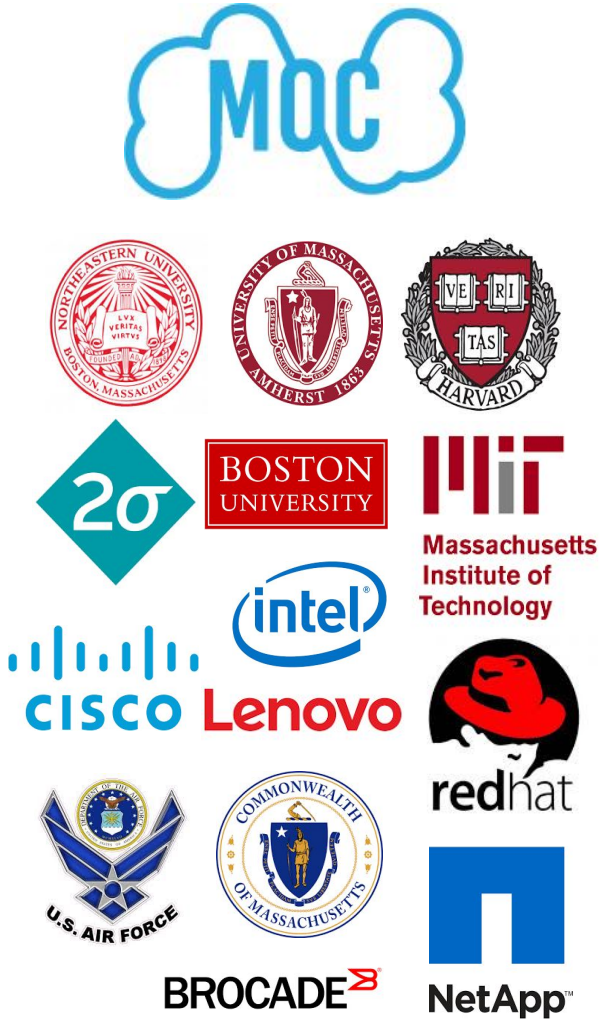
ChRIS Code Lab

Introductions

Massachusetts Open Cloud (MOC)

- Collaborative effort bw/ 5 research universities, government, and industry
- Unlike Amazon/Microsoft/Google an ***open ecosystem of cloud services***
- Research and education over a production-scale public cloud
  - Operating over a 15MW datacenter
  - Backed by OpenStack and OpenShift



ChRIS Introduction

- ChRIS (Children's Research Integration System) is a web-based medical image platform that allows for various forms of medical image (Ex: MRIs) processing.
- ChRIS itself is comprised of multiple open source projects (https://github.com/FNNDSC/) and the intention is to make the research and capabilities available to other hospitals.

Combined Goal

- The desire of Boston Children's Hospital, Boston University and Red Hat is to help improve the scale and efficiency of this platform with the MOC (Massachusetts Open Cloud) and various Red Hat technologies including OpenShift and OpenStack.
- Reduce image processing time from hours to mins
- Democratize medical image processing

The Technology

Red Hat Enterprise Linux (RHEL)

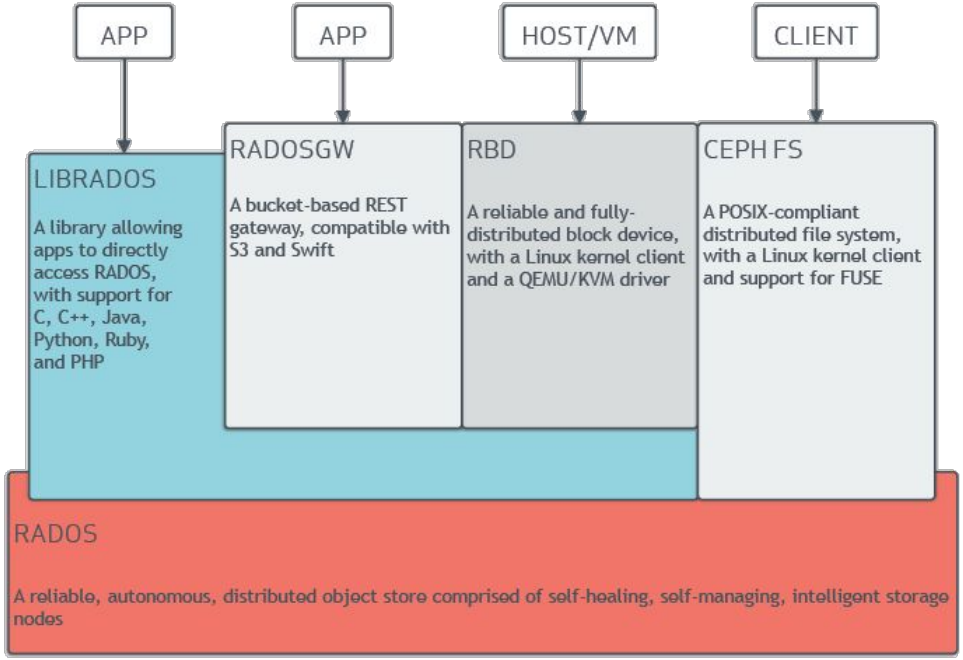
- Industry leading, stable, secure linux distribution

