



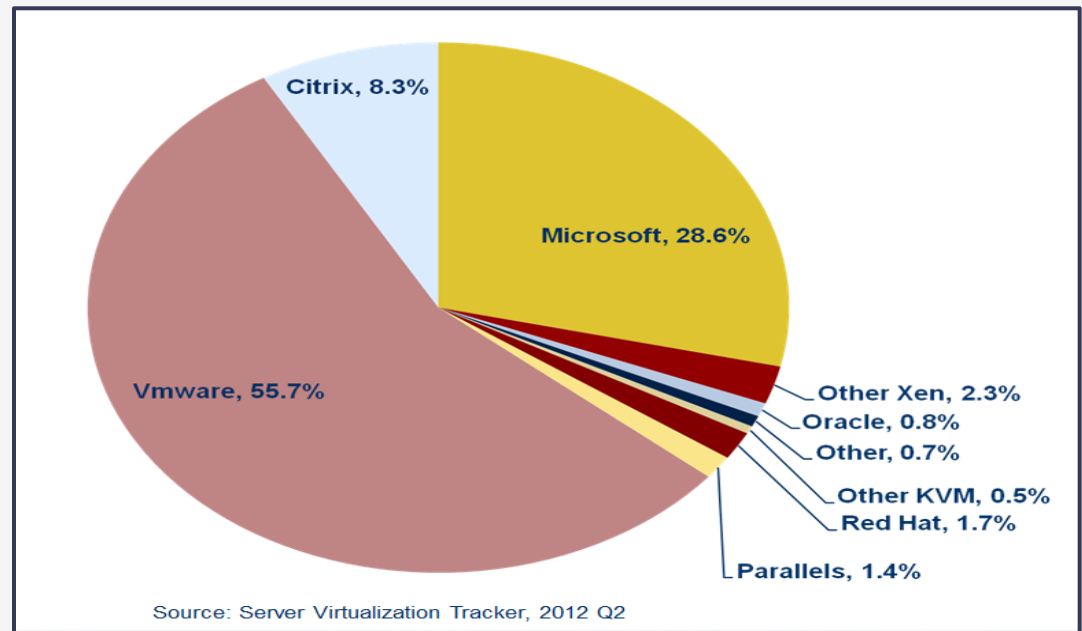
ACI Hypervisor Integration

Tiger Team Bootcamp

ACI Hypervisor Integration Overview

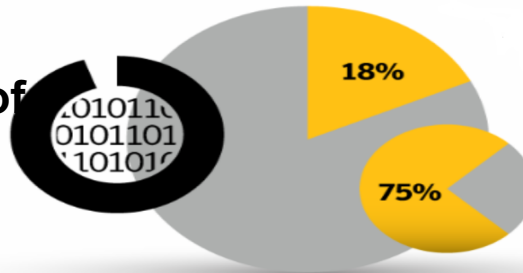
Virtualization Landscape

- VMware leading
- Microsoft Hyper-V is the biggest challenger in Enterprise space
- Red Hat gaining traction with adoption of OpenStack



Key Virtualization Trends

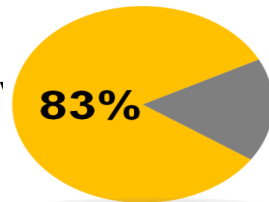
18% have virtualized the majority of their compute infrastructure



52% plan on full virtualization within two years



83% are changing hyper



83% moving to a multi-hypervisor environment

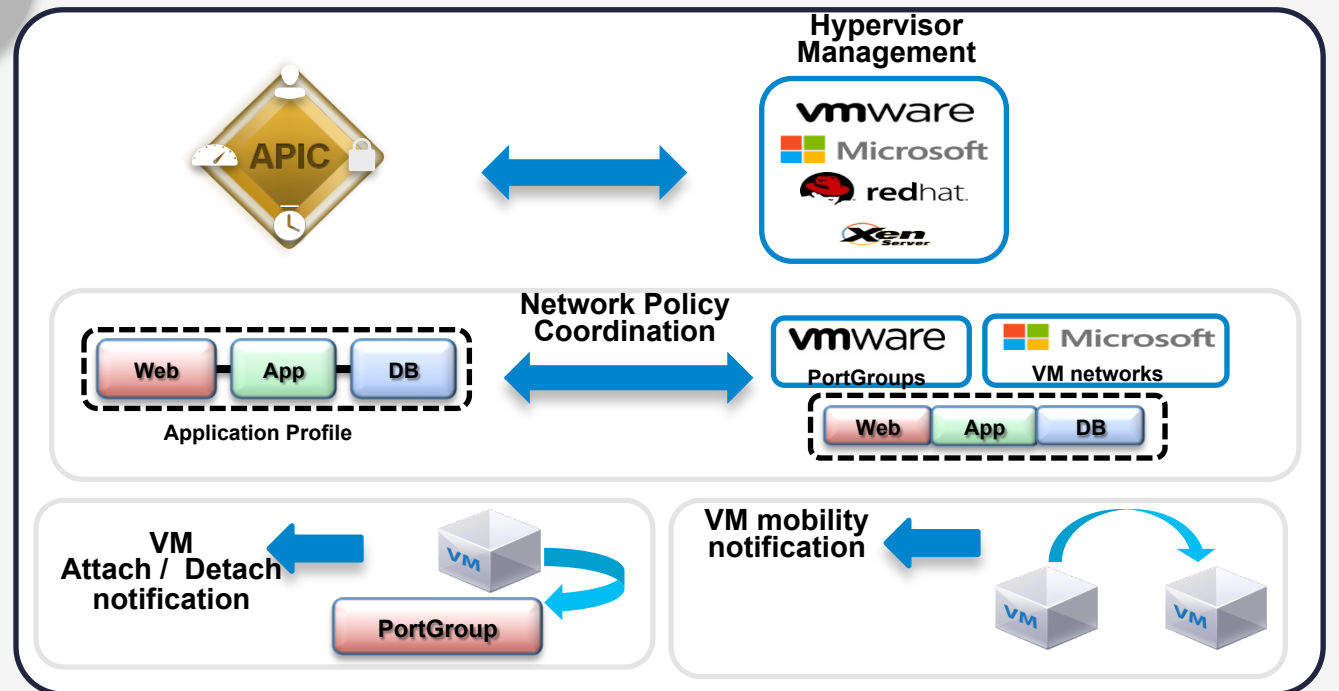
Source: Symantec's Windows Server 2012 Migration/Virtualization Survey

