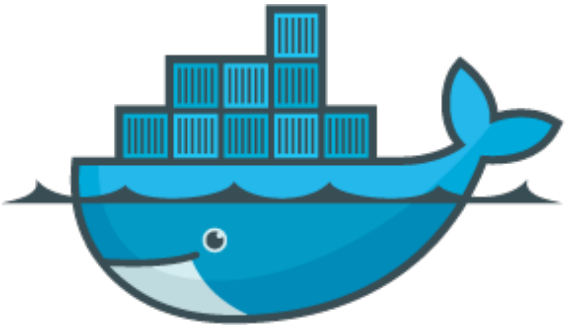
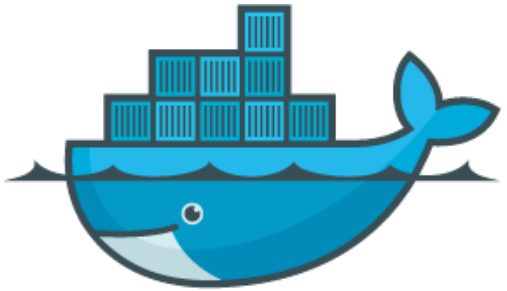


Orchestrating Docker containers at scale

Maciej Lasyk

JavaCamp #13

Kraków, 2014-11-22



Join Fedora Infrastructure!

- learn Ansible
- learn Docker with Fedora Dockerfiles

http://fedoraproject.org/en/join-fedora

Agenda

- Why use Docker?
- Brief history of envs evolution
- Docker – what is it?
- To PaaS or not to PaaS
- Orchestration at scale

Quick survey

- How many of you...

Quick survey

- How many of you...
  - Knows what Docker is?

Quick survey

- How many of you...
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  - Played with Docker?

Quick survey

- How many of you...
  - Knows what Docker is?
  - Played with Docker?
  - Runs it on production?

Why use Docker?

With Docker we can solve many problems

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- “it works on my machine”

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- Infrastructure configuration spaghetti – automation!

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Why use Docker?

With Docker we can solve many problems

- “it works on my machine”
- reducing build & deploy time
- Infrastructure configuration spaghetti – automation!
- Libs dependency hell
- Cost control and granularity

A brief story of envs evolution

- classical approach (for & scp/ssh & conf.d)

A brief story of envs evolution

- classical approach (for & scp/ssh & conf.d)
- configuration management

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A brief story of envs evolution

- classical approach (for & scp/ssh & conf.d)
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- Bare vs IaaS vs PaaS
- Continuous Integration
- So when to use Docker?

Docker – what is it?

Docker – what is it?

“automates the deployment of any application as a lightweight, portable, self-sufficient container
that will run virtually anywhere”

Docker – what is it?

Java’s promise: Write Once. Run Anywhere.

Docker – what is it?

Java’s promise: Write Once. Run Anywhere.

Even on Windows now!

https://blog.docker.com/2014/10/docker-microsoft-partner-distributed-applications/

Docker – what is it?

