



Introduction to Container Storage

Day of Cloud Native Oslo, 20 March 2018

Cheryl Hung, Product Manager



Cheryl

Product manager, StorageOS

Cloud Native London

@oicheryl



- Why is state so tricky?
- How should I compare storage?
- What storage should I use with Kubernetes?



- Why is state so tricky?
- How should I compare storage?
- What storage should I use with Kubernetes?

Anti-objective:

- Should I use a database/message queue/key-value store... for my app?





Why is state so tricky?



Why do I need storage?

@oicheryl





First challenge: No pet storage

@oicheryl



Second challenge: Data needs to follow

@oicheryl



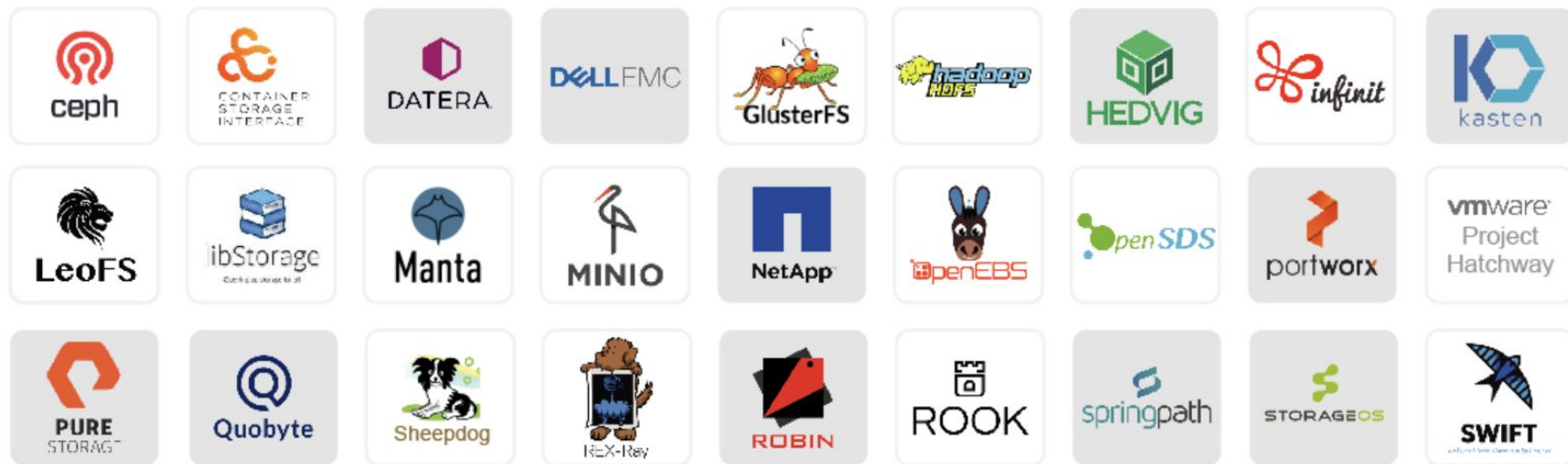
Third challenge: Humans are fallible






@oicheryl



How should I compare storage?

Cloud-Native Storage



	 Azure	 Google	 AWS
Object Storage	Azure Blob Storage	Google Cloud Storage	Amazon Simple Storage Service (S3)
Virtual Machine / Block Storage	Azure Page Blobs / Premium Storage	Persistent Disk	Amazon Elastic Block Storage (EBS)
File Storage	Azure File Storage		Amazon Elastic File System (EFS)
Long Term Cold Storage	Azure Cool Storage	Google Coldline Storage	Amazon Glacier
Hybrid / Gateway Storage	Azure StorSimple		AWS Storage Gateway

Eight Principles of Cloud Native Storage



Horizontally scalable

No single point of failure

Resilient and self healing

Minimal operator overhead

Decoupled from the underlying platform



1 Application centric

Storage should be presented to and consumed by applications, not by operating systems or hypervisors



1 Application centric

Storage should be presented to and consumed by applications, not by operating systems or hypervisors

2 Platform agnostic

The storage platform should be able to run anywhere. Upgrades and scaling is non-disruptive.



1 Application centric

Storage should be presented to and consumed by applications, not by operating systems or hypervisors

2 Platform agnostic

The storage platform should be able to run anywhere. Upgrades and scaling is non-disruptive.

3 Declarative & composable

Storage resources should be declared and composed just like all other resources required by applications and services.



1 Application centric

Storage should be presented to and consumed by applications, not by operating systems or hypervisors

2 Platform agnostic

The storage platform should be able to run anywhere. Upgrades and scaling is non-disruptive.

3 Declarative & composable

Storage resources should be declared and composed just like all other resources required by applications and services.

4 API driven

Storage resources and services should be easy to be provisioned, consumed, moved and managed via an API.

Storage services should integrate and inline security features such as encryption and RBAC.

**5 Natively
secure**



Storage services should integrate and inline security features such as encryption and RBAC.

The platform should be able to move application data between locations, dynamically resize and snapshot volumes.

**5 Natively
secure**

6 Agile



Storage services should integrate and inline security features such as encryption and RBAC.

The platform should be able to move application data between locations, dynamically resize and snapshot volumes.

The storage platform should offer deterministic performance in complex distributed environments.

**5 Natively
secure**

6 Agile

7 Performant

Storage services should integrate and inline security features such as encryption and RBAC.

The platform should be able to move application data between locations, dynamically resize and snapshot volumes.

The storage platform should offer deterministic performance in complex distributed environments.

The storage platform should ensure high availability, durability, consistency with a predictable, proven data model.

