LXC, Docker, and the future of software delivery

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docker

Outline

- Why Linux Containers?
- What are Linux Containers exactly?
- What do we need on top of LXC?
- Why Docker?
- What is Docker exactly?
- Where is it going?

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Why Linux Containers?

What are
we trying
to solve?

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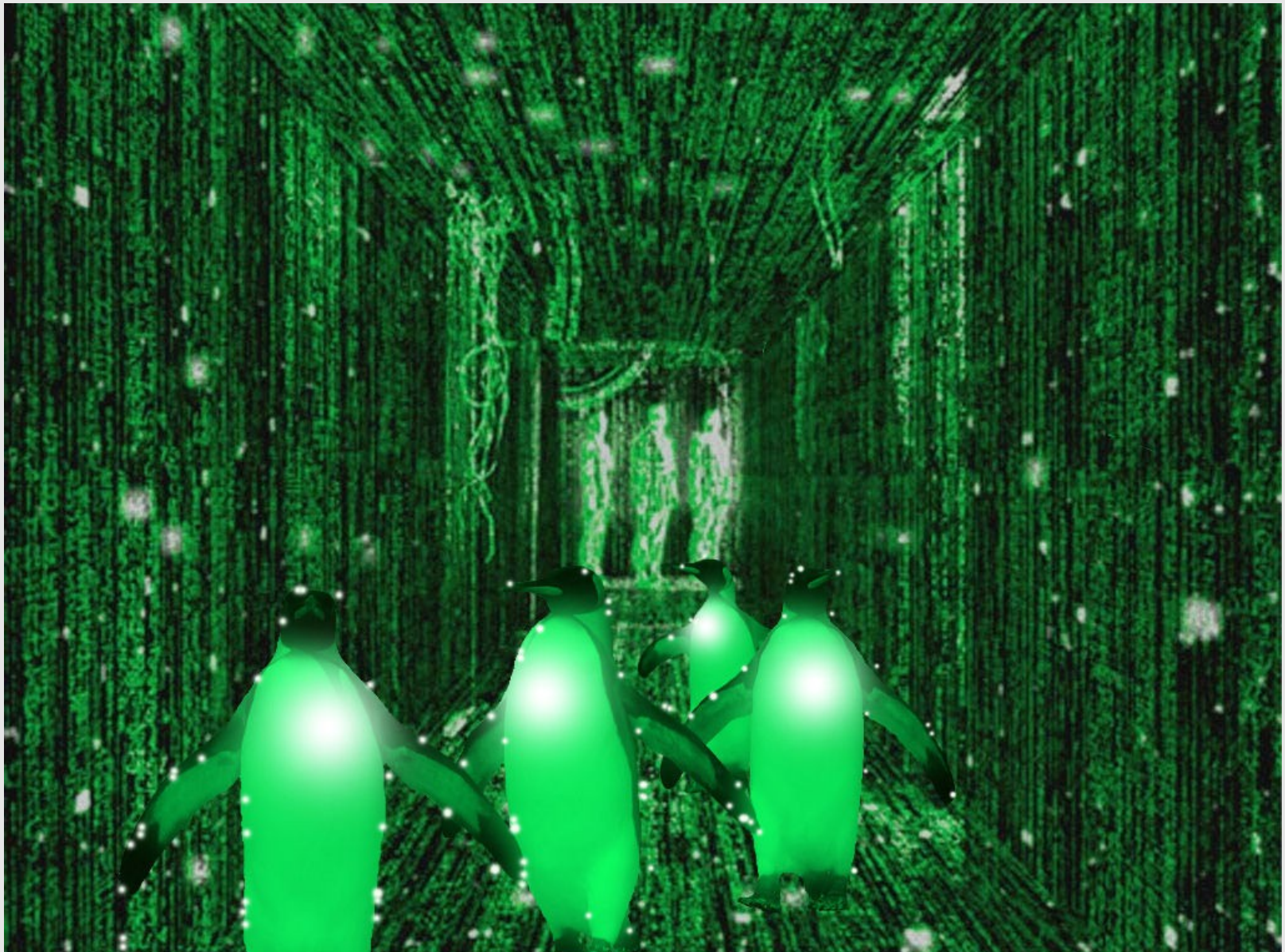
The Matrix From Hell

docker

The Matrix From Hell



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Many payloads

- backend services (API)
- databases
- distributed stores
- webapps

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Many payloads

- Go
- Java
- Node.js
- PHP
- Python
- Ruby
- ...