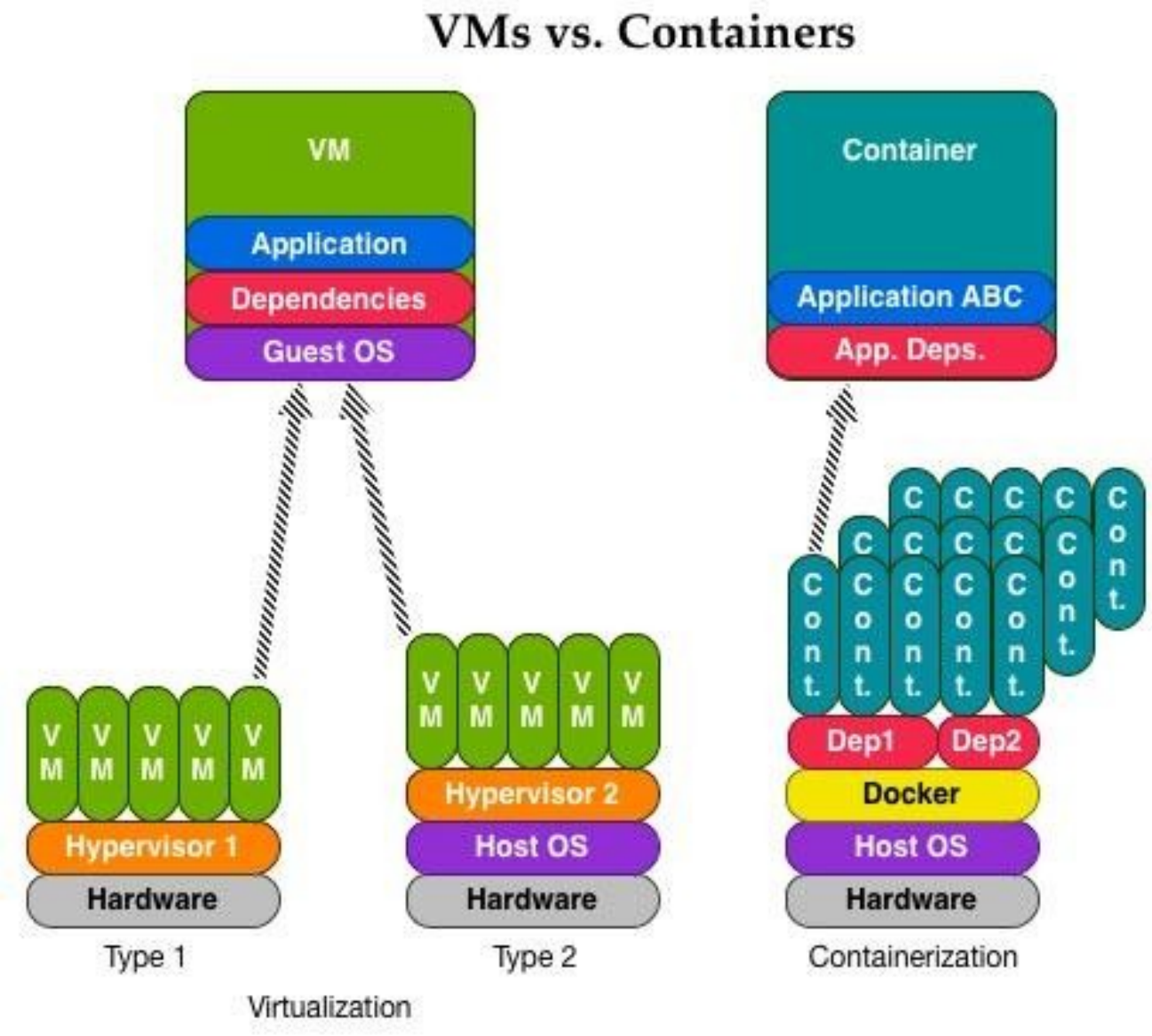
Docker is lightweight

Docker – what is it?

Docker is lightweight

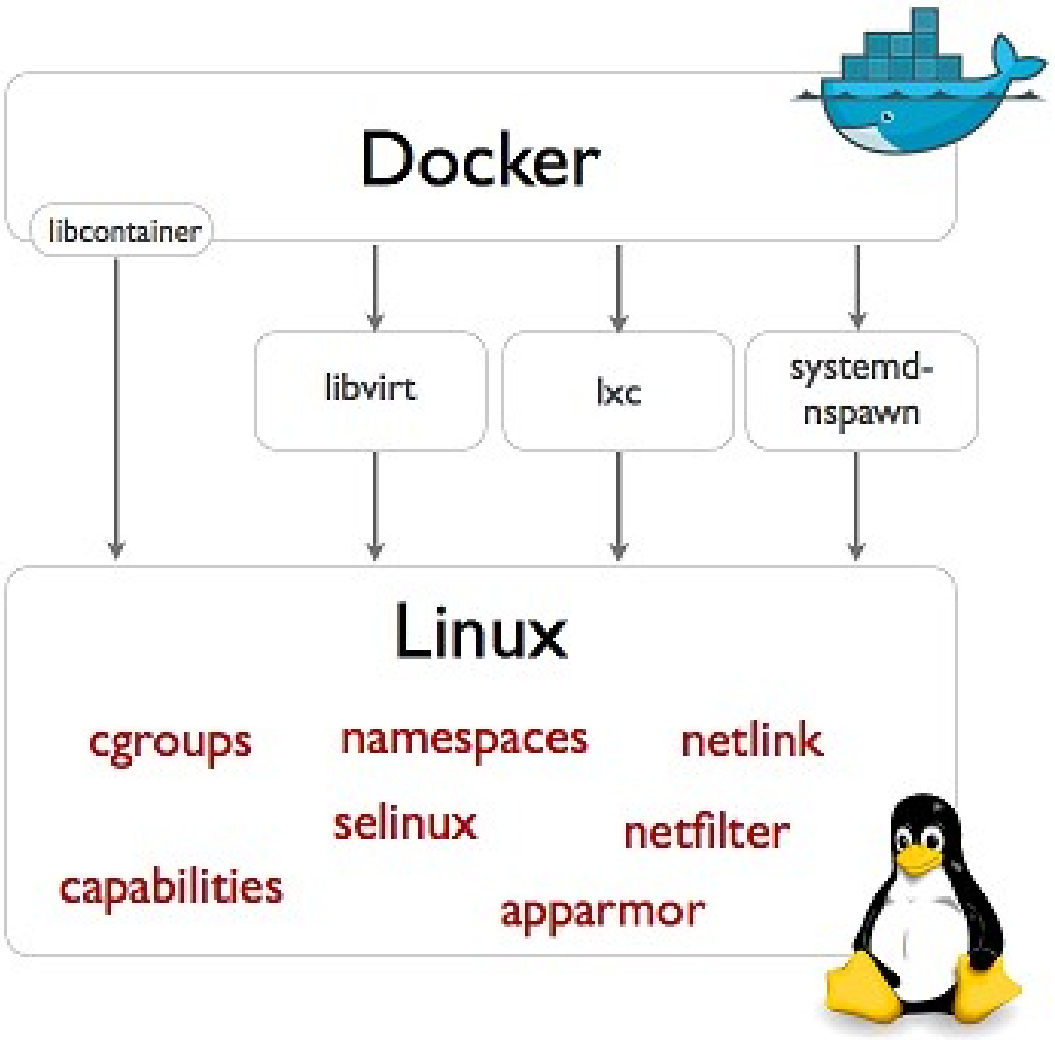
```
================================================================================
 Package              Arch              Version                Repository          Size
================================================================================
Installing:
 docker-io            x86_64            1.3.0-1.fc20           updates            4.3 M
```

