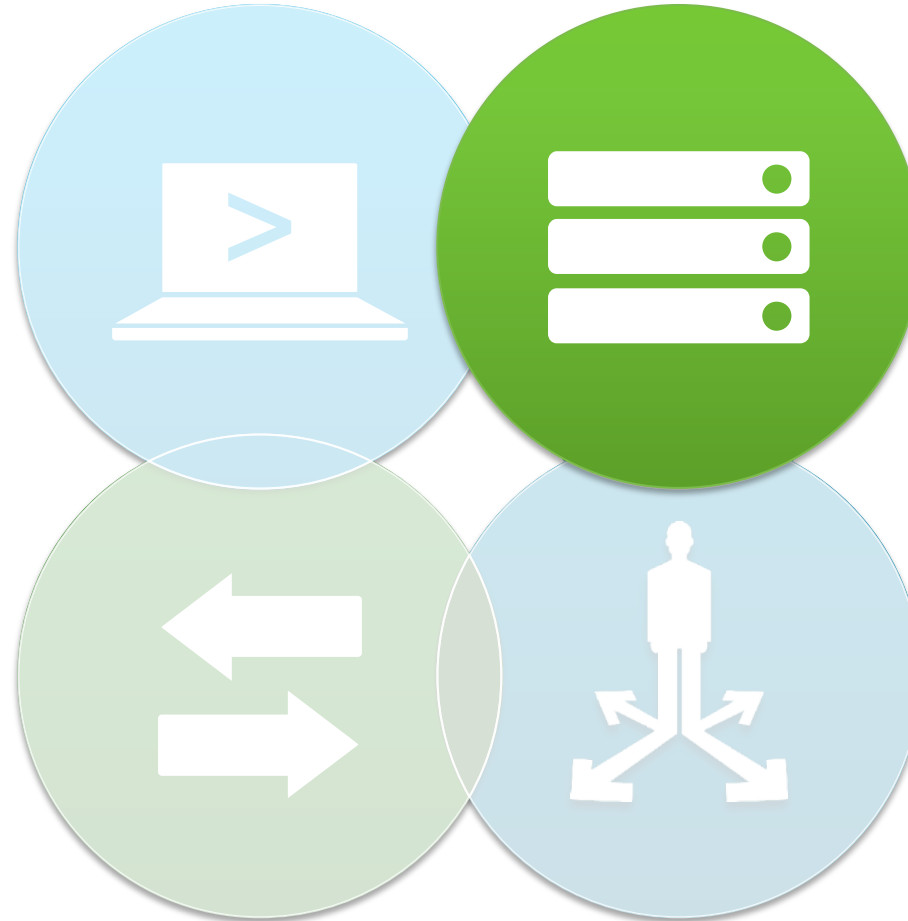


vSphere Virtual Volumes

Technical Walkthrough

The Software-Defined Data Center



Transform **storage**
by aligning it with
app demands

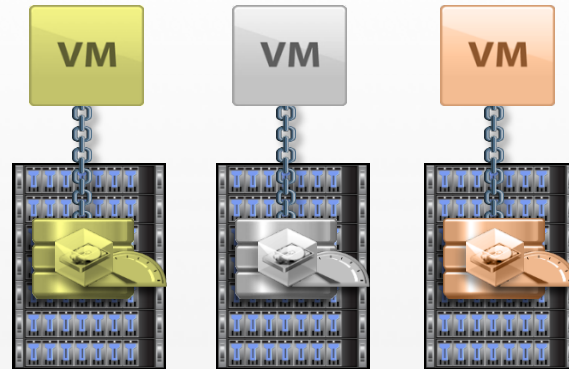
Traditional Storage Architectures Can't Keep Up

Specialized Costly HW



- ✗ Not commodity
- ✗ Low utilization
- ✗ Overprovisioning

Device-centric Silos



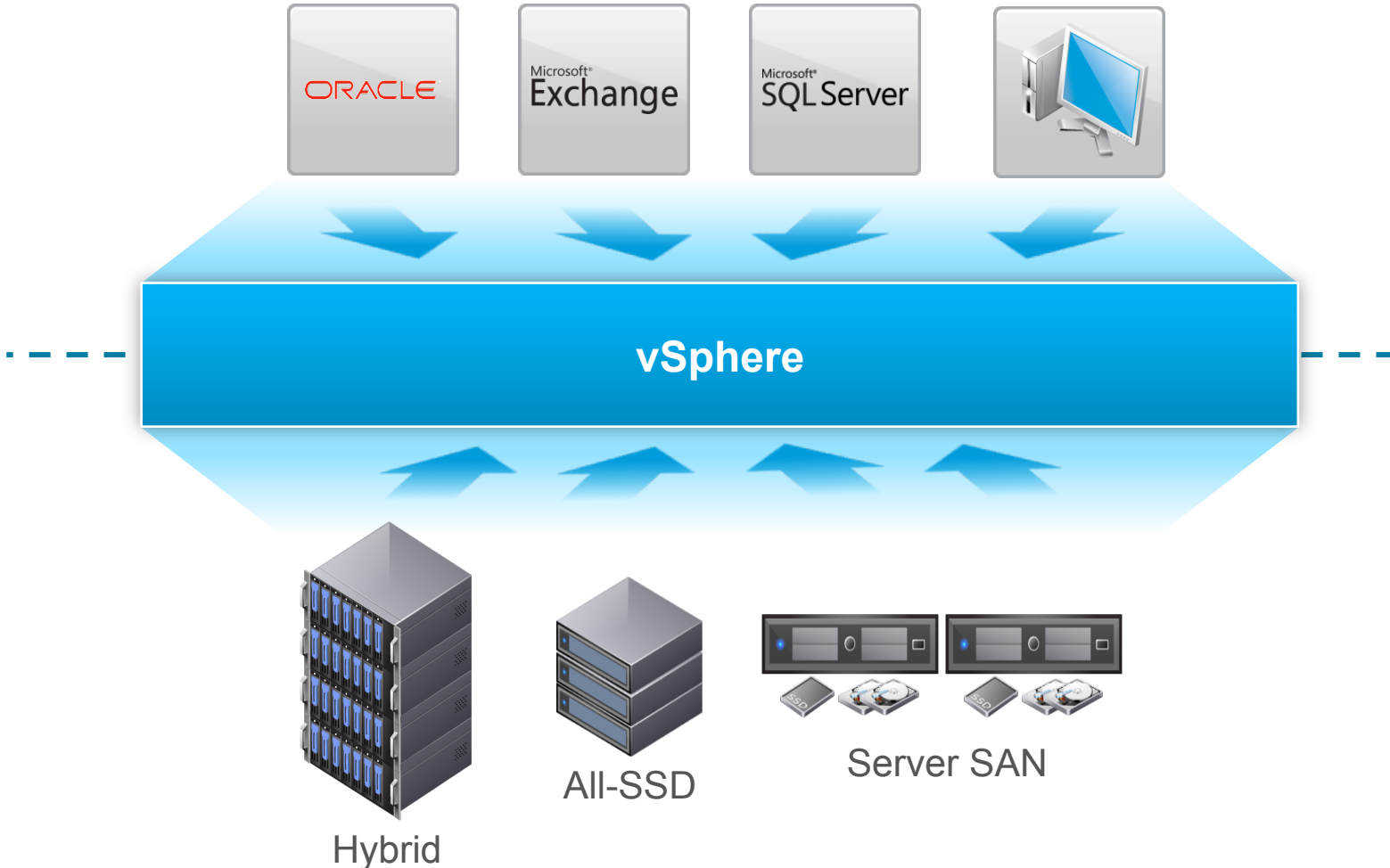
- ✗ Static classes of service
- ✗ Rigid provisioning
- ✗ Lack of granular control
- ✗ Frequent data migrations

Complex Processes



- ✗ Time consuming processes
- ✗ Lack of automation
- ✗ Slow reaction to request

The Hypervisor Enables App-Centric Storage Automation

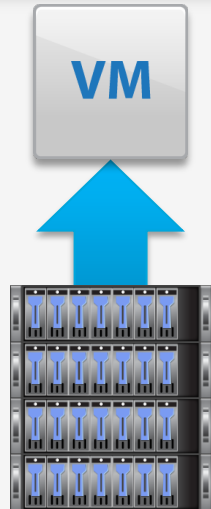


The hypervisor is the right place to drive automation:

- Knows the needs of all apps in real time
- Sits directly in the I/O path
- Has global view of all underlying storage systems
- Can configure storage dynamically
- Hardware agnostic

App-centric Automation Drives Agility and QoS

Today's Infrastructure-centric Model



- Static pre-allocation of shared storage container (LUN)
- Data services tied to storage container
- Vendor specific management

- ✗ Long provisioning cycles
- ✗ Overprovisioning of resources
- ✗ Management complexity
- ✗ Frequent data migrations

App-centric Automation



- Dynamic delivery of storage service levels when needed
- Fine control of data services at the VM level
- Common management across heterogeneous devices

- ✓ Rapid provisioning
- ✓ No overprovisioning of resources
- ✓ QoS automation
- ✓ Simple change management

What's New In The vSphere 6.0 Release

Hypervisor-converged
SDS Stack

External Storage
App-Centric Automation

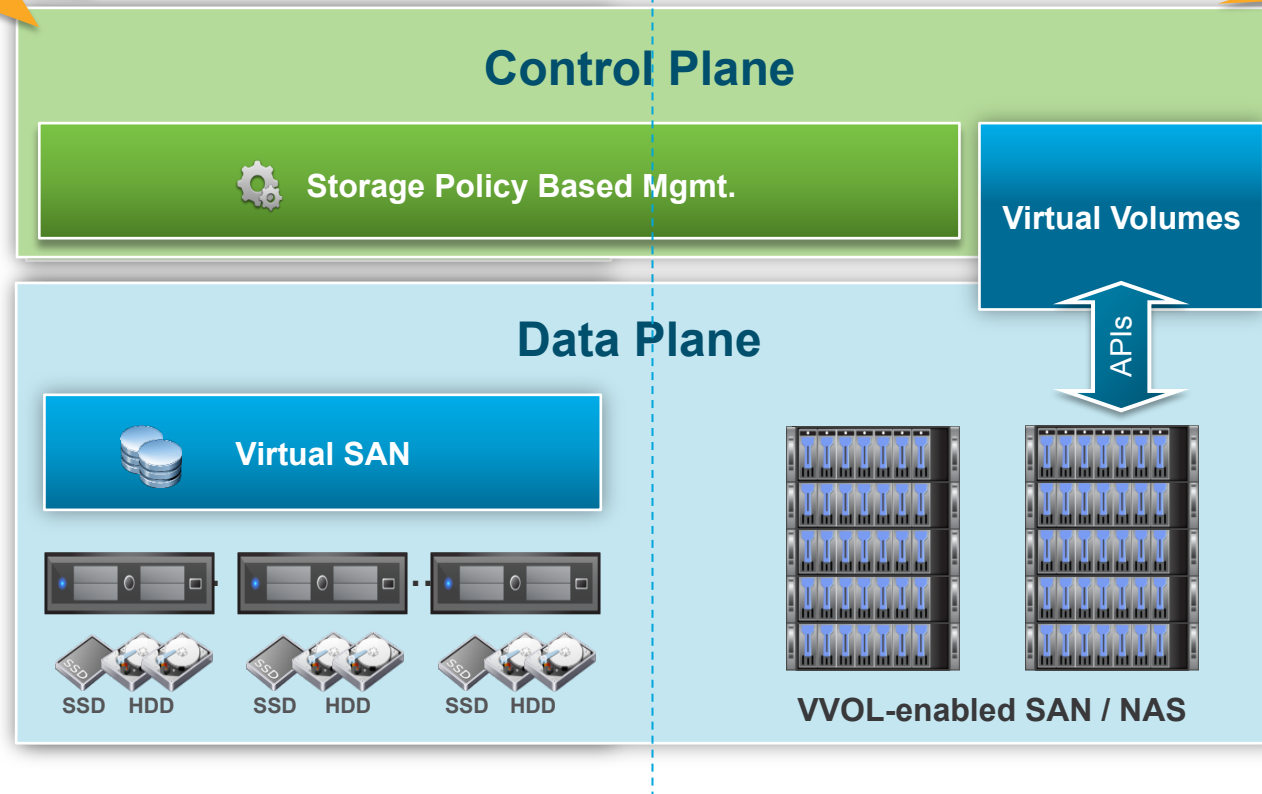
NEW

NEW

Virtual SAN 6.0

Radically Simple
Hypervisor-Converged
Storage for VMs

- ✓ All-Flash architecture
- ✓ 2x greater scalability
- ✓ 4x greater with All-Flash;
2x performance with
Hybrid
- ✓ Virtual SAN Snapshots
and Clones



