

# Strategic Overview of Docker in Fifteen Minutes

for Middleware And Grid Interagency  
Coordination (MAGIC)

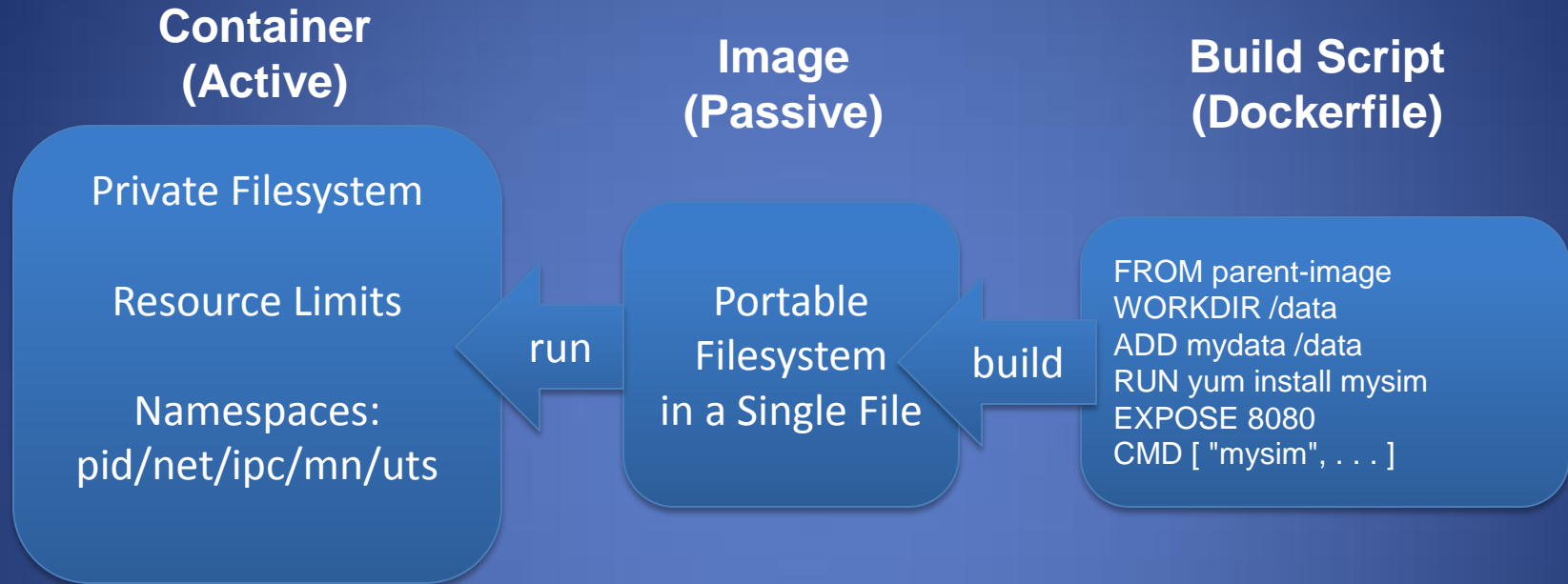
7 February 2018

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