Policy Coordination with VM Managers

Virtual Integration

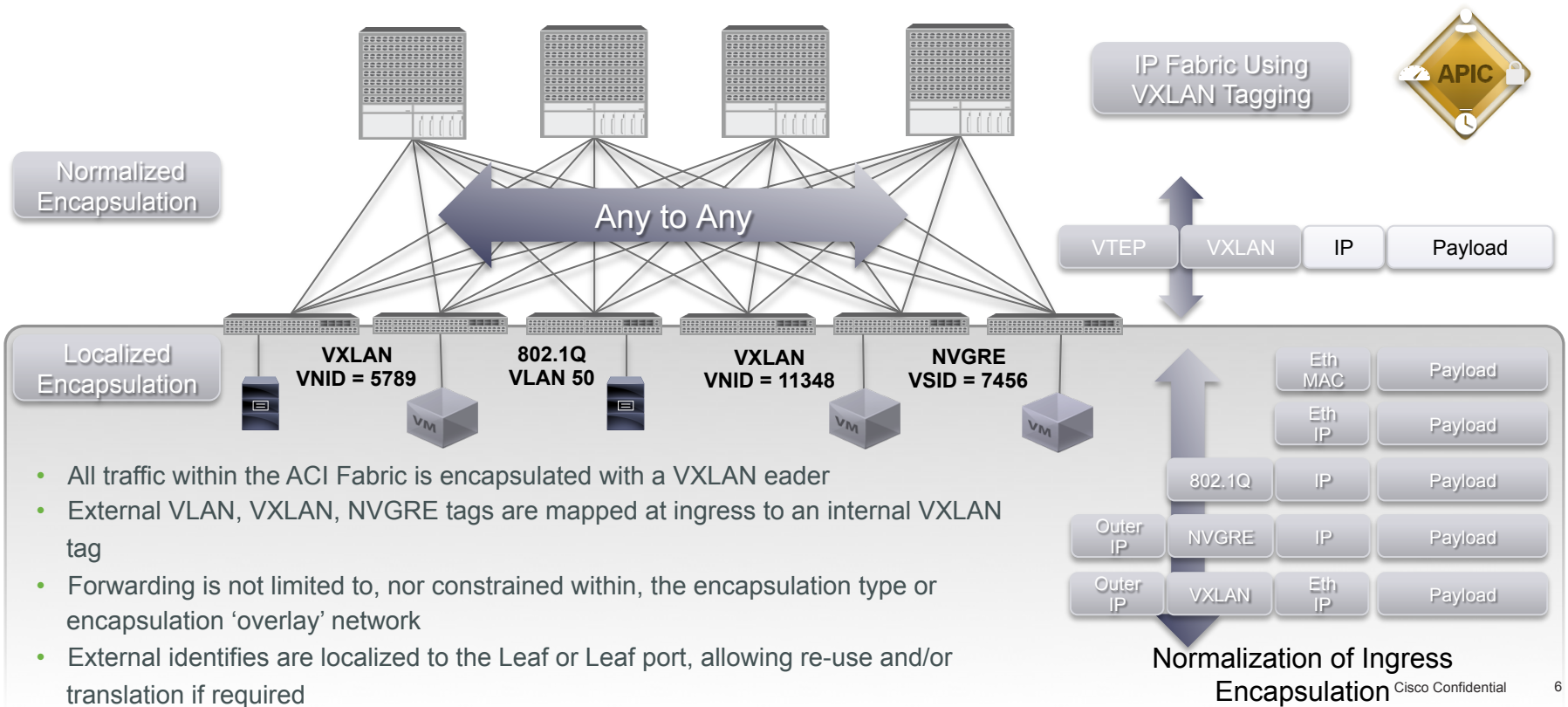


- Network policy coordination with virtualization managers
- Automatic virtual end point detection and policy placement
- Policies consistently implemented in virtual and physical
- Network policy stays sticky with VM



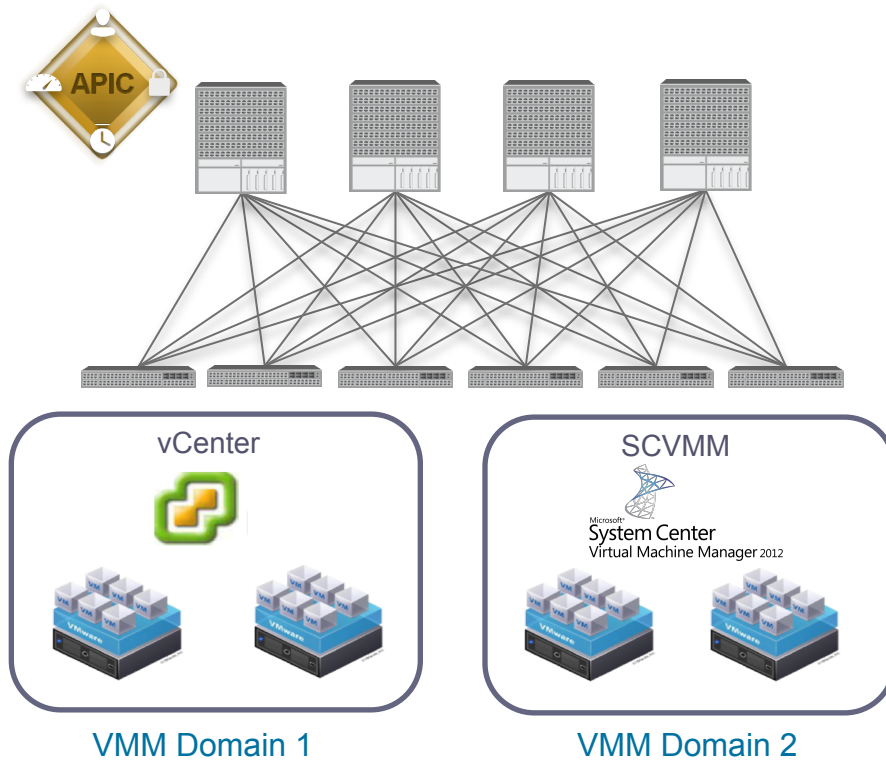
ACI Fabric – Integrated Overlay

Multi-Hypervisor Encapsulation Normalization



Hypervisor Integration with ACI

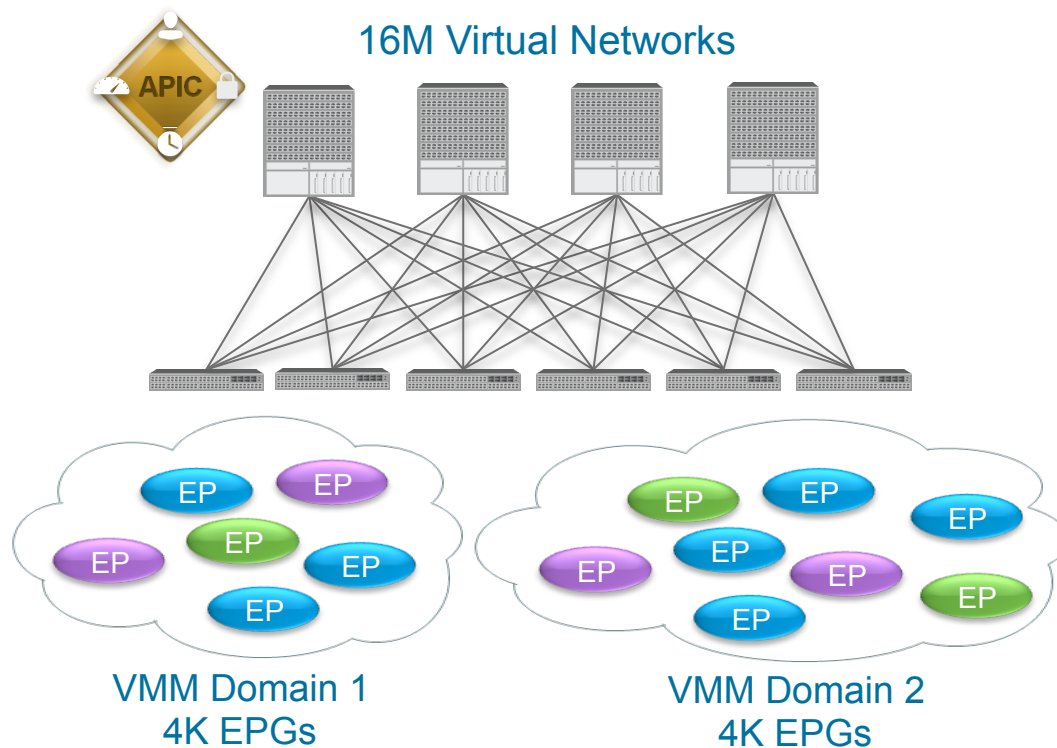
VMM Domains



- Multiple Virtual Machine Managers (VMMs) likely on a single Fabric
- Each VMM and associated Virtual hosts are grouped within APIC
- Called VMM Domain

Hypervisor Integration with ACI

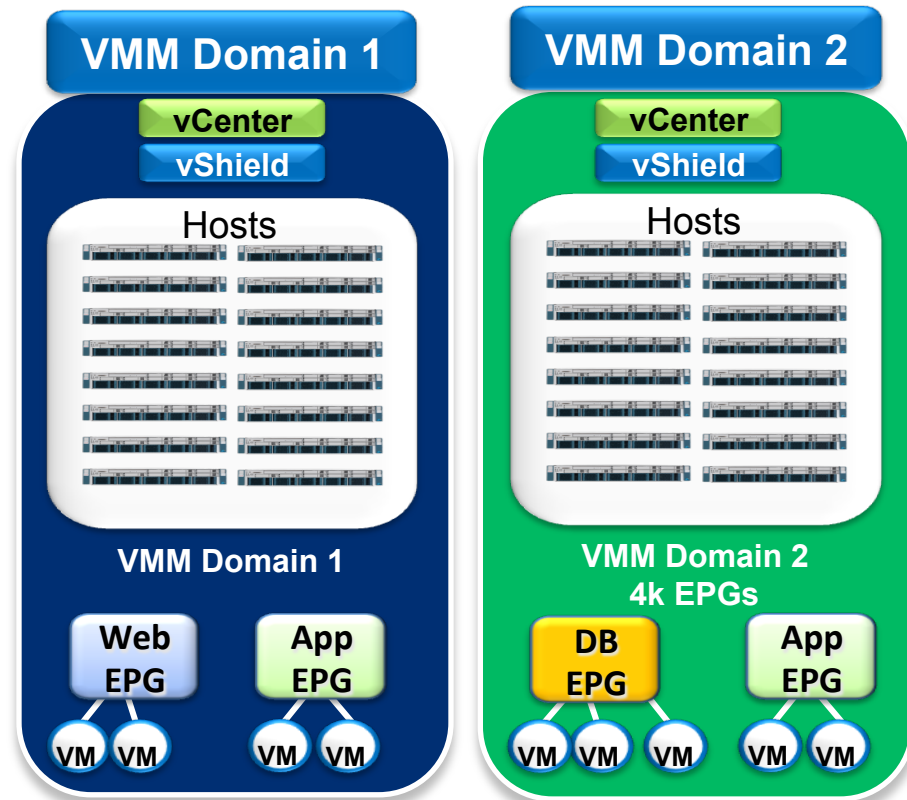
VMM Domains & VLANs



- VLAN ID only gives 4K EPGs (12 bits)
- Scale by creating “pockets” of 4K EPGs
- Map to scope of live migration
- Place VM anywhere
- Live migrate within VMM domain