vSphere Virtual Volumes

Management & Integration
Framework for External Storage

- ✓ Virtualizes SAN/NAS
devices
- ✓ Uses native array
capabilities
- ✓ VM-level operations
- ✓ Included with vSphere

vSphere Virtual Volumes

A More Efficient Operational Model For External Storage

VMware vSphere Virtual Volumes

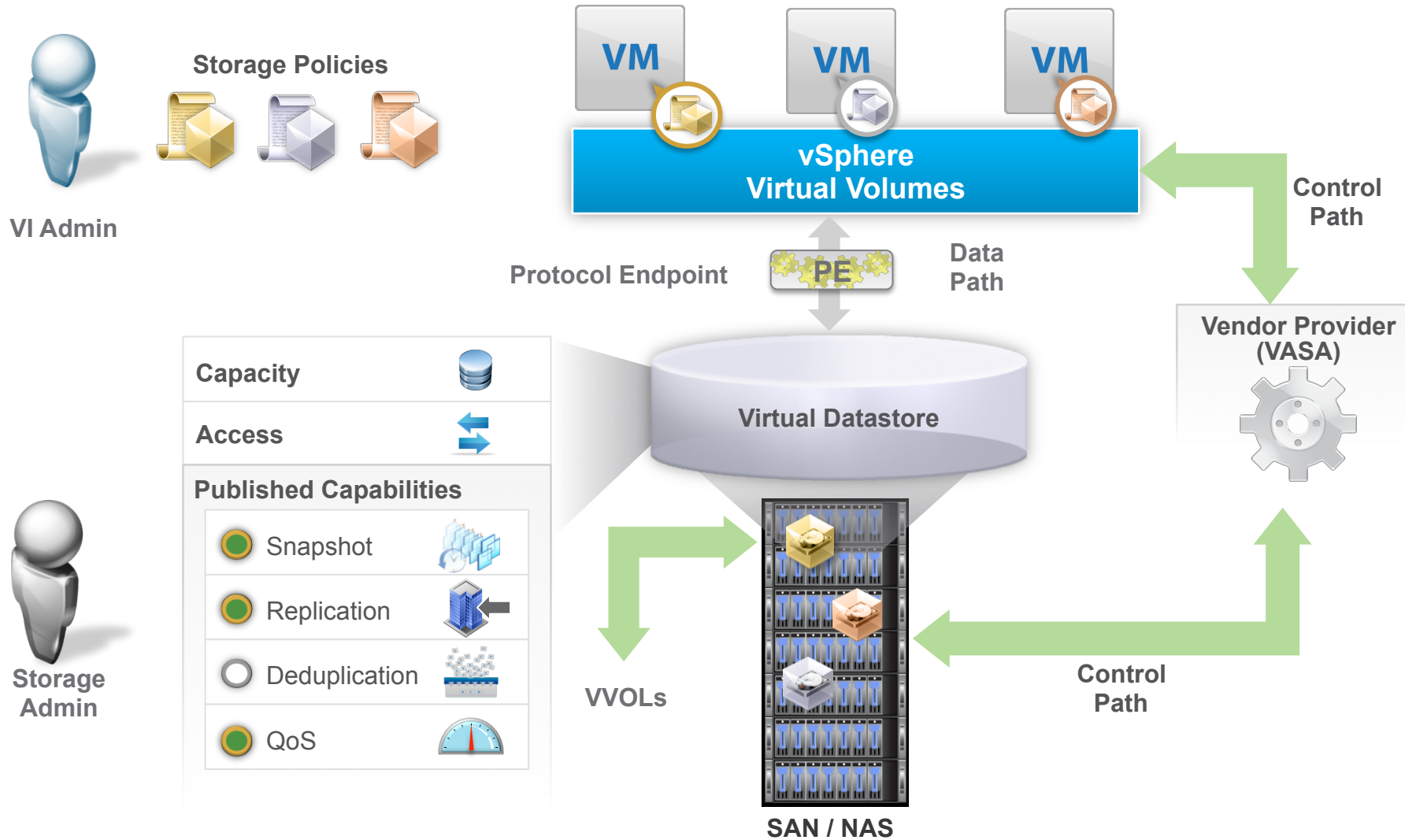
Integration Framework for VM-Aware Storage



Overview

- Virtual disks are natively represented on arrays
- Enables VM granular storage operations using array-based data services
- Extends vSphere Storage Policy-Based Management to the storage ecosystem
- Supports existing storage I/O protocols (FC, iSCSI, NFS)
- Based on T10 industry standards
- Industry-wide initiative supported by major storage vendors
- Included with vSphere

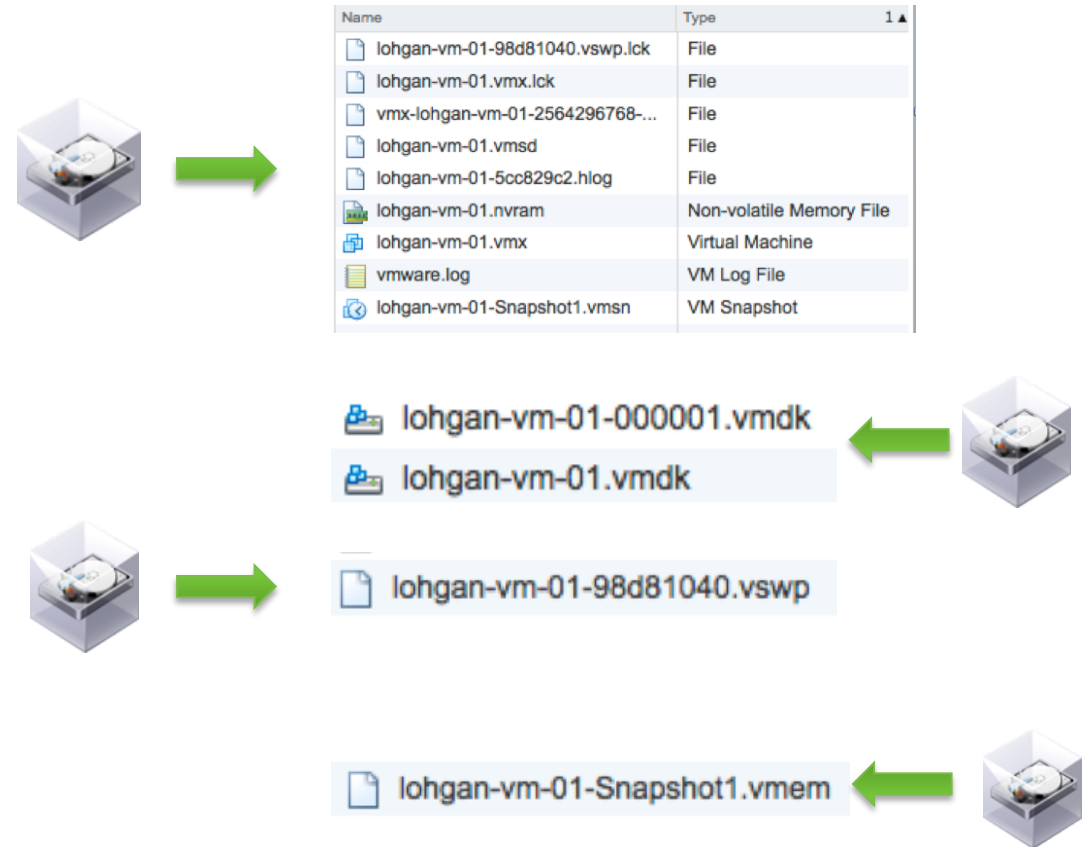
vSphere Virtual Volumes Architecture



vSphere Virtual Volumes

- **Virtual Volumes**
 - Virtual machine objects stored natively on the array.
 - No Filesystem on-disk formatting required
- There are **five** different types of recognized Virtual Volumes:
 - **CONFIG** – vmx, logs, nvram, log files, etc
 - **DATA** – VMDKs
 - **MEM** – Snapshots
 - **SWAP** – Swap files
 - **Other** – vSphere solution specific type

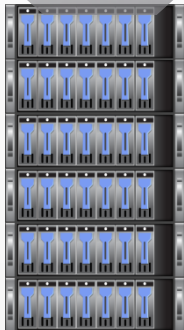
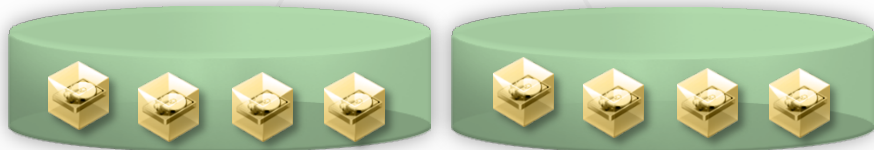
vSphere Web Client View



Storage Container



Storage Containers



SAN / NAS

Storage Containers

- Logical storage constructs for grouping of virtual volumes.
- Typically defined and setup by **storage administrators** on the array in order to define:
 - Storage capacity allocations and restrictions
- Capacity is based on physical storage capacity
- Logically partition or isolate VMs with diverse storage needs and requirement
 - Storage policy settings based on data service capabilities
- Minimum one storage container per array
- Maximum depends on the array

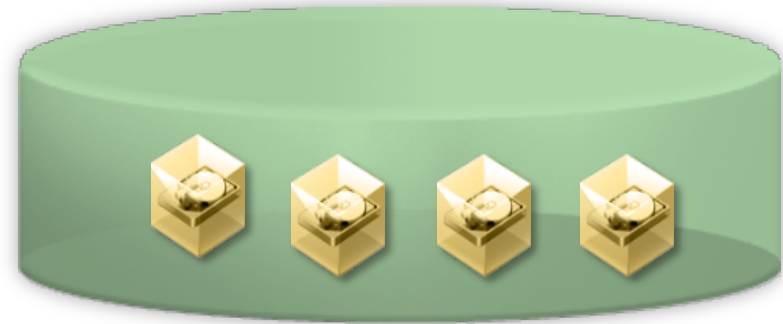
Storage Container

Do I still need to create Datastores?

