Using containers to speed up development, to run integration tests and to teach about distributed systems

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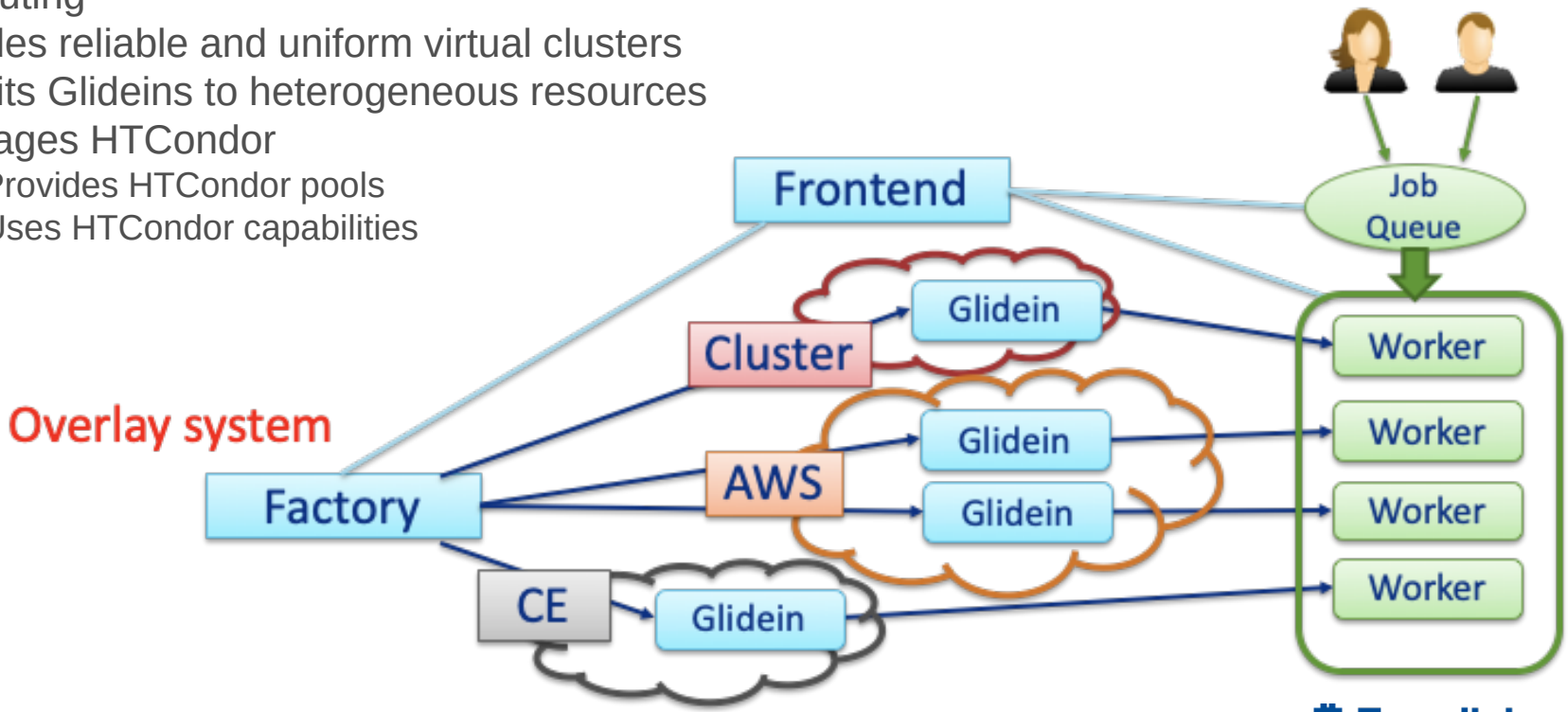
CHEP2024

Krakow, Poland, October 19-25, 2024

This work was supported by the Fermi National Accelerator Laboratory, managed and operated by Fermi Research Alliance, LLC under Contract No. DE-AC02-07CH11359 with the U.S. Department of Energy - FERMILAB-SLIDES-24-0285-CSAID