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Many payloads

- CherryPy
- Django
- Flask
- Plone
- ...

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Many payloads

- Apache
- Gunicorn
- uWSGI
- ...

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Many payloads

+ your code

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Many targets

- your local development environment
- your coworkers' developement environment
- your Q&A team's test environment
- some random demo/test server
- the staging server(s)
- the production server(s)
- bare metal
- virtual machines
- shared hosting

+ your dog's Raspberry Pi

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Many targets

- BSD
- Linux
- OS X
- Windows

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Many targets

- ~~BSD~~
- Linux
- ~~OS X~~
- ~~Windows~~

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The Matrix From Hell

	Development VM	QA Server	Single Prod Server	Onsite Cluster	Public Cloud	Contributor's laptop	Customer Servers
Static website	?	?	?	?	?	?	?
Web frontend	?	?	?	?	?	?	?
background workers	?	?	?	?	?	?	?
User DB	?	?	?	?	?	?	?
Analytics DB	?	?	?	?	?	?	?
Queue	?	?	?	?	?	?	?







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Real-world analogy: containers

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Many products

- clothes
- electronics
- raw materials
- wine
- …

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Many transportation methods

- ships
- trains
- trucks
- ...

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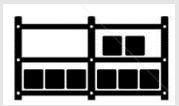
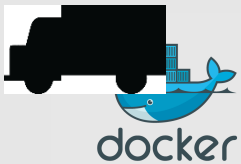
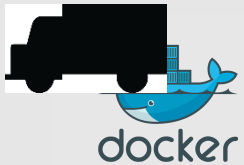
Another matrix from hell

	?	?	?	?	?	?	?
	?	?	?	?	?	?	?
	?	?	?	?	?	?	?
	?	?	?	?	?	?	?
	?	?	?	?	?	?	?
	?	?	?	?	?	?	?
							

Solution to the transport problem: the *intermodal shipping* container



Solution to the transport problem: the *intermodal shipping* container

- 90% of all cargo now shipped in a standard container
- faster and cheaper to load and unload on ships (by an order of magnitude)
- less theft, less damage
- freight cost used to be >25% of final goods cost, now <3%
- 5000 ships deliver 200M containers per year

Solution to the deployment problem: the *Linux* container

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Linux containers...

- run everywhere
  - regardless of kernel version
  - regardless of host distro
  - (but container and host architecture must match)
- run anything
  - if it can run on the host, it can run in the container
  - i.e., if it can run on a Linux kernel, it can run

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What are Linux Containers exactly?

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High level approach: it's a lightweight VM

- own process space
- own network interface
- can run stuff as root
- can have its own /sbin/init (different from the host)

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Low level approach: it's chroot on steroids

- can also *not* have its own /sbin/init
- container = isolated process(es)
- share kernel with host
- no device emulation (neither HVM nor PV)

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Separation of concerns: Dave the Developer

- inside my container:
  - my code
  - my libraries
  - my package manager
  - my app
  - my data

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Separation of concerns: Oscar the Ops guy

- outside the container:
  - logging
  - remote access
  - network configuration
  - monitoring

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How does it work?
Isolation with namespaces

- pid
- mnt
- net
- uts
- ipc
- user

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How does it work?
Isolation with cgroups

- memory
- cpu
- blkio
- devices

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Efficiency: *almost* no overhead

- processes are isolated,
  but run straight on the host
- CPU performance = native performance
- memory performance = a few % shaved off for (optional) accounting
- network performance = small overhead; can be optimized to zero overhead

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Efficiency: storage-friendly

- unioning filesystems
  (AUFS, overlayfs)
- snapshotting filesystems
  (BTRFS, ZFS)
- copy-on-write
  (thin snapshots with LVM or device-mapper)

This wasn't part of LXC at first; but you definitely want it!