Docker – what is it?



http://sattia.blogspot.com/2014/05/docker-lightweight-linux-containers-for.html

Docker – how it works?



http://blog.docker.com/2014/03/docker-0-9-introducing-execution-drivers-and-libcontainer/

Docker – how it works?

- LXC & libcontainer

Docker – how it works?

- LXC & libcontainer
- control groups

Docker – how it works?

- LXC & libcontainer
- control groups
- kernel namespaces

Docker – how it works?

- LXC & libcontainer
- control groups
- kernel namespaces
- layered filesystem
  - btrfs
  - devmapper thin provisioning & loopback mounts
  - no more AUFS
  - http://developerblog.redhat.com/2014/09/30/overview-storage-scalability-docker/

Docker – concepts

- images
  - read only
  - act as templates

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  - extends the base image
  - results in a new image

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  - extends the base image
  - results in a new image
- Containers: instances running apps

dockerfile + base image = docker container

Dockerfile

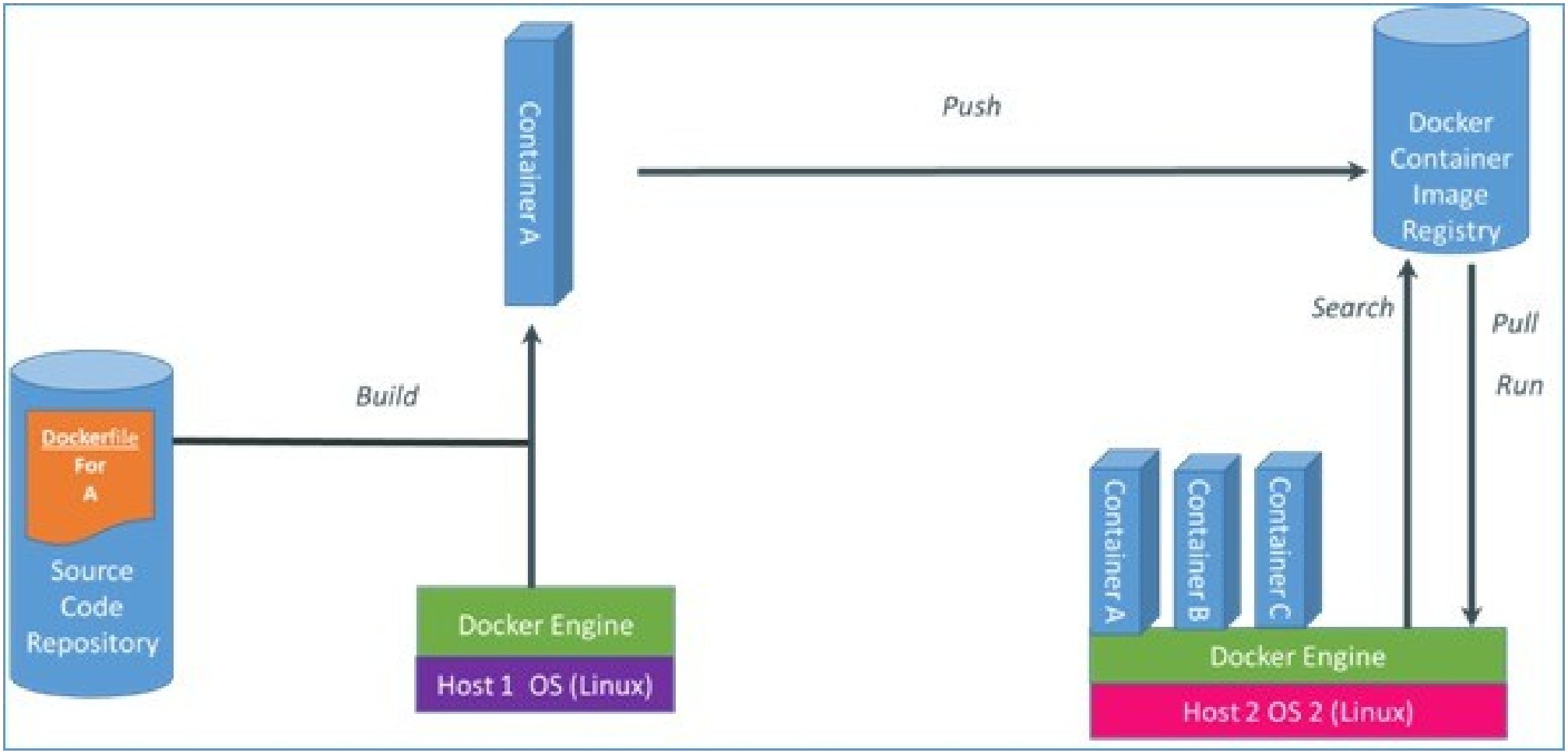
```
FROM fedora
MAINTAINER scollier <scollier@redhat.com>

RUN yum -y update && yum clean all
RUN yum -y install nginx && yum clean all
RUN echo "daemon off;" >> /etc/nginx/nginx.conf
RUN echo "nginx on Fedora" > /srv/www/index.html

EXPOSE 80

CMD [ "/usr/sbin/nginx" ]
```