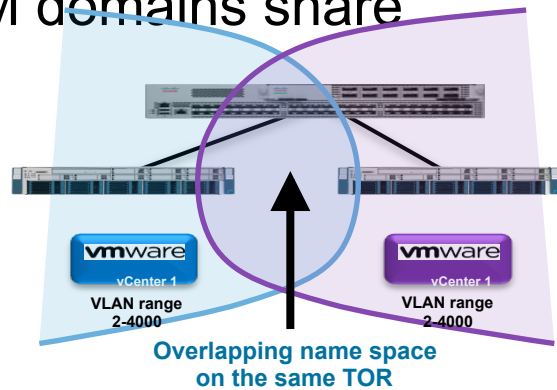
EPG Spanning across VMM Domains

- EPGs can take different network identities across VMM Domain
- Applications can be deployed across VMM Domains
- VM Mobility is not allowed between VMM Domain due to vCenter/SCVMM limitation

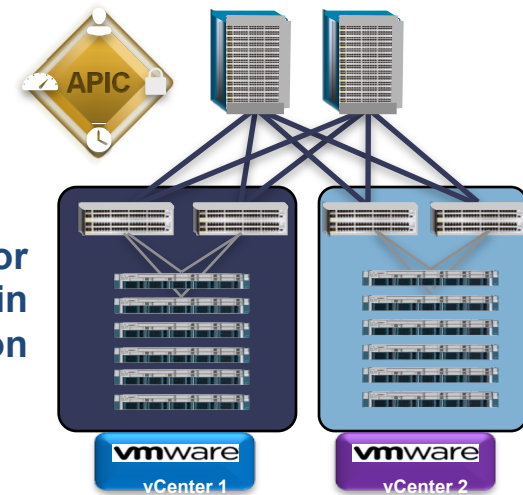


Recommended Practice for VLAN Networks

- Well separated VMM Domains
 - VLAN name space can be overlapping
- Separate VLAN name space when VMM domains share TOR



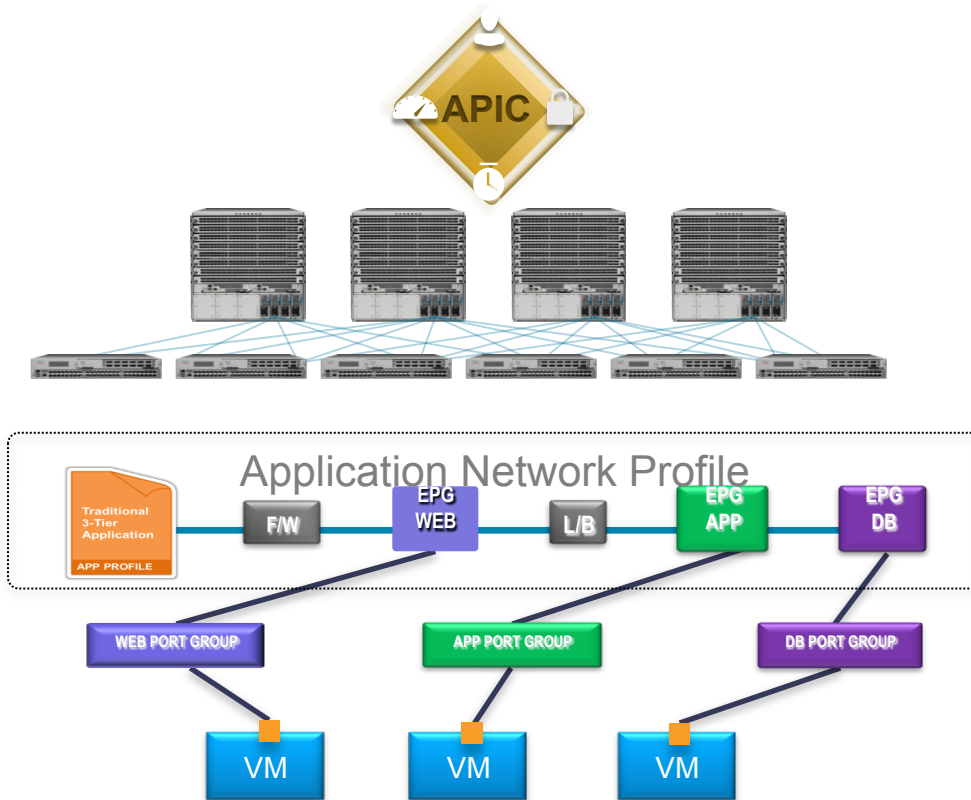
Best Practice for VMM Domain definition



VMM Definition to avoid

Integration with VMWare DVS

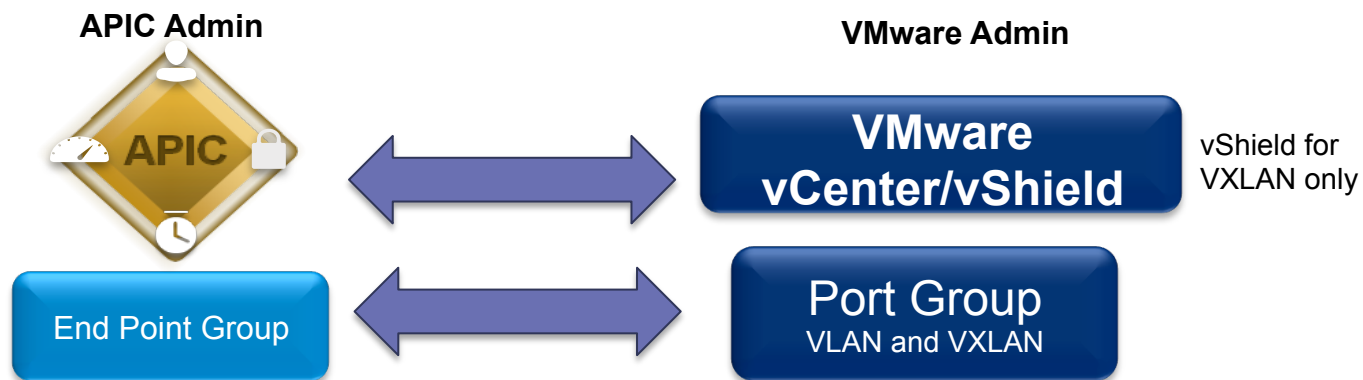
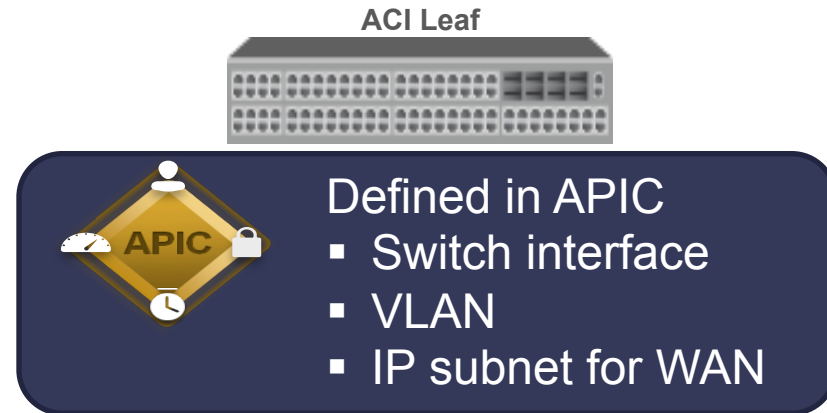
ACI Fabric and VMWare DVS Integration



