Building Containers in GitLab-CI

Just the first steps

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DESY.

Why We Need a CI?

Consistency, Reproducibility

- Local environment independence
  - Do I know all dependencies when I build locally?
- Reproducibility
  - Can you still build after OS update? After another package is installed?
- Process documentation
  - Do have documentation how to build? Do you keep it up-to-date?
  - Do you need all build dependencies at runtime?
- Testability
  - Do you regularly test your software? Can others do it as well?
- How I get your software

Why We Need a CI?

Consistency, Reproducibility

The **CI** gives a common framework to get stuff done with a **predictable and reproducible result**.

Gitlab-CI on One Slide

All you need to know :)

- Jobs defines an action at a particular stage
  - All jobs run a script action
  - Jobs are executed by *runners*
- A job belongs to a single stage
  - Stage defines when job should run
- Stages might consist out of multiple jobs
  - All jobs in a stage must succeed to before next stage can start
- Stages run sequentially
- Jobs in a single stage run parallel
- Jobs can pass artifacts to each other
- Jobs can depend on each other

- One or more stages build a *pipeline*
- *Pipeline* triggered by:
  - Event: push, merge, …
  - Scheduler
  - Manually
- Default stages:
  - *build*
  - *test*
  - *deploy*

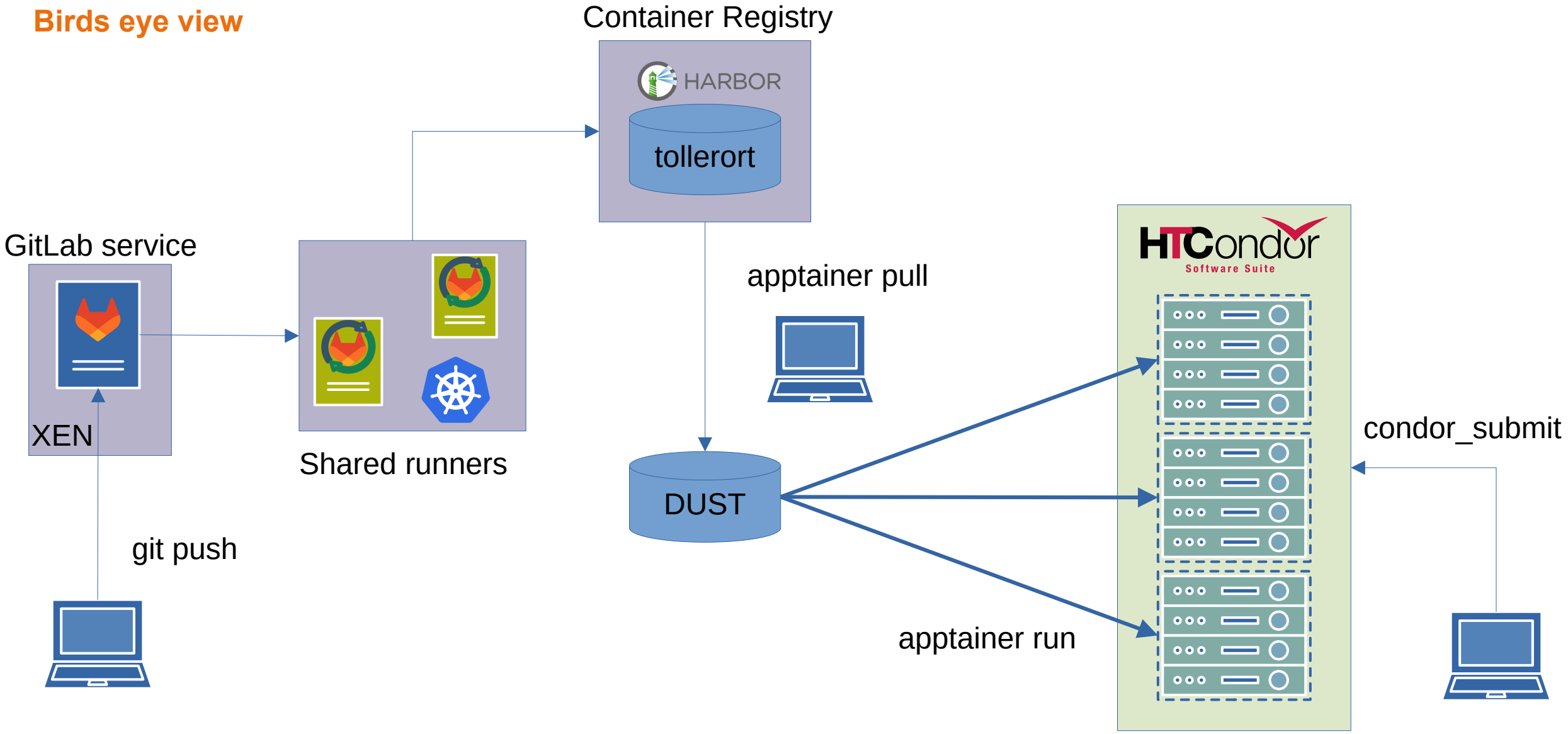
The Actors

Lot of moving parts

- GitLab CI
  - Code repository and CI
  - Store intermediate artifacts
- Kubernetes
  - To execute GitLab runners (to execute pipeline)
- Container registry
  - To publish/share container images
- Workgroup server
  - To prepare job environments
  - Submit the jobs
  - Get the results
- NAF
  - Access to batch resources
  - Access to data (DUST, dCache, CVMFS)

Container CI Workflow with NAF

Birds eye view



Harbor (tollerort.desy.de) integration

Yeah!

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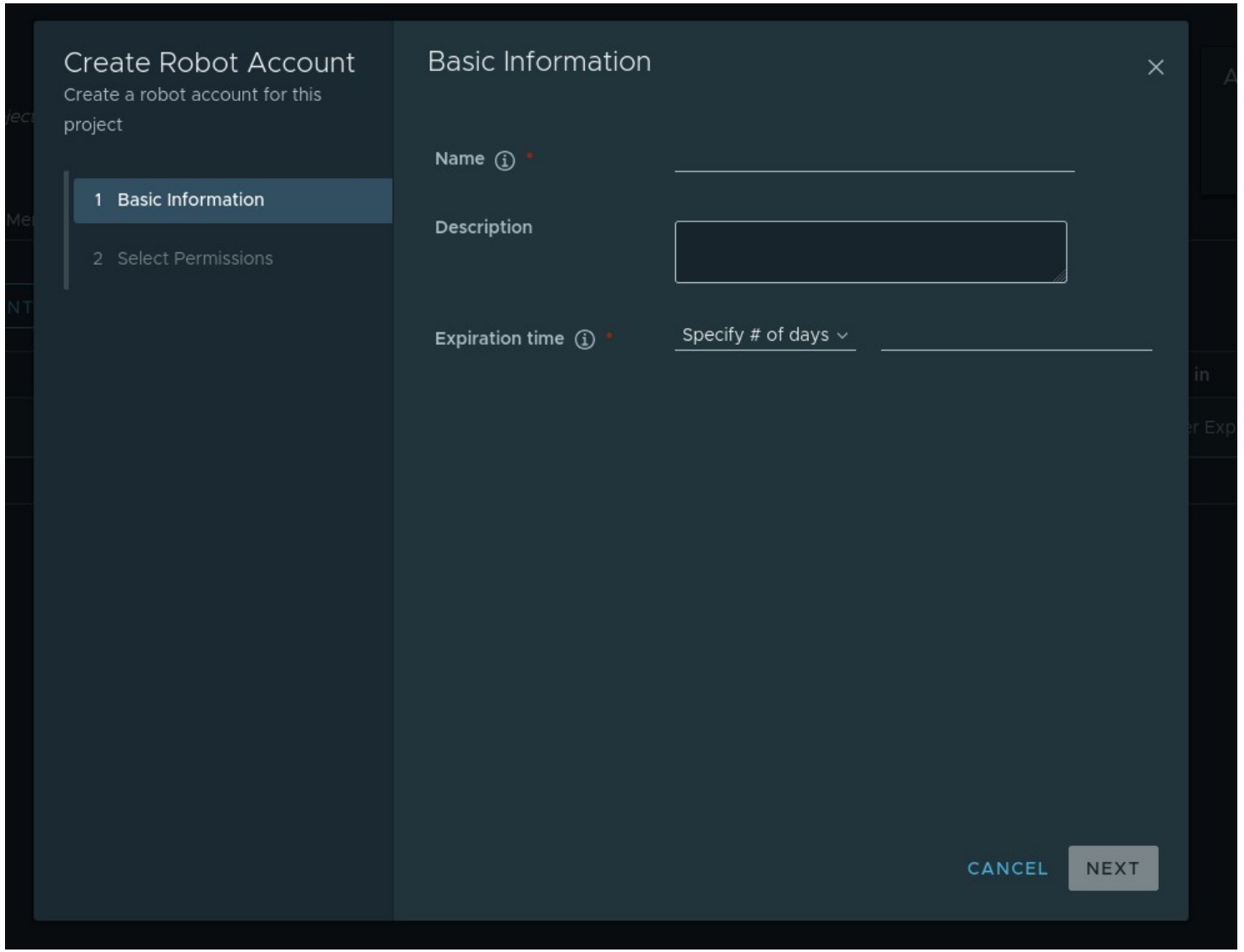

Some Do and Don’ts

Use your power wisely!