Docker – registry



http://osv.io/blog/blog/2014/06/19/containers-hypervisors-part-2/

Docker – registry

- git like semantics
- pull, push, commit
- private and public registry
- https://github.com/dotcloud/docker-registry
- yum install docker-registry

```
$ docker pull
$ docker push
$ docker commit
```

Docker – images hierarchy

base image
    -> child image
        -> grandchild image

Docker – images hierarchy

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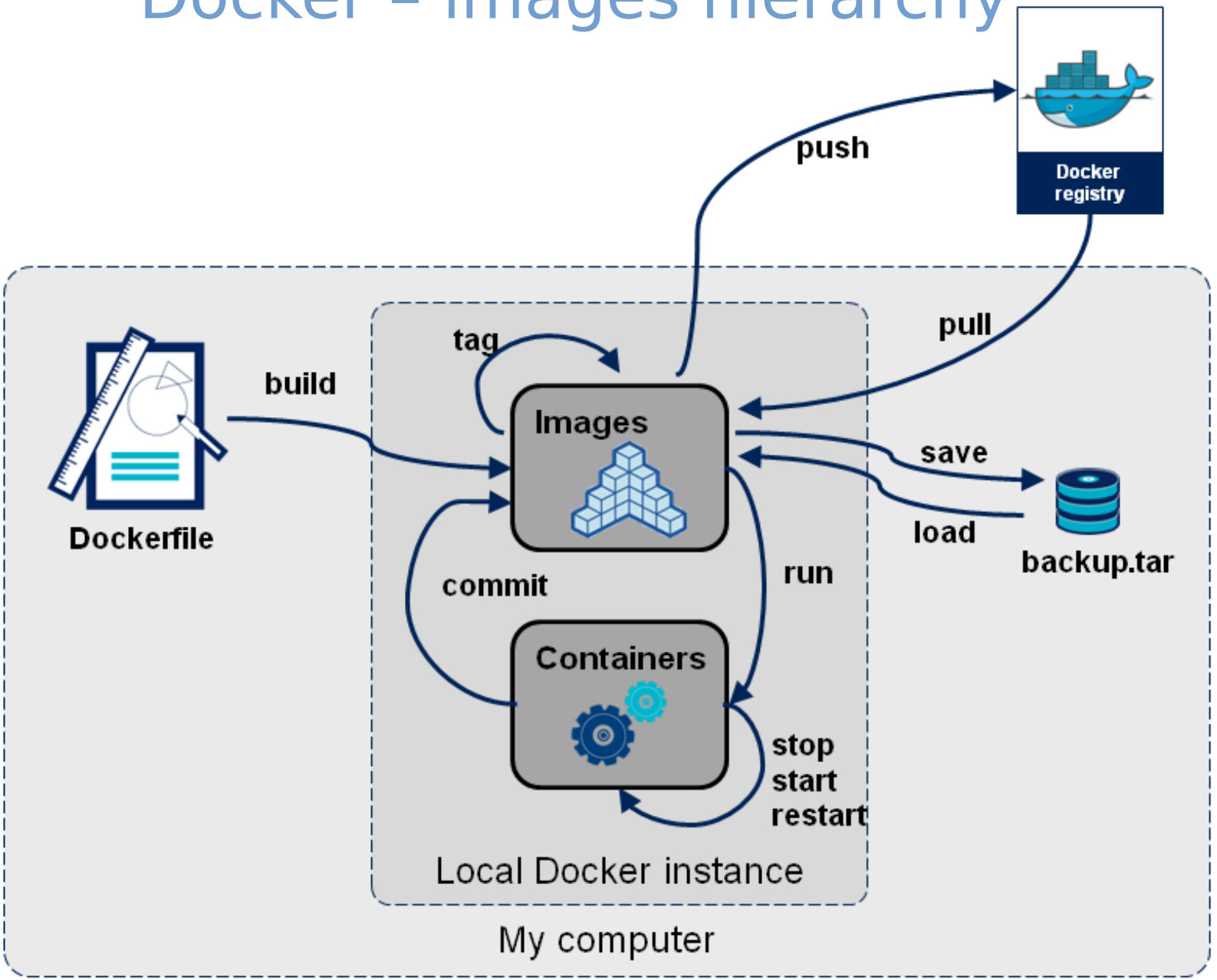
-> grandchild image