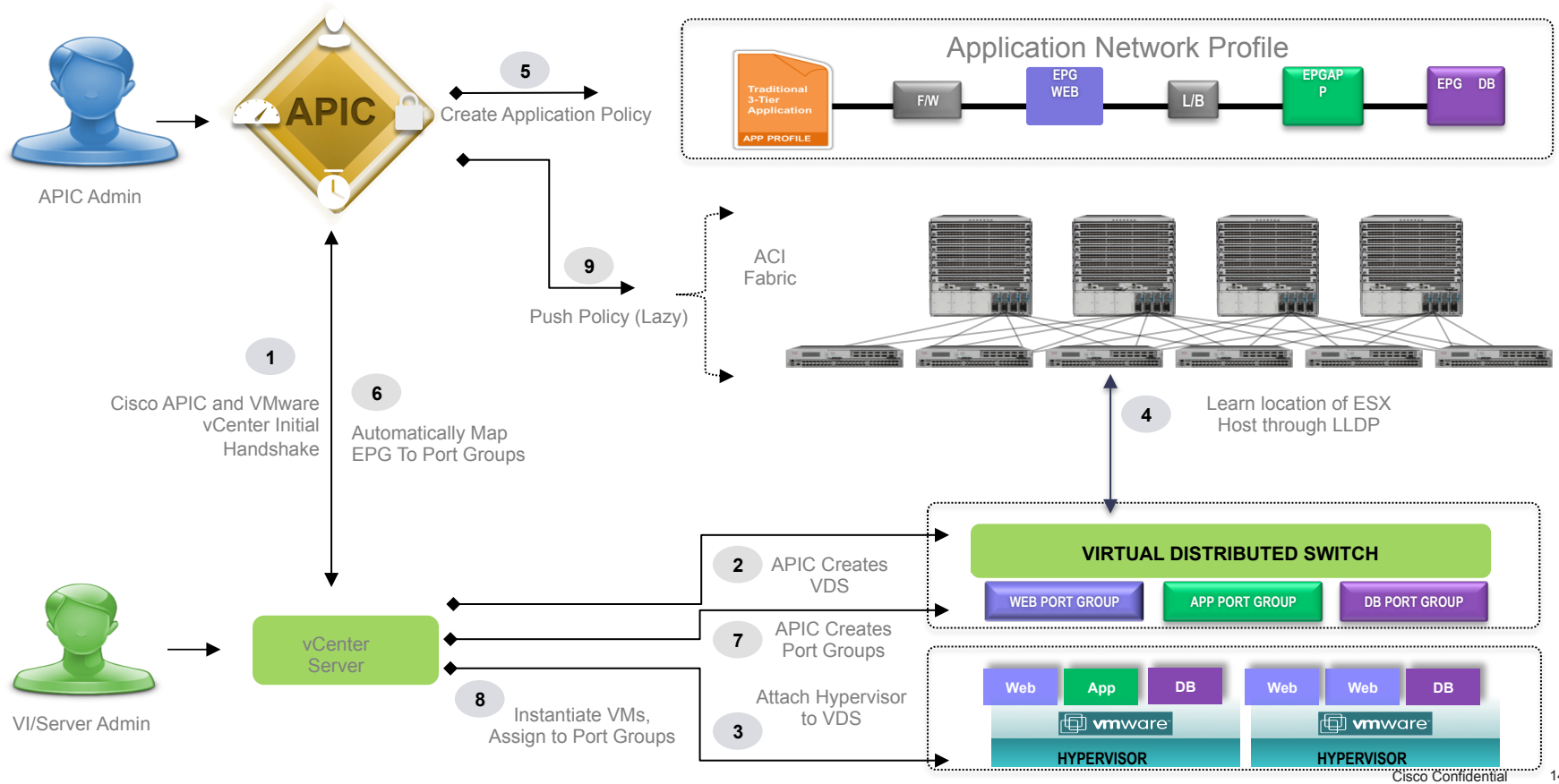
- How does ACI Fabric implement policy ?
 - Assigning EPs to EPGs
- What are EPs in virtual environment ?
 - VM vNICs
- How does VMware apply network configuration ?
 - Port Groups
- How are EPGs exposed to VMware ?
 - Map EPGs to Port Groups

End-Point identification

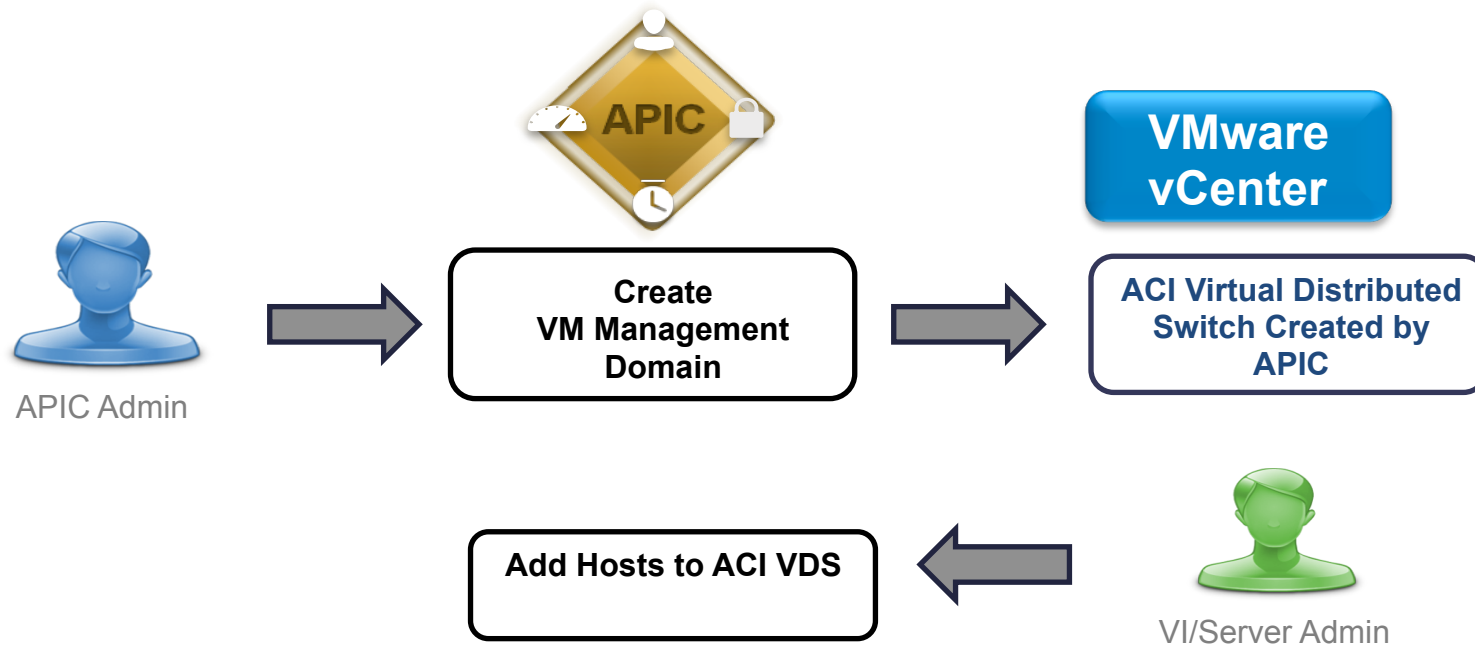
- Physical end-point
Baremetal server
- Virtual end-point



