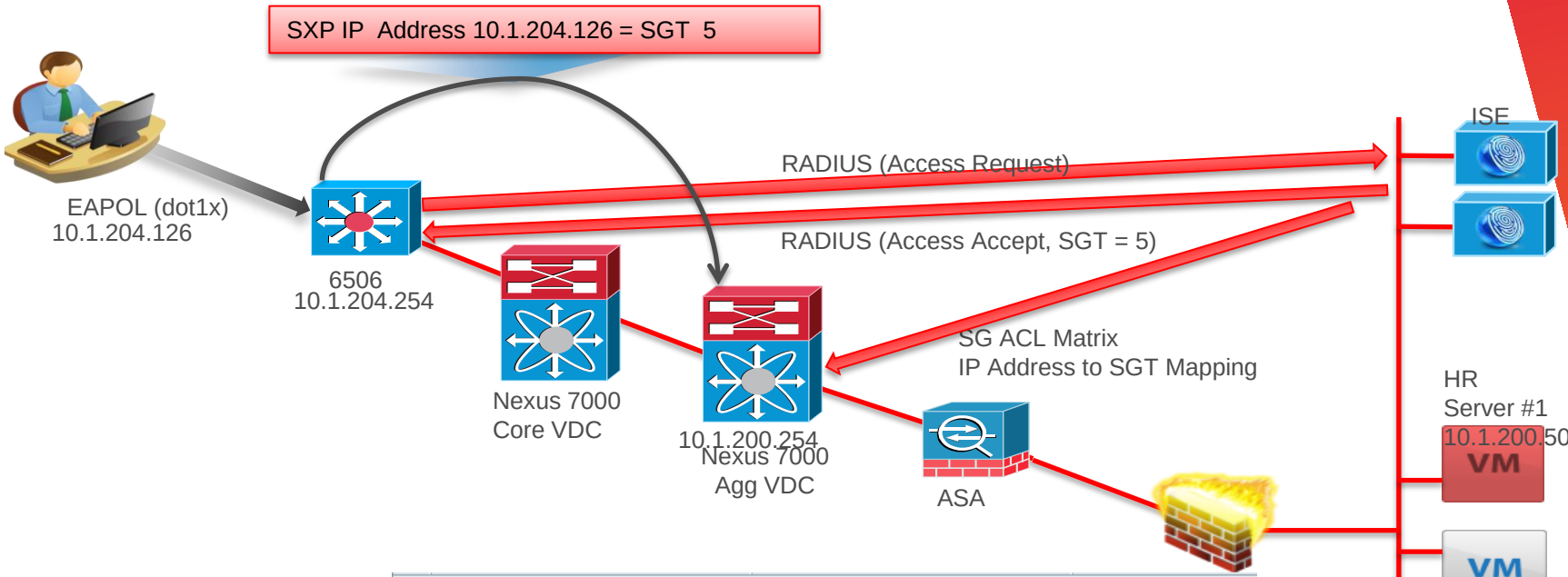
VSG

Syslog from VSG

Learn. Connect. Collaborate. together.