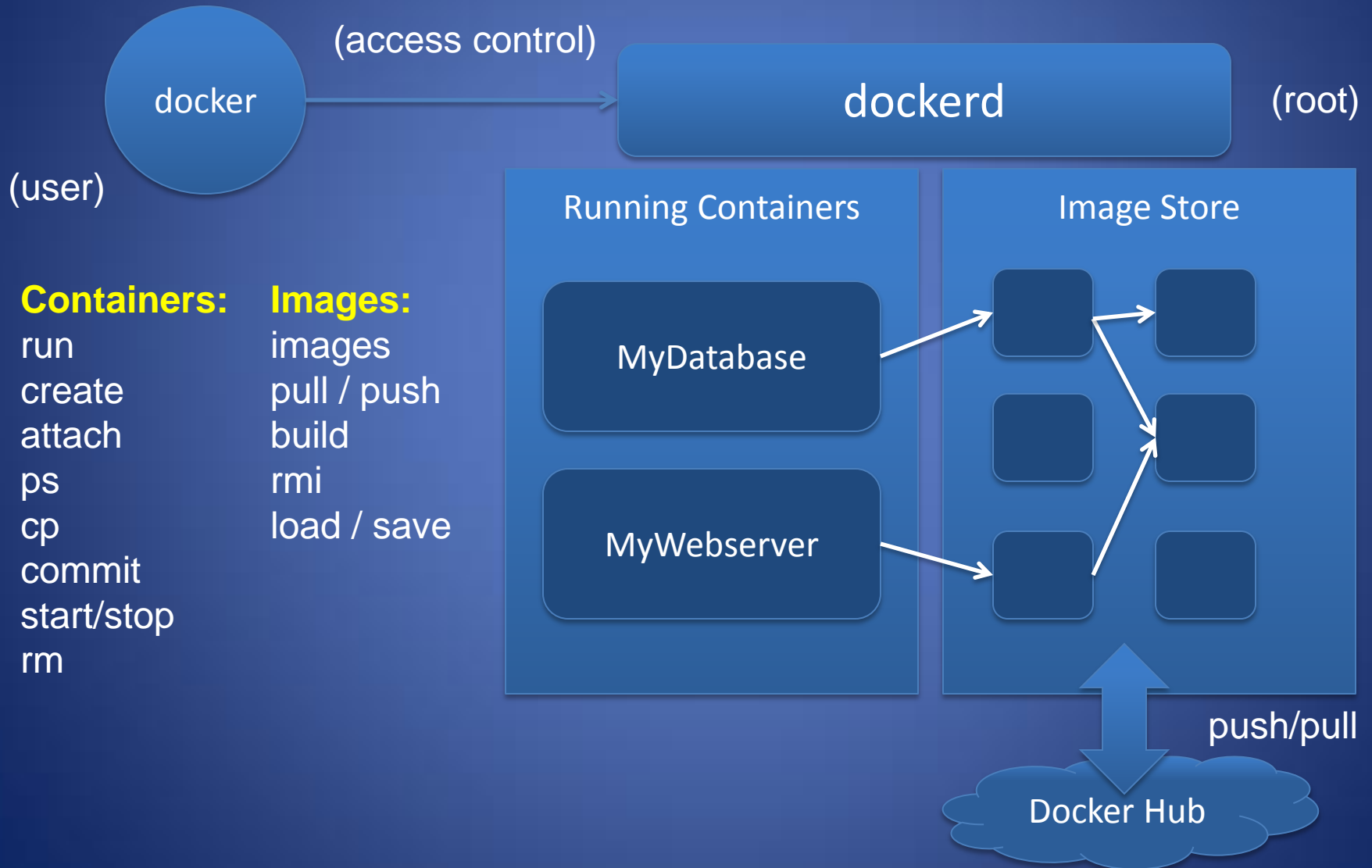
# Container Overview



## Purpose:

To provide independent applications with the ability to define private, customized environments that are easily distributable.