**5 Natively
secure**

6 Agile

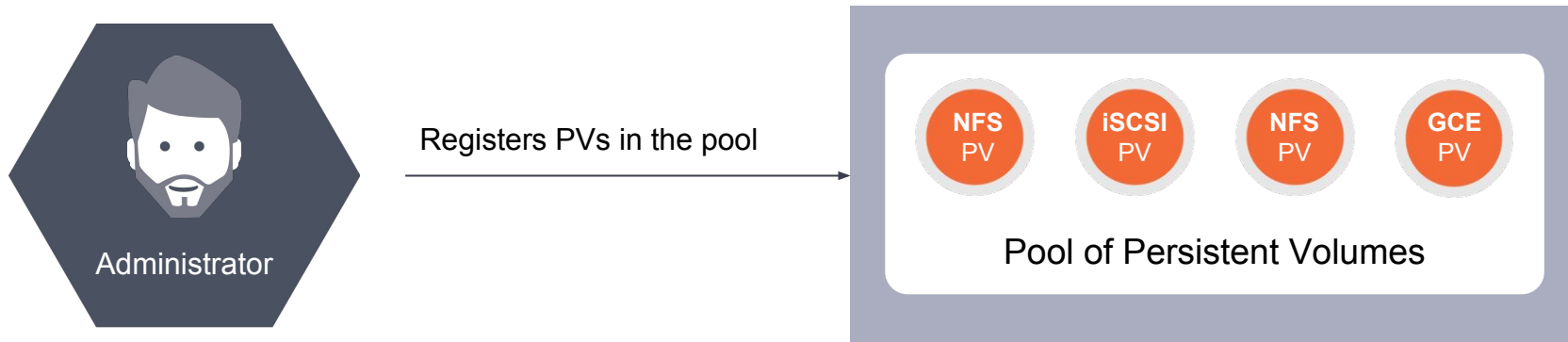
7 Performant

**8 Consistently
available**

What storage should I use with Kubernetes?

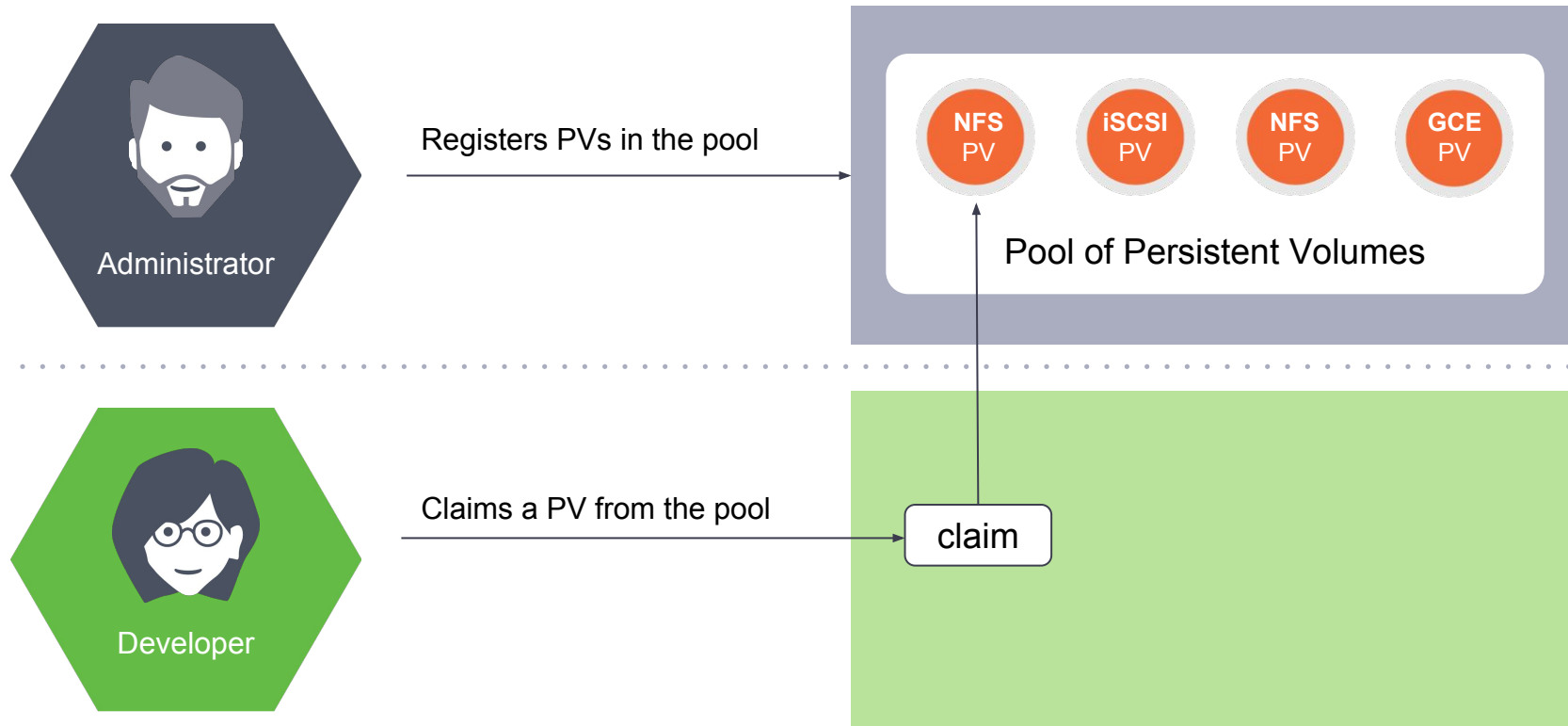
Kubernetes Storage Model: Persistent Volumes and Claims