Adding Identity and Access Control Services : ISE and TrustSec

ISE Traffic Flow

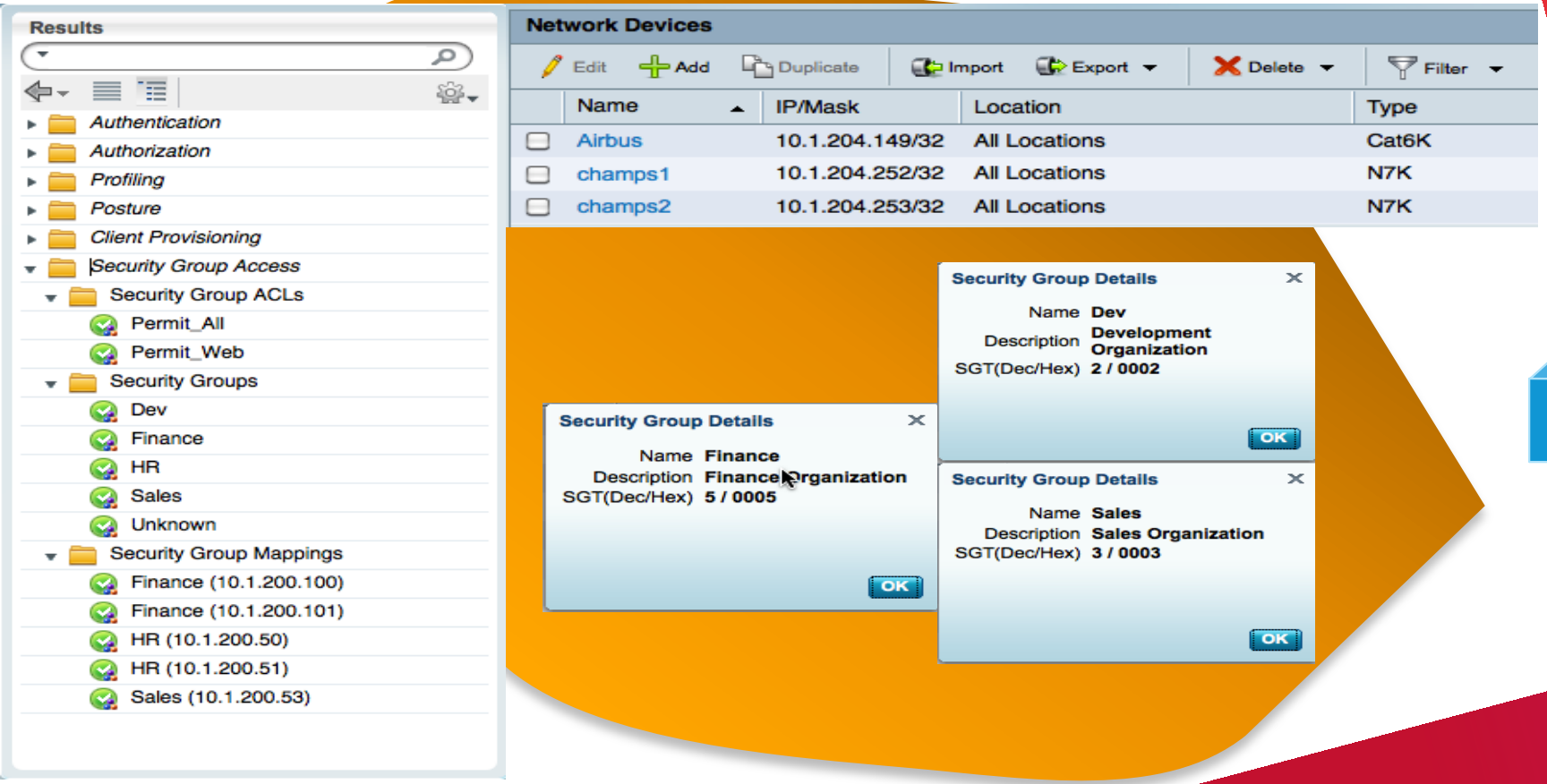


Finance → Finance ✓

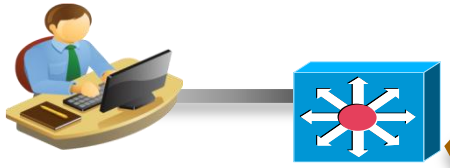
Finance → HR ✗

☐	Dev (2/0002)	Dev (2/0002)	Permit IP
☐	Finance (5/0005)	Finance (5/0005)	Permit IP
☐	HR (4/0004)	HR (4/0004)	Permit IP
☐	Sales (3/0003)	HR (4/0004)	Deny IP
☐	Sales (3/0003)	Sales (3/0003)	Permit_All,Permit IP
☐	Finance (5/0005)	HR (4/0004)	Permit_Web,Deny IP