Git’s promise: Tiny footprint with lightning fast performance

Docker – images hierarchy



http://blog.octo.com/en/docker-registry-first-steps/

Docker – security

- Isolation via kernel namespaces
- Additional layer of security: SELinux / AppArmor / GRSEC
- Each container gets own network stack
- control groups for resources limiting

f20 policy: https://git.fedorahosted.org/cgit/selinux-policy.git/tree/docker.te?h=f20-contrib

What's there?

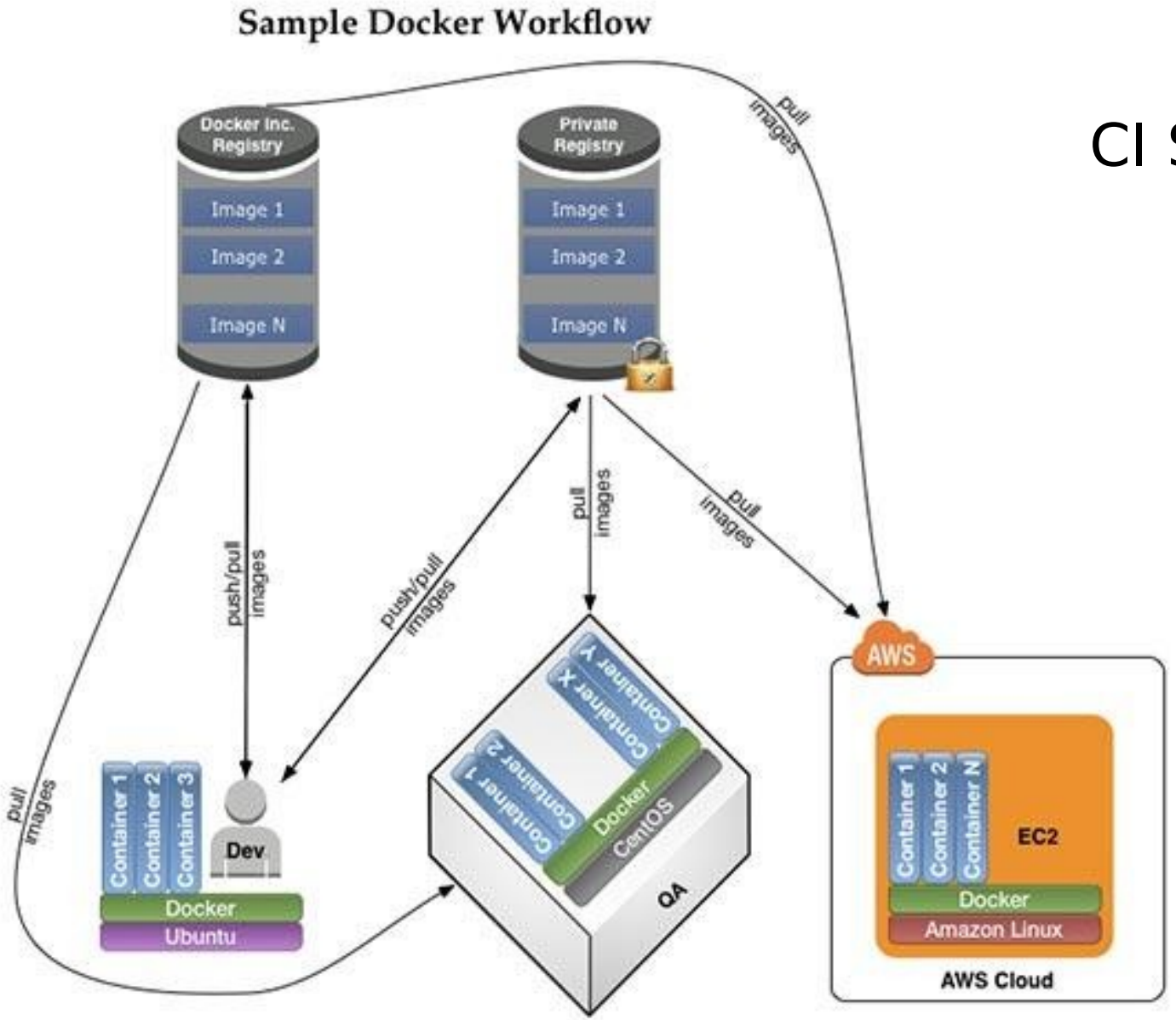
seinfo -t -x | grep docker

sesearch -A -s docker_t (and the rest)

or just unpack docker.pp with semodule_unpackage

Docker – security

Docker – use cases



CI Stack