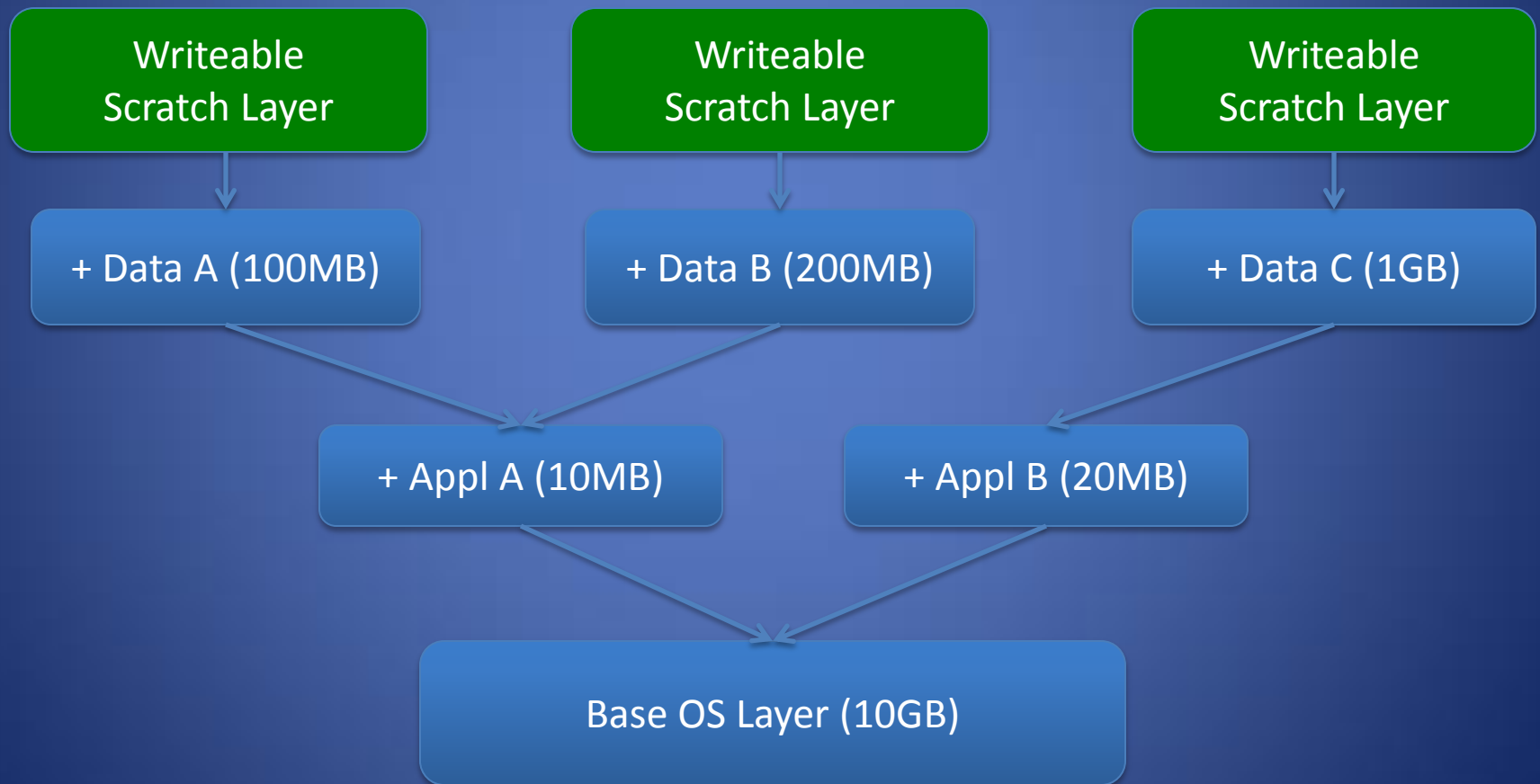
# Docker Structure



# Container Sub-Structure

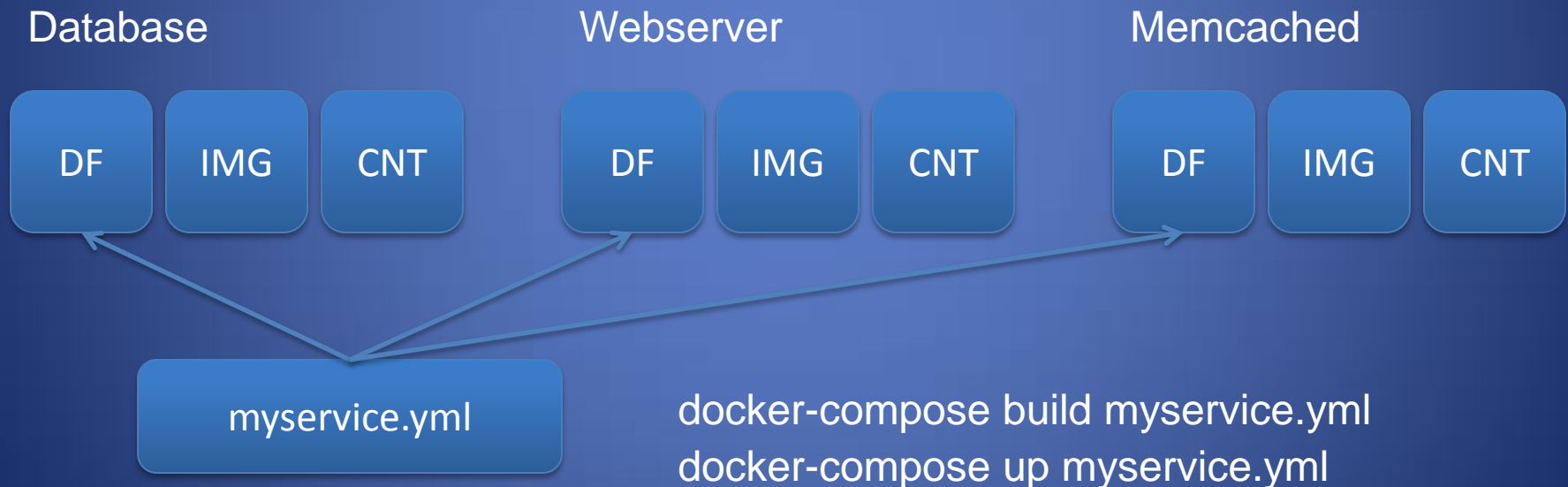