@oicheryl



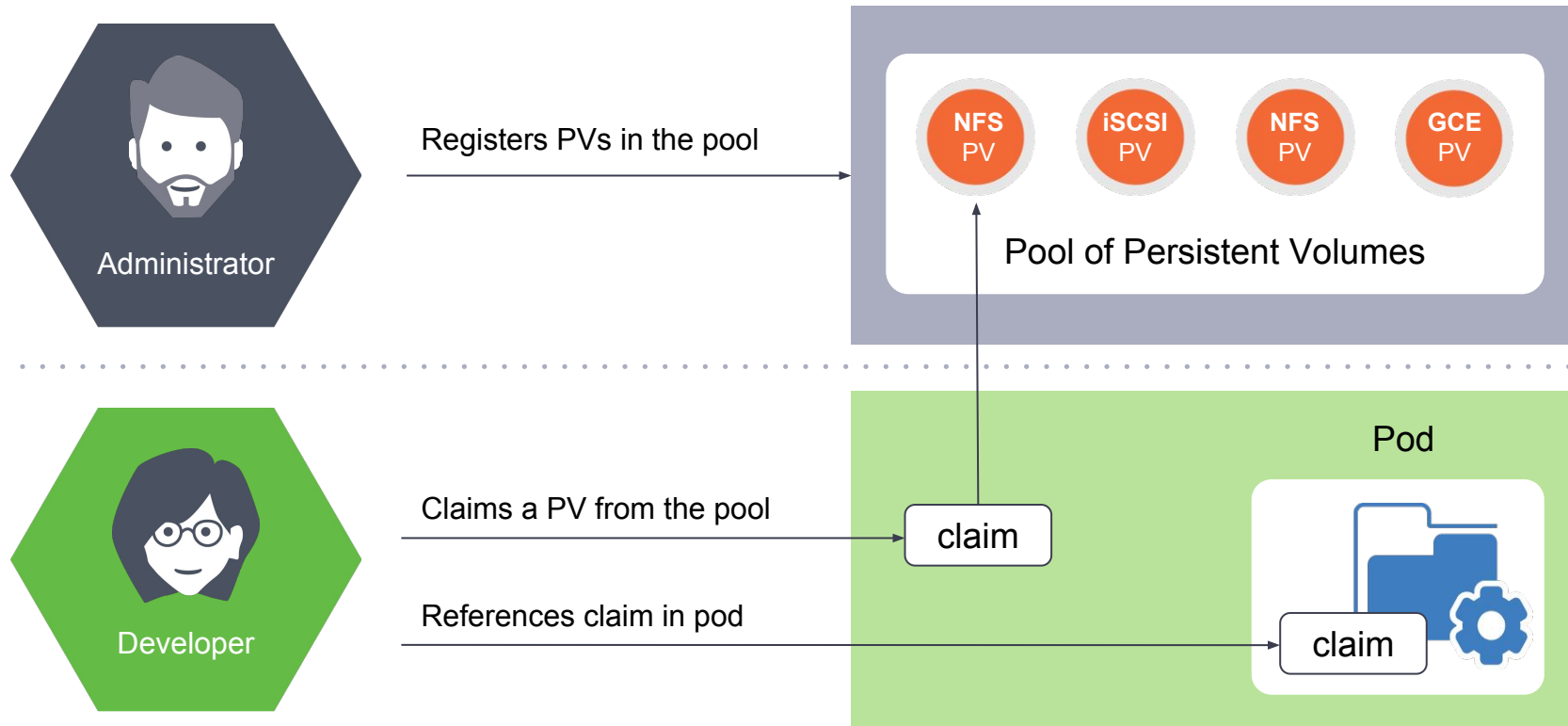
Kubernetes Storage Model: Persistent Volumes and Claims

@oicheryl



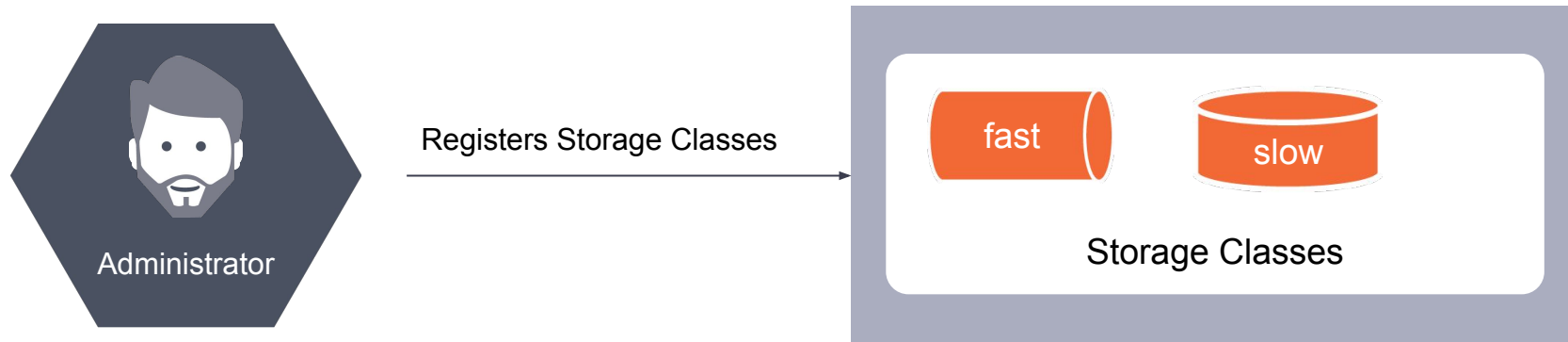
Kubernetes Storage Model: Persistent Volumes and Claims

@oicheryl



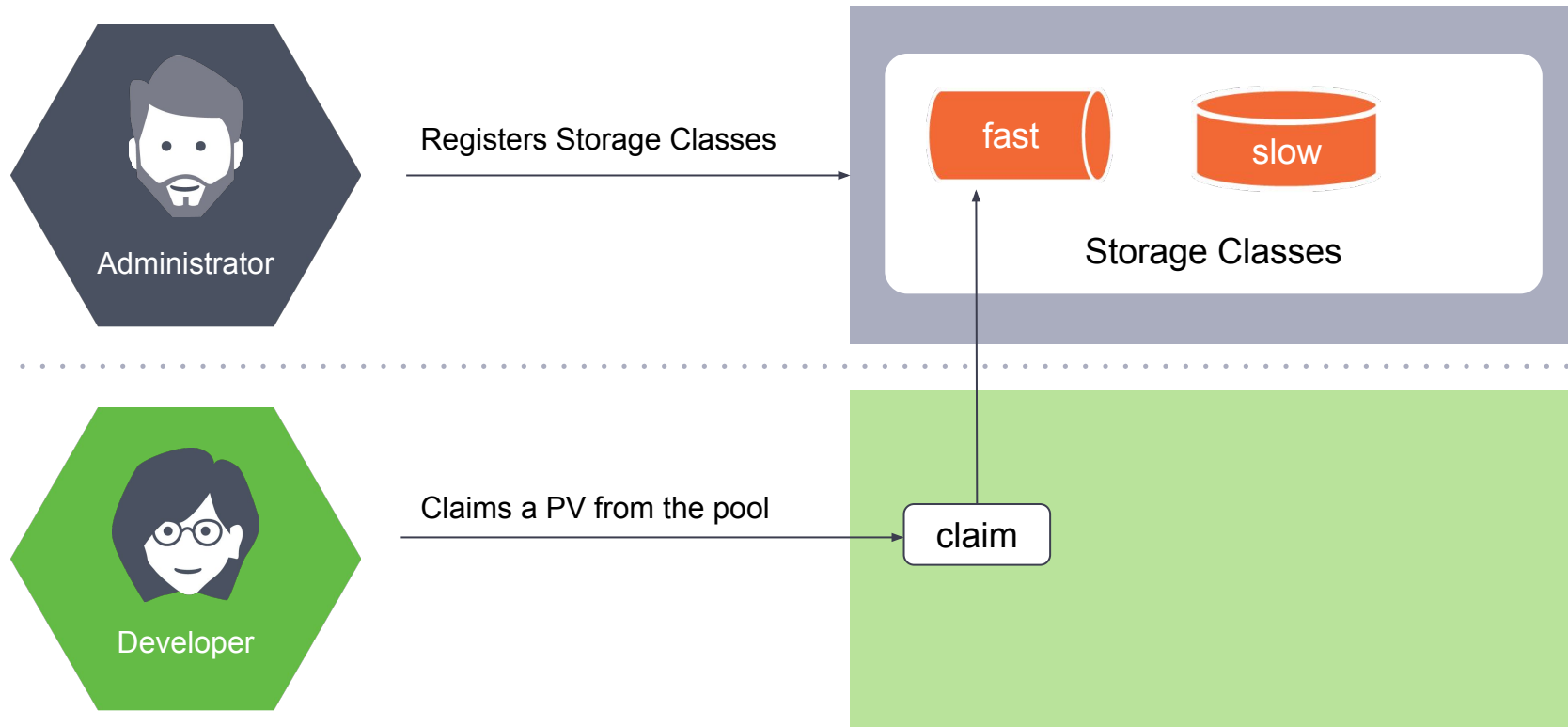
Dynamic provisioning with Storage Classes