OpenStack

- On-premises IaaS
  - Compute
  - Networking
  - Storage

Ceph / Swift / Cinder

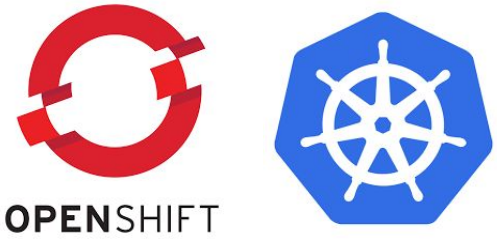
- Software-defined distributed object and block storage



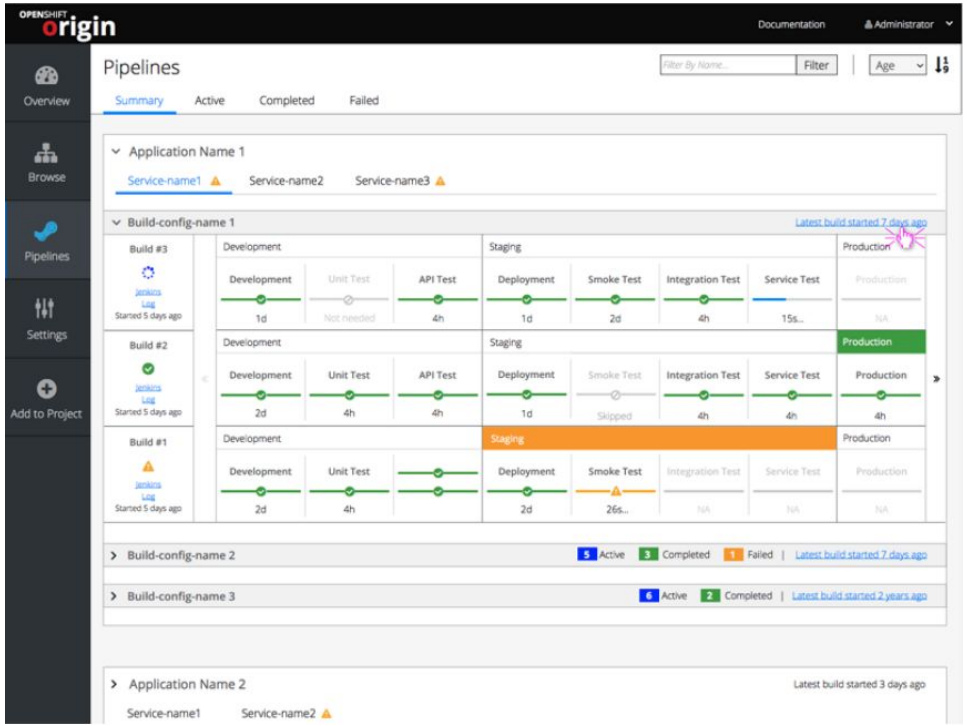