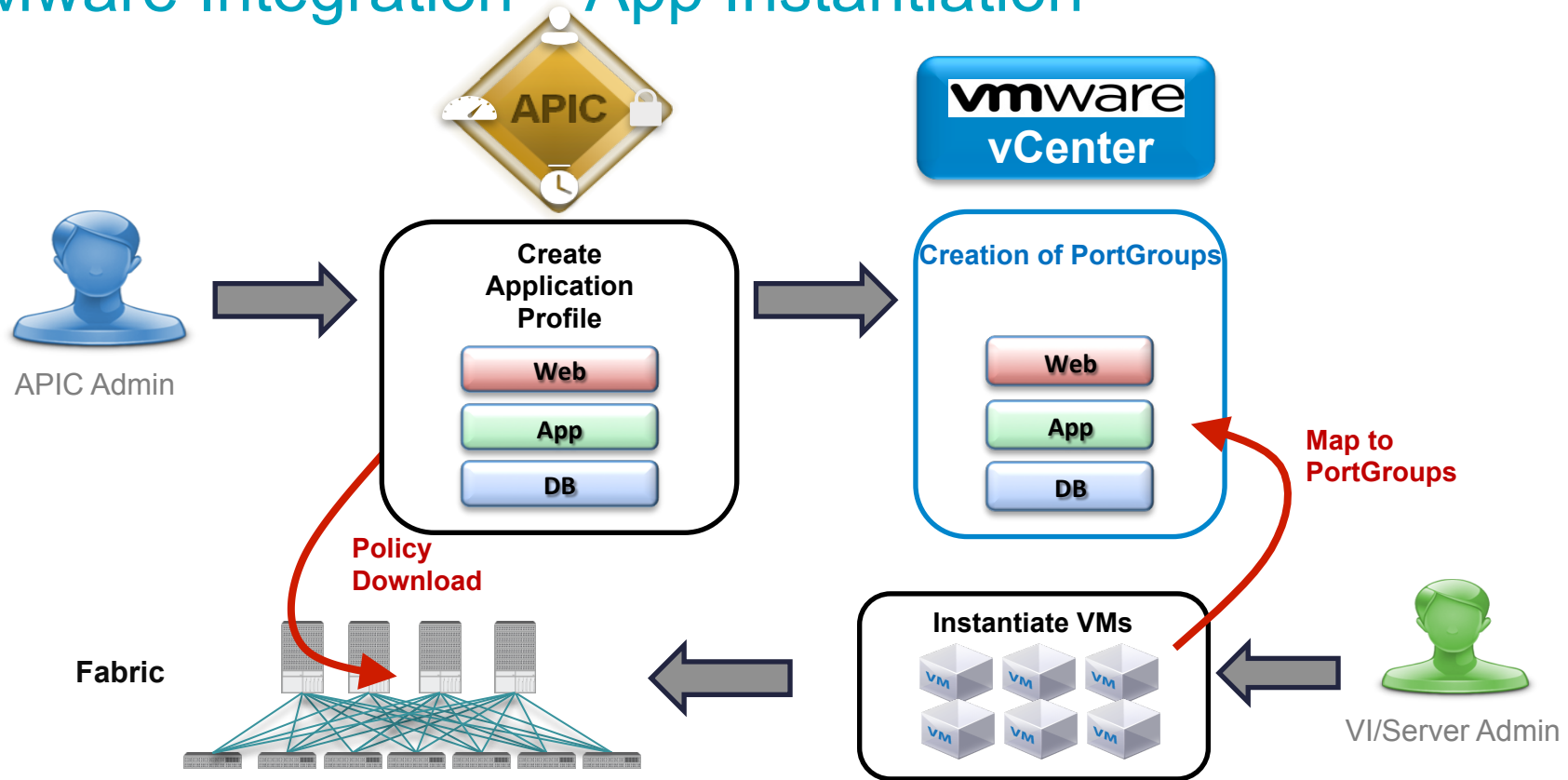
Cisco ACI Hypervisor Integration – VMWare DVS



Pre-Staging VMware Integration



VMware Integration – App Instantiation



ACI VMWare Integration – Create VMM Domain

Create vCenter Domain

The screenshot displays the Cisco APIC web interface. The main navigation bar includes SYSTEM, TENANTS, FABRIC, VM NETWORKING, L4-L7 SERVICES, and ADMIN. The current page is titled 'CREATE VCENTER DOMAIN'. The configuration window is titled 'Specify vCenter domain users and controllers' and contains the following fields and sections:

- Name:** A text input field with a red error indicator.
- Virtual Switch:** Radio buttons for 'VMWare vSphere Distributed Switch' (selected) and 'Cisco AVS'.
- Associated Attachable Entity Profile:** A dropdown menu with the text 'select or type to pre-provision'.
- VLAN Pool:** A dropdown menu with the text 'select an option'.
- vCenter Credentials:** A table with columns 'Profile Name', 'Username', and 'Description'. It is currently empty.
- vCenter vShield:** A table with columns 'Name', 'IP', 'Type', and 'Stats Collection'. It is currently empty.

At the bottom of the configuration window are 'SUBMIT' and 'CANCEL' buttons. The background shows the APIC navigation menu and a list of policies on the left side.

ACI VMWare Integration – Create VMM Domain

Create VLAN Namespace

The screenshot displays the Cisco APIC (Application Policy Infrastructure Controller) web interface. The main navigation bar includes 'SYSTEM', 'TENANTS', 'FABRIC', 'VM NETWORKING', 'L4-L7 SERVICES', and 'ADMIN'. The 'VM NETWORKING' section is active, and a 'CREATE VMM DOMAIN' dialog box is open, with the 'CREATE VLAN POOL' sub-dialog box in focus.

The 'CREATE VLAN POOL' dialog box contains the following fields and options:

- Name:** vns100
- Description:** optional
- Allocation Mode:** Dynamic Allocation, Static Allocation
- Encap Blocks:** A table with one entry:

VLAN Range
[100-199]

Buttons for 'SUBMIT' and 'CANCEL' are located at the bottom of the dialog box.

ACI VMWare Integration – Create VMM Domain

Create vCenter Credentials

The screenshot displays the Cisco APIC web interface with a modal window titled "CREATE VCENTER DOMAIN". The window is titled "Specify vCenter domain users and controllers" and contains the following configuration options:

- Name: DC1
- Virtual Switch: VMWare vSphere Distributed Switch, Cisco AVS
- Associated Attachable Entity Profile: select or type to pre-provision
- VLAN Pool: vns100-dynamic

Below these options are two tables for adding credentials and vShield information:

vCenter Credentials:

Profile Name	Username	Description
vmwareAdmin	root	

vCenter/vShield:

Name	IP	Type	Stats Collection
------	----	------	------------------

At the bottom of the modal window are "SUBMIT" and "CANCEL" buttons.

ACI VMWare Integration – Create VMM Domain

Create vCenter Controller Association

The screenshot displays the Cisco APIC web interface. The main navigation bar includes SYSTEM, TENANTS, FABRIC, VM NETWORKING, L4-L7 SERVICES, and ADMIN. The current page is titled 'CREATE VCENTER DOMAIN'. The configuration form is as follows:

Specify vCenter domain users and controllers

Name:

Virtual Switch: VMWare vSphere Distributed Switch
 Cisco AVS

Associated Attachable Entity Profile:

VLAN Pool:

vCenter Credentials:

Profile Name	Username	Description
vmwareAdmin	root	

vCenter/vShield:

Name	IP	Type	Stats Collection
vCenter	172.21.128.16	vCenter	Disabled

Buttons: SUBMIT, CANCEL

ACI VMWare Integration – Create VMM Domain

Display VMM Domain Association

The screenshot shows the Cisco APIC web interface. The browser address bar displays the URL `172.21.128.43/#fa/comp/prov-VMware/dom-DC1`. The navigation menu includes SYSTEM, TENANTS, FABRIC, VM NETWORKING, L4-L7 SERVICES, and ADMIN. The left-hand inventory tree shows a hierarchy: Quick Start, Microsoft, VMware, DC1, vCenter, Hypervisors, and three vCenter instances with IP addresses 172.21.128.61, 172.21.128.62, and 172.21.128.63. The main content area displays the configuration for the VMM Domain named DC1. The domain is associated with a vCenter server.

Domain - DC1

GENERAL | OPERATIONAL | HISTORY

PROPERTIES

Name: **DC1**

NAME	STATE	MODEL	SERIAL	REVISION
vCenter	Online	VMware vCenter Server 5.1.0 build-1364037	C974564D-0849-49F0-9564-22259A3...	5.1.0

ACI VMWare Integration – Create VMM Domain

Display new DVS on vCenter



ACI VMWare Integration – Associate EPG to VMM

Add VMM Domain Association

The screenshot displays the Cisco APIC web interface. The top navigation bar includes 'SYSTEM', 'TENANTS', 'FABRIC', 'VM NETWORKING', 'L4-L7 SERVICES', and 'ADMIN'. The 'TENANTS' tab is active, showing a tree view of the 'Tenant Coke' configuration. The 'Domains (VMs and bare metals)' section is expanded, revealing a table of VMM domains.

VMM DOMAIN	STATE
DC1	formed

The interface also shows various configuration options and a search bar for the tenant's resources.

ACI VMWare Integration – Associate EPG to VMM

Add VMM Domain Association

What is a vSphere Distributed Switch?

A vSphere Distributed Switch acts as a single virtual switch across all associated hosts. This allows virtual machines to maintain consistent network configuration as they migrate across hosts.