@oicheryl



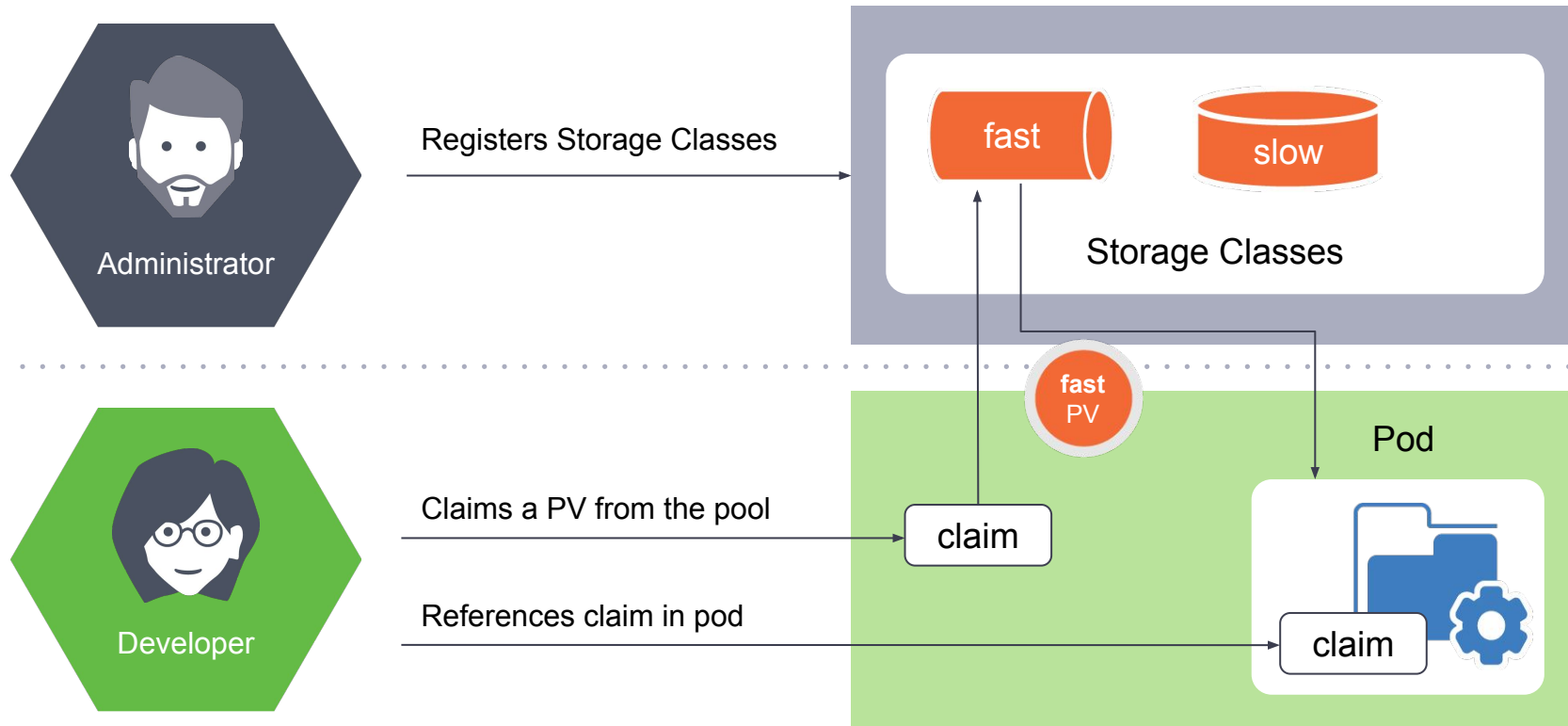
Dynamic provisioning with Storage Classes

@oicheryl



Dynamic provisioning with Storage Classes

@oicheryl





**KEEP
CALM
IT IS
DEMO
TIME**



- A DevOps engineer at a media company
- Migrating client Wordpress websites into Kubernetes
- Wants to follow the cloud native principles

Volume Plugin	Internal Provisioner	Config Example
AWSElasticBlockStore	✓	AWS
AzureFile	✓	Azure File
AzureDisk	✓	Azure Disk
CephFS	-	-
Cinder	✓	OpenStack Cinder
FC	-	-
FlexVolume	-	-
Flocker	✓	-
GCEPersistentDisk	✓	GCE
Glusterfs	✓	Glusterfs
iSCSI	-	-
PhotonPersistentDisk	✓	-
Quobyte	✓	Quobyte
NFS	-	-
RBD	✓	Ceph RBD
VsphereVolume	✓	vSphere
PortworxVolume	✓	Portworx Volume
ScaleIO	✓	ScaleIO
StorageOS	✓	StorageOS

Volume Plugin	Internal Provisioner	Config Example
AWSElasticBlockStore	✓	AWS
AzureFile	✓	Azure File
AzureDisk	✓	Azure Disk
CephFS	-	-
Cinder	✓	OpenStack Cinder
FC	-	-
FlexVolume	-	-
Flocker	✓	-
GCEPersistentDisk	✓	GCE
Glusterfs	✓	Glusterfs
iSCSI	-	-
PhotonPersistentDisk	✓	-
Quobyte	✓	Quobyte
NFS	-	-
RBD	✓	Ceph RBD
VsphereVolume	✓	vSphere
PortworxVolume	✓	Portworx Volume
ScaleIO	✓	ScaleIO
StorageOS	✓	StorageOS

1. What is my **use case**?
2. What are my **performance requirements**?
3. How should developers **access** storage?
4. Where is the storage **deployed and managed**?