Docker / OCI

- Container runtime and image format
- Standardizes image processors

OpenShift / Kubernetes

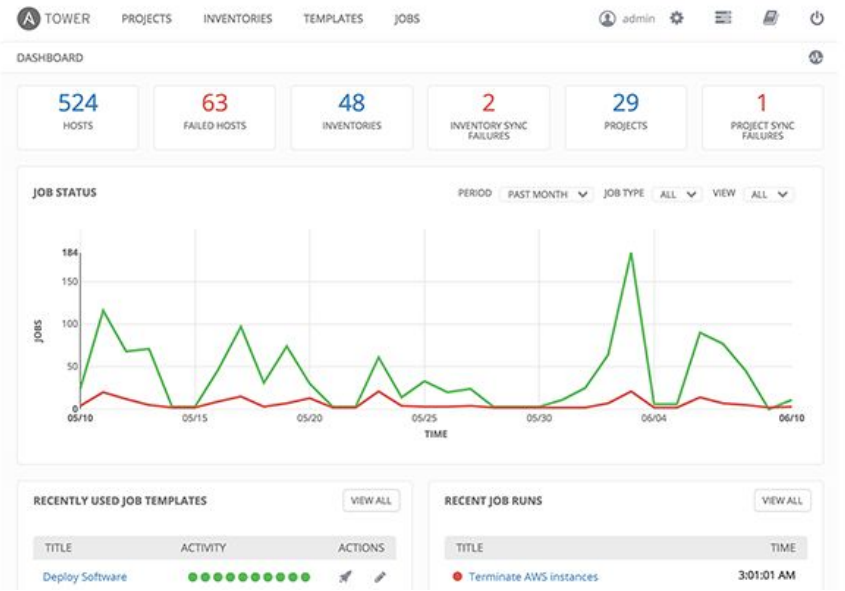


- Provides scaled job framework for running image processors