Managed in similar fashion in vSphere, with additional goodness



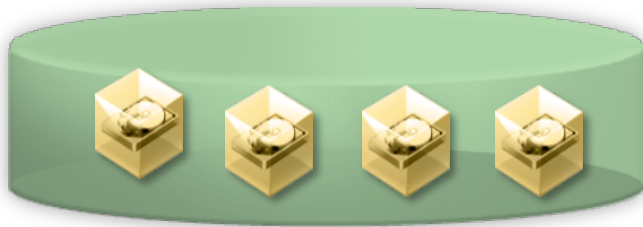
vSphere Datastore



Storage Container

Differences between Storage Containers and LUNs

Storage Containers



LUN



- Size based on array capacity
- Max number of SCs depend only on the array ability
- Size of SC can be extended
- Can distinguish heterogeneous capabilities for different VMs (Virtual Volumes) provisioned in that SC
- Fixed size mandates more number of LUNs
- Needs a FileSystem
- Can only apply homogeneous capability on all VMs (VMDKs) provisioned in that LUN.
- Managed by In-band FileSystem commands

Storage Container (SC)

- What do the Admins see?
- How are the storage containers setup?
- What does the vSphere Admins see?
- Why are we still creating datastores in this new model?



Storage Container (SC)

New Datastore

- ✓ 1 Location
- ✓ 2 Type
- ✓ 3 **Name and container selection**
- 4 Select hosts accessibility
- 5 Ready to complete

Datastore name:

Backing Storage Container

Filter

Name	Identifier	Maximum Disk Size	Existing Datastore
vvol-block-container	vvol:2cbafac55a214aa8-b...	2 TB	-

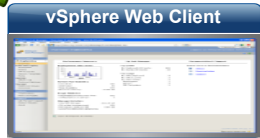
1 items

Backing Storage Container Details

Storage array(s)	iSCSI_SCST_ARRAY
Storage provider(s)	VMware VVol Provider 8443

Back Next Finish Cancel

Virtual Volumes



vSphere Admin View

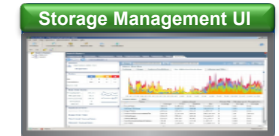
The screenshot shows the vSphere Admin View for a VMware Datastore (VMwareDS). The interface includes tabs for Summary, Monitor, Manage, and Related Objects. Under the Manage tab, there are sub-tabs for Settings, Alarm Definitions, Tags, Permissions, Scheduled Tasks, and Files. The main area displays a tree view of the datastore contents, with a folder named 'lohgan-vm-01' selected. A table lists the objects within this folder, including files like .vswp, .vmx, .vmsd, .vmem, .hlog, .nvram, .vmdk, .vmx, and .vmsn, along with their types and sizes.

Name	Type	Size	VM Name
lohgan-vm-01-98d81040.vswp.lck	File	0...	[VM...]
lohgan-vm-01.vmx.lck	File	0...	[VM...]
vmx-lohgan-vm-01-2564296768-...	File	1...	[VM...]
lohgan-vm-01-98d81040.vswp	File	0...	[VM...]
lohgan-vm-01.vmsd	File	0...	[VM...]
lohgan-vm-01-Snapshot1.vmem	File	0...	[VM...]
lohgan-vm-01-5cc829c2.hlog	File	0...	[VM...]
lohgan-vm-01.nvram	Non-volatile Memory File	8...	[VM...]
lohgan-vm-01-000001.vmdk	Virtual Disk	2...	[VM...]
lohgan-vm-01.vmdk	Virtual Disk	2...	[VM...]
lohgan-vm-01.vmx	Virtual Machine	2...	[VM...]
vmware.log	VM Log File	2...	[VM...]
lohgan-vm-01-Snapshot1.vmsn	VM Snapshot	5...	[VM...]

VM objects view from a datastore



Storage Admin View



The screenshot shows the Storage Management UI (EqualLogic Group Manager) for VMware. The interface displays a tree view of storage containers, with 'Virtual Machines' selected. A table lists the virtual machines (VMs) and their associated VVols. The table includes columns for VM name, Guest OS, Allocated space, and Description. A second table lists the VVols for a specific VM, including columns for VVol name, Type, Storage container, Reported size, and Status.

VM	Guest OS	Allocated space	Description
vra-sabu-vm-0017	Other Linux (32-bit)	0 MB	
wvol-VM01	Other Linux (32-bit)	3.54 GB	
vra-sabu-vm-0001	Other Linux (32-bit)	0 MB	
eng-tc-server	SUSE Linux Enterprise 11 (64-bit)	8.36 GB	
eng-web-server	SUSE Linux Enterprise 11 (64-bit)	7.49 GB	

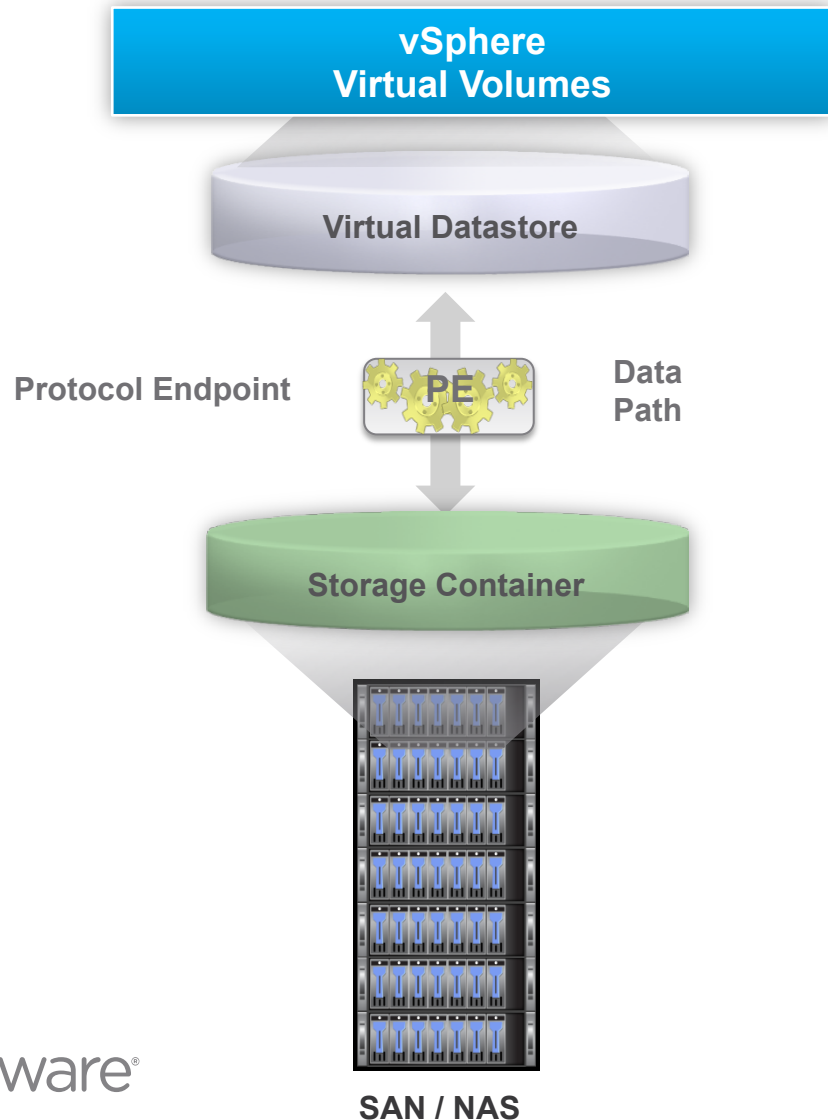
VVol	Type	Storage container	Reported size	Status
eng-tc-server	Config	Engineering	4 GB bound	
eng-tc-server.vmdk	Data	Engineering	6 GB bound	
eng-tc-server-133b20ea.vswp	Swap	Engineering	1 GB bound	
eng-tc-server-Snapshot1.vmem	Memory	Engineering	1 GB unbound	

VM objects view from a storage container on an array

Data Plane

vSphere Virtual Volumes

Protocol Endpoints



Protocol Endpoints

- Access points that enables communication between ESXi hosts and storage array systems.
 - Part of the physical storage fabric
 - Created by Storage administrators

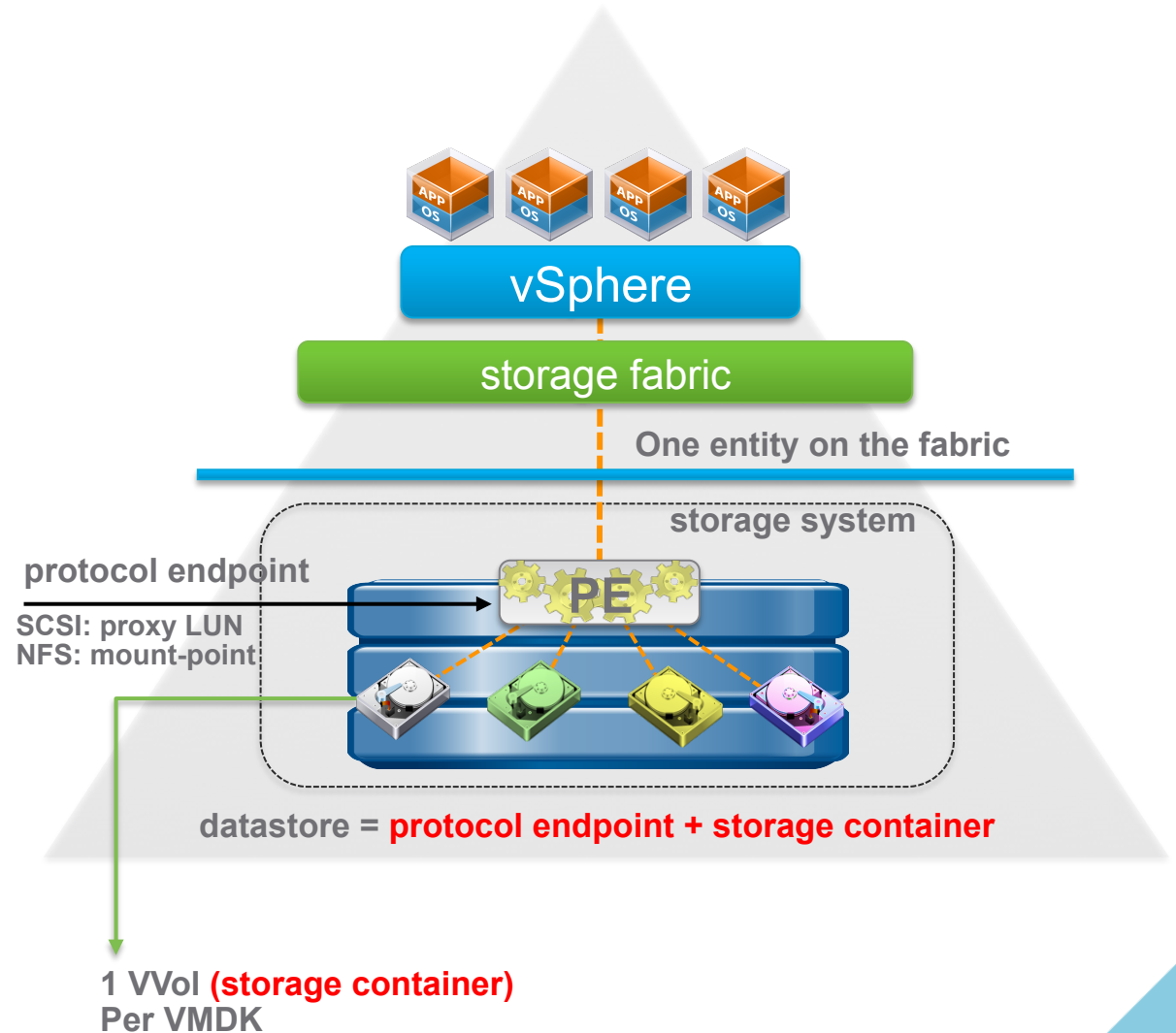
Scope of Protocol Endpoints

- Compatible with all SAN and NAS Protocols:
 - iSCSI
 - NFS v3
 - FC
 - FCoE
- A Protocol Endpoint can support any one of the protocols at a given time
- Existing multi-path policies and NFS topology requirements can be applied to the PE