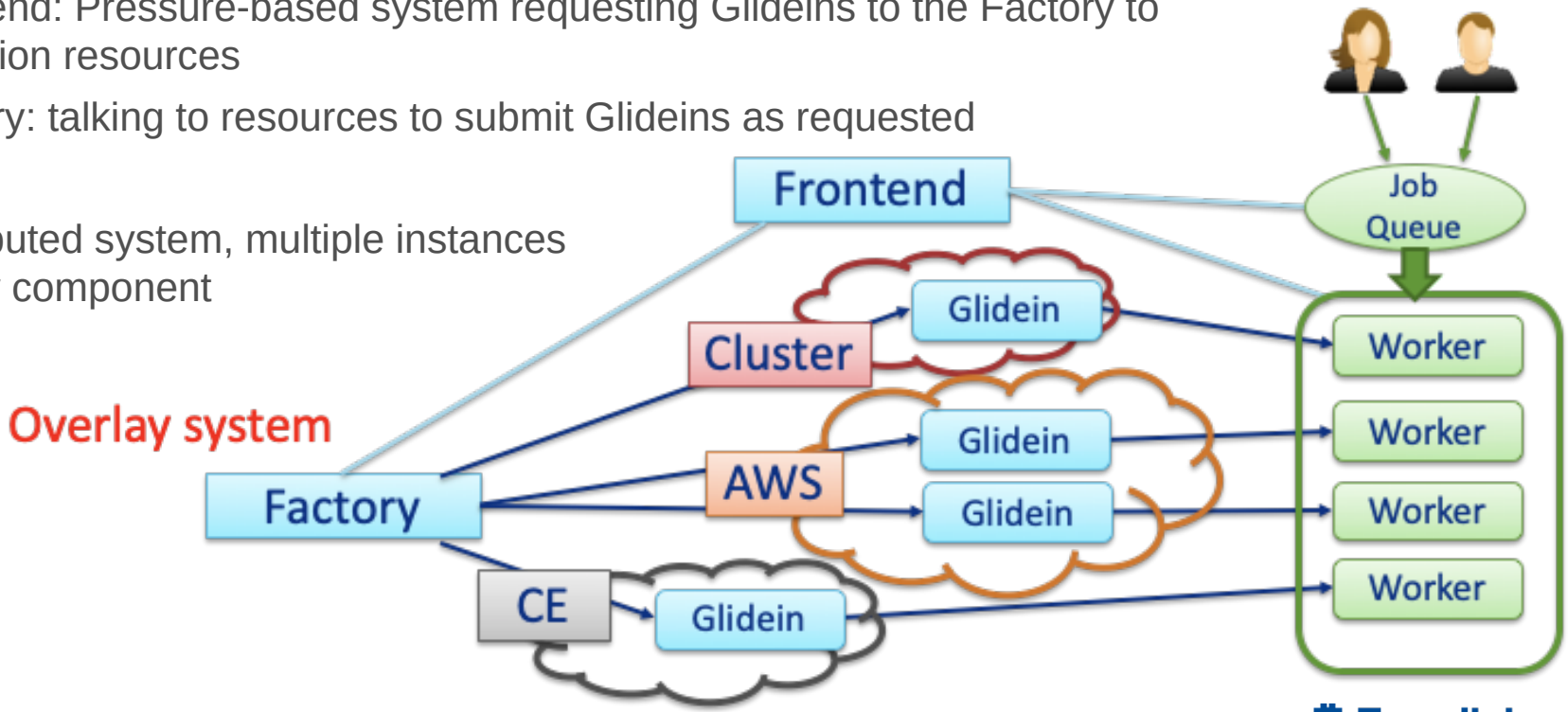
GlideinWMS

- GlideinWMS is a pilot-based resource provisioning tool for distributed High Throughput Computing
- Provides reliable and uniform virtual clusters
- Submits Glideins to heterogeneous resources
- Leverages HTCondor
  - Provides HTCondor pools
  - Uses HTCondor capabilities