NAF/HTCondor is a powerful compute facility, so...

- Don’t pull/push images directly from/to container registry as a part of your job.
  - Pull images manually before hand.
- Don’t pull images to AFS.
  - Use DUST.
  - Defined environment variables.
- Don’t put data into containers.
  - dCache/DUST accessible at runtime.

Hands-on

Hello World Example

```
# Dockerfile
FROM almalinux:9-minimal
RUN microdnf install -y epel-release
RUN microdnf install -y figlet
CMD [ "figlet", "Hello", "World" ]
```

```
# helloworld.def
Bootstrap: docker
From: almalinux:9-minimal
%post
    microdnf install -y epel-release
    microdnf install -y figlet
%runscript
    figlet "Hello Apptainer"
```

Build Apptainer Container

```
Build Apptainer container:
  stage: build
  image: almalinux:9
  script:
    - dnf install -y epel-release
    - dnf install -y apptainer
    - apptainer build --fakeroot helloworld.sif container/helloworld.def
    - apptainer registry login --username "$HARBOR_USERNAME" \
        --password "$HARBOR_PASSWORD" docker://$HARBOR_HOST
    - apptainer push $CI_PROJECT_NAME.sif \
        oras://$HARBOR_HOST/$HARBOR_PROJECT/$CI_PROJECT_NAME:apptainer-
$CI_COMMIT_SHORT_SHA
```

Build OCI/Docker Container

```
Build OCI/Docker container:
  stage: build
  image: gcr.io/kaniko-project/executor:debug
  script:
    - cp $CI_PROJECT_DIR/container/* .
    - mkdir -p /kaniko/.docker
    - echo "{\"auths\":{\"$CI_REGISTRY\":{\"username\":\"$CI_REGISTRY_USER\",
\"password\":\"$CI_REGISTRY_PASSWORD\"}}}" > /kaniko/.docker/config.json
    - >
      /kaniko/executor
      --context $CI_PROJECT_DIR
      --dockerfile $CI_PROJECT_DIR/Dockerfile
      --destination $CI_REGISTRY_IMAGE:$CI_COMMIT_SHORT_SHA
```

Run OCI Container in Pipeline

```
Run the container:
  stage: test
  image: $CI_REGISTRY_IMAGE:$CI_COMMIT_SHORT_SHA
  script:
    - figlet "Hello GitLab!"
```

Run Containers

```
Run OCI/Docker container:
  stage: test
  image: $CI_REGISTRY_IMAGE:$CI_COMMIT_SHORT_SHA
  script:
    - figlet "Hello GitLab!"
```

```
Run Apptainer container:
  stage: test
  image: almalinux:9
  script:
    - dnf install -y epel-release
    - dnf install -y apptainer
    - apptainer run helloworld.sif # assumes artifacts is configured
```

Convert Docker → Apptainer , option

```
Convert OCI to Apptainer format:
  stage: convert
  image: almalinux:9
  script:
    - dnf install -y epel-release
    - dnf install -y apptainer
    - apptainer registry login --username "$CI_REGISTRY_USER" --password
"$CI_REGISTRY_PASSWORD" docker://$CI_REGISTRY
    - apptainer pull docker://$CI_REGISTRY_IMAGE:$CI_COMMIT_SHORT_SHA
    - mv ${CI_REGISTRY_IMAGE##*/}_$CI_COMMIT_SHORT_SHA.sif $CI_PROJECT_NAME.sif
  artifacts:
    paths:
      - $CI_PROJECT_NAME.sif
    expire_in: "1 days"
```

Convert Docker → Apptainer , option 2

```
Convert docker-archive to Apptainer:
  stage: convert
  image: almalinux:9
  dependencies:
    - Build OCI/Docker tar container
  script:
    - dnf install -y epel-release
    - dnf install -y apptainer
    - apptainer build $CI_PROJECT_NAME.sif docker-archive:$CI_PROJECT_NAME-
$CI_COMMIT_SHORT_SHA.tar
  artifacts:
    paths:
      - $CI_PROJECT_NAME.sif
    expire_in: "1 days"
```

More examples:

https://gitlab.desy.de/fh-sustainability-forum/sustainable-coding-tutorial/ci4naf

Thank you

Contact

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