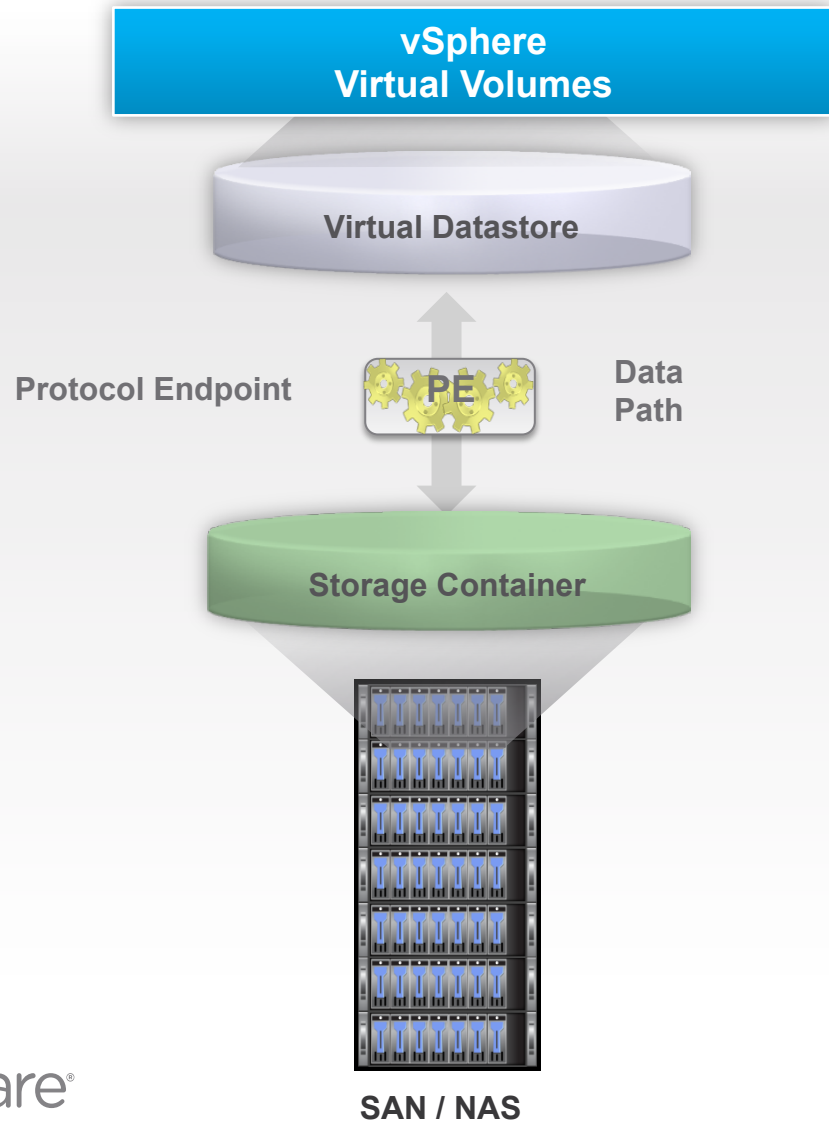
Why Protocol Endpoints?

Protocol Endpoints

- **Today**, there are different types of logical management constructs to store VMDKs/objects:
 - NFS Mount Points
 - IP or block based datastores
- **Datastores serve two purposes today:**
 - Endpoints – receive SCSI or NFS reads, write commands
 - Storage Container – for large number of VMs metadata and data files
- **Differences between Protocol Endpoints and Datastores:**
 - PEs no longer stores VMDKs but it only becomes the access point.
 - Now you wont need as many datastores or mount point as before
- Certain offloading operation will be done via VASA and other will be done using the standard protocol commands



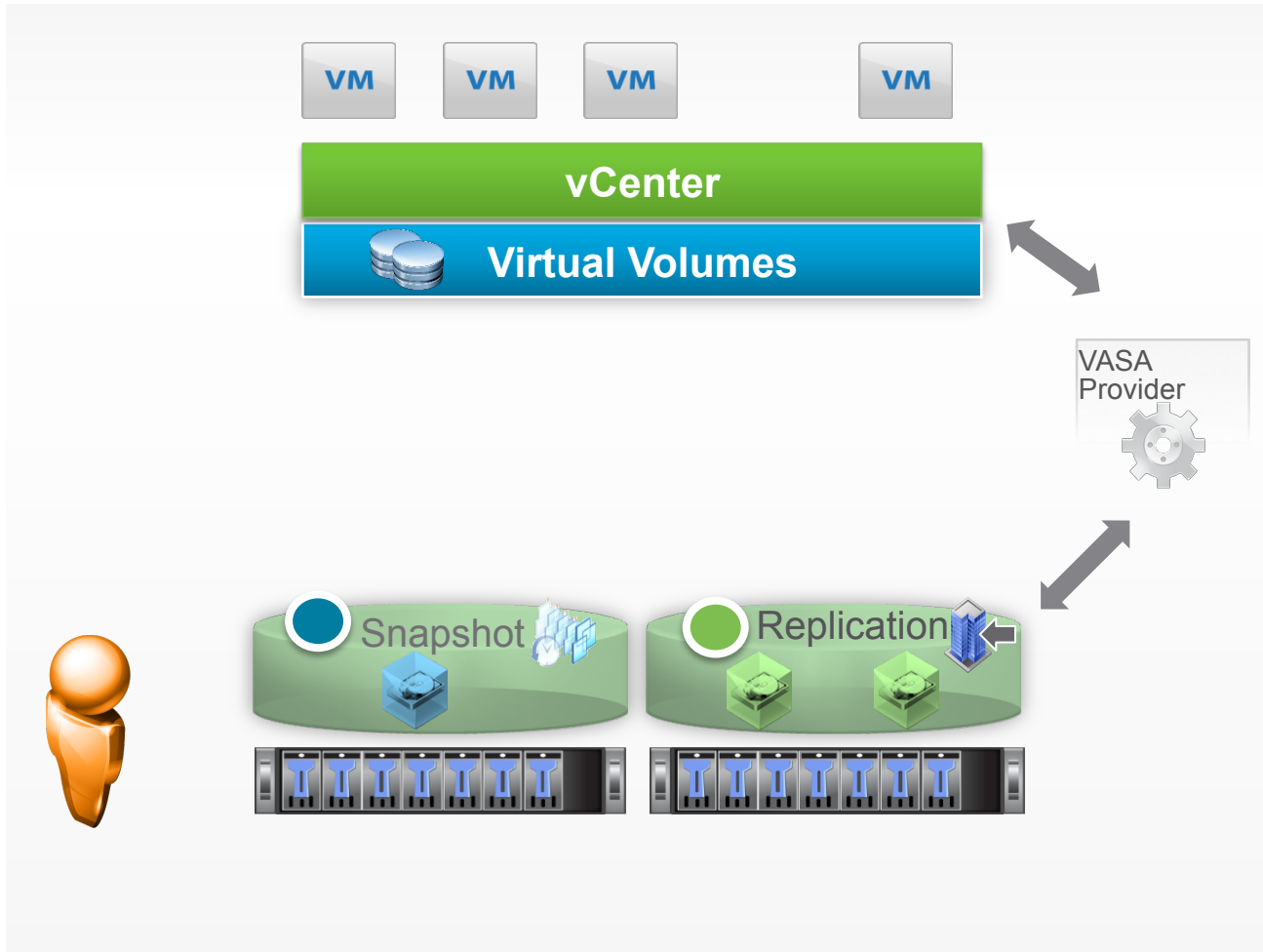
Discovery Procedures – Protocol Endpoint



Protocol Endpoint discovery process

- SCSI PEs are discovered during an ESX rescan
- NFS PEs are maintained as IP addresses or file paths
- ESX will identify PE and maintain all discovered PEs in a database.

Discovery Procedures – Storage Container



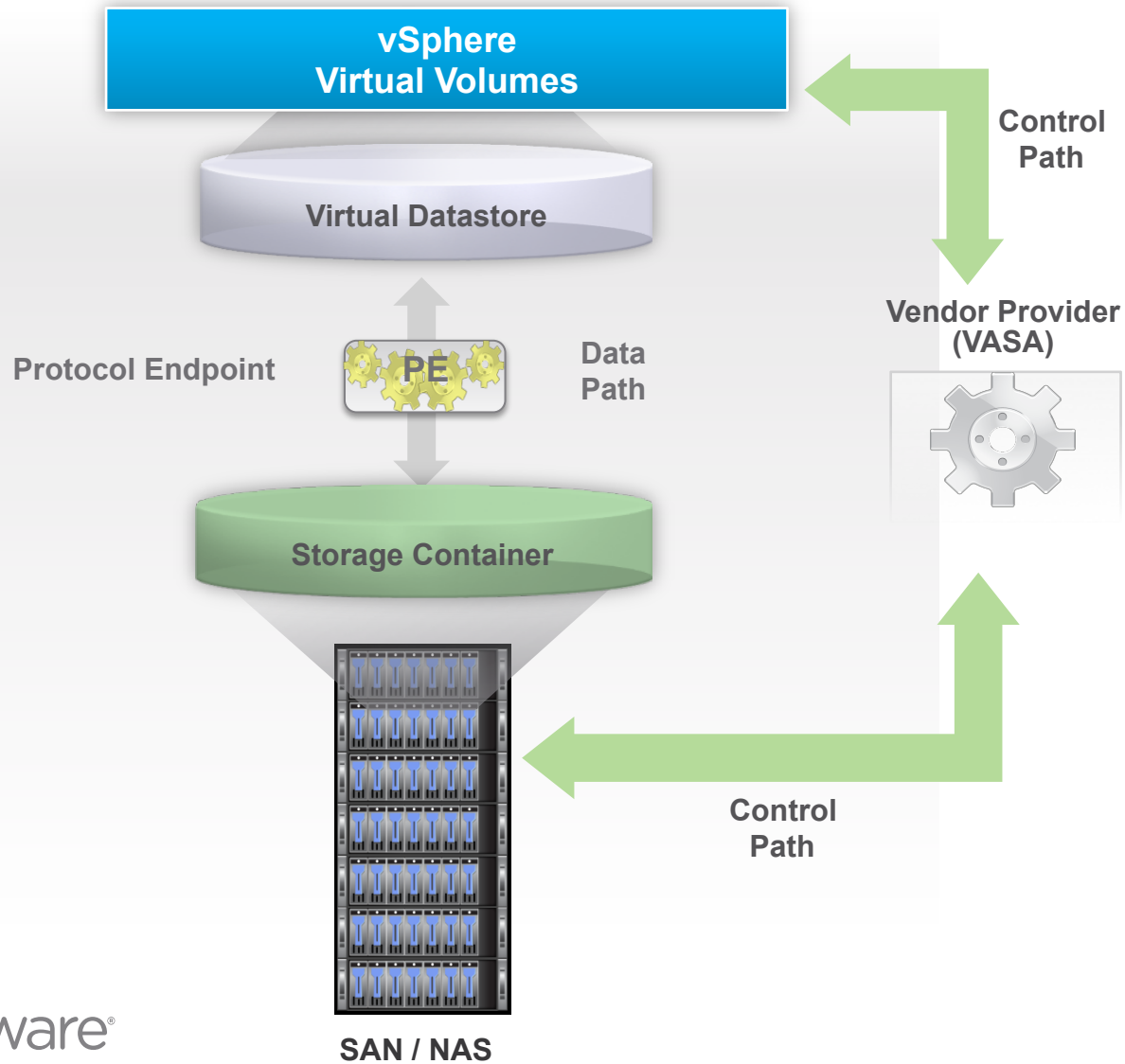
Storage Container Discovery Process

- Storage admin sets up Storage Container with desired capacity
- Desired Capabilities are applied to the Storage Containers
- VASA Provider discovers Storage Container and reports to vCenter
- Any new VMs that are created will subsequently be provisioned in the Storage Container