ISE Configuration Highlights



ISE Authentication



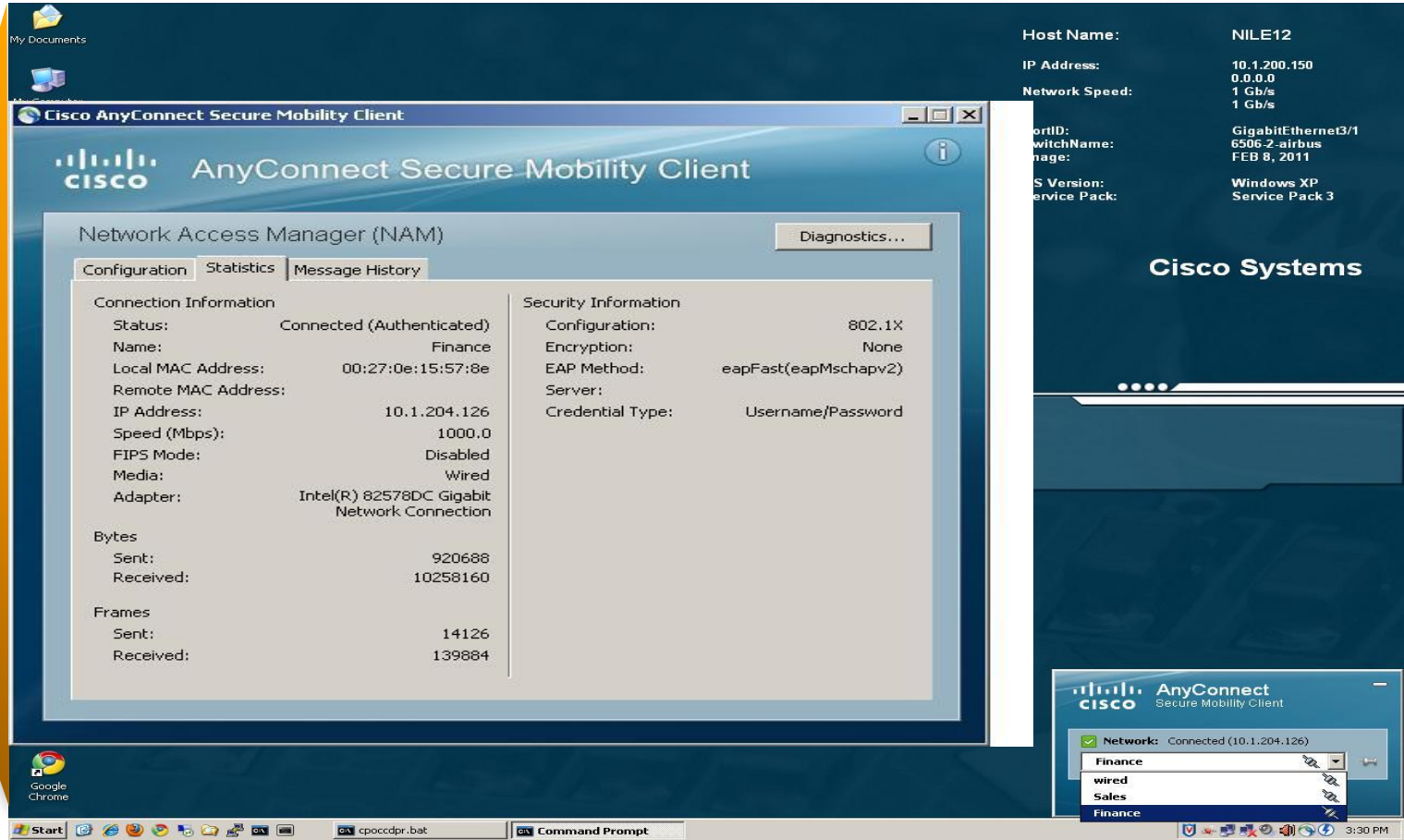
Catalyst 6500

ISE

Apr 28,11 03:31:03.651 PM finance1 00:27:0E:15:57:8E

```
6506-2-airbus#sho authen sess int g3/1
           Interface:  GigabitEthernet3/1
         MAC Address:  0027.0e15.578e
          IP Address:  10.1.204.126
           User-Name:  finance1
              Status:  Authz Success
              Domain:  DATA
      Oper host mode:  multi-auth
    Oper control dir:  both
     Authorized By:  Authentication Server
       Vlan Policy:  N/A
                SGT:  0005-0
     Session timeout:  N/A
       Idle timeout:  N/A
  Common Session ID:  0A01CC950000000D0EDFC178
    Acct Session ID:  0x0000001E
             Handle:  0xC500000D

Runnable methods list:
      Method   State
      mab      Failed over
      dot1x    Authc Success
```

AnyConnect Authenticated Client Details



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Driving Simplicity: Data Center Design – Resources from Cisco

Validated Design Guides

Design Zone

A Cisco Competitive Differentiator

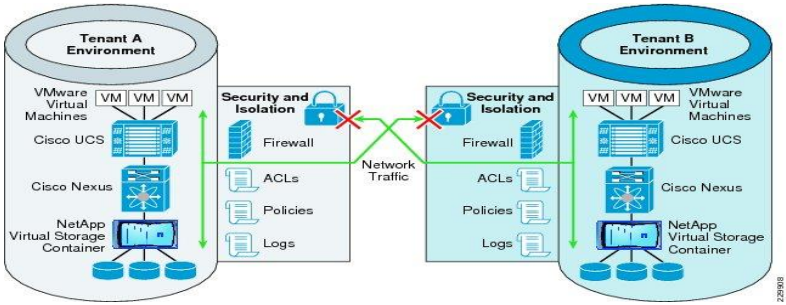
- Cisco Validated Designs are recommended, validated, end-to-end designs for next-generation networks.
- The validated designs are tested and fully documented to help ensure faster, more reliable, and more predictable customer deployments.
- 3 types of guides
  - Design Guides – comprehensive design/implementation
  - Application Deployment Guides - Third-party applications
  - System Assurance Guides - intensive, ongoing system assurance test programs targeted at major network architectures or technologies.