1. What is my use case?

@oicheryl



App binaries



App data



Config



Backup

2. What are my performance requirements?

@oicheryl



App binaries
Ephemeral



App data
Latency,
availability,
performant



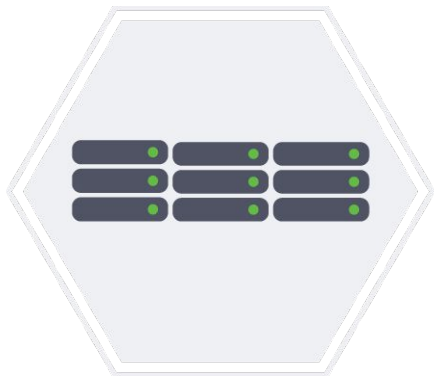
Config
Shared



Backup
Cost efficient,
cloud

3. How should developers access storage?

@oicheryl



Block

Fixed-size 'blocks' in a rigid arrangement – ideal for enterprise databases



File

'Files' in hierarchically nested 'folders' – ideal for active documents

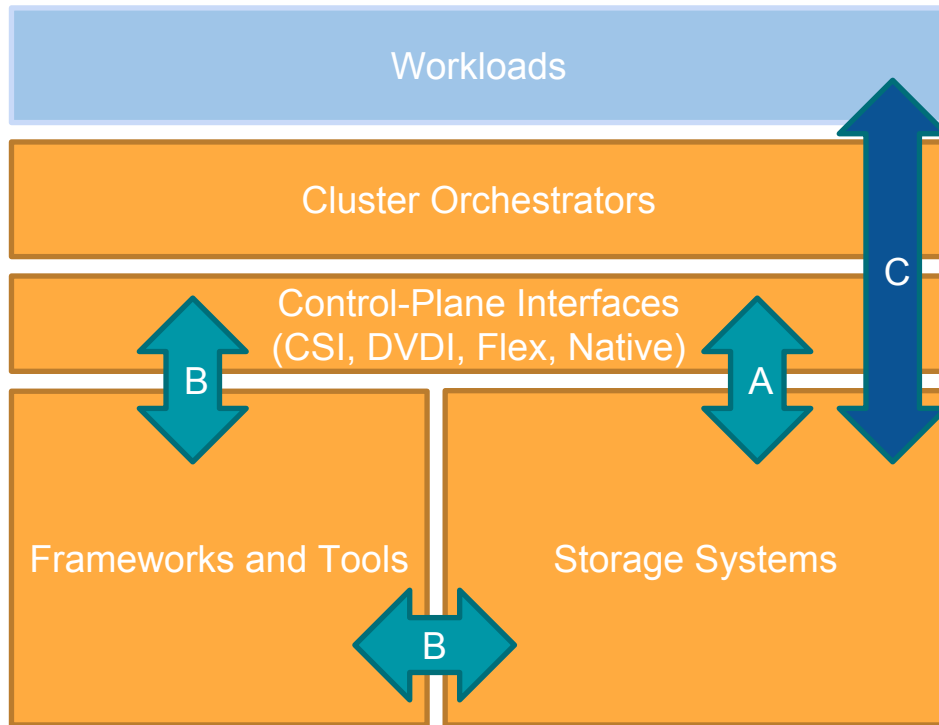


Object

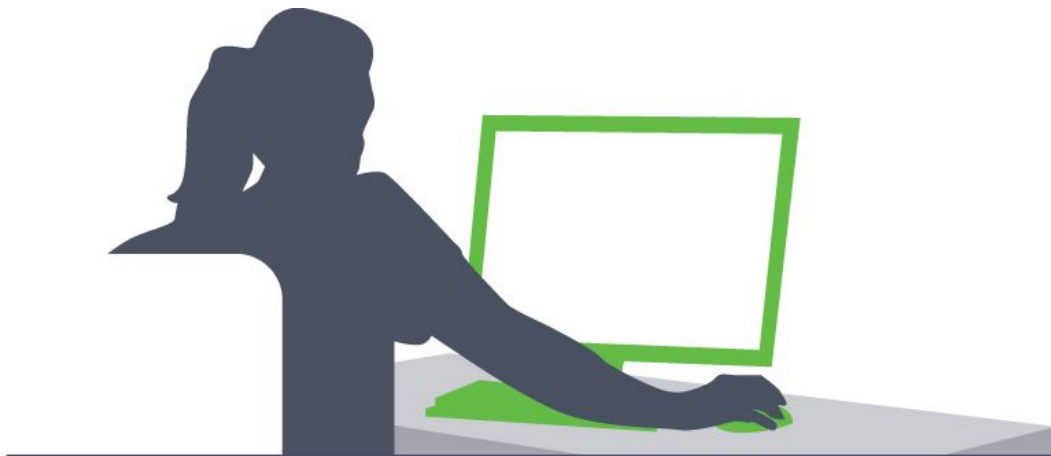
'Objects' in scalable 'buckets' – ideal for unstructured big data and archiving

4. Where is the storage deployed and managed?

@oicheryl



- CO supports one or more **Interfaces** to interact with the Storage System
- Storage System can **(A)** support control-plane interface API directly and interact directly with the CO or can **(B)** interact with the CO via an **API framework layer** or other **Tools**.
- Storage system must support the ability to provision and consume (C) volumes through a standard interface to be considered **Interoperable**
- Workloads interact (C) with storage systems over various data-plane methods



- Postgres database for application data
- Database location, credentials
- Database and website backups
- User uploaded media

1. **Use case?** Configuration
2. **Performance requirements?** Shared across instances
3. **Access?** Kubernetes provides Secrets for sensitive data such as passwords, and ConfigMap for arbitrary config. Both can be accessed by the application through environment variables
4. **Deployed and managed?** Tight integration with Kubernetes

1. **Use case?** Shared media
2. **Performance requirements?** Large blobs of data, shared across pods
3. **Access?** Shared filesystem
4. **Deployed and managed?**

