Rootless Containers with `runc`

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“Required Reading”

- “Kubernetes meets Linux” — **Vishnu Kannan** — 1030 yesterday.
- “Containers from scratch - the sequel!” — **Liz Rice** — 1235 yesterday.
- “OCI and Open Container Standards” — **Jonathan Boulle** — 1645 yesterday.
- “Mixing cgroupfs v1 and cgroupfs v2” — **Christian Brauner** — T-plus 35 minutes.

Revision: Open Container Initiative

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- Standards body created in 2015 to standardise container formats and runtimes.
- Two main components:
  - Runtime configuration.
  - Image format.
- `runc` is the de-facto implementation of the runtime specification.
  - It just needs a root filesystem and configuration file.
- … and it's the runtime used by Docker and containerd.

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- Not actually a hypothetical — this was me in early 2016.
- … and many other researchers have this problem.

Revision: The stuff that containers are made of

- Containers are mostly made of Linux kernel namespaces.
  - `cgroup`s are not actually required.
- We just want isolation — and we want it without privileges.
- The key kernel feature is USER namespaces.
  - You can “pretend” that an unprivileged user is root.
  - I’ve already given a talk about how it works.
  - New kernels (3.8) let you create this namespace as an unprivileged user.

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- Or you could do it by hand (Liz-style) …
  - `unshare -UrmunipCf bash`
  - `mount --make-rprivate / && mount --rbind rootfs/ rootfs/`
  - `mount -t proc proc rootfs/proc`
  - `mount -t tmpfs tmpfs rootfs/dev`
  - `mount -t devpts -o newinstance devpts rootfs/dev/pts`
  - `# … skipping over a lot more mounting …`
  - `pivot_root rootfs/ rootfs/.pivot_root && cd /`
  - `mount --make-rprivate /.pivot_root && umount -l /.pivot_root`
  - `exec bash # finally`

What works?

- `runc` recently got support for rootless containers.
- Due to kernel limitations and our requirements, some things are not possible.

Works	Broken
`run`	`checkpoint` [criu]
`exec`	`restore` [criu]
`kill`	`pause` [cgroups]
`delete`	`resume` [cgroups]
`list`	`events` [cgroups]
`state`	`ps` [cgroups]
`spec`	
`create`	
`start`	
`--detach`	

What doesn't?

- Checkpoint and restore isn't well-tested and still needs kernel work.
  - Unprivileged live migration of any process!
- `cgroup`s — Let's not go there. 30 minutes is too short for the full rant, and we're all far too sober.
  - *Not every hierarchy should be a VFS.*
- Network namespaces aren't really useful (so we don't use them).

What about images?

- Runtime is only half of the story — what about images?
- Recently, two tools have been created to make this very easy.

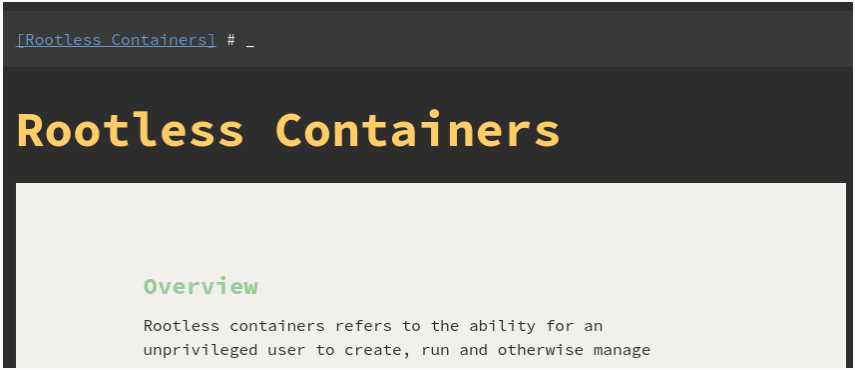
  skopeo Download and convert images from various sources and registries.

  umoci Unpack, repack and otherwise modify local OCI images.
- Now you can use images as an unprivileged user too!
- You can even build `Dockerfile` images with **orca-build**.

Live Demo!

May the demo gods have mercy.

What's next?



rootlesscontaine.rs

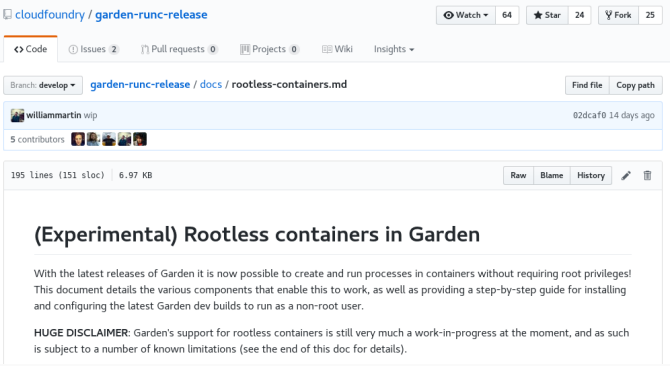
Kernel Stuff

- Currently only `btrfs` supports unprivileged “subvolume” operations.
  - Ubuntu ships `overlayfs` allowing unprivileged mounting.
- The demo didn’t create a new `NET` namespace — it used the hosts’s.
  - …but what if we want to use cool networking and still have network access?
  - I have some horrific ideas with implementing `veth` in user-space.

Unprivileged clusters!

- I have access to a bunch of nodes and want to manage jobs across those, what do I do?
- Biggest blocker looks to be networking (see `kube-proxy`).
- Most orchestrators assume root and it's hard to work around those assumptions upstream.

Unprivileged clusters!

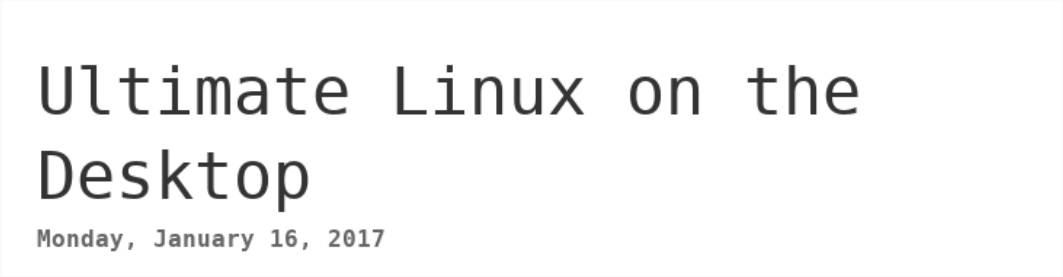


https://github.com/cloudfoundry/garden-runc-release

Contain absolutely everything!!

- Why stop at servers, why can't we run all of our things inside containers.
- `Flatpak` is working on this, but is not going all the way with containers.
- If you can run it as your user, it should be able to work in rootless containers.
  - *Unprivileged overlay might have some interesting properties here ...*
- *Ultimate convergence ^{TM}: What if you could use container features in desktop applications?*

Contain absolutely everything!!



Ultimate Linux on the Desktop

Monday, January 16, 2017

https://blog.jessfraz.com/post/ultimate-linux-on-the-desktop/

Acknowledgements

- **Jessie Frazelle** — started working on this first and inspired me with her PoC, binctr.
- **Eric Biederman** and **Serge Hallyn** — working tirelessly to get **USER** namespaces and countless other unprivileged kernel features working.
- **James Bottomley** — helped me with kernel patches trying to fix the `cgroup` issue and also has done a lot of kernel “container” work.

Questions?

https://www.cyphar.com/src/talks