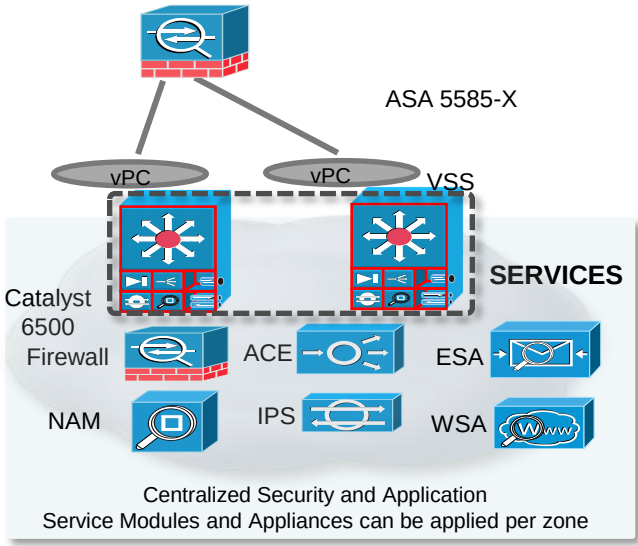
Cisco Validated Designs for the DC

- **CVD > SAFE**
- **http://www.cisco.com/en/US/docs/solutions/Enterprise/Security/SAFE_RG/SAFE_rg.pdf**

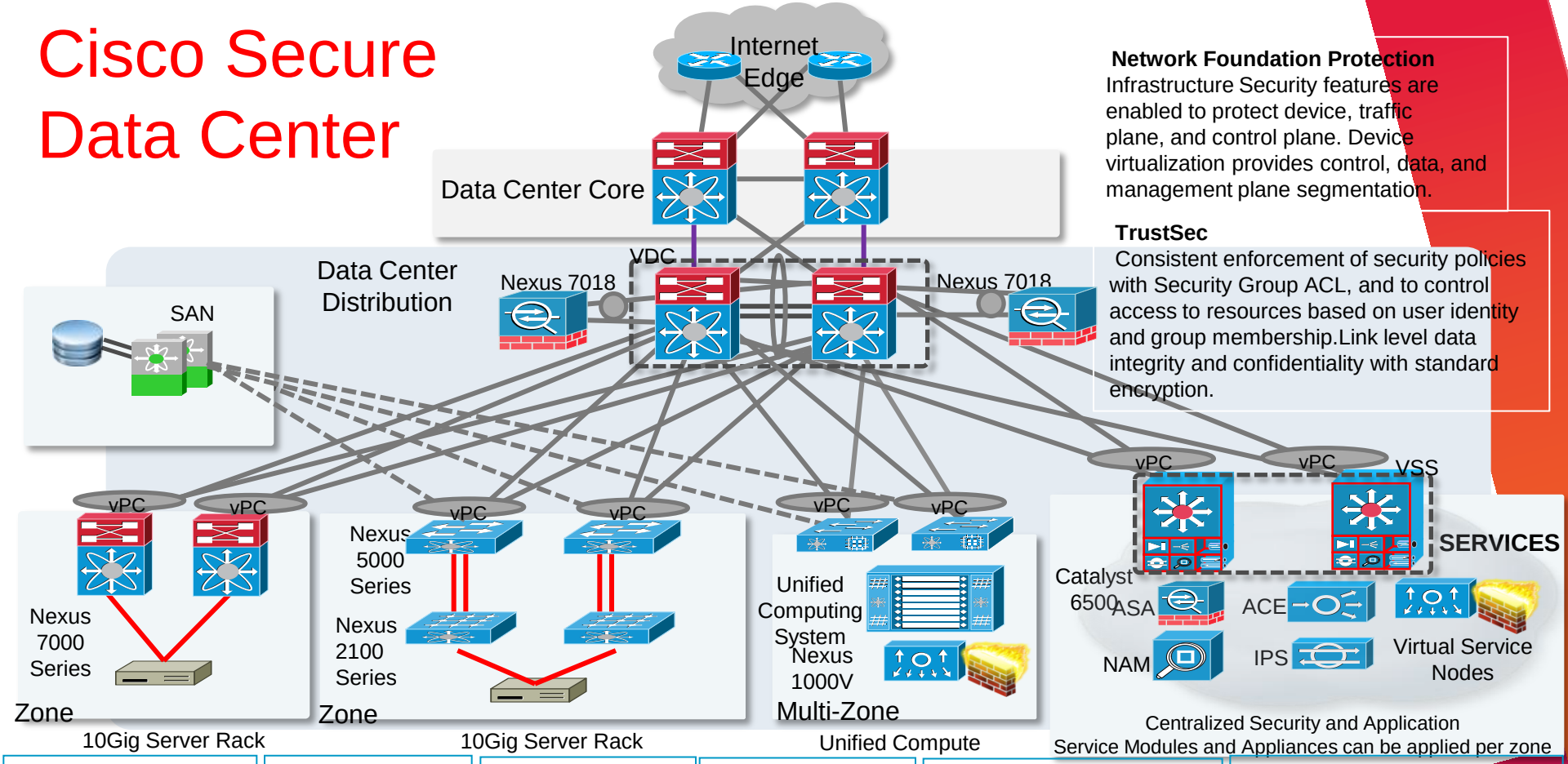
- **CVD >Virtualized Multi-Tenant Data Center (VMDC)**
- **http://www.cisco.com/en/US/partner/docs/solutions/Enterprise/Data_Center/VMDC/1.1/design.html**