Cloud: Managed NFS, or object store if the app can support it

On prem: Distributed FS (not NFS)

1. **Use case?** Backup and archival
2. **Performance requirements?** Durability, cost, snapshots
3. **Access?** Object store
4. **Deployed and managed?**

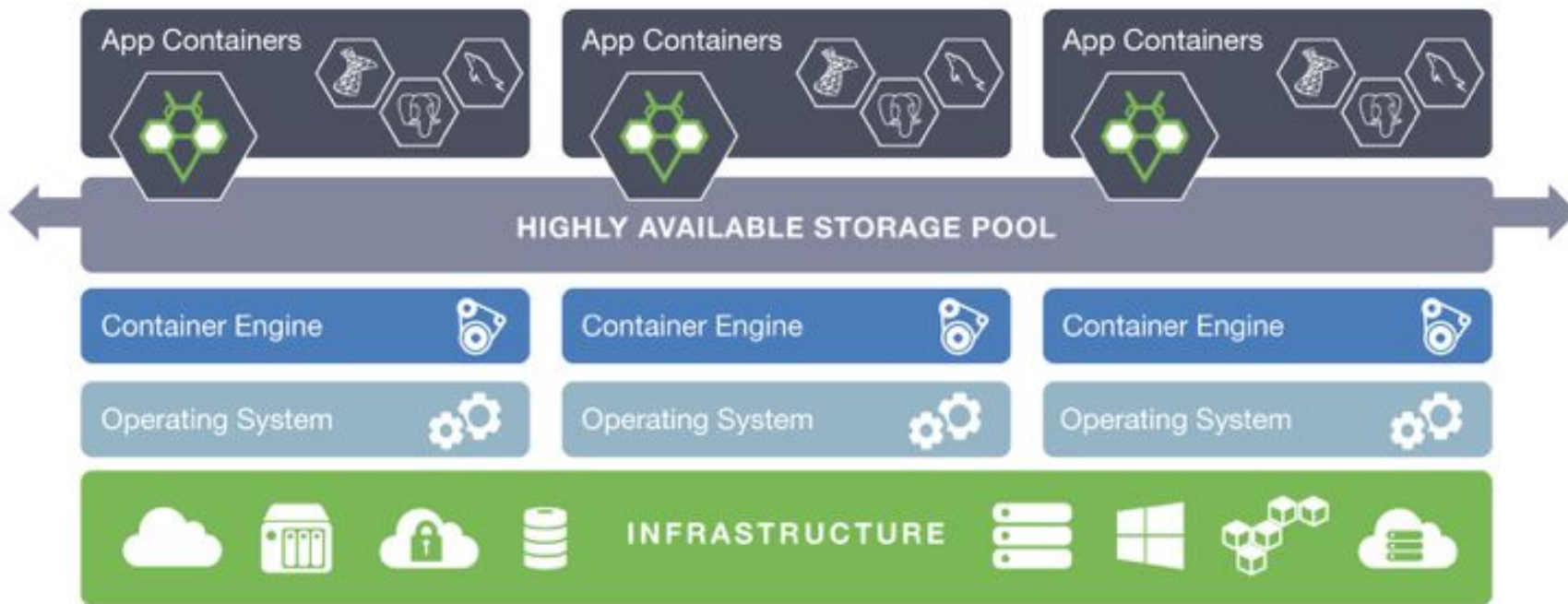
Cloud: Managed object store, long term cold storage

On prem: Object store, NAS

1. **Use case?** Transactional database
2. **Performance requirements?** High availability, low latency, deterministic performance
3. **Access?** Database connector
4. **Deployed and managed?**

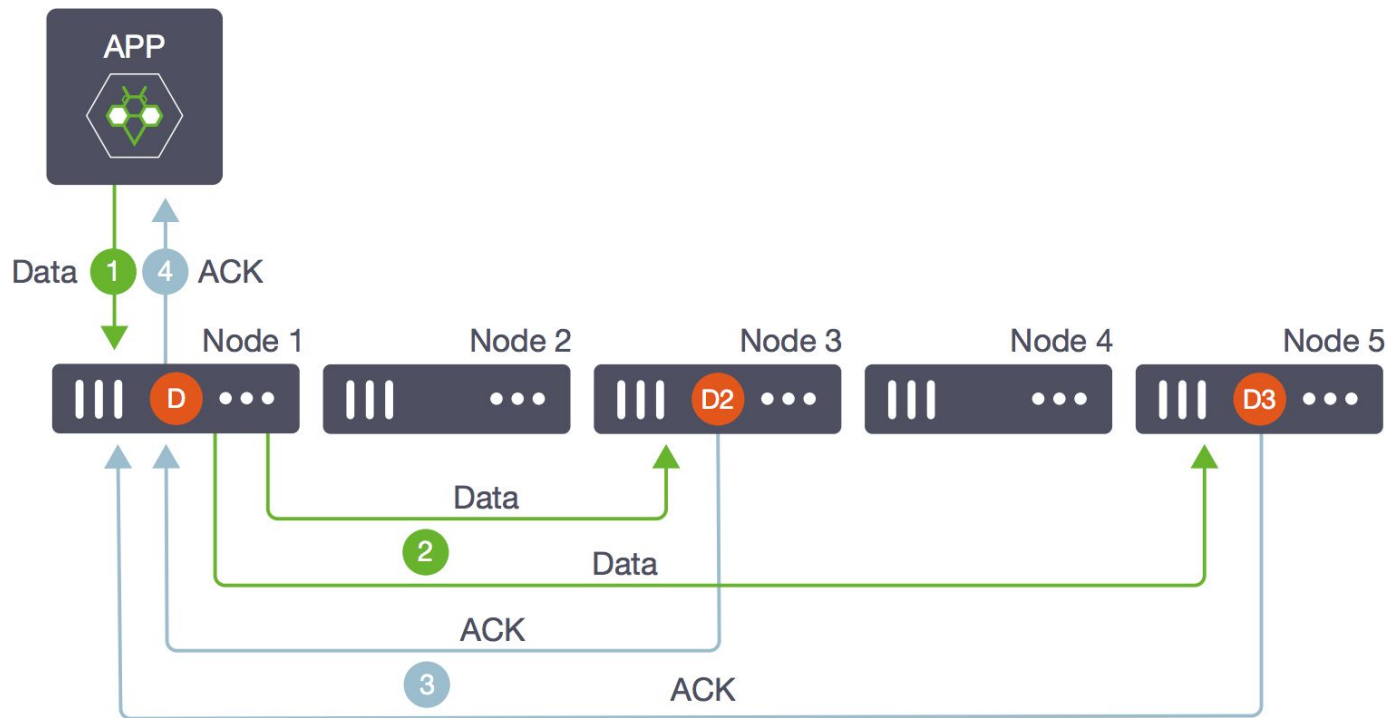
Cloud: Cloud volumes (watch out for attach/detach times, compliance) or managed db (limited offerings)