http://sattia.blogspot.com/2014/05/docker-lightweight-linux-containers-for.html

Docker – use cases

Continuous Integration

- local dev
    - with Docker it's easy to standardize envs
- deployment
    - rolling updates (e.g. w/Ansible)
- testing
    - unit testing of any commit on dedicated env
    - don't worry about cleaning up after testing
    - parrarelized tests across any machines

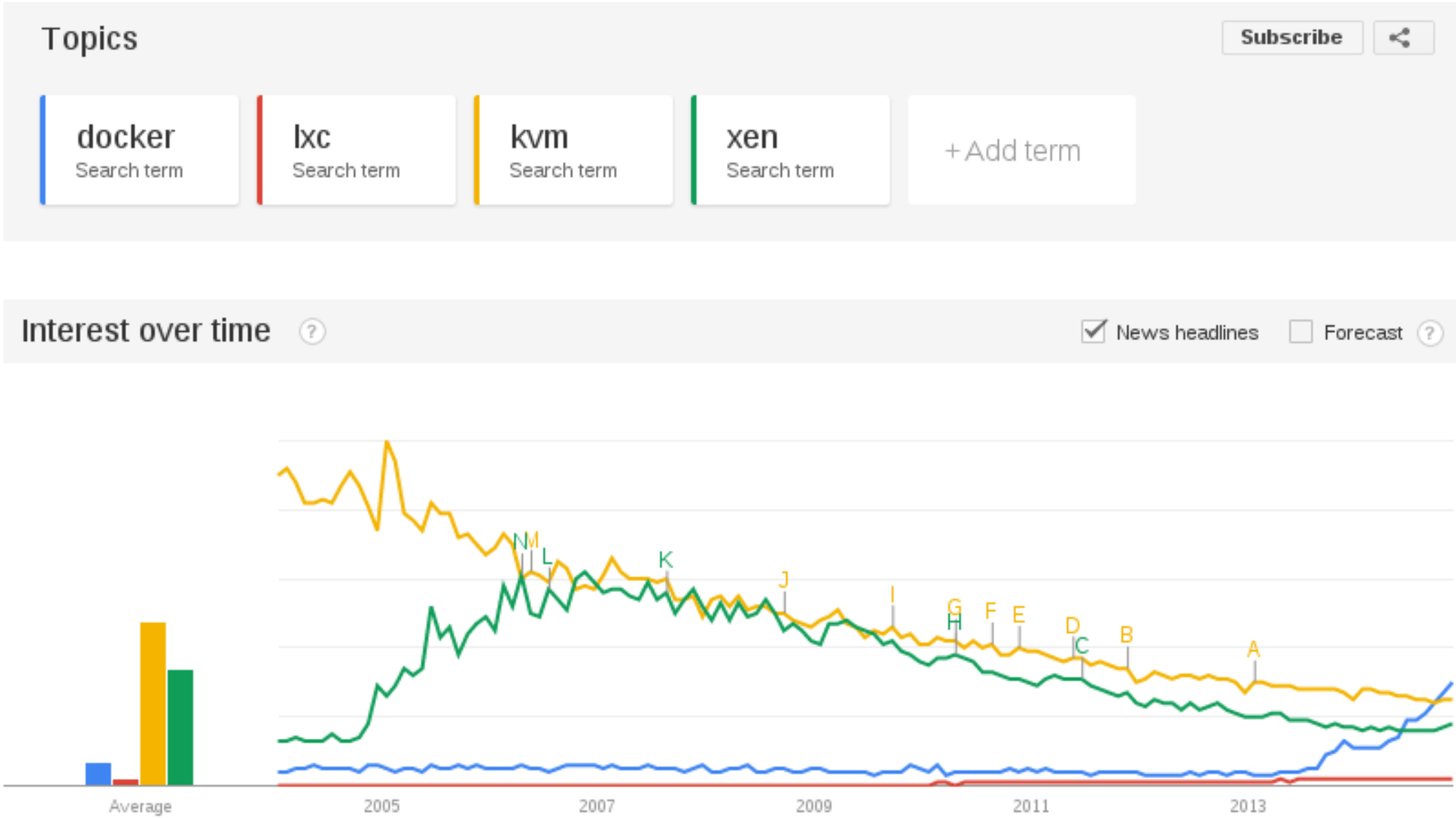
Docker – use cases

- version control system for apps
- microservices
    - Docker embraces granularity
    - Services can be deployed independently and faster
    - parallelized tests across any machines
- continuous delivery
- PaaS