- **CVD > Secure Multi Tennant CVD**
- **http://www.cisco.com/en/US/solutions/ns340/ns414/ns742/ns743/ns1050/landing_dcVDDC.html**





Cisco Secure Data Center



Network Foundation Protection
Infrastructure Security features are enabled to protect device, traffic plane, and control plane. Device virtualization provides control, data, and management plane segmentation.

TrustSec
Consistent enforcement of security policies with Security Group ACL, and to control access to resources based on user identity and group membership.Link level data integrity and confidentiality with standard encryption.

Centralized Security and Application Service Modules and Appliances can be applied per zone

Stateful Packet Filtering
Additional Application Firewall Services for Server Farm zone

Network Intrusion Prevention
IPS/IDS: provides traffic analysis and forensics

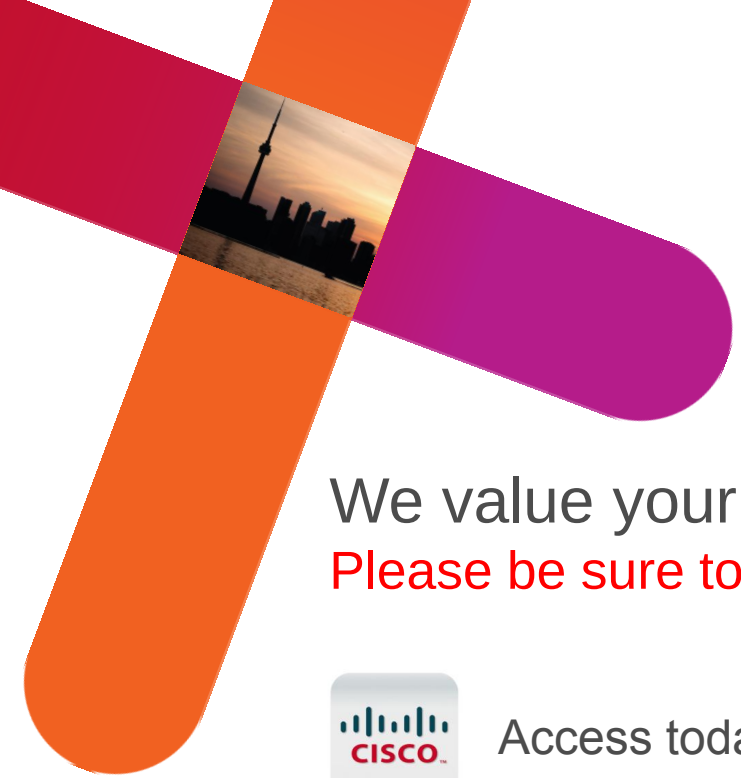
Server Load Balancing
Masks servers and applications and provides scaling

Web and Email Security
Security and filtering for Web and Email applications

Access Edge Security
ACL, Dynamic ARP Inspection, DHCP Snooping, IP Source Guard, Port Security, Private VLANs, QoS

Flow Based Traffic Analysis
NAM virtual blade. Traffic analysis and reporting, Application performance monitoring. VM-level interface statistics

Q&A



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