# Encourage De-Duplication



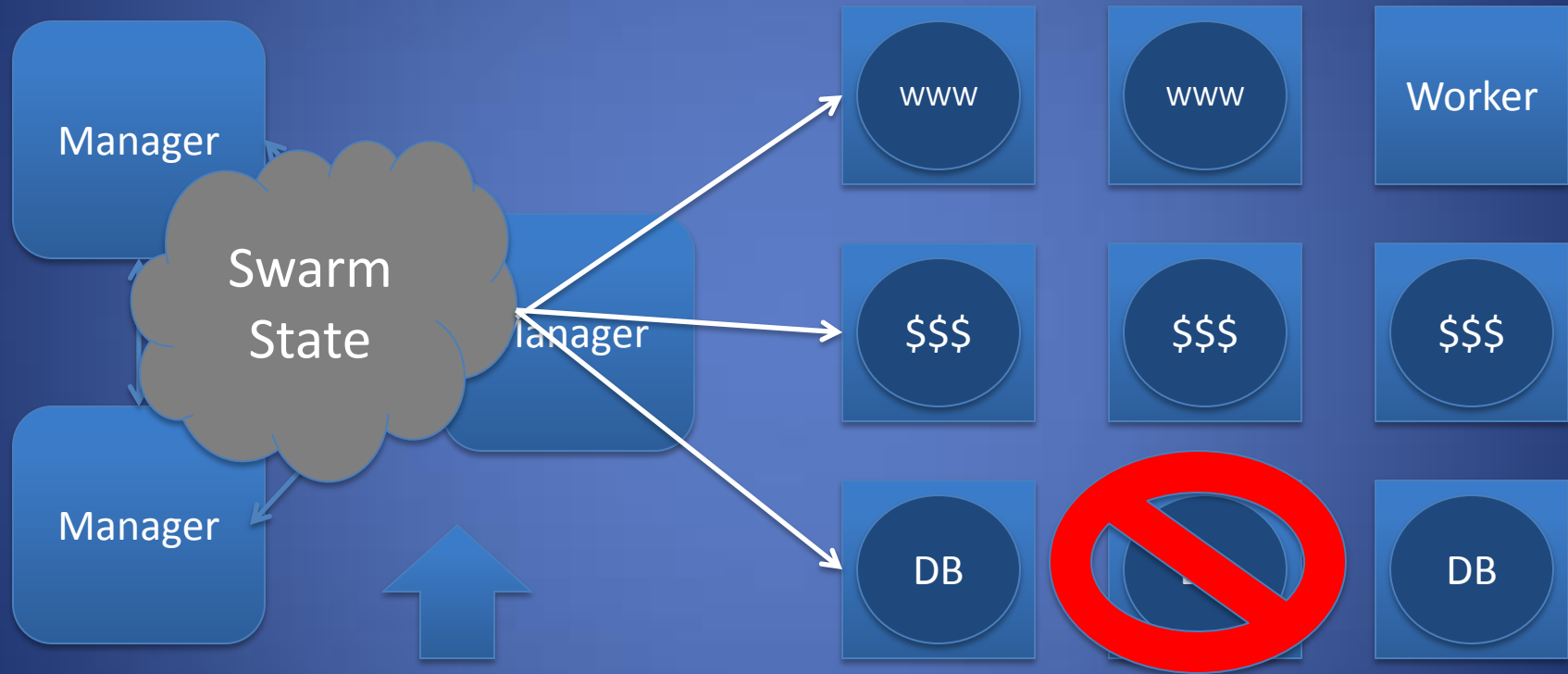
# Docker Compose (Static)

- Common case: a web-service that consists of multiple concurrent services.



