Integrating container-based virtualization technologies into **ARC-powered** grid infrastructure

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Software challenges in grid

- Hetergenous systems
 - different OS distributives (SL5.X, SL6.X, SL7.X)
 - a lot of computing clusters
- A lot of application project
 - each project require own software
 - own configuraton per researche
- Existing solutions:
 - cvmfs
 - build software in runtime

Rainbow ARC in the Cloud framework



- Using prepared VM images
- Putting user data inside VM
- Hardware
 - accelerated VM
- Interactive
 access

Rainbow Apliance in medical researches

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Downsides of full virtualization in Rainbow

- VM images are inconvenient
 - hard to update software
 - hard to maintain software
 - take a lot of space
- Perfomance drop

Container-based virtualization in Rainbow

- Use docker to run containers
- Advantages:
 - ~0 overhead
 - Images are lightweight easy to modify
- Docker supports numerous platforms
 - SL 6, 7
 - Fedora 20 and higher
 - Debian wheezy and higher
 - Ubuntu 12.04 and higher

BYOWN - Bring Your Own Work Node



- Container
 virtualization
- Image downloading from centralized VO registry
 Job session directory
 - mounting direct inside container

Features

- Centralized image management
- High density
- Reproducible environment
- Unified runtime environment
- Global ARC registry / per VO
- Fine grained resource control(QOS)

LRMS for Containers

- Using popular HPC LRMS is imperfect:
 - Extra layer of complexity
 - Could not leverage container capabilities
 - Hardware may only be used for HPC
- Solution use LRMS designed with containers in mind

ARC and Kubernetes Container Cloud

- Kubernetes is a viable option for a mature LRMS
- In a nutshell:
 - Used by Google, eBay, Wikipedia, RedHat
 - Maintains desired state of an application
 - Primarily runs stateless scale-out web applications
 - Rapidly developing
- Use A-REX as a front-end for Kubernetes

Proposed Architecture



Job's Lifecycle

- 1. A-REX parses Job Description and fetches input files
- 2. LRMS script forwards request to ARKd
- 3. ARKd launches a job in Kubernetes pod
- 4. Status updates are provided to A-REX by ARKd

Advantages of Kubernetes

- Converged cloud with applications and HPC jobs
- Container-aware LRMS
- Scales to large number of nodes
- Automated deployment with SaltStack provided
- Possibility to run ARC CE inside the cloud

State of development

- Work in Progress:
 - Architecture design complete
 - Kubernetes cluster deployed and operational
 - ARKd in early stages
- Proof of Concept to come by the fall
- Testdrive cern alice job`s

Thank you for attention