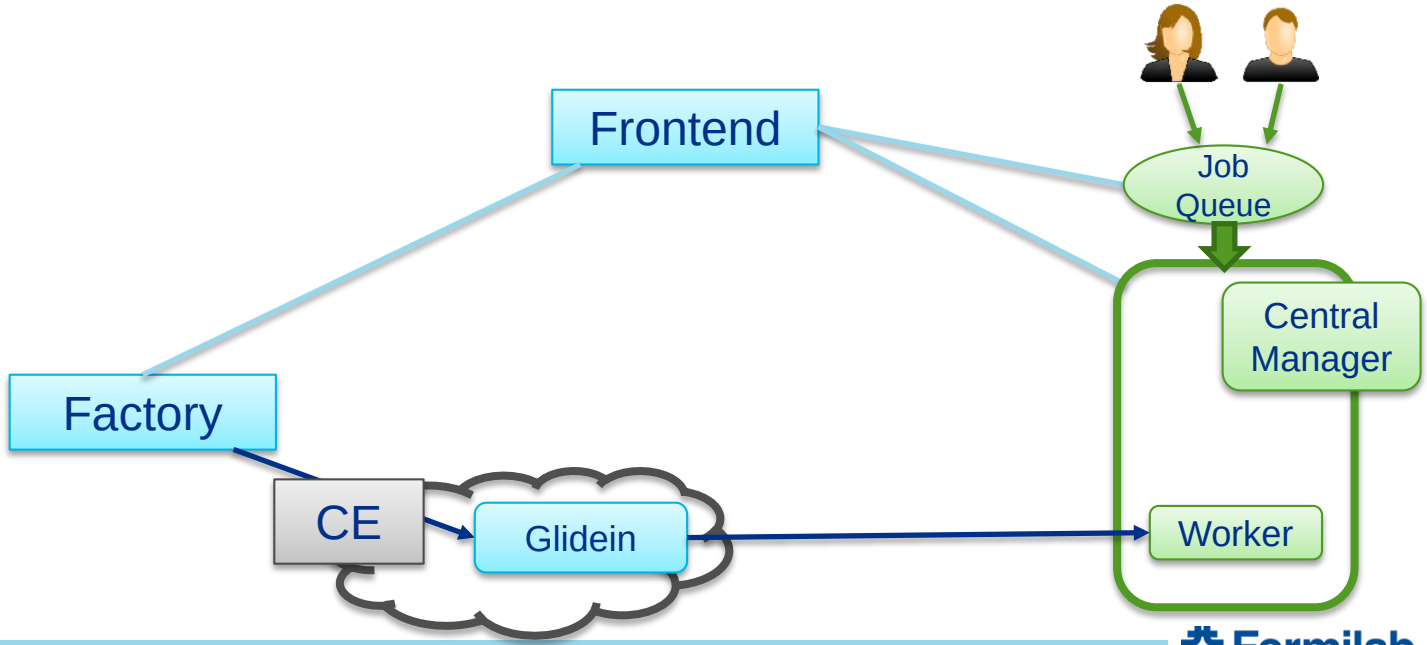


GlideinWMS components

- Glidein: pilot job for node testing and customization and for running user jobs
- Frontend: Pressure-based system requesting Glideins to the Factory to provision resources
- Factory: talking to resources to submit Glideins as requested
- Distributed system, multiple instances of any component