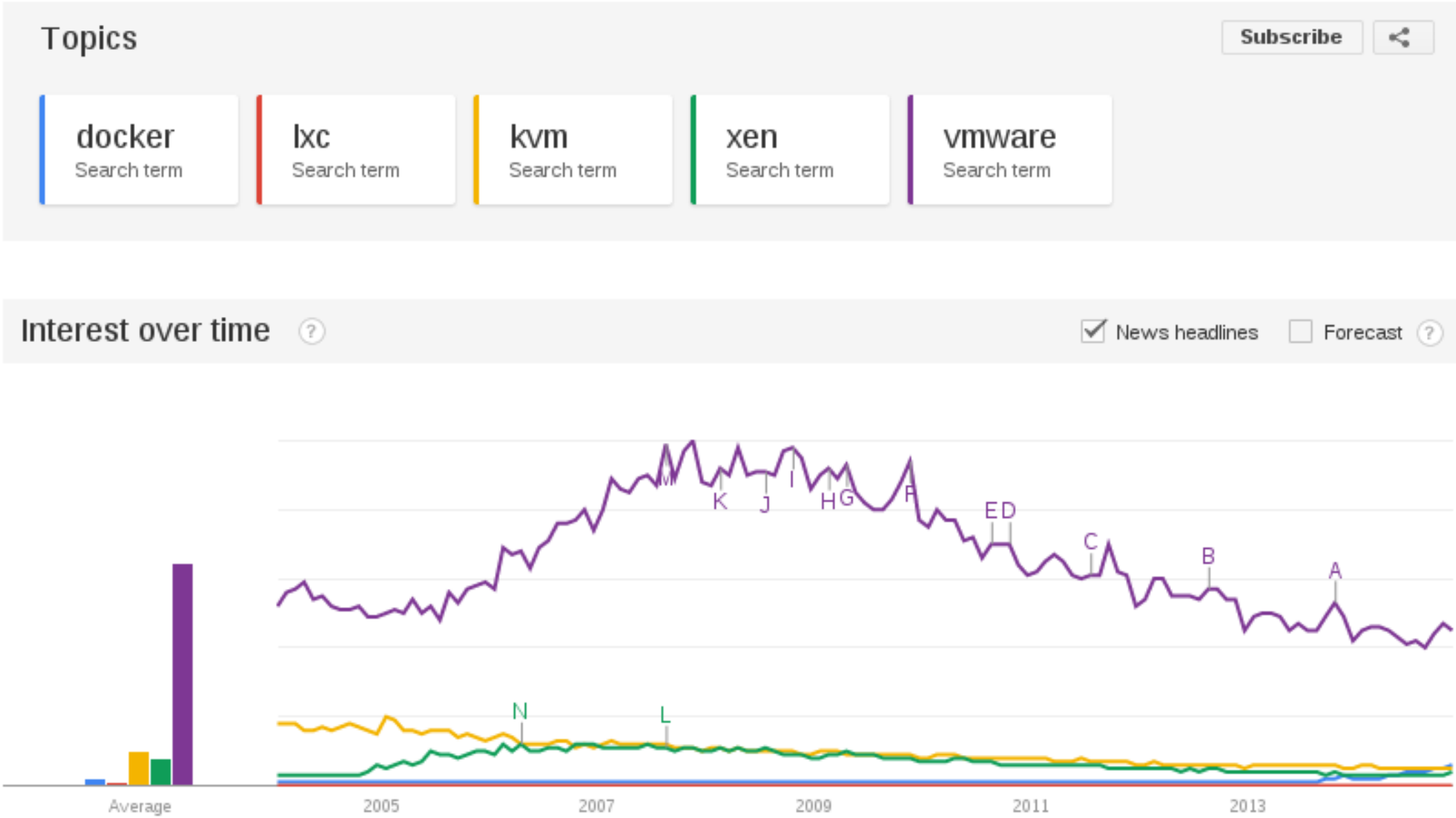
Docker – history

- 2013-01: dotCloud worked on own PaaS (Python based)
- 2013-03: Docker went public (AUFS, LXC)
- middle 2013: Red Hat joined, devmapper, SELinux
- late 2013: removed LXC, rewritten in Go
- 2014-02: stable 1.0