Persistent state is **outside** the cluster.  
Requires external supervision to maintain.

# Docker Swarm (Dynamic)



create service www (2)  
create service memcached (3)  
create service database (2)

Persistent state is **inside** the cluster.  
Once created, self-maintaining.

# Docker Ecosystem

- Docker containers are used widely in industry and have become an interchange format.
- Google GCE, Amazon ECS, Mesos, Kubernetes all support Docker container execution. (But not necessarily using Docker per se.)
- Running your own container cluster is rather challenging! One opinion:  
<https://thehftguy.com/2016/11/01/docker-in-production-an-history-of-failure/>



# Problem: Garbage Collection

- Problem: Any authenticated user can consume storage by create/pulling new images, and nothing removes them automatically. Any automated activity will eventually consume all storage and wedge docker.
- A cronjob seems to be the community solution:

```
docker images -q -a | xargs -no-run-if-empty docker rmi
```

- However, this doesn't take into account containers that are "needed" even if not currently run.
- Effective use requires one of several ideas:
  - Use a small number of containers widely.
  - Trust users to delete unneeded containers.
  - Make use cases robust to periodic removal.

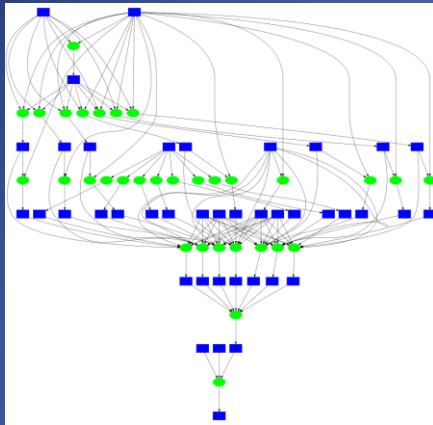
# Problem: Adding Docker to HPC

- Idea sounds simple: You already have a batch system, just put Docker on every node.
- **Very** challenging to get this right:
  - Docker has very specific kernel requirements, consumes large amounts of local space, resources conflict with each other, independent scheduling.
- Underlying challenge: Docker really wants to be your core resource manager. It's fighting with the ones you already have: batch system, parallel file system..
- (Shifter, Singularity, CharlieCloud, and others are working to address this space directly.)