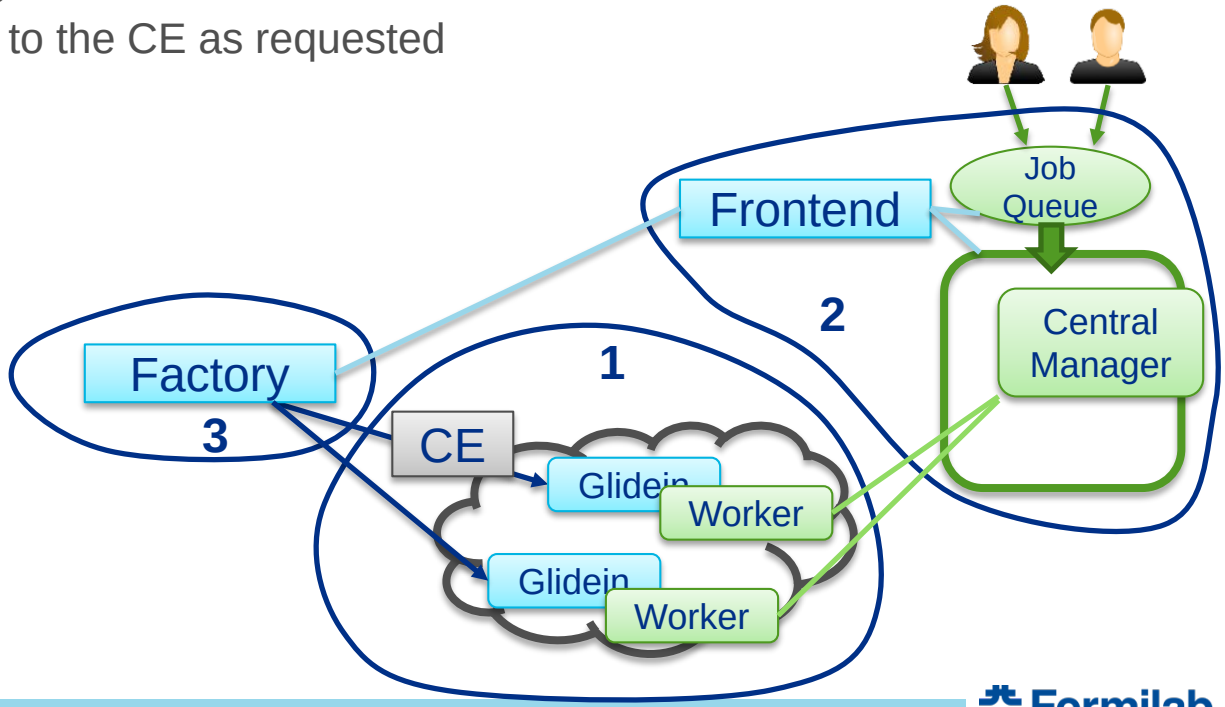


Minimal deployment



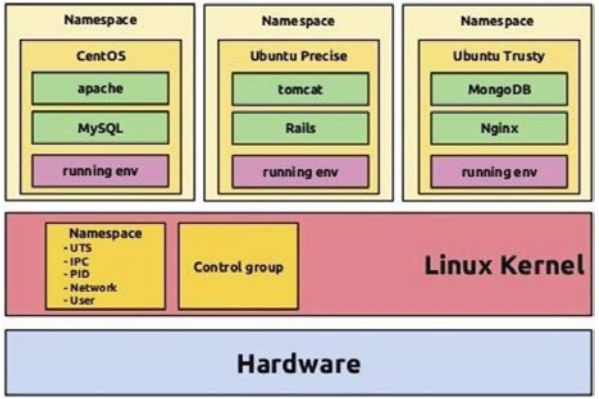
Minimal deployment

1. **CE**: one-node HTCondor CE and cluster, running Glideins and jobs
2. **Frontend and Virtual Cluster**: Access Point and Central Manager of the virtual cluster and Frontend requesting Glideins
3. **Factory**: submitting Glideins to the CE as requested



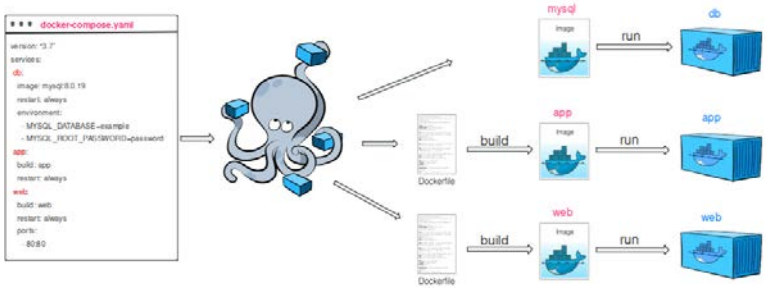
Containers and Composition

- Containers are
  - Isolated and restricted set of processes
  - Lightweight VM
  - Bundle of data with everything to run an application
- See: https://docs.docker.com/get-started/resources



DOI:10.14201/adcaij.28351

- Composition is a tool for defining and running multi-container applications
- See: https://docs.docker.com/compose/



https://www.biaudelle.fr/docker-compose/

Workspaces

- Containerized VM-like workspaces with multiple applications, for development and testing
- Different from production (microservice – one purpose) containers
- Idea from alnoda.org – Hub with Ubuntu-based images for (Web) development
- RHEL-based images with hacks
  - Supervisor (systemd and similar don't work well in containers)
  - Docker systemctl replacement (run systemctl commands without systemd)
- Compatible w/ Docker and Podman
- Self-contained
- Easy to use

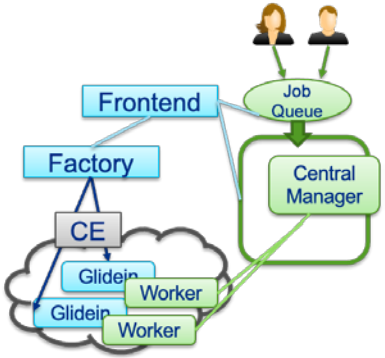
```
mkdir ws-test; cd ws-test
TEST_DIR=$(pwd)
git clone https://github.com/glideinWMS/containers.git
cd containers/workspaces
mkdir "$TEST_DIR"/gwms  # Optional, shared with containers
GWMS_PATH="$TEST_DIR"/gwms/ podman-compose up -d
```

