What’s New in Container Storage

Live Webcast
February 26, 2019
10:00 am PT
Today’s Presenters

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SNIA-At-A-Glance

185 industry leading organizations

2,000 active contributing members

50,000 IT end users & storage pros worldwide
What We Do

Educate vendors and users on cloud storage, data services and orchestration

Support & promote business models and architectures: OpenStack, Software Defined Storage, Kubernetes, Object Storage

Understand Hyperscaler requirements. Incorporate them into standards and programs

Collaborate with other industry associations
What is a Container?

- Starts with a base OS system image
- Container init = 1 process only
- Process runs in its own namespace
- Shared access to system resources (hardware, network, etc)
- Containers Copy-on-Write image is NOT saved when process exits!
Container Community Orgs

- **Cloud Native Computing Foundation (CNCF)**
  - [https://www.cncf.io/](https://www.cncf.io/)

- **Open Container Initiative (OCI)**
  - [https://www.opencontainers.org/](https://www.opencontainers.org/)

- **Both are part of the Linux Foundation**
  - [https://www.linuxfoundation.org/](https://www.linuxfoundation.org/)
Container Storage Types

- Runtime Storage - Graph Driver
- Cold Storage for Images - Registry Storage
- Persistent Storage
Integration point determined by container runtime

- [https://blog.mobyproject.org/where-are-containерs-graph-drivers-145fc9b7255](https://blog.mobyproject.org/where-are-containерs-graph-drivers-145fc9b7255)

- Basically, two driver styles:
  - Overlay
    - OverlayFS, AUFS
  - Snapshot
    - Btrfs, zfs, devicemapper
Container Runtimes

- **Docker (containerd)**
  - Default for most container installs, widest user base

- **CoreOS (rkt)**
  - Aims to be ultra-thin, ultra-simple
  - CoreOS acquired by RedHat May 2018

- **CRI-O**
  - Intended to be Kubernetes-native runtime

- **Upstream of these projects are all CNCF efforts.**
Many private registry options.

Pretty much all use either
- File-based storage
- Object storage

Docker Registry can use either
- Supports any mounted filesystem for file-based
- S3 or OpenStack Swift APIs for object storage
Persistent Storage

- This category is the single most important integration point for most storage vendors.

- There is little support within the container ecosystem for native persistence, and yet it is a major need for users.
Every implementation works pretty much the same:
- Plugin/integration code receives instructions from the framework to manipulate a file or block device
- Plugin reaches out to backing store to mount the new device on the host system and prepare it for use (formatting, etc)
- Plugin hands mount point back to framework
- Framework bind-mounts it into a container prior to container launch

APIs are a little different, and some other capabilities (snapshots, RBAC, etc) may or may not be baked into the APIs
Container Frameworks

- Docker Swarm
- Kubernetes
- Mesosphere
Docker Swarm & Mesosphere Integration

- Docker Volume Plugin supports two versions:
  - V1: Supports Windows and Linux
    - Installs out-of-band of container solution
    - Less secure by default (can be manually tightened down)
  - V2:
    - Install is containerized, so very easy for users
    - Uses Linux kernel capability controls for security management
    - Unfortunately, that makes it Linux-only
- [https://docs.docker.com/engine/extend/plugins_volume/](https://docs.docker.com/engine/extend/plugins_volume/)
- Requires Docker Engine, either Community or Enterprise
Kubernetes is becoming the de facto standard for new container projects. (With growing pains involved)

You should be considering Kube Integration.

Kubernetes is a community project. Like all major community projects, there are many cooks. Which means there’s several ways to integrate.
Kubernetes Concepts

- Kube is operator-centric: admins must prepare volume offerings to users
- Applications are managed in pods
  - Users don’t manage singleton containers in Kube - always app stacks via pods
- Admins prepare resources for users
- Storage Class - Admin prepares
  - Persistent Volume Claim - Declared in pod file
    - Persistent Volume - Dynamically created at runtime for pod
- Community links to get started
  - [https://github.com/kubernetes/community/tree/master/sig-storage](https://github.com/kubernetes/community/tree/master/sig-storage)
  - [https://github.com/kubernetes/community/blob/master/sig-storage/contributing.md](https://github.com/kubernetes/community/blob/master/sig-storage/contributing.md)
These are baked in to the Kubernetes source
Most distros will ship them
https://kubernetes.io/docs/concepts/storage/
Example volume driver:
  - https://github.com/kubernetes/kubernetes/tree/master/pkg/volume/rbd
You WILL need to join the Kubernetes community org and sign their Contributor License Agreement - this may not be a good fit for everyone!
This is slowly being deprecated for CSI.
FlexVolume Plugins

- 1st released persistence API for Kubernetes
- Fully GA and supported as of Kubernetes 1.8
- Docs are hard to find - Kube docs team are moving things
- [https://github.com/kubernetes/community/blob/master/contributors/devel/flexvolume.md](https://github.com/kubernetes/community/blob/master/contributors/devel/flexvolume.md)
- Internal Kubernetes project
Container Storage Interface (CSI)

- CNCF Incubator Project
  - This means more overall community support than FlexVolume
  - However, this is also newer, and only recently GA.
  - Cloud Foundry (not specifically containers) and Mesos have announced support for CSI as well
  - Note that most distros have lag time for supporting Kube releases

- [https://github.com/container-storage-interface](https://github.com/container-storage-interface)
  - Several repos there that are useful.
  - Full specification is in the Spec repository
  - [https://github.com/container-storage-interface/spec/blob/master/spec.md](https://github.com/container-storage-interface/spec/blob/master/spec.md)
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