Using Docker Hub's public registry for CI/CD builds - An ONAP use-case

Paul Vaduva
Cristina Pauna
Jessica Wagantall

ARM, ENEA, Linux Foundation
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2. Using Docker Hub for CI/CD in LF projects

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   - Possible solutions
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1. Brief introduction on Docker Hub
What is Docker Hub?

- Docker Hub is the world's largest library and community for container images
- It offers a huge repository for storing container images
- It is available world-wide
- It can automatically build container images from GitHub and Bitbucket and push them to Docker Hub
- It offers seamless support for multi-arch images through fat manifest
Who uses Docker Hub?

- All major open source projects use Docker Hub to release their software including LF projects OPNFV and ONAP
2. Using Docker Hub for CI/CD in LF projects
How LF projects use Docker Hub

● LF projects have multiple labs and their own infrastructure when it comes to handle docker images. Therefore, out of the multiple features that Docker Hub offers, CI pipelines in LF focuses on these three:
  ○ Build docker images with CI jobs and push them to the Docker Hub registry
  ○ Pull docker images in CI jobs to run certain features or perform testing
  ○ Provide release images

● Integration of Jenkins with Docker Hub is handled by LF and it’s quick and easy to configure

● The jobs that run in Jenkins can afterwards call push and pull commands to docker
Building images for Docker Hub

- When building the docker images in CI, complex relationships can be defined:
  - build images in a certain order
  - build multiple images in parallel

MultiJob Project fuel-docker-hunter

<table>
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<tr>
<th>S</th>
<th>W</th>
<th>Job</th>
<th>Last Success</th>
<th>Last Failure</th>
<th>Last Duration</th>
<th>Console</th>
<th>Built On</th>
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<td>10 min</td>
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<td>build fuel images</td>
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Using images from Docker Hub

- When using the docker images in CI, just pull and use

```yaml
version: '2'
services:
  opnfv-fuel-salt-master:
    container_name: "fuel"
    image: "opnfv/fuel:saltmaster-reclass:{{ conf.MCP_DOCKER_TAG }}"
    restart: always
  mcpcontrol:
```

```bash
"${COMPOSE_PREFIX}docker-compose" -f docker-compose/docker-compose.yml down
if [[ ! "${MCP_DOCKER_TAG}" == 'verify' ]]; then
  "$COMPOSE_PREFIX"docker-compose -f docker-compose/docker-compose.yml pull
fi
```
<table>
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<tr>
<th>Image Name</th>
<th>Size</th>
<th>Last Update</th>
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<tbody>
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<td>saltmaster-reclass-arm64-latest</td>
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<td>a day ago</td>
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<tr>
<td>salt minion maas amd64-latest</td>
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<tr>
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<td>343 MB</td>
<td>3 days ago</td>
</tr>
<tr>
<td>salt minion maas arm64-hunter</td>
<td>344 MB</td>
<td>3 days ago</td>
</tr>
</tbody>
</table>
3. ONAP use-case

- Limitations and challenges
Current state of daily CI/CD in ONAP

- Currently ONAP Projects use Nexus3 docker registry implementation to store the intermediate images / Staging

- ONAP Projects sometimes build docker images that have dependencies on other ONAP Projects docker builds. This multiple source dependencies issue is solved in LF by grouping together docker registries in Nexus3

- ONAP already uses Docker Hub to make available the release images, as it’s the largest library and community for docker images

- The intention is to move the registry from Nexus3 to Docker Hub
Multi-Arch Support: Parallel CI/CD Pipeline

- The main reason for doing the migration from Nexus3 to Docker Hub is multi-arch support.
LF Infrastructure Upgrade Challenges

LF Infrastructure Team Priority:

1. **CIMAN-234**: Nexus2 - Migrate to Global-jjb gerrit-maven-stage job (opened 1/29/19)
2. **CIMAN-229**: Multi-cpu docker build jobs (opened 1/4/19)
3. **CIMAN-239**: Nexus3 - Migrate teams to start deploying images in DockerHub (opened 2/13/19)

The goal for the Dublin timeframe was to use Nexus 3 with the necessary changes requested by the ARM team. This effort was abandoned after efforts from both teams to make it work concluded it’s not technically possible.

ONAP El Alto proposed release includes a shorter technical debt release

Request is to include Docker Hub Migration in El Alto as part of the “Test Automation & CI/CD Pipeline and Deployment procedure”

So what's the problem with Nexus docker registry?