Distributed virtual networking configuration consists of three parts. The first part takes place at the datacenter level, where vSphere Distributed Switches are created, and hosts and distributed port groups are added to vSphere Distributed Switches. The second part takes place at the host level, where host ports and networking services are associated with vSphere Distributed Switches either through individual host networking configuration or using host profiles. The third part takes place at the virtual machine level, where virtual machine NICs are connected to distributed port groups either through individual virtual machine NIC configuration or by migrating virtual machine networking from the vSphere Distributed Switch itself.

Basic Tasks

- Add a host
- Manage this vSphere distributed switch

Recent Tasks

Name	Target	Status	Details	Initiated by	vCenter Server	Requested Start Time	Start Time	Completed Time
Add Distributed Port G...	apic/vswitch	Completed		root	localhost	2/17/2014 7:04:49 AM	2/17/2014 7:04:49 AM	2/17/2014 7:04:49 AM

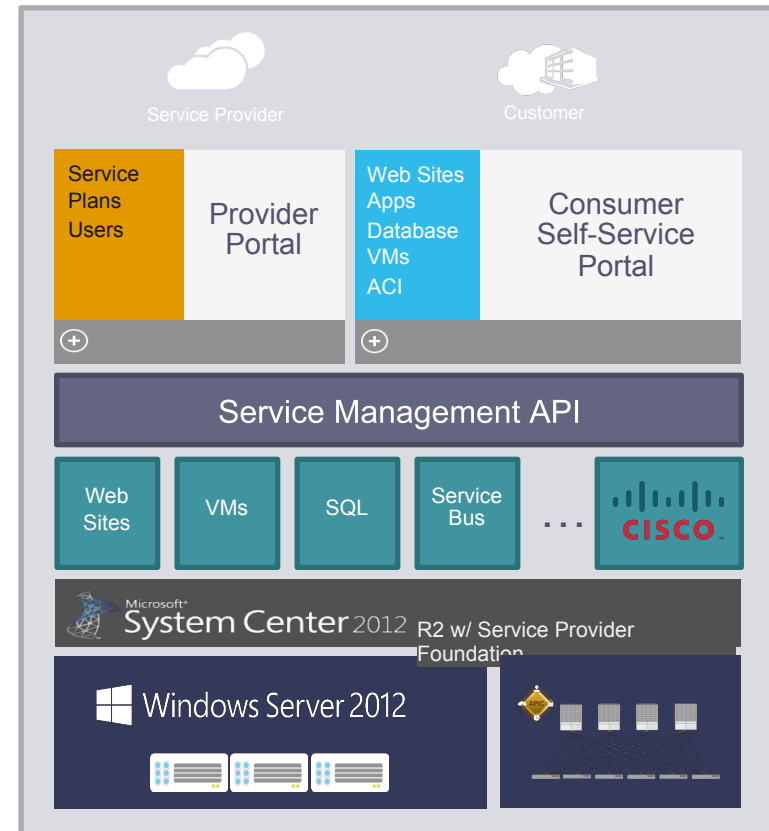
Integration with Microsoft

Microsoft integration DEMO ONLY

- Microsoft integration with fabric is a DEMO ONLY at FCS
- Integration using VLAN networking only, no NVGRE
- Full feature support is targeted for FCS+6 with SCVMM 2012

Microsoft Azure Pack Integration

- Integration with Microsoft requires:
 - Windows Server 2012
 - Systems Center 2012 R2 with SPF
 - Windows Azure Pack
- Azure Pack provides single pane of glass for Definition, creation, management of their cloud service
- Divided into Provider (Admin) portal and Consumer Self-Service (Tenant) portal



Microsoft Azure Pack Integration Admin Experience

The screenshot shows the 'Service Management Portal' for 'aci'. The top navigation bar includes 'QUICKSTART', 'TENANTS', 'PRODUCTS', 'SETTINGS', and 'CONTROLS'. The left sidebar lists various service categories: ALL ITEMS, ACI, HELLO WORLD, WEB SITE CLOUDS (0), VM CLOUDS (1), SERVICE BUS CLOUDS (0), SQL SERVERS (0), MYSQL SERVERS (0), AUTOMATION (0), PLANS (2), USER ACCOUNTS (3), and USER COSTS. A callout box points to the ACI category with the text: 'Add & Configure service providers for this deployment (APIC IP Address, Login Credentials, etc.)'. Another callout box points to the USER COSTS category with the text: 'Usage & Billing statistics per user and other admin functions'. The main content area features a large blue arrow graphic and the heading 'ACI' with the instruction 'Finish the following steps to complete your ACI setup'. Below this is a checkbox labeled 'Skip Quick Start the next time visit'. A checklist item 'Register your ACI REST endpoint' is shown with a checkmark and the subtext 'Connect the portal to your ACI resource provider.' The bottom of the interface has a '+ NEW' button and a help icon.

Microsoft Azure Pack Integration

Tenant Experience

Service Management Portal | admin@pepsi.com

ALL ITEMS

- ACI NETWORKS
- VIRTUAL MACHINES
- SQL SERVER DATABASES
- MY ACCOUNT

aci networks

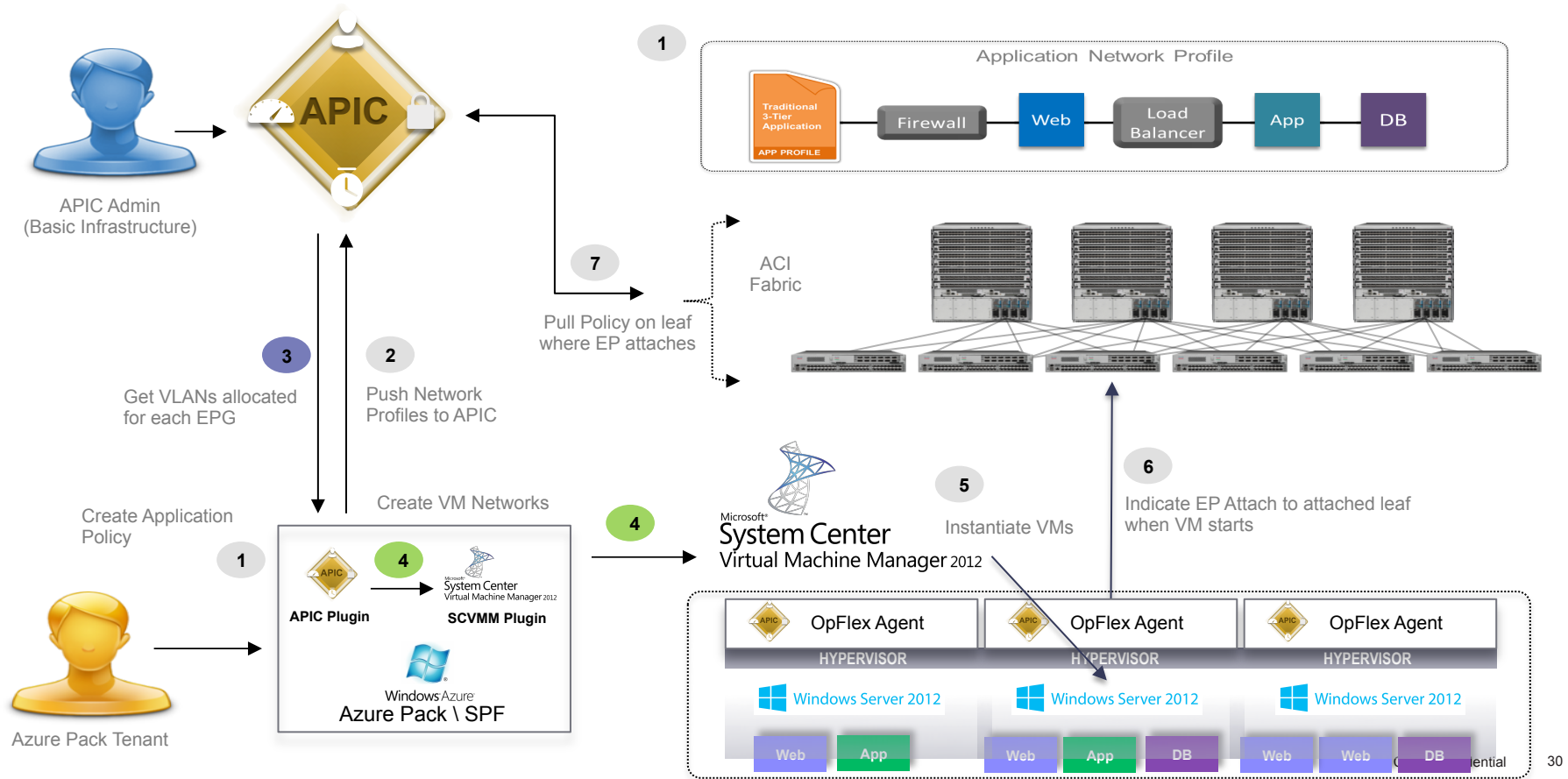
ENDPOINT GROUP	TENANT	SUBSCRIPTIONID	VLAN
PepsiHr-InsiemePortal-WEB	PepsiHr	94a3bd30-9bdb-4d89-a623-0851ef776bba	13
PepsiHr-InsiemePortal-APP	PepsiHr	94a3bd30-9bdb-4d89-a623-0851ef776bba	9
PepsiEng-InsiemePortal-APP	PepsiEng	94a3bd30-9bdb-4d89-a623-0851ef776bba	10
PepsiEng-InsiemePortal-WEB	PepsiEng	94a3bd30-9bdb-4d89-a623-0851ef776bba	5