On prem: Software defined storage



High availability with StorageOS

@oicheryl



Kubernetes Persistent App demo - Rocket.Chat

@oicheryl

The screenshot displays a web browser window at `localhost:3000/group/prime-subscriber-delivery-missions`. The interface is divided into three main sections:

- Left Sidebar:** Contains navigation options for 'all.prime.services', 'general' channel, 'DIRECT MESSAGES', 'PRIVATE GROUPS' (selected), and 'HISTORY'.
- Chat Area:** Shows a conversation log for the group 'prime-subscriber-delivery-missions' dated October 17, 2015. The messages are as follows:
 - AS** (all.prime.services) 14:40: @fleet.manager: Drone 1 on mission A3 waypoint 7 looks out of fuel. How can that be?
 - FM** (fleet.manager) 14:41 (edited): @all.prime.services: Verifying service records - please hold.
 - AS** (all.prime.services) 14:41: @fleet.manager: Yeah, please hurry up. Only 30% fuel left, doesn't look good.
 - FM** (fleet.manager) 14:42 (edited): @all.prime.services: Strange! That bird went missioning with 100% fuel only 2 minutes ago.
 - AS** (all.prime.services) 14:44: @fleet.manager: You think it is a faulty sensor gauge? How much can we trust it?
 - FM** (fleet.manager) 14:45 (edited): @all.prime.services: Standard operating procedure says we must trust the instrumentations. Call it back to base!
 - AS** (all.prime.services) 14:45: P#@#! It is mission A3 waypoint 7 - no way in hell it is going to make it back with 30% fuel!
 - FM** (fleet.manager) 14:46: @all.prime.services: Just got OK for contingency services from HQ on Drone 1 mission A3 waypoint 7.
 - AS** (all.prime.services) 14:50: @fleet.manager: So what? We blew it up over a bush? Tank it into retention pond? Or crash land it for civilian recovery?
 - FM** (fleet.manager) 14:51 (edited): @all.prime.services: We've got some MF insurance coverage! Even indirect forest fire up to 200 acres. Do whatever you want!
 - AS** (all.prime.services) 14:55: @fleet.manager: grin: fire: fire: fire: Haha. OK. Will confer with engineering. Oh, this is a new drone from 3Dr @3dr.drones
 - 3Dr.drones** 14:56: @all.prime.services: Yes SIR!
 - AS** (all.prime.services) 14:57: @3dr.drones: Our drone 1, model SoloWayTooLoney, serial 323838 has a faulty fuel gauge, please advise of disposal.
 - 3Dr.drones** 14:58 (edited): @all.prime.services: WTF! That bird is still in our labs. It has **not** been FAA cleared for civilian airspace. How can you guys be flying it?
 - AS** (all.prime.services) 14:59: @3dr.drones: Ummm... we're the ones manufacturing them for you in Shenzhen, remember?
- Right Panel:** Displays a Google Map of an area with streets like 'Tjane Flats', 'Wendy's', 'Which Wich', 'Tavern', 'Buffalo Wild Wings', 'Sudbury Ct', 'Linden Pkwy', 'Eden Hills Ct', 'Remington Ct', and 'Linden Pkwy'. Two drone locations are marked: Drone 1 (mission A3 waypoint 7) with 30% fuel (red dot) and Drone 2 (mission A7 waypoint 2) with 100% fuel (green dot). Below the map are buttons for 'RETURN TO BASE' and 'CANCEL'.

lab.democluster.com

- Create Kubernetes cluster (`--cluster-version=1.7` in step 3) and install helm. You may have to reboot to disable SELinux and step 16 should be `print $3`.
- Install Rocket.Chat with MongoDB, backed by PVs
- Delete pod running MongoDB
- Wait for Kubernetes to restart MongoDB

To Recap...



**1 Application
centric**

**5 Natively
secure**

**2 Platform
agnostic**

6 Agile

**3 Declarative/
composable**

7 Performant

4 API driven

**8 Consistently
available**

1. **Use case?**
2. **Performance requirements?**
3. **Access?**
4. **Deployed and managed?**





Objective is to define an industry standard “Container Storage Interface” (CSI) that will enable storage vendors to develop a plugin once and have it work across a number of container orchestration systems.

Browser-based demo

- demo.storageos.cloud

Quickstart

- storageos.com/kubernetes





Thanks

Slides at oicheryl.com

A software-defined, scale-out storage platform for running enterprise containerized applications in production



What is StorageOS?