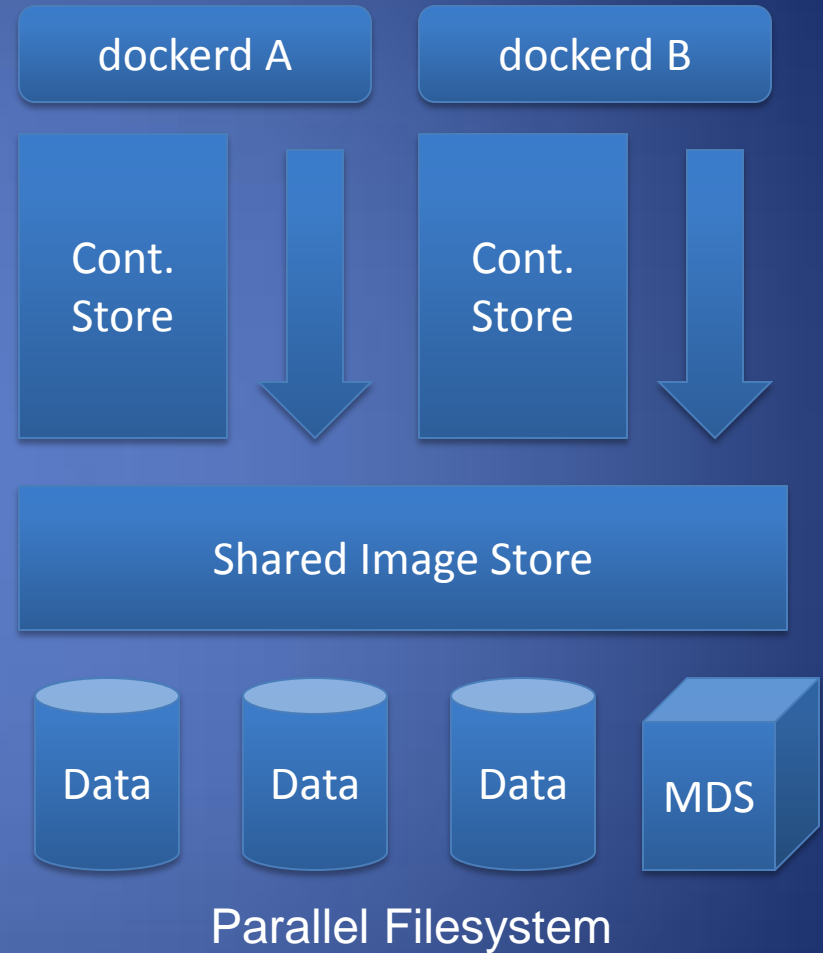
# Takeaways

- Designed for deploying micro services, which is different than executing HTC/HPC jobs.
- Docker container format is now standard.
- Docker works very well within its own ecosystem, but is quite difficult to integrate into existing facilities.
- Garbage collection remains unsolved prob.
- Very sensitive to underlying kernel tech.

## Container Portability In Makeflow



## Wharf: Containers on Shared Filesystems



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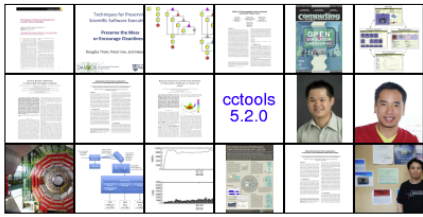
Take the [ACIC 2015 Tutorial](#) on Makeflow and Work Queue

### About the CCL

We design [software](#) that enables our [collaborators](#) to easily harness [large scale distributed systems](#) such as clusters, clouds, and grids. We perform fundamental [computer science research](#) in that enables new discoveries through computing in fields such as physics, chemistry, bioinformatics, biometrics, and data mining.

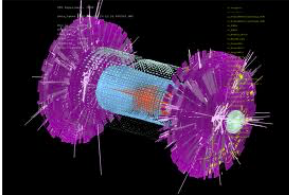
### CCL News and Blog

- [Global Filesystems Paper in IEEE CISE](#) (09 Nov 2015)
- [Preservation Talk at iPres 2015](#) (03 Nov 2015)
- [CMS Case Study Paper at CHEP](#) (20 Oct 2015)
- [OpenMalaria Preservation with Umbrella](#) (19 Oct 2015)
- [DAGVz Paper at Visual Performance Analysis Workshop](#) (13 Oct 2015)
- [Virtual Wind Tunnel in IEEE CISE](#) (09 Sep 2015)
- [Three Papers at IEEE Cluster in Chicago](#) (07 Sep 2015)
- [CCTools 5.2.0 released](#) (19 Aug 2015)
- [Recent CCL Grads Take Faculty Positions](#) (18 Aug 2015)
- [\(more news\)](#)



### Community Highlight

Scientists searching for the Higgs boson have profited from Parrot's new support for the [CernVM Filesystem \(CVMFS\)](#), a network filesystem tailored to providing world-wide access to software installations. By using Parrot, CVMFS, and additional components integrated by the [Any Data. Anytime. Anywhere](#) project, physicists working in the [Compact Muon Solenoid](#) experiment have been able to create a uniform computing environment across participating institutions. Parrot is used to manage highly-available CVMFS installation files are downloaded as needed and efficiently. A pilot project at the University of Wisconsin demonstrated the feasibility of this approach by computing jobs to run in the Open Science Grid harnessing 370,000 CPU-hours across access to 400 gigabytes of software in a repository.



- Dan Bradley, University of Wisconsin

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Distributed computing for big data problems in science and engineering.

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My grad students now summarize research papers by preparing a whiteboard in advance. Much better than a slide deck!



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