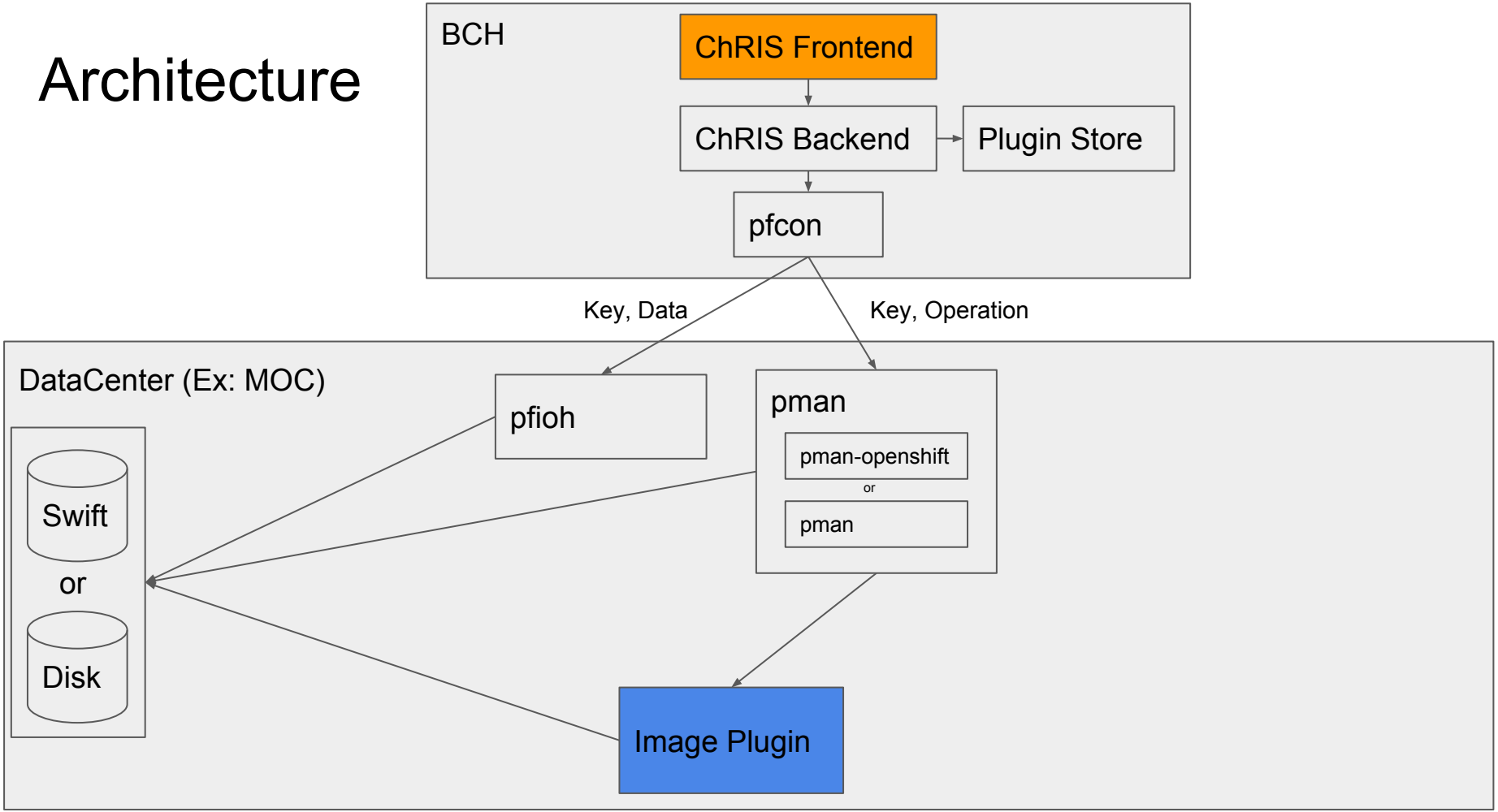


Ansible

- Cluster Management
- Declarative Orchestration



Architecture



Swift Flow

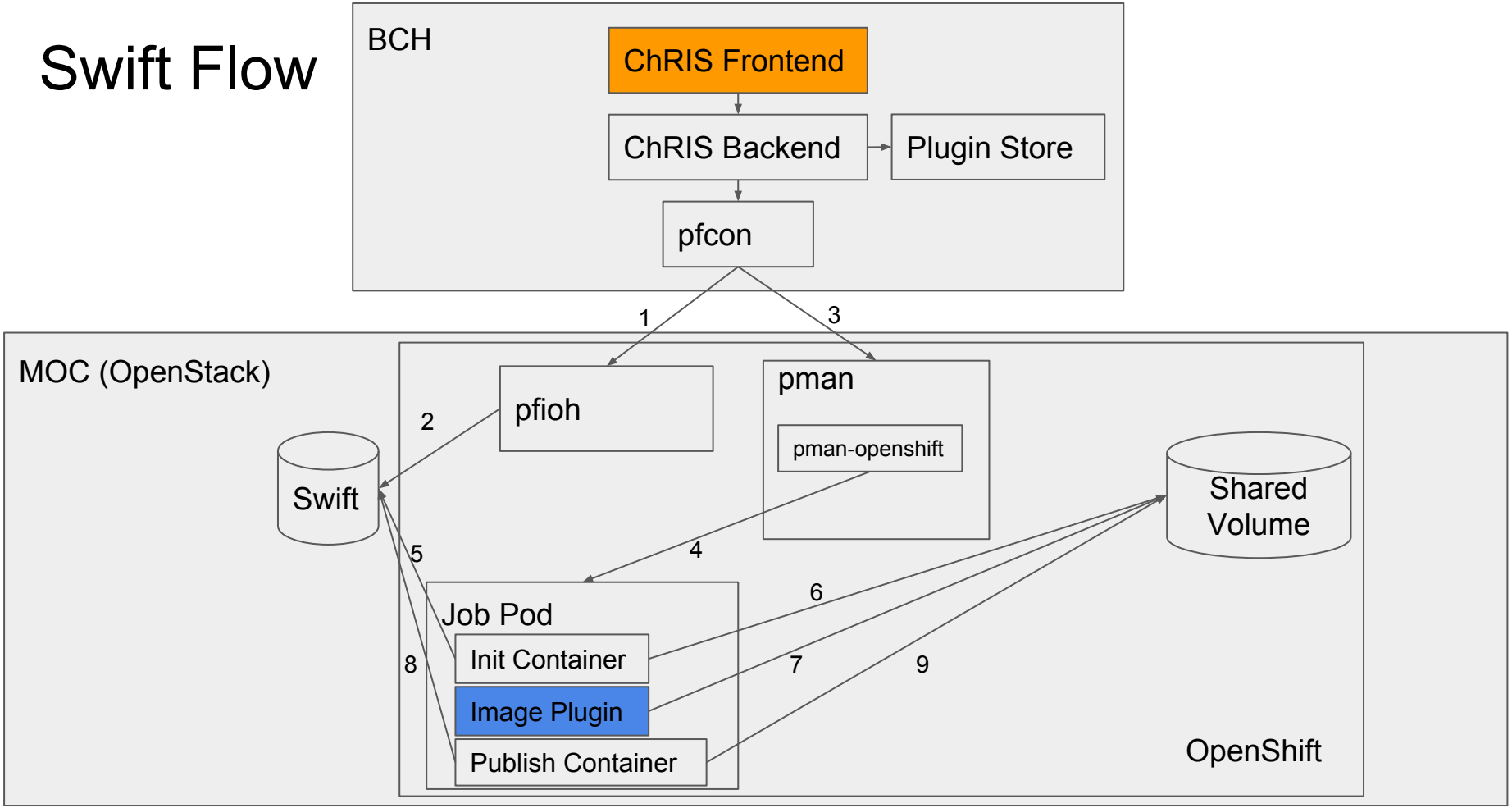
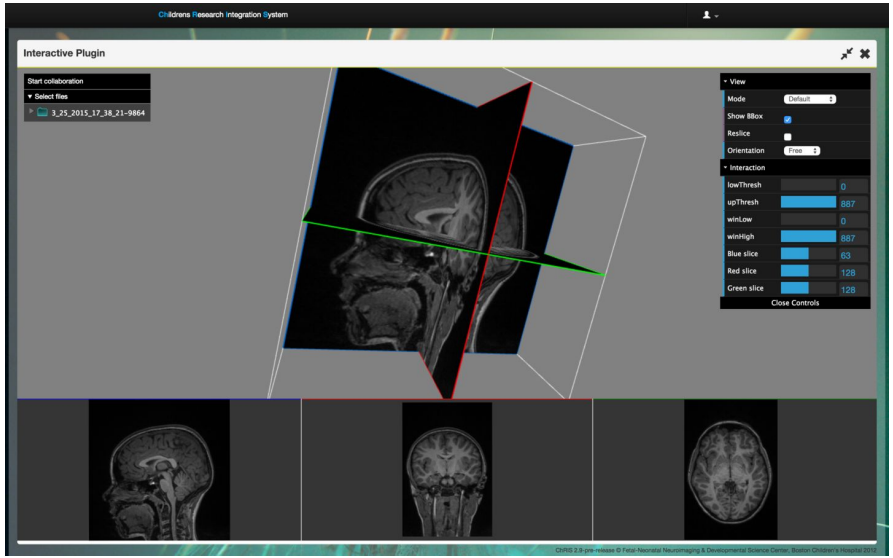

