runc: The Little (container) Engine That Could

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About Me

Phil Estes
Senior Technical Staff Member
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Container Strategy/Open Source Leader

Docker community core engine maintainer <
Linux/open source expertise for 15 years @ IBM <

Community activities & accomplishments
> Brought user namespace support to the Docker engine
> Helped design v2.2 image specification with multi-platform support
> Implemented first tool to create multi-platform images in Docker v2.3 registry
> Member of the "Docker Captains" program

What is the OCI?

Open Container Initiative (OCI)

- A **Linux Foundation** Collaborative Project
- Free from **control** by any particular vendor's specific cloud stack or ecosystem
- Includes:
    - **container runtime specification**
    - reference **runtime***
    - and now, an **image format specification**

seeded with **runc + **libcontainer** by Docker*

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OCI Specs and Status

> **Runtime specification: Release 1.0.0–rc1 / June 2016**

https://github.com/opencontainers/runtime-spec/releases/tag/v1.0.0-rc1

Approaching a finalized **1.0 release** (**–rc2** being cut very soon)
Includes required core for containerization on Linux, Solaris, & Windows

> **Image format specification: Milestone 0.4.0 / August 2016**

https://github.com/opencontainers/image-spec/milestones/v0.4.0

Seeded with Docker registry v2.2 specification
Cadence of pre-releases underway in the repository:
–   0.4.0 release last week
–   0.5.0 –> 1.0.0 releases underway

- Announced June 20th, 2015
- Charter signed on December 8th, 2015
- **48** current member companies
- Targeting 1.0 spec releases in 2016

https://opencontainers.org
https://github.com/opencontainers

What is runc?

Introduction to `runc`

> **runc** is a client wrapper around **libcontainer**
> **Libcontainer** is the operating system interface

runC requires two pieces of information: **a)** an OCI **config** (JSON) and **b)** a root **filesystem**

```
$ docker run -it --read-only -v /host:/hostpath alpine sh
/#
```

```
{
  "ociVersion": "0.6.0-dev",
  "platform": {
    "os": "linux",
    "arch": "amd64"
  },
  "process": {
  "terminal": true,
  "args": [
    "sh"
  ],
  "env": [
    "PATH=/usr/local/sbin:/usr/local/bin:/bin"
```

config.json

runc: An open innovation platform

`INTEREST` **Implement low-level container features**
- Operating system level features should be defined in the OCI runtime specification
- New capabilities (PID cgroup controls, checkpoint/restore, seccomp) implemented in runC

`INTEREST` **OCI compliance/pluggable execution engine**
- Implement a OS/environment for containers via an OCI spec compliant binary
- Examples: runz (Solaris zones), runv (hypervisor–based), Intel Clear Containers

`INTEREST` **Iterative container configuration test/debug**
- Simple variant of "Docker–like" containers with less friction for quick modifications
- Low bar for dependencies: single **binary** + physical rootfs **bundle** + JSON **config**

Top 10 contributing companies to opencontainers/runc

1. Docker   2. OpenVZ   3. Huawei   4. Redhat   5. Google   6. IBM   7. SuSE   8. Pivotal   9. Fujitsu   10. Microsoft

Let's Demo `runc`!

```
# you'll see the following tools/projects during the demo:

/usr/bin/runc              https://github.com/opencontainers/runc

/usr/bin/ocitools          https://github.com/opencontainers/ocitools

/usr/local/bin/riddler     https://github.com/jfrazelle/riddler

/usr/local/bin/netns       https://github.com/jfrazelle/netns

/usr/local/bin/uidmapshift  http://bazaar.launchpad.net/~serge-hallyn/+junk/nsexec/view/head:/uidmapshift.c
```

OCI Futures

- **Image Format Specification**
  - Implementation details under discussion; get involved if an area of interest for you or your company
- **More users/contributed implementations of the OCI spec(s)**
- **runC innovations moving up the stack**
  - checkpoint/restore underway (exposed via Docker engine)
  - Seccomp, user namespaces, PID limits are prior examples
- **What do you plan to do with OCI and/or the runC implementation?**

Thank You!

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