- Nexus3 docker registry implementation does not allow the creation of manifest-list (multiarch images)
  - [https://issues.sonatype.org/browse/NEXUS-18546](https://issues.sonatype.org/browse/NEXUS-18546)

- Nexus3 docker caching registry does not allow to pull and cache a multiarch docker image (caches only the x86_64 image).
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- Possible solutions
This storage solution is available but currently out of the picture as a possible solution:

- Additional cost for ONAP which hasn’t been proposed yet
  - Will need additional planning and analysis to provide the exact numbers
- Extra cost for running operations to support it
- Availability of resources from the Infrastructure team will need to be acquired
- Requires about 6+ weeks for implementation if approved
1. ONAP teams need to provide a component dependency chart to plan for an effective migration.
2. Tagging convention is still not consistent across components. Requires a fixing by tech teams.
3. Create additional jobs for building each container on new arch e.g. arm64 (under works to support it)
   a. The jobs would use the same jjb templates but be required to run on the arm64 docker build machines
   b. The result would be a docker image that would have the same microservices as the x86_64 but would run on arm64 infrastructure.
   c. Together with LF we can enable these jobs, but we will respect and involve the tech teams as much as they want to be involved.
4. Projects to migrate to global-jjb docker jobs.
5. Switching from Nexus3 docker registries to Docker Hub.
6. Rename all docker images to contain a suffix (a reference to arch of the image) to have different names for each architecture.
7. Create an additional job for building the manifest list (multi-arch image) out of the existent arch specific images e.g. aarch64 and amd64.
ONAP Teams: Component dependencies:

- Each ONAP Tech Team needs to provide docker components dependencies (e.g. Docker image deps):
  - SO (Service Orchestrator base image):
    ```
    FROM docker.io/openjdk:8-jdk-alpine
    
    ARG http_proxy
    ARG https_proxy
    ENV HTTP PROXY=$http_proxy
    ................
    ```
  - SO base image depends on openjdk-8-jdk-alpine
Proposed migration plan and stakeholders

Activities happening or that can happen right now:
- Docker templates:
  - RELENG: Templates for Maven-Docker projects → COMPLETED
  - RELENG: Templates for Docker only projects → COMPLETED
  - ONAP: Define component dependency chart → PENDING (1 hr, maybe a PTL meeting task June 17?)

Order of activities that will happen after TSC approval and after Nexus2 migration (starting July 22):
1. RELENG + ONAP + MULTIARCH: Schedule a call to plan the migration → 1 hr
2. ONAP + MULTIARCH: Modify any docker registries mentions in the code and any changes to the code to make it multi-ach friendly. → (2 hr min average, Time depends on # of components per project)
3. ONAP + RELENG: Add global-jjb jobs in project yaml files. → 20 mins
4. ONAP + RELENG + MULTIARCH: Test jobs and address any issues → Best case scenario 2 hr
   a. Verify that the right artifacts were produced and pushed into DockerHub -> 1 hr
   b. Attempt to run multi-architecture pulls and make sure DockerHub calls the right manifest -> 1 hr
   c. Functional tests? Scope and ETA need to be defined by tech team.
5. ONAP: Confirm dependencies and needed images appear in Docker Hub. → 20 min
6. ONAP + RELENG: Remove deprecated Nexus3 jobs → 20 min

Notice these are best case scenario situations. If any ONAP component requires an upgrade on the global-jjb jobs, such upgrade will need to be evaluated and developed by RELENG.
At all times (until #6 is executed), Nexus3 jobs could be running in parallel as long as the Nexus3 registries are still used.
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- Questions and concerns
Performance Concerns using Docker Hub

- Since Docker Hub registry is not in the proximity of the build infra, one could have concerns regarding bandwidth and performance for the docker build / push jobs.

- LF has given assurances that if such an issue arises they will provide docker images caching in the proximity of the build infrastructure.
Security Concerns using Docker Hub

● The recent security breach refers to a database of Docker Hub accounts whose account information have been stolen

● The impact of this incident is
  ○ Proprietary code of companies could have been hacked
    ■ Not applicable to ONAP as all code is open source
  ○ Images build with Docker autobuild system might contain injected code
    ■ Not applicable to ONAP as it uses its own build servers

● The conclusion is that this incident does not affect ONAP in any way, nor will possible future similar incidents
Docker Hub Availability

• The world’s leading service for finding and sharing container images with your team and the Docker community.

• Docker Hub is the world’s largest repository of container images with an array of content sources including container community developers, open source projects and independent software vendors (ISV) building and distributing their code in containers.*

• Incidents / downtime reported are related in the vast majority to their automated build system, not the registry itself.**

*https://www.docker.com/products/docker-hub
**https://cloudstatus.eu/status/docker
Nexus3 Availability/Performance Requirements

- There are no High Availability implementations for ONAP Nexus or Nexus3. They are individual services running on virtual machines in a shared cloud environment at Vexxhost.
  - `nexus3.onap.org` is running on a VM with 4x Intel Xeon 2.9GHz CPU, 15G of RAM, and 12G SSD disk.
  - `nexus.onap.org` is running on a VM with 4x Intel Xeon 2.5GHz CPU, 16G of RAM, and 10G SSD disk.

- LF doesn’t have any Application Performance Monitoring (APM) in place for Nexus3 at this time, their monitoring is strictly at the system level, system load, number of processes, disk fill, network latency, open ports, total memory usage, etc.
Summary

ONAP Platform mandates support for any CPU architecture (e.g., Resource agnostic) to allow deployments on any hardware infrastructure.

Nexus3 docker registry does not support multi-arch images.

Request is to include Docker Hub Migration in El Alto as a Non-Functional Requirement.
Questions
Thank you