Management Plane

vSphere Virtual Volumes

VASA Provider (VP)









- Software component developed by Storage Array Vendors
- ESX and vCenter Server connect to VASA Provider
- Provides Storage awareness services
- Single VASA Provider can manager multiple arrays
- Supports VASA APIs exported by ESX
- VASA Provider can be implemented within the array's management server or firmware
- Responsible for creating Virtual Volumes

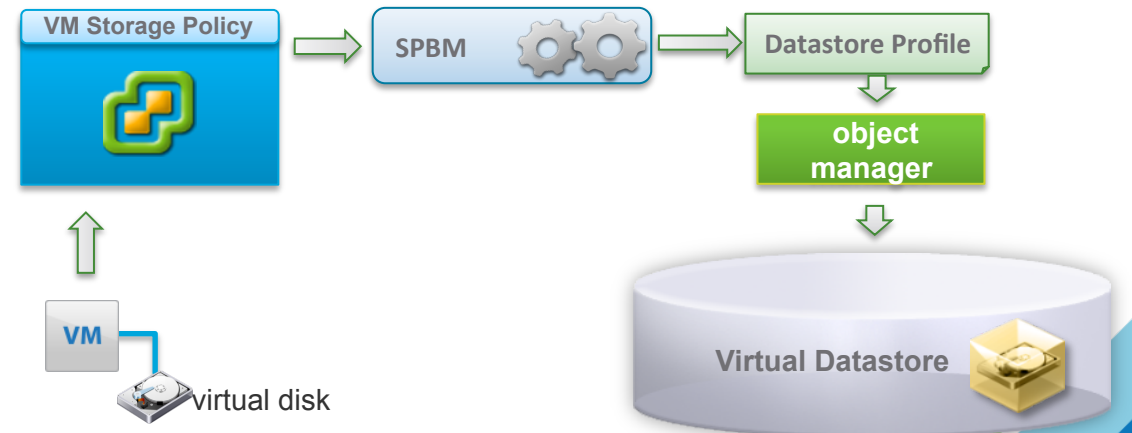
Storage Capabilities and VM Storage Policies

- **Storage Capabilities** – are array based features and data services specifications that capture storage requirements that can be satisfied by a storage arrays advertised as capabilities.
- Storage capabilities define what an array can offer to storage containers as opposed to what the VM requires.
- Arrays Storage Capabilities are advertises to vSphere through the Vendor Provider and VASA APIs
- In vSphere Storage Capabilities are consumed via VM Storage Policy constructs.
- **VM Storage Policies** is a component of the vSphere Storage Policy-based management framework (SPBM)

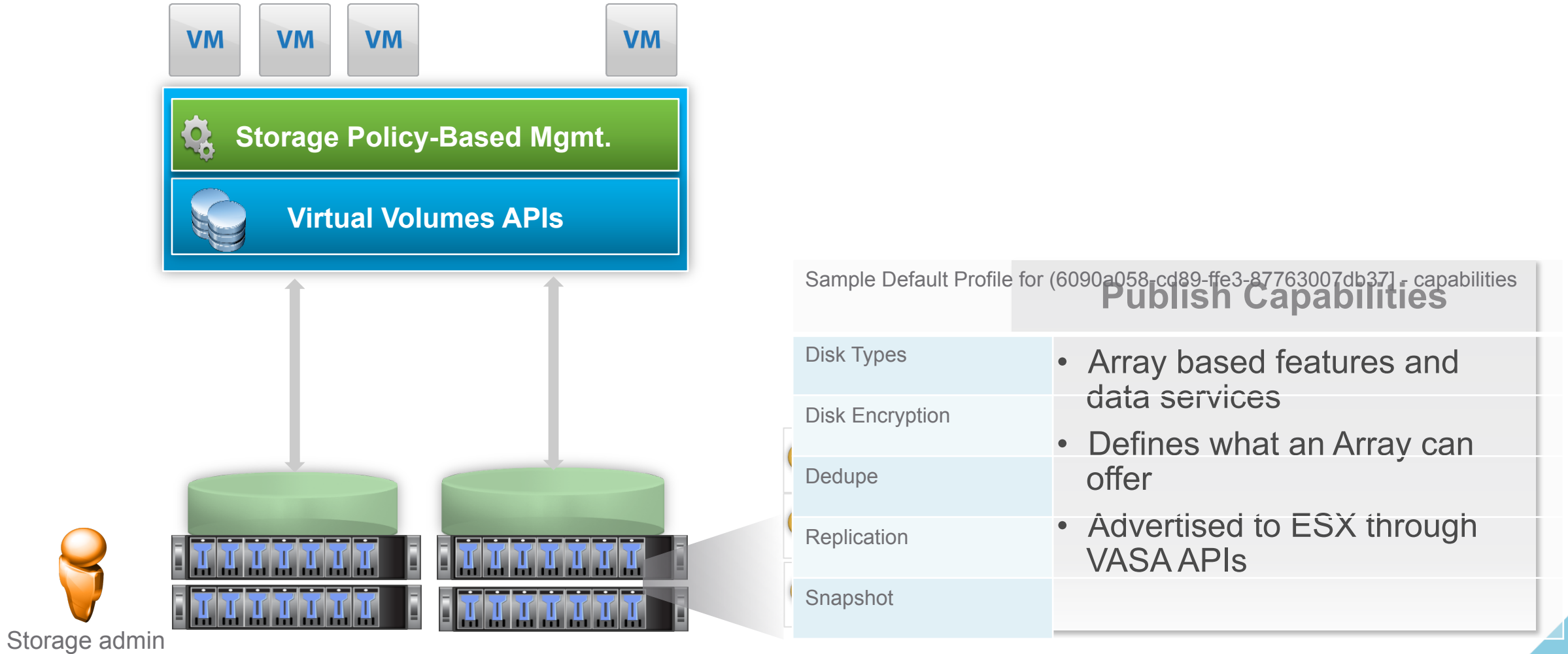
Storage Capabilities for Storage Array

Capacity	
Access	
Published Capabilities	
<input checked="" type="checkbox"/> Snapshot	
<input checked="" type="checkbox"/> Replication	
<input type="checkbox"/> Deduplication	
<input checked="" type="checkbox"/> QoS	

vSphere VM Storage Policy Management Framework



Storage Policy Based Management (SPBM) – Array Capabilities



Storage Policy Based Management (SPBM) – VM Policies

Create New VM Storage Policy

✓ 1 Name and description
✓ 2 Rule-Sets
 2a Rule-Set 1
3 Storage compatibility
4 Ready to complete

Rule-Set 1
Select rules to create your VM storage policy.
• The VM storage policy will match datastores that satisfy any of the rule sets.
• A rule set will match datastores that satisfy all of the selected rules.

Rules based on common capabilities
<Add capability>



Rules based on vendor-specific capabilities

<Add capability>

- WriteLatency.label
- Snapshot.label
- Encryption.label
- Deduplication.label
- Backup.label
- HighAvailability.label

Storage Policy Based Management (SPBM)

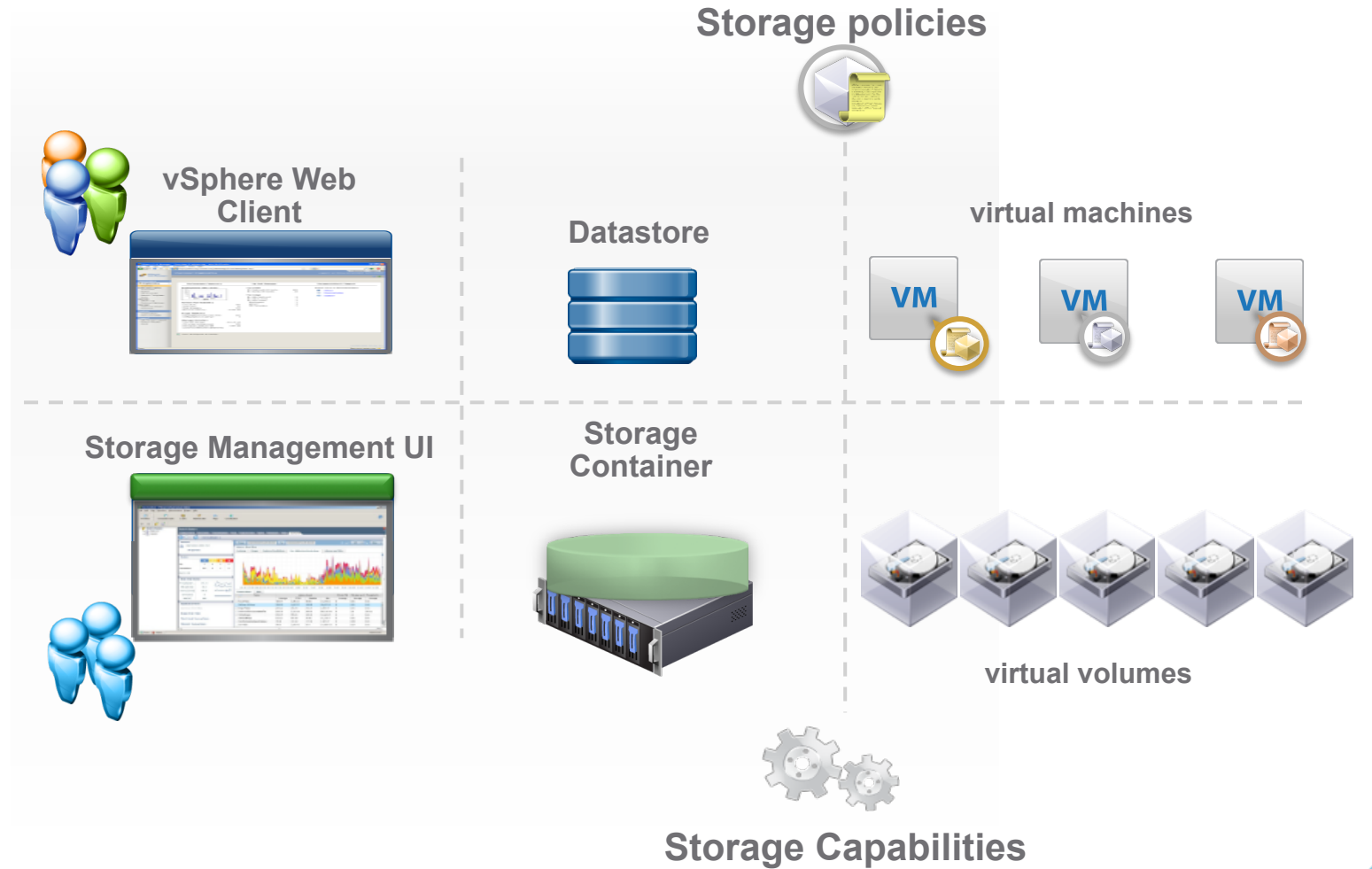
VM Storage Policies

VM Storage Policies	 GoldPolicy
VM Storage Policy Compliance	 Compliant
Last Checked Date	8/20/14, 5:29 PM