Services this account has access to

Resources of ACI service currently created and consumed by this tenant

Application Network Profiles are created through Azure Pack, and pushed to APIC using REST APIs

ACI Azure Pack Integration

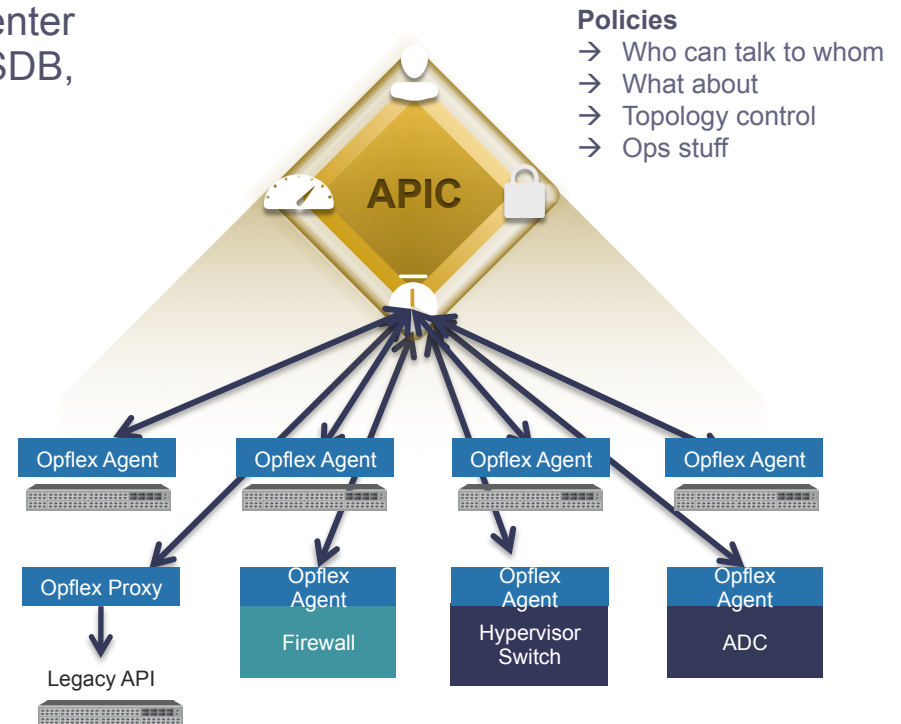


Integration with OpFlex

OpFlex – A Flexible, Extensible Policy Protocol

OPFLEX is a new extensible policy resolution protocol designed for declarative management of any datacenter infrastructure. Unlike legacy protocols such as OVSDB, OPFLEX was designed to offer:

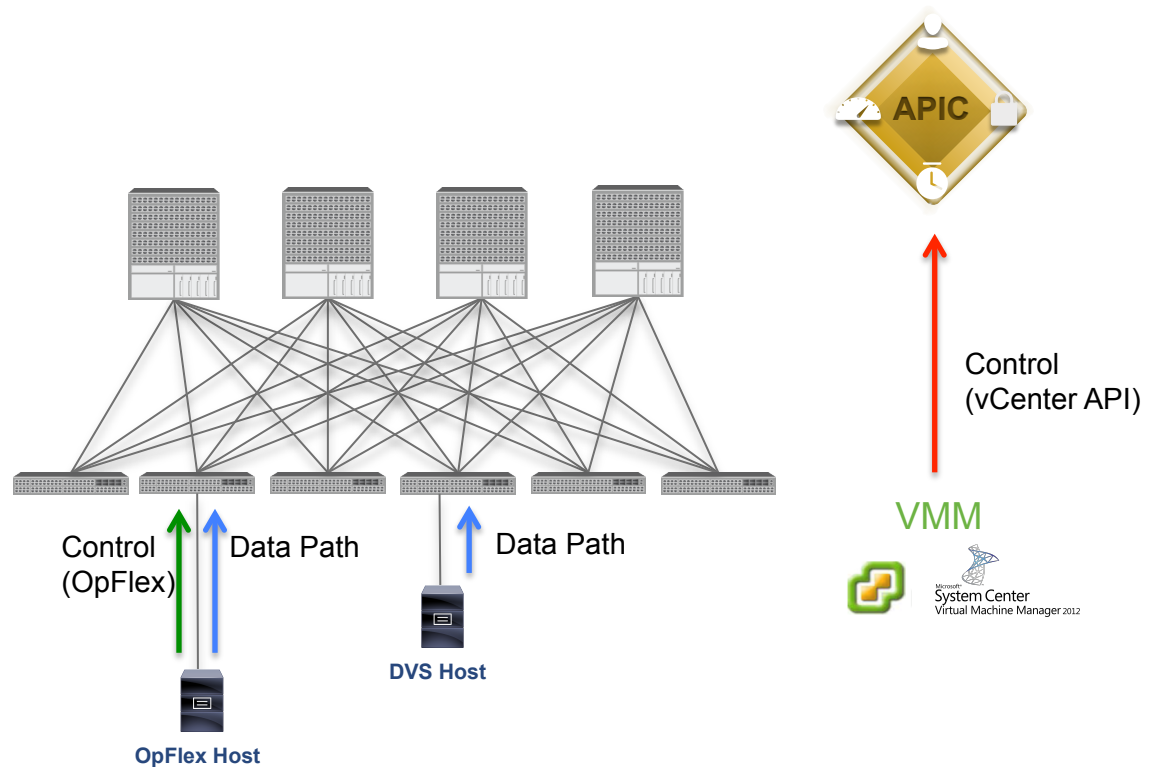
- Declarative resolution – Push + Pull API support
- Abstract policies rather than device-specific configuration
- Flexible, extensible definition of using XML / JSON
- Support for any device – vswitch, physical switch, network services, servers, etc.



Hypervisor Integration with ACI

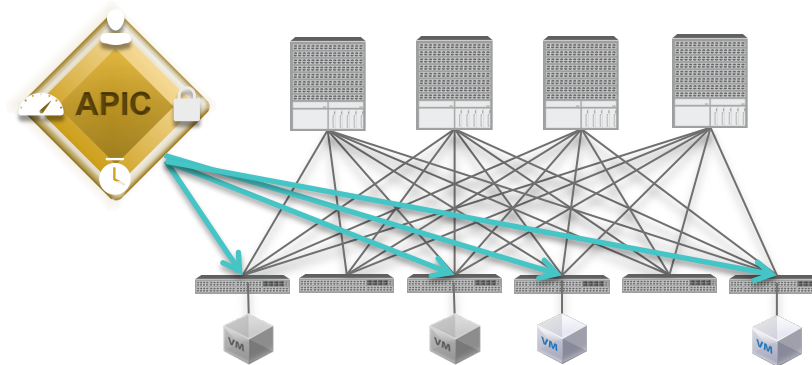
Endpoint Discovery

- Virtual Endpoints are discovered for reachability & policy purposes via 2 methods:
- Control Plane Learning:**
 - Out-of-Band Handshake: vCenter APIs
 - Inband Handshake: OpFlex-enabled Host (N1KV, Windows Server 2012, etc.)
- Data Path Learning:**
Distributed switch learning