Docker – popularity



Docker – popularity



Orchestration at scale w/Docker

Orchestration at scale w/Docker

This might be a little problem

Orchestration at scale w/Docker

Orchestration at scale w/Docker

	Big Data	Cloud Platform	IaaS	Data Center OS	Docker OS	Docker Mgmt.	PaaS	Orch. Config Mgmt.
Ansible & Docker								x
Amazon EC2 & Docker		x						
Apache Brooklyn & Docker								x
Apache Hadoop & Docker	x							
Apache Storm & Docker	x							
AppScale & Docker							x	
Atomic Hosts & Docker					x			
Chef & Docker								x
Clocker & Docker								x
Cloud Foundry & Docker	x						x	
CloudStack & Docker			x					
CoreOS & Docker					x			
Deis & Docker							x	
Decker & Docker							x	
Docker & Docker			x		x	x	x	x
Dokku & Docker							x	
Eucalyptus & Docker			x					
Flynn & Docker							x	
Google Compute Platform & Docker		x						
IBM Bluemix & Docker	x						x	
Kubernetes & Docker			x			x	x	x
Mesos, Mesosphere & Docker	x			x		x	x	x
Microsoft Azure & Docker		x						
OpenCamp & Docker		x	x			x	x	
OpenShift & Docker							x	
OpenStack & Docker			x					
Panamax & Docker						x		
Puppet & Docker								x
SaltStack & Docker							x	x
Shipyard & Docker						x		
Stackato & Docker							x	
Tsuru & Docker							x	
VMware & Docker			x					

http://www.cloudssky.com/en/blog/Docker-Is-Not-Enough

To Paas or not to PaaS?

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- you think PaaS will solve your problems?

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- so is operating your apps tough enough to move?
- private PaaS or not?
- Rainbow and Unicorn Piss:

  http://blog.lusis.org/blog/2014/06/14/paas-for-realists/

To Paas or not to PaaS?

- flynn.io
  - Open source PaaS (Go)
  - Uses Docker to manage containers
  - Ops should be a product team, not consultants
  - under development
  - Git push deployment
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Don't forget maestro-ng!
https://github.com/signalfuse/maestro-ng

To Paas or not to PaaS?

Remember, that PaaS might fail; plan & test for disaster !

Docker & CLI

```
$ docker run -t -i fedora /bin/bash
> yum -y update
> yum -y install nginx
$ docker commit 73fa45674fd docent/fedora
```

Docker & CLI

Or via Dockerfile:

```
$ docker build -t fedora –rm .
$ docker run --name=nginx fedora
```

FIG

- http://www.fig.sh
- for single host env

FIG

- http://www.fig.sh
- for single host env

```
FROM python:2.7
ENV PYTHONUNBUFFERED 1
RUN mkdir /code
WORKDIR /code
ADD requirements.txt /code/
RUN pip install -r requirements.txt
ADD . /code/
```

FIG

```
db:
  image: postgres
web:
  build: .
  command: python manage.py
runserver 0.0.0.0:8000
  volumes:
    - /srv/app/code:/code
  ports:
    - "8000:8000"
  links:
    - db
```

FIG

```
$ fig run web django-admin.py startproject figexample .
$ fig up
```

Management during runtime?

```
$ fig run web python manage.py syncdb
```

Docker & Ansible

Ansible + Docker

&

Docker + Ansible

Docker & Ansible

Ansible docker core module:
http://docs.ansible.com/docker_module.html

```
- hosts: web
  sudo: yes
  tasks:
  - name: run tomcat servers
    docker: >
          image=centos
          command="service tomcat6 start"
          ports=8080
          count=5
          memory_limit=128MB
          link=mysql
          expose=8080
          registry=...
          volume=...
```

Docker & Ansible

Building image with Ansible:

```
FROM ansible/centos7-ansible:stable
ADD ansible /srv/example/
WORKDIR /srv/example
RUN ansible-playbook web.yml -c local
EXPOSE 80
ENTRYPOINT ["/usr/sbin/nginx", "-DFOREGROUND"]
```

Docker & Ansible

Building image with Ansible:

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FROM ansible/centos7-ansible:stable
ADD ansible /srv/example/
WORKDIR /srv/example
RUN ansible-playbook web.yml -c local
EXPOSE 80
ENTRYPOINT ["/usr/sbin/nginx", "-DFOREGROUND"]
```

```
ansible/web.yml:
- hosts: localhost
tasks:
- yum: pkg=nginx state=latest
- copy:
      src: web.conf
      dest: /etc/nginx/conf.d/web.conf
      group: "nginx"
      mode: "0644"
```