[Check Compliance](#)

Management Workflow

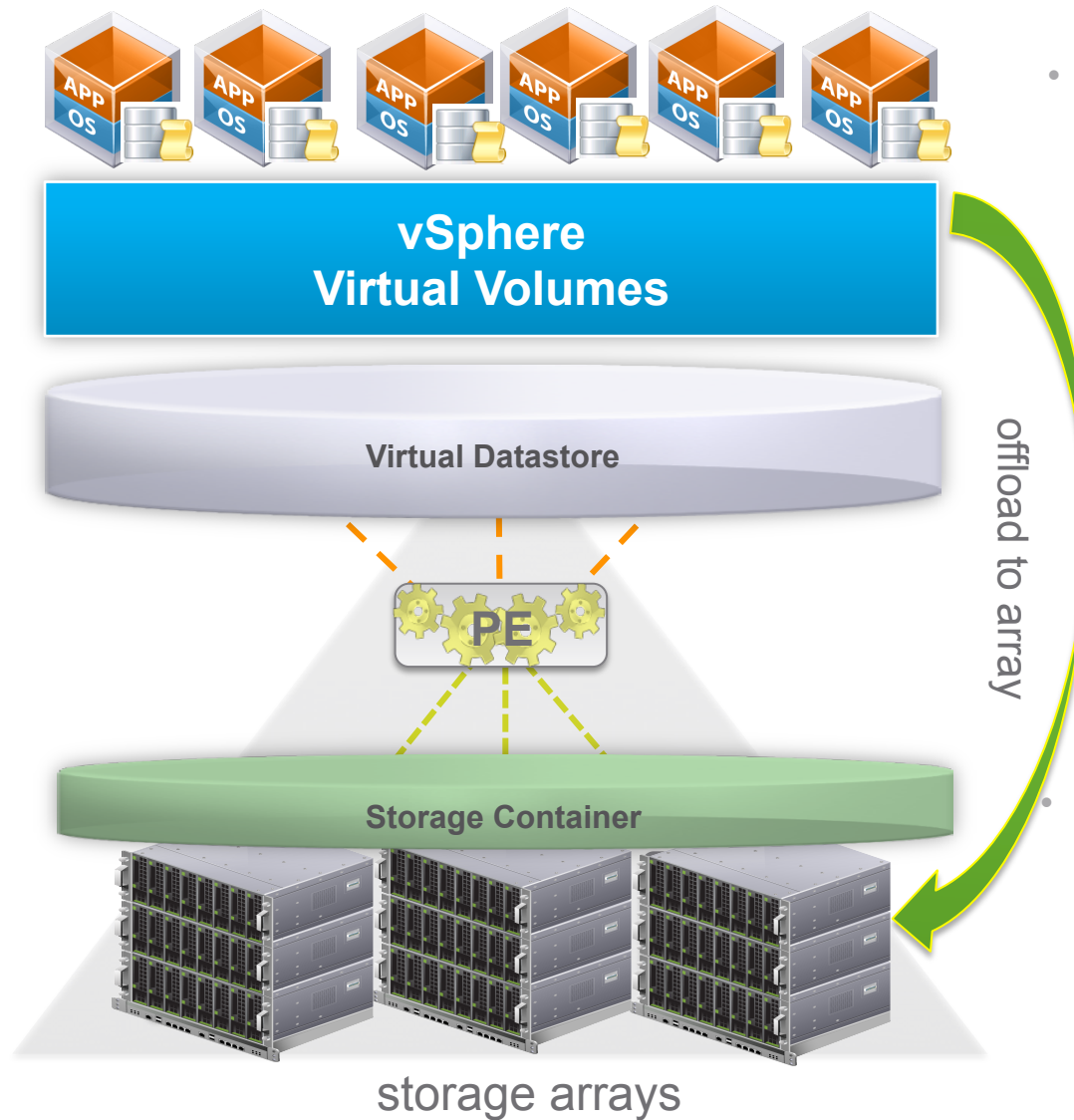
- What do the Admins see?
- How are the storage containers setup?
- What does the vSphere Admins see?
- Why are we still creating datastores in this new model?



Provision and Lifecycle Workflows

Binds

Provisioning Workflow



vSphere Admin

1. Create Virtual Machines
2. Assign a VM Storage Policy
3. Choose a suitable Datastore

Under the Covers

- **Provisioning** operations are translated into VASA API calls in order to create the individual virtual volumes.

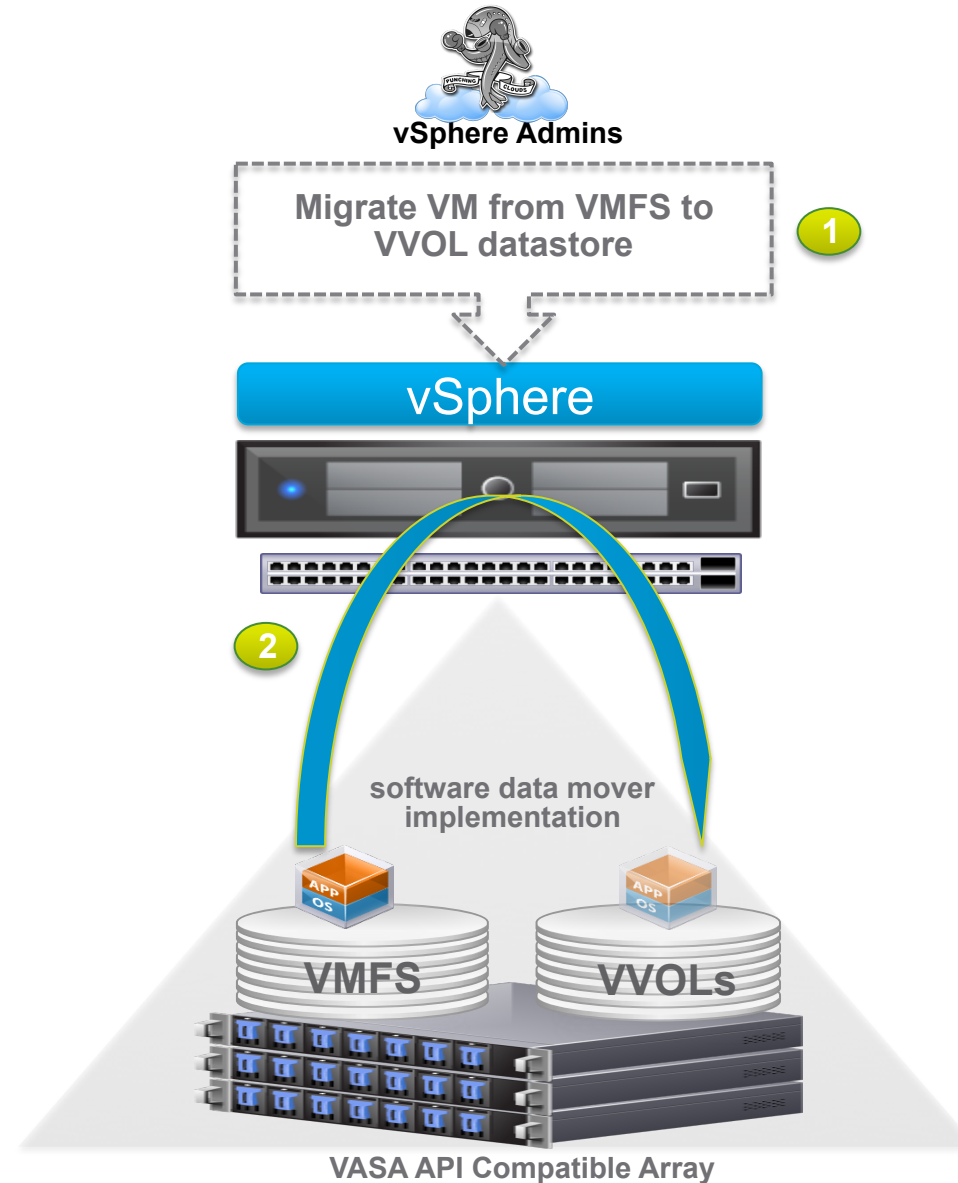
Under the Covers

- **Provisioning** operations are offloaded to the array for the creation of virtual volumes on the storage container that match the capabilities defined in the VM Storage Policies