Hypervisor Integration with ACI

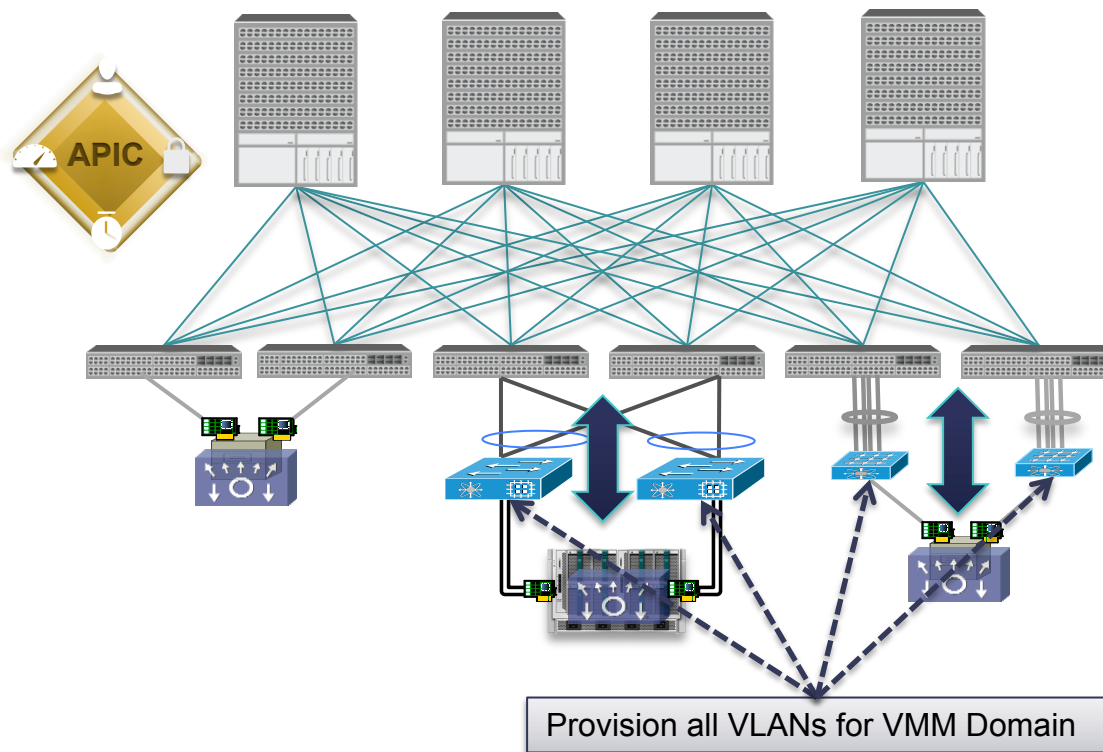
Policy Resolution Immediacy



- Policies are pushed to Leaf nodes based on Resolution Immediacy defined upon association of EPG to VMM Domain
 - **Immediate:** All policies (VLAN / NVGRE / VXLAN bindings, Contracts, Filters) pushed to leaf node upon Hypervisor pNIC attachment. LLDP or OpFlex used to resolve Hypervisor to Leaf node attachment.
 - **Lazy:** Policies only pushed to leaf node upon pNIC attachment AND vNIC association with port-group (EPG)
- Policy programming in Leaf node hardware based on Instrumentation Immediacy
 - **Immediate:** Policies programmed in Policy CAM once received by APIC as defined by Resolution Immediacy Policy
 - **Lazy:** Policies programmed in hardware Policy CAM only when reachability is learnt through data path

Design Considerations

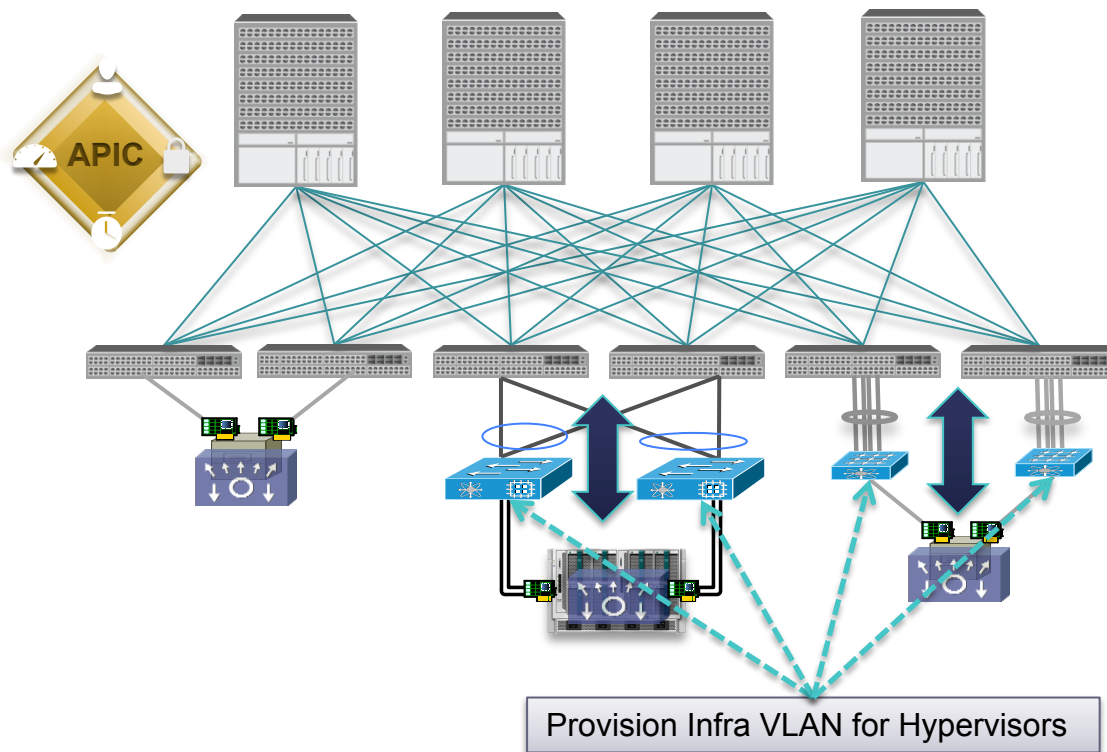
VLAN-Based Hypervisor Networks



- Hosts are assigned VLAN ID to EPG binding through VMM & APIC Integration
- Intermediate L2 nodes not managed – need to manage VLANs on these for each VMM Domain
- Endpoint location discovered through “stitching” LLDP TLVs (non OpFlex-enabled Hosts)

Design Considerations

VXLAN & NVGRE-based Hypervisor Networks



- Hosts are assigned VNID and VSID to EPG binding through VMM & APIC Integration
- Infra-VLAN is extended out to front-panel tenant ports - Infra-VLAN needs to be provisioned on intermediate L2 Nodes
- Endpoint location discovered through “stitching” LLDP TLVs (non OpFlex-enabled Hosts)

Roadmap Virtualization Integration

Fabric FCS

VMware

- VMware vCenter and vCNS 5.1/5.5
- Network Policy coordination
- VM Attach event detection and policy placement
- VMotion event detection and network policy mobility
- VM network stats collection

Microsoft - **Demo only, no production release**

- Network Policy coordination with SCVMM 2012
- VM attach/detach, VM Mobility event detection and policy placement

Nexus 1000V

- Non-switching and local switching modes
- OpFlex policy model implementation
- APIC Network policy extension into N1KV
- APIC centralized controller for N1KV VEMs

Fabric FCS+6

VMware

- VMware 2014

Microsoft

- SCVMM 2014 vNext+

KVM OVS with OpenStack Integration

Integration Features comparison between VMware, MS and OpenStack

	VMware	Microsoft	OpenStack
Products APIC integrated with	VMware vCenter, vShield, vCloud Director 5.1	System Center Virtual Machine Manager (SCVMM 2012)	Havana Release
Networks	VLAN and VxLAN	VLAN only Demo at Fabric FCS	VLAN & VXLAN using Quantum Provider network extension
Network Policy coordination	APIC creating a PortGroup in vCenter/ vShield for VLAN and VxLAN networks	VM Networks in SCVMM	OpenStack Quantum plug-in creating APIC Application profiles APIC EPG mapping to networks & Security Groups
VM Movement detection and network policy mobility	vCenter notification to APIC and detection on the wire	Via Insieme Host Agent installed in Hyper-V relaying VM mobility notification	
VM attach to networks detection	vCenter notification to APIC and detection on the wire	Via Insieme Host Agent installed in Hyper-V relaying VM attach/detach events	Via the Quantum Plug-in
VM Network Statistics collection	VM health, status, statistics Per EPG stats		Via OpenStack Ceilometer
Application Visibility	Per application, knowledge of all end points (virtual and physical) attached to EPGs and L4-7 Services	Per application, knowledge of all end points (virtual and physical) attached to EPGs and L4-7 Services	Per application, knowledge of all end points (virtual and physical) attached to EPGs and L4-7 Services

Thank you.