BCH
ChRIS Frontend
ChRIS Backend
Plugin Store
pfcon
1
3
MOC (OpenStack)
pfioh
2
pman
pman-openshift
Swift
Shared Volume
5
4
6
Job Pod
Init Container
Image Plugin
Publish Container
8
7
9
OpenShift

Image Processing Examples

- Registration
  - Coalesce multiple images
- Classification
  - Identification and pointing out abnormalities
- Tractography
  - Ex: Mapping paths through the brain to be able to operate around



Writing Plugins

Scaling Plugins

Architecture

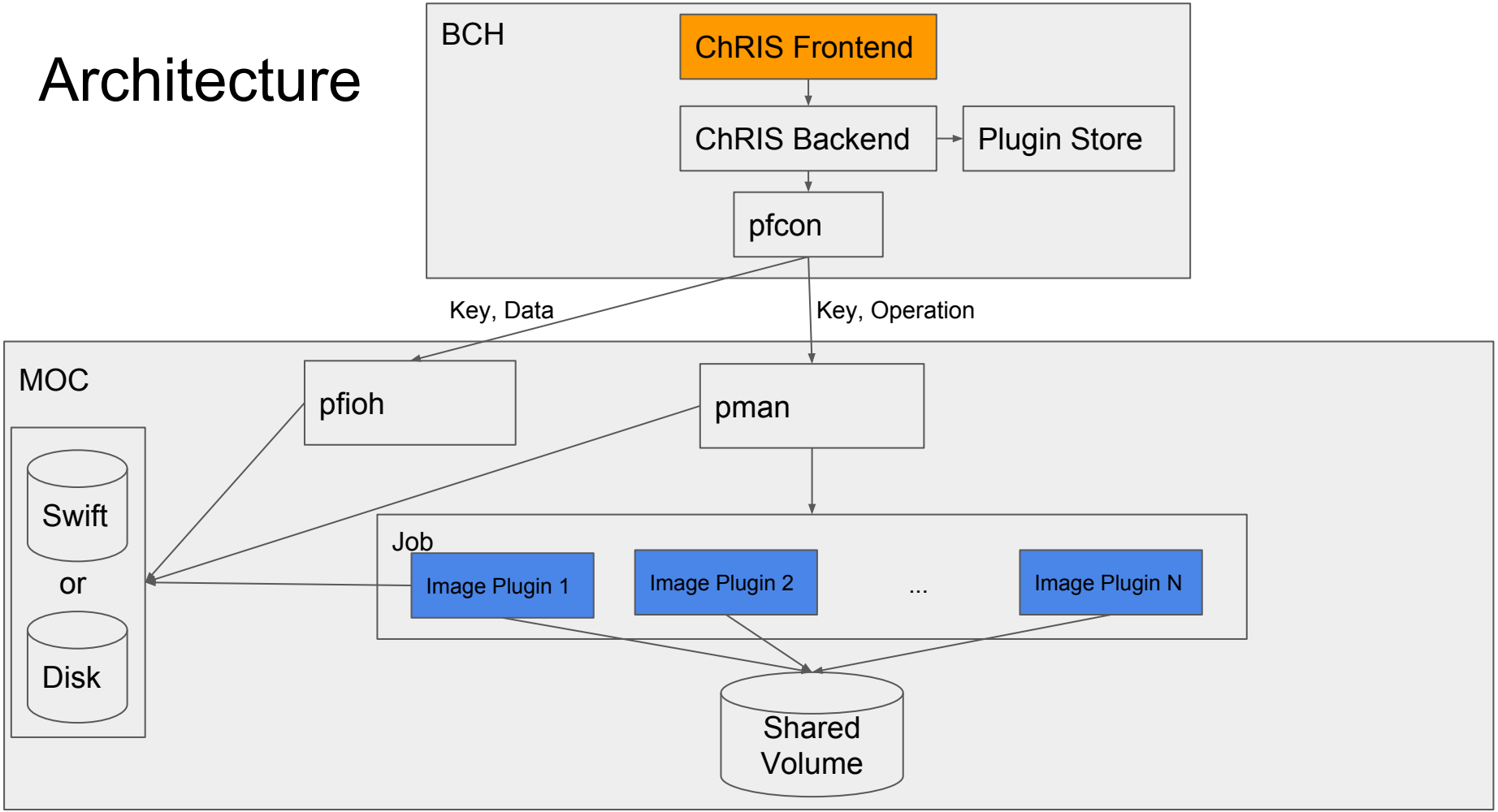
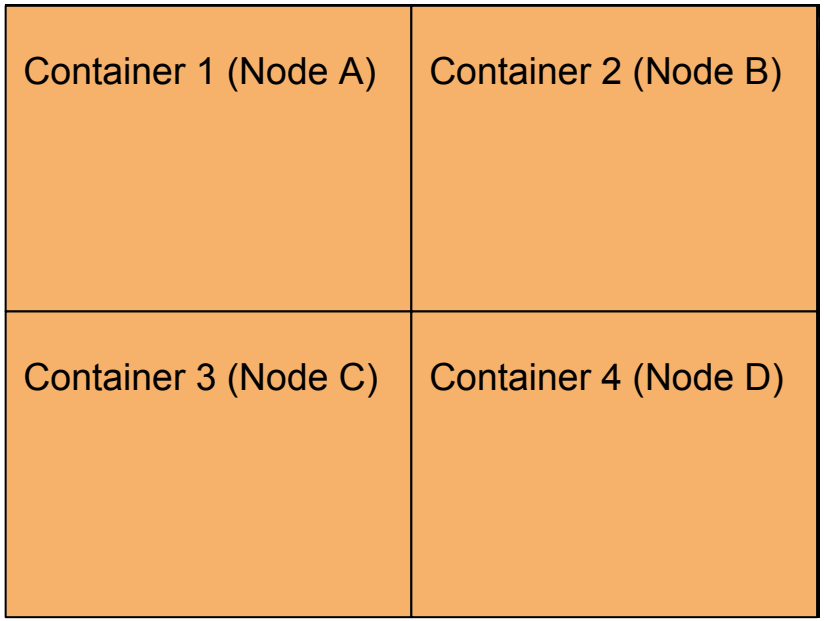


Image Processing

- Parallel Processing with Kubernetes Job Framework
- N workers run until worker 1-N completes
  - NUMBER_OF_WORKERS
- Communication through FS or Network