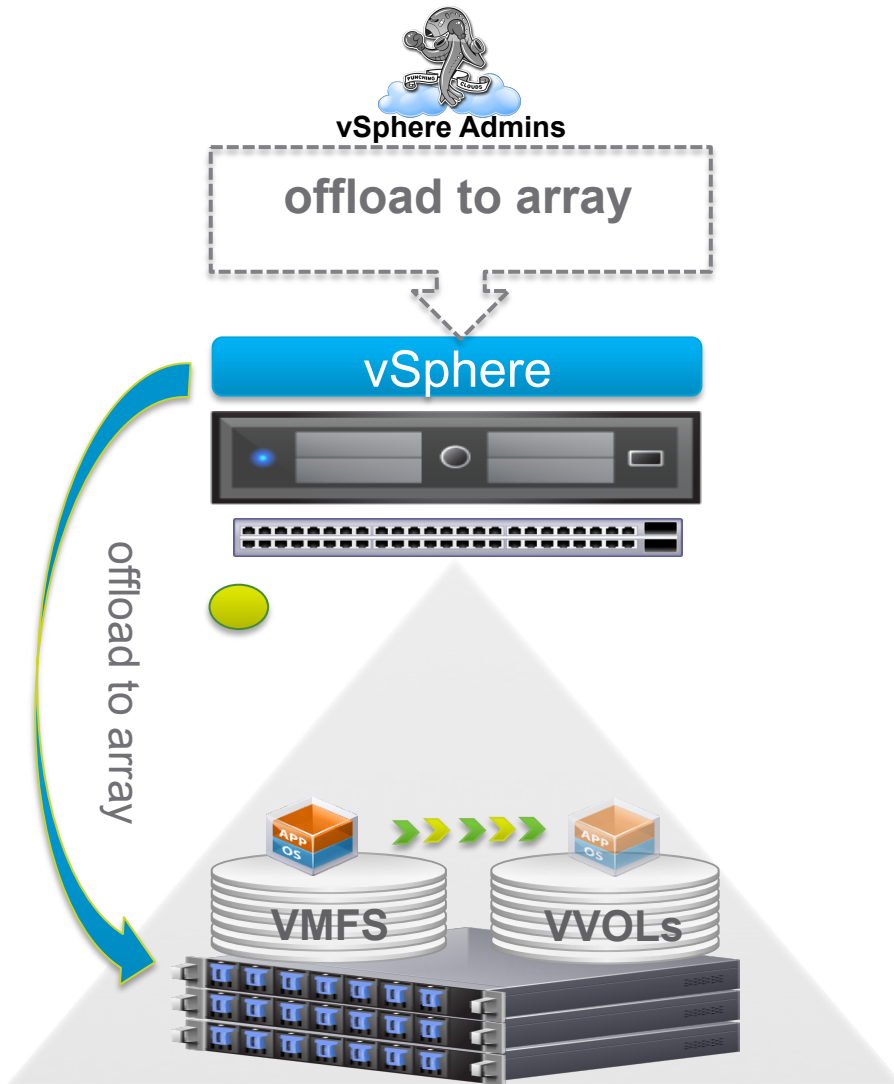
Operation Scenarios

Offload, Migrations, Snapshots

Migration Scenario: with VAAI vs Virtual Volumes



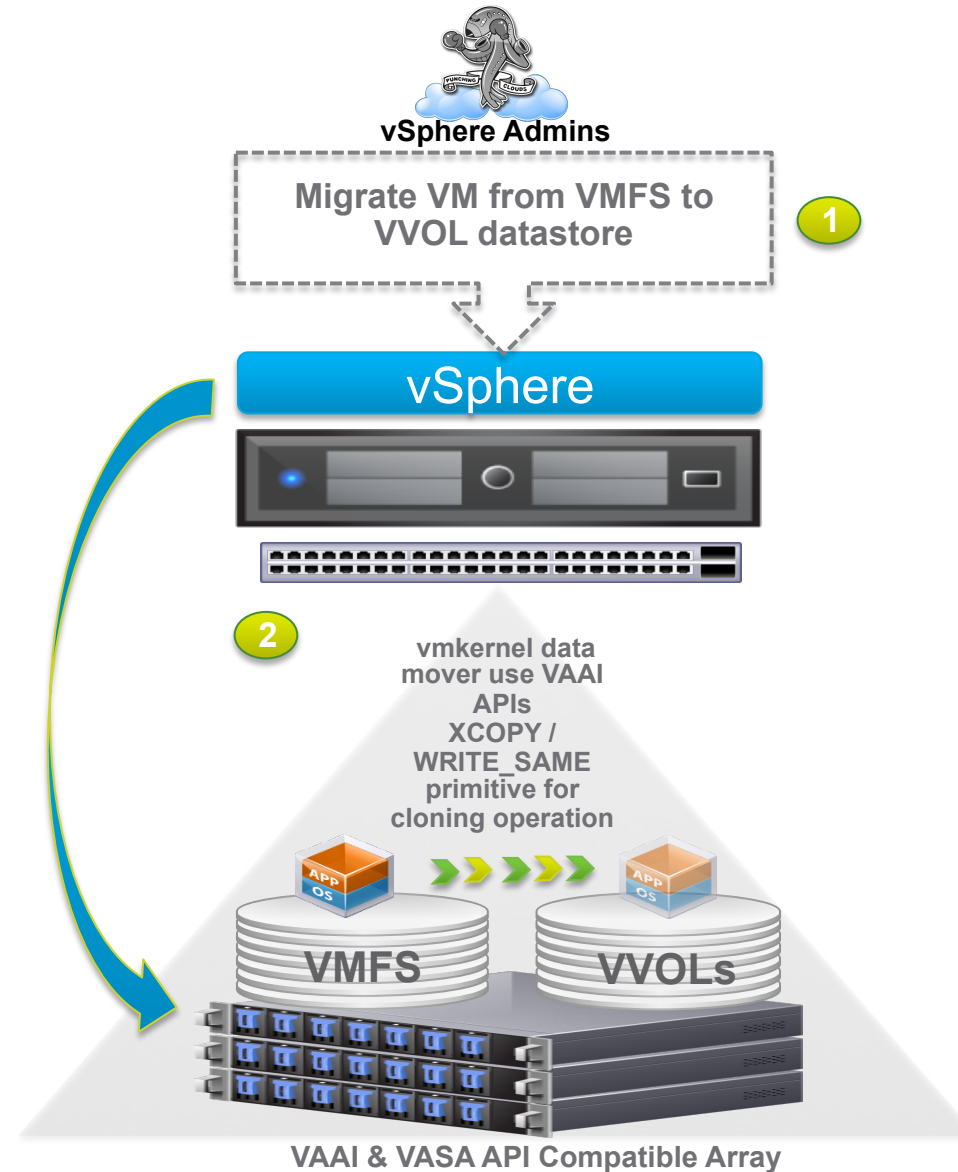
vSphere Virtual Volumes Offload Operations



Virtual Machine Operation Offloaded

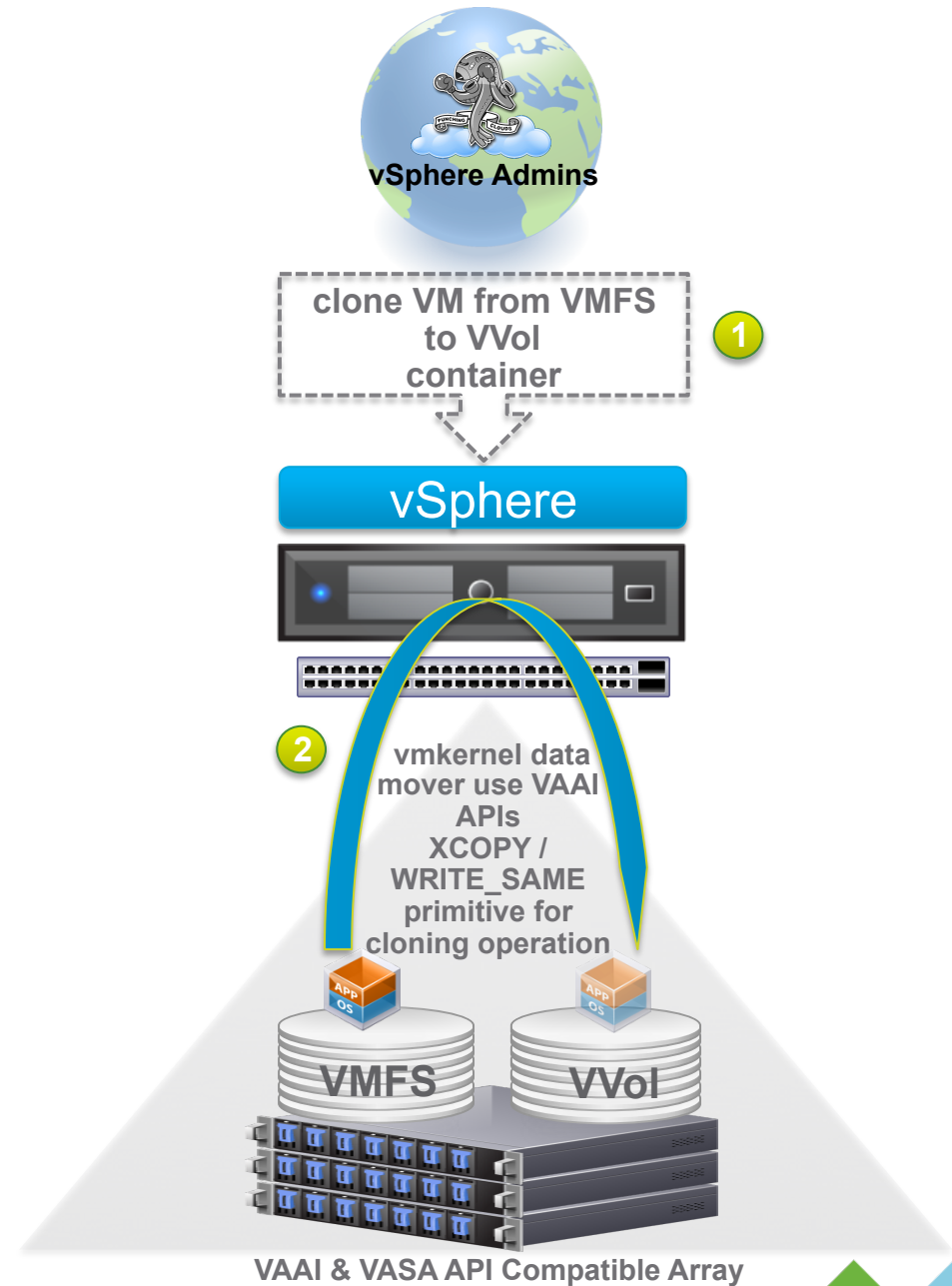
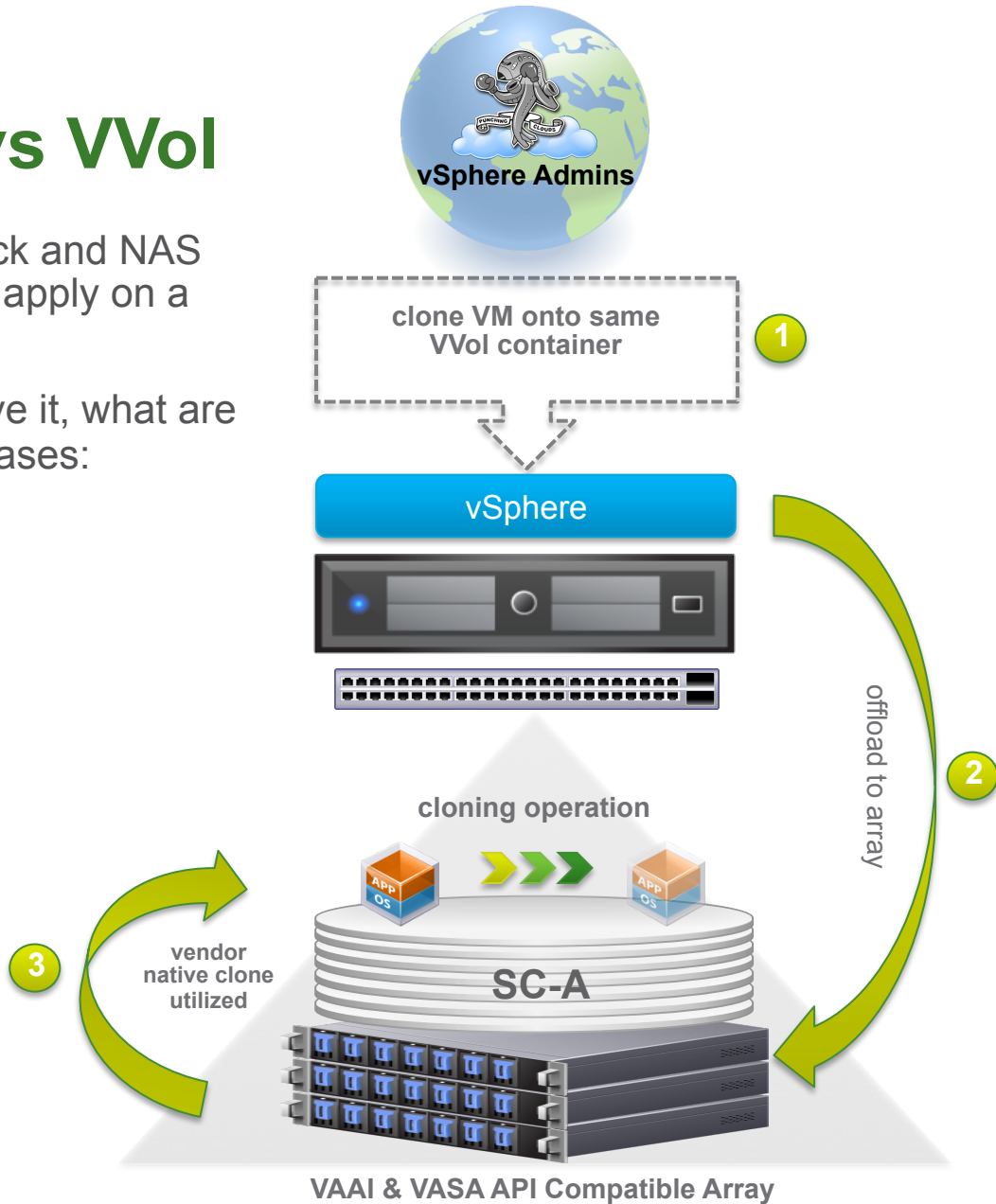
- Virtual Machine provisioning
- Virtual Machine deletes
- Virtual Machine full clones
- Virtual Machine Linked Clones
- Virtual Machine Snapshots
- Storage vMotion (Powered off VMs)

