Building OCI Images Without Privilege

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Requirements.
Open Container Initiative

Image Format Specification

This specification defines an OCI Image, consisting of a manifest, an image index (optional), a set of filesystem layers, and a configuration.

The goal of this specification is to enable the creation of interoperable tools for building, transporting, and preparing a container image to run.

Table of Contents

- Introduction
- Notation and Conventions
not #
yum -y install ...
./configure ... 
sed -i ...
What exists?
shiftfs

- In kernel solution to uid-map files based on namespace map
- Author uses it for building container images
- Other interesting applications
- https://lwn.net/ml/linux-fsdevel/1529098514.4048.41.camel@HansenPartnership.com/
“rootless” containers

- umoci has rootless support without user namespaces
- Buildah has (recent) support for user namespaces
- https://github.com/genuinetools/img supports exactly the Docker “API” unprivileged
stacker
How do I use it?

first:

from:

  type: docker
  url: docker://centos:latest

import:

  - config.json
  - install.sh

run: |

  mkdir -p /etc/myapp
  cp /stacker/config.json /etc/myapp/
  cp /stacker/install.sh /stacker/install.sh
How do I use it?

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from:
  type: docker
  url: docker://centos:latest
import:
  - config.json
  - install.sh
run: |
  mkdir -p /etc/myapp
  cp /stacker/config.json /etc/myapp/
  /stacker/install.sh
How do I use it?

first:
   from:
      type: docker # or tar, oci, etc.
      url: docker://centos:latest
import:
    - config.json
    - install.sh
run: |
    mkdir -p /etc/myapp
    cp /stacker/config.json /etc/myapp/
    /stacker/install.sh
How do I use it?

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  from:
    type: docker
    url: docker://centos:latest
import:
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  - install.sh
run:
  mkdir -p /etc/myapp
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How do I use it?

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    type: docker
    url: docker://centos:latest
  import:
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    - install.sh
  run: |
    mkdir -p /etc/myapp
    cp /stacker/config.json /etc/myapp/
    /stacker/install.sh
How does it work?

- lblxc
- go-lxc
- umoci
- skopeo
  - No API :(
- btrfs
  - Multiple images built from the same source are only extracted once
What does the run environment look like?

- User namespaces
- Host network namespace
- Bind mounted /etc/resolv.conf
- /proc/sys and /proc/sysrq-trigger readonly (proc:mixed in LXC)
- Reasonable devices in /dev (lxc.autodev = 1)
- Bind mounted /sys from host
- /stacker directory mounted r/o for import:s
- Reasonable default $PATH
- Mostly looks like a reasonable system, yum, apt, etc. work fine
odds & ends
$ stacker inspect --oci-dir oci

layer 0: sha256:256b176b... (75 MB)
layer 1: sha256:276a625d... (156 kB)

Annotations:
  ws.tycho.stacker.stacker_yaml: ...

Image config:
{
  "created": "2018-08-06T16:33:04.379695767-06:00",
  "os": "linux",
  "config": {
    "Env": [
      "PATH=/usr/local/sbin:/usr/local/bin:/usr/sbin:/usr/bin:/sbin:/bin"
    ], ...
  }
}
updating.
A strategy for container updating

A:

from:
  type: docker
  url: docker://centos:latest
run:
  - yum install openssl
  - yum install python3
  - git clone https://example.com/A
  - ./A/install

B:

from:
  type: docker
  url: docker://centos:latest
run:
  - yum install openssl
  - yum install python3
  - git clone https://example.com/B
  - ./B/install
A strategy for container updating

```yaml
python3:
  from:
    type: docker
    url: docker://centos:latest
  run:
    - yum install python3

ssl:
  from:
    type: docker
    url: docker://centos:latest
  run:
    - yum install openssl

A:
  from:
    type: docker
    url: docker://centos:latest
  apply:
    - docker://ssl:latest
    - docker://python3:latest
  run:
    - git clone https://example.com/A
    - ./A/install
```
A strategy for container updating

python3:
  from:
    type: docker
    url: docker://centos:latest
  run:
    - yum install python3

8ab6c5e1cb34a35a35... -> python:latest
e05f2ab2a890d758805... -> centos:latest
39ad9e63562e5d7087...
A strategy for container updating

python3:
  from:
    type: docker
    url: docker://centos:latest
  run:
    - yum install openssl

64fabd853e4de75a7e... -> ssl:latest
e05fab2a890d758805... -> centos:latest
39ad9e63562e5d7087...
End result

e05fab2a890d758805... -> centos:latest
39ad9e63562e5d7087...
End result

64fabd853e4de75a7e... -> ssl:latest, included verbatim
E05fab2a890d758805... -> centos:latest
39ad9e63562e5d7087...
End result

8ab6c5e1cb34a35a35... -> python:latest, included verbatim
64fabd853e4de75a7e... -> ssl:latest, included verbatim
e05fab2a890d758805... -> centos:latest
39ad9e63562e5d7087...
End result

c34553482dda4a28dd... -> diff from app install
8ab6c5e1cb34a35a35... -> python:latest, included verbatim
64fabd853e4de75a7e... -> ssl:latest, included verbatim
e05fab2a890d758805... -> centos:latest
39ad9e63562e5d7087...
A:

```yaml
from:
  type: docker
  url: docker://centos:latest

apply:
  - docker://ssl:latest
  - docker://python3:latest

run:
  - git clone https://example.com/A
  - ./A/install
```
For posterity

- https://github.com/anuvu/stacker
  (https://github.com/anuvu/stacker/blob/master/doc/tutorial.md)
- https://github.com/opencontainers/image-spec
- https://github.com/lxc/lxc
Thanks!

We are hiring! Linux, containers, secure boot, etc.

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