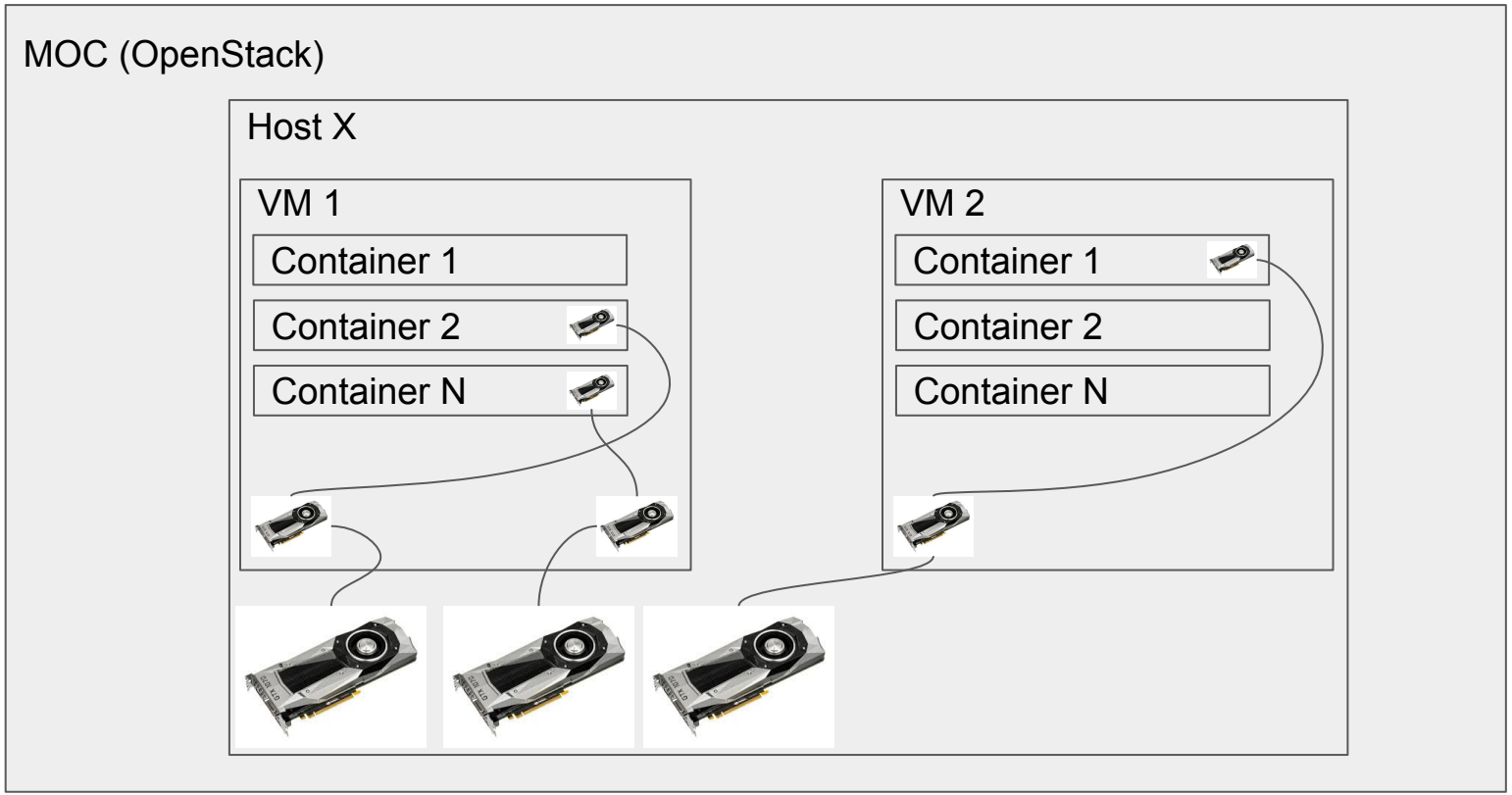


ANTS

- Among the highest quality algorithms for non-rigid registration
  - https://github.com/stnava/ANTs
  - https://github.com/FNNDSC/pl-antsreg

GPU Enabled Plugins

GPU Topology



GPU Details

- Plugins register themselves as requiring or desiring a GPU
- ChRIS schedules plugins onto nodes with available GPUs

Container 1 (Node A) 	Container 2 (Node B) 
Container 3 (Node C) 	Container 4 (Node D)