Migration Scenario: with VAAI vs Virtual Volumes



VAAI vs VVol

- VAAI Block and NAS how they apply on a VVol
- If you have it, what are the use cases:





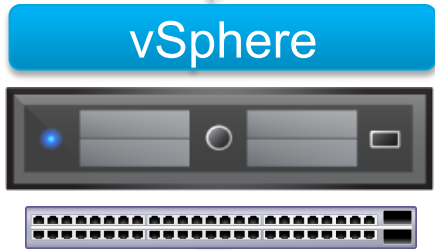
VAAI vs VVOLS



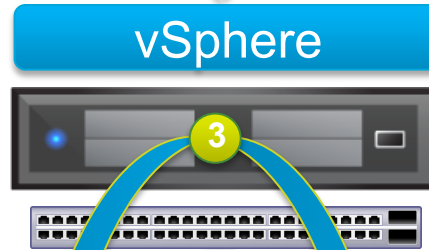
1 VM operation from VVOLS container to different VVOLS container

1 VM operation from VVOLS container to different VVOLS container

2



always attempt default operation with VASA API primitives



2

offload to array

offload to array



If default operations fails VAAI API primitives are used

cloning operation



SC-A

SC-B

3



vendor native clone utilized with VASA primitives
Fully VAAI & VASA APIs Compatible Array

vmkernel data mover uses VAAI primitives for cloning operation

SC-A

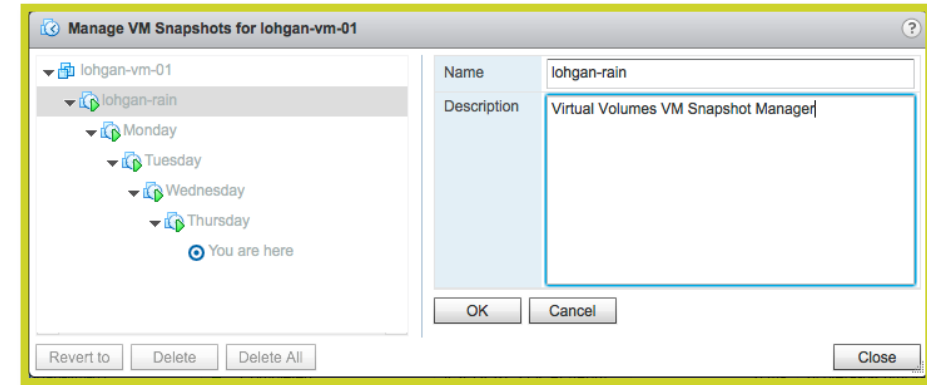
SC-B

Fully VAAI & VASA APIs Compatible Array

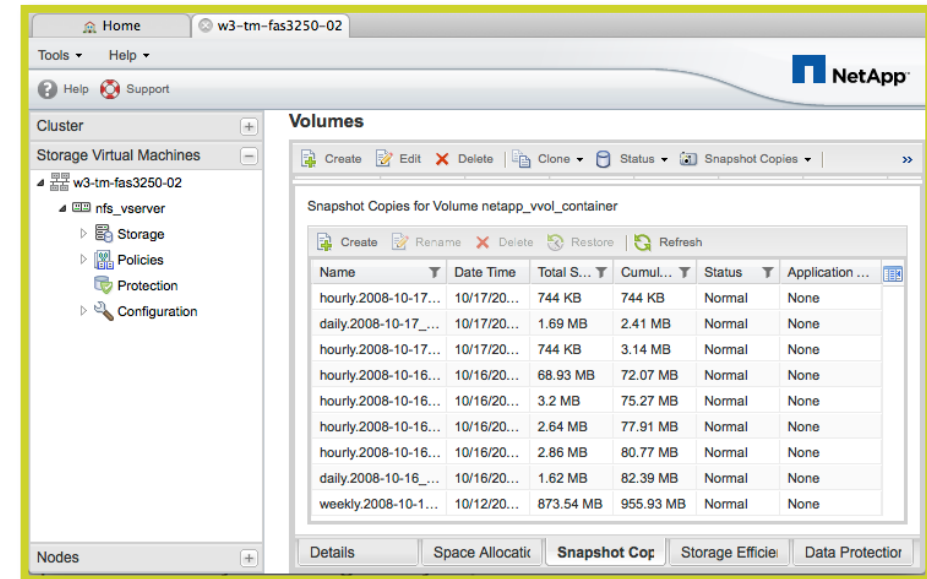
Snapshots

- Snapshots are a point in time copy on write image of a Virtual Volume with a different ID from the original.
- Virtual Volumes snapshots are useful in the contexts of creating:
 - a quiesced copy for backup or archival purposes, creating a test and rollback environment for applications, instantly provisioning application images, and so on.
- Two type of snapshots supported:
 - Managed Snapshot – Managed by ESX.
 - A maximum of 32 vSphere managed snapshot are supported for linked clones of an individual VM
 - Unmanaged Snapshot – Manage by the storage array.
 - Maximum snapshot dictated by the storage array

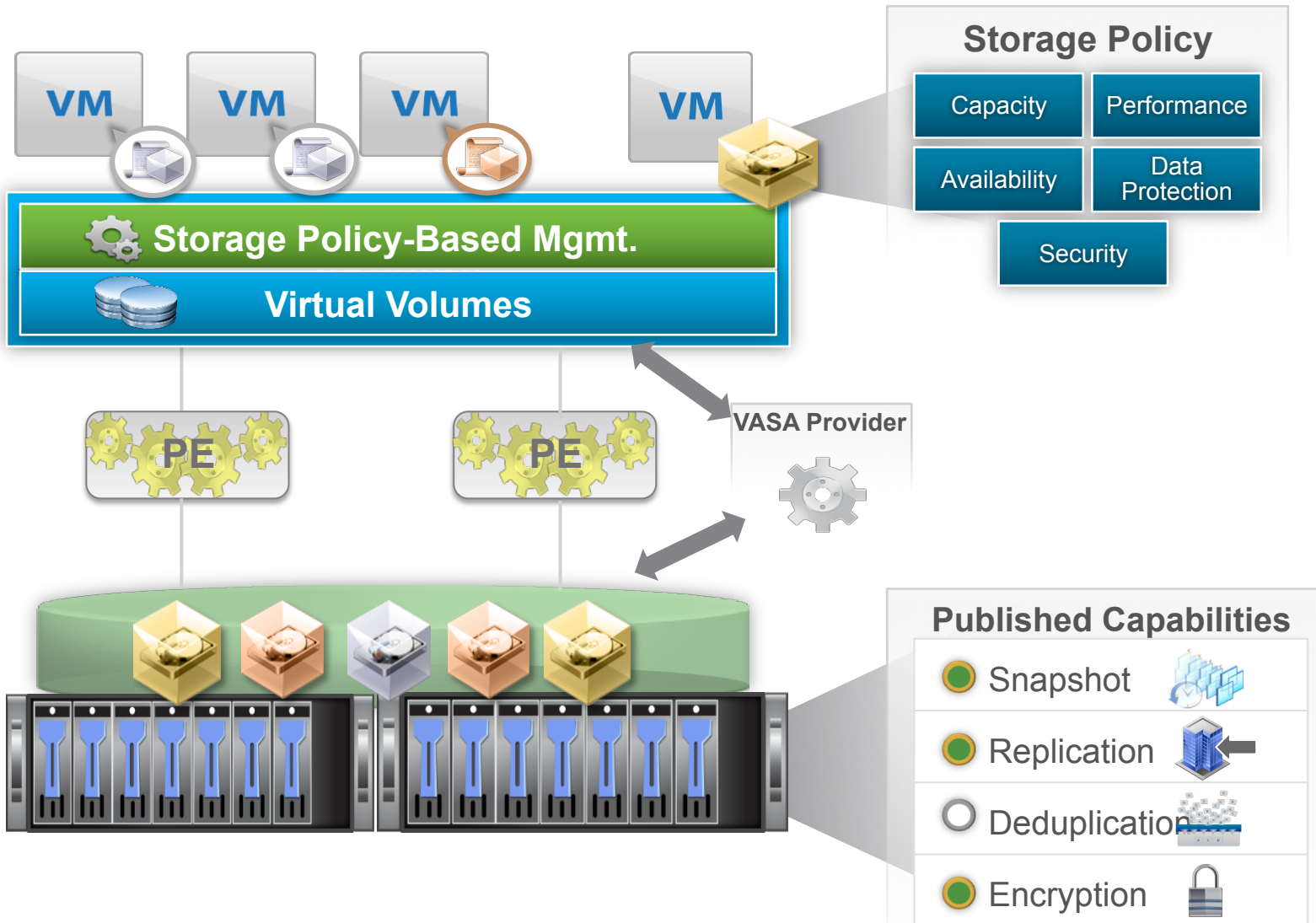
Managed Snapshot - vSphere



Unmanaged Snapshot - Array



vSphere Virtual Volumes Supported Features



Supported vSphere Features

- SPBM
- Thin Provisioning
- Linked Clones
- Native Snapshots
- Protocols: NFS3, iSCSI, FC, FCoE
- View Storage Accelerator (CBRC)
- vMotion
- SvMotion
- DRS
- XvMotion
- vSphere SDK (VC APIs)
- VDPA/VDP
- View
- vRealize Operations
- vRealize Automation
- Stateless / Host Profiles

The Benefits of vSphere Virtual Volumes

A More Efficient Operational Model For External Storage

Simplifies Storage Operations



- Eliminate inefficient handoffs between VI and Storage Admin
- Faster storage provisioning through automation
- Simplified change management through flexible consumption
- Self-service provisioning via cloud automation tools.

Simplifies Delivery of Service Levels



- Leverage native array-based capabilities
- Fine control at the VM level
- Dynamic configuration on the fly
- Ensure compliance through policy enforcement using automation

Improves Resource Utilization



- Increase capacity utilization.
- Eliminate overprovisioning
- Reduce management overhead

vSphere Virtual Volumes Is An Industry-wide Initiative



And Many More...

29 Partners
in the
Program

Multiple
Ready at GA

Unique
capabilities

THANK YOU



Rawlinson Rivera
@PunchingClouds