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Efficiency: storage-friendly

- provisioning now takes a few milliseconds
- … and a few kilobytes
- creating a new base/image/whateveryoucallit takes a few seconds

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Docker

What's Docker?

- Open Source engine to **commoditize** LXC
- using copy-on-write for quick provisioning
- allowing to create and share *images*
- propose a standard format for containers

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Yes, but...

- « I don't need Docker; I can do all that stuff with LXC tools, rsync, some scripts! »
- correct on all accounts; but it's also true for apt, dpkg, rpm, yum, etc.
- the whole point is to **commoditize**,
  i.e. make it ridiculously easy to use

Docker: authoring images

- you can author « images »
  - either with « run+commit » cycles, taking snapshots
  - or with a Dockerfile (=source code for a container)
  - both ways, it's ridiculously easy
- you can run them
  - anywhere
  - multiple times

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Dockerfile example

```
FROM ubuntu

RUN apt-get -y update
RUN apt-get install -y g++
RUN apt-get install -y erlang-dev erlang-manpages erlang-base-hipe ...
RUN apt-get install -y libmozjs185-dev libicu-dev libtool ...
RUN apt-get install -y make wget

RUN wget http://.../apache-couchdb-1.3.1.tar.gz | tar -C /tmp -zxf-
RUN cd /tmp/apache-couchdb-* && ./configure && make install

RUN printf "[httpd]\nport = 8101\nbind_address = 0.0.0.0" >
    /usr/local/etc/couchdb/local.d/docker.ini

EXPOSE 8101
CMD ["/usr/local/bin/couchdb"]
```

Docker: sharing images

- you can push/pull images to/from a registry (public or private)
- you can search images through a public index
- dotCloud maintains a collection of base images (Ubuntu, Fedora...)
- satisfaction guaranteed or your money back

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Docker: *not* sharing images

- private registry
  - for proprietary code
  - or security credentials
  - or fast local access

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Typical workflow

- code in local environment
  (« dockerized » or not)
- each push to the git repo triggers a hook
- the hook tells a build server to clone the code and run
  « docker build » (using the Dockerfile)
- the containers are tested (nosetests, Jenkins...),
  and if the tests pass, pushed to the registry
- production servers pull the containers and run them
- for network services, load balancers are updated

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Hybrid clouds

- Docker is part of OpenStack « Havana »,
  as a Nova driver + Glance translator
- typical workflow:
  - code on local environment
  - push container to Glance-backed registry
  - run and manage containers using OpenStack APIs
- Docker confirmed to work with:
  Digital Ocean, EC2, Joyent, Linode, and many more
  (not praising a specific vendor, just pointing that it « just works »)

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Docker: the community

- Docker: >160 contributors
- latest milestone (0.6): 40 contributors
- GitHub repository: >600 forks

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Docker: the ecosystem

- CoreOS (full distro based on Docker)
- Deis (PAAS; available)
- Dokku (mini-Heroku in 100 lines of bash)
- Flynn (PAAS; in development)
- Maestro (orchestration from a simple YAML file)
- OpenStack integration
- Shipper (fabric-like orchestration)

And *many* more

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Docker roadmap

- Today: Docker 0.6
  - LXC
  - AUFS
- Tomorrow: Docker 0.7
  - LXC
  - device-mapper thin snapshots (target: RHEL)
- The day after: Docker 1.0
  - LXC, libvirt, qemu, KVM, OpenVZ, chroot…
  - multiple storage back-ends
  - plugins

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Thank you! Questions?

http://docker.io/

https://github.com/dotcloud/docker

@docker

@jpetazzo

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