

Lectures on Advanced Operating Systems (SS'26)

Containers

Exercise 04

Containers on Linux

nginx web server



PID: 4
Procs: 1, 3
Host: "MyBox"

python flask app



PID: 4
Procs: 2, 3
Host: "MyBox"

Isolation

"Looks like it runs alone"

Global Namespace

PID: 1, 7, 8, 92, 104, ...
IPC: shmem:42, sem:43, ...

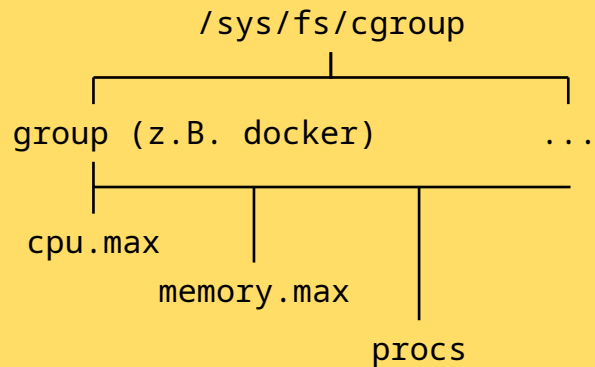
Namespace

PID: 1 (→ 92), 3 (→ 104)
IPC: shmem:1 (→ shmem:4)

→ Namespaces

Resource Control

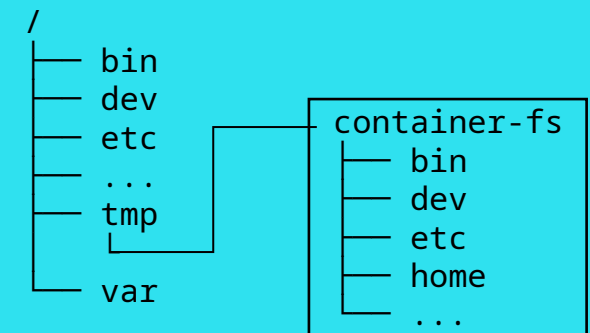
"No single container hogs the system"



→ CGroups

Packaging

"Bundles its own dependencies"



→ OverlayFS

Host kernel

OverlayFS

nginx web server



python flask app



Writable layer
(logs, tmp, ...)

Writable layer
(sessions, uploads, logs, tmp, ...)

nginx 1.25
(binaries, configuration, html files)

flask app
(app.py, gunicorn, requirements)

Python 3.11
(pip, packages)

Debian slim base (e.g. Bookworm)
(libc, bash, apt)

Disk

Lab Outline

1. Download VM image (either Qemu + SSH (VSCode) or Virtualbox)
2. Create cgroup
3. Create isolated process with own namespaces
4. Move process into cgroup
5. Configure further namespaces
6. Mount the container filesystem
7. Execute the container binary
8. Wait & clean up