GlideinWMS workspaces

- gwms-workspace – Base image with OS, customization, OSG repos and base software
- ce-workspace – HTCondor cluster and HTCondor-CE using SciTokens
- factory-workspace – GlideinWMS Factory from the OSG RPM repo (or optionally linked Git code)
- frontend-workspace – HTCondor AP and CM (for User Pool), GlideinWMS Frontend

- All nodes are in a bridged network
- Self-signed host certificates in glideinwms.org domain (fictitious)
- Network ports can be exposed to interact with outside components compose-wports.yml
- Multi-OS: Alma Linux 9 with Python3.9, Scientific Linux 7 with Python 3.6

GlideinWMS development and testing

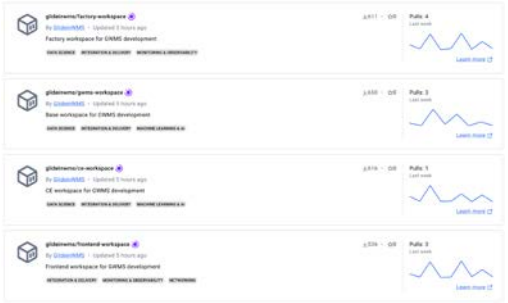


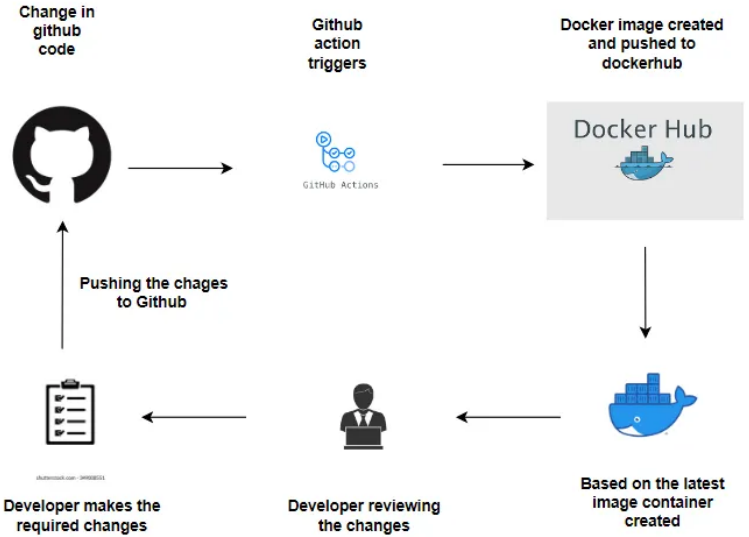
- Used to test releases, new development and troubleshooting
  - Testing of RPM install or upgrade
  - Automated smoke test
    - Submits user jobs and triggers the Glideins request and cycle
  - Optional Git integration
    - Running off a GWMS Git repository
- Ease developer and intern onboarding, convenient training testbed [1]
  - Can run off any Linux VM (also WSL2 on Windows, and CoLiMa/Podman on M1 Mac)
  - Running from VSCode [2]

[1] Computational HEP Traineeship Summer School 2024 - https://indico.cern.ch/event/1405035/
[2] https://github.com/glideinWMS/glideinwms/wiki/Windows-Setup

Workspaces CI/CD – GitHub workflow

- On push or via dispatch (gh api repos/glideinwms/containers/dispatches …)
- Alma9/SL7 and release Tag controlled via inputs
- Multi-platform images (linux/amd64, linux/arm64)
  - Parametric Dockerfile
  - Buildx
  - Manifest + multiple real images
- Push to Docker Hub





Summary

- GlideinWMS is a distributed system which can be emulated using at least 3 nodes: CE and Cluster, Frontend and Virtual Cluster, Factory
- Workspaces are multi-process containers used to run each of the nodes
- Container composition allows to start all with one command
- Multi-platform images are distributed via Docker Hub
- GitHub workflows are used for CI/CD
- Used for testing, development and training

- Try it on your laptop: https://github.com/glideinWMS/containers/tree/main/workspaces