@oicheryl

Platform
agnostic

Horizontally
scalable

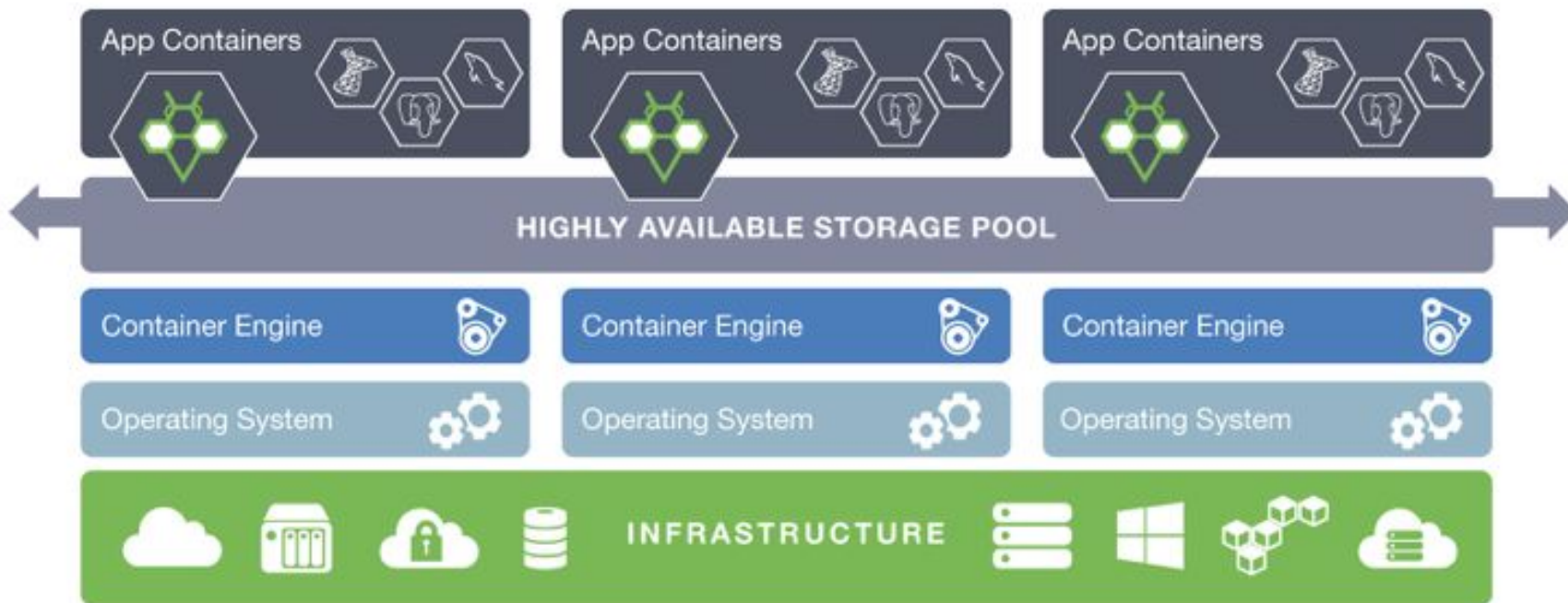
Database (ie.
block)

A software-defined, scale-out storage
platform for running enterprise
containerized applications in production

Docker/K8s
integration

High
availability





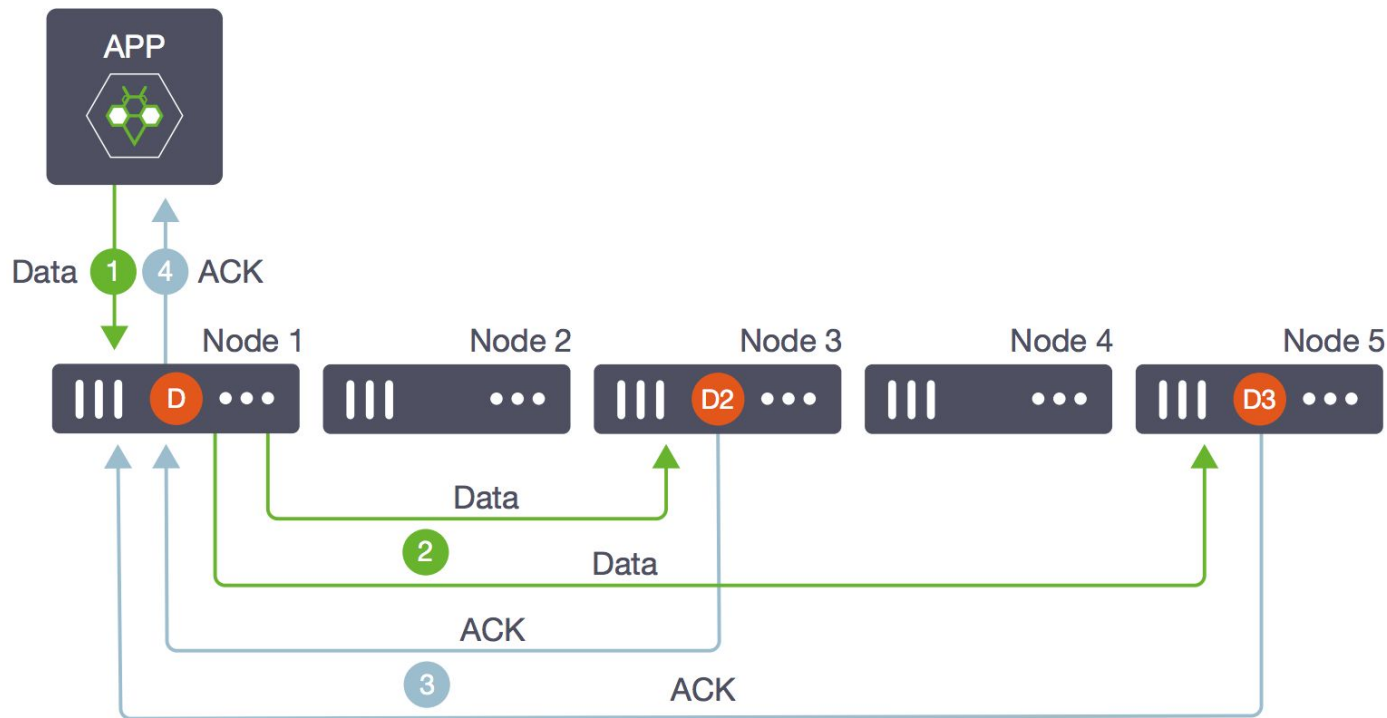
StorageOS is conceptually pretty simple; it's a virtualization layer on top of any commodity or cloud storage. It's deployed as one [container](#) per node, similar to a DaemonSet.

1. Nodes contribute local block storage to the storage pool.
2. Virtual volumes (block storage formatted with a standard filesystem) are created using the [StorageOS volume plugin](#).
3. Any pods can mount the virtual volumes from any node. If a pod is rescheduled to a different node, StorageOS simply redirects reads and writes so the pod can continue to access the storage.

It's designed to scale horizontally by adding more nodes. New nodes contribute their storage into the storage pool, or, if they don't have storage themselves, can access storage on other nodes.

High availability with StorageOS

@oicheryl



StorageOS uses a hybrid master/replica architecture, where replicas are distributed across nodes.

Replication is very simple in StorageOS. Volume D is created with two replicas. StorageOS creates the replicas (D2, D3) and schedules them to two different nodes (N3, N5). Incoming writes to D are synchronously replicated to D2 and D3, ie. writes are not persisted until acknowledged by both replicas.

If N1 fails, one of D2 or D3 gets promoted to master, providing instant failover and no interruption of service. StorageOS creates and resyncs a new replica on N2 or N4 in the background.

More reading

Download the technical architecture overview at storageos.com/storageos-platform-architecture-overview.

Try out in your browser, with zero downloads or configuration: demo.storageos.cloud

Full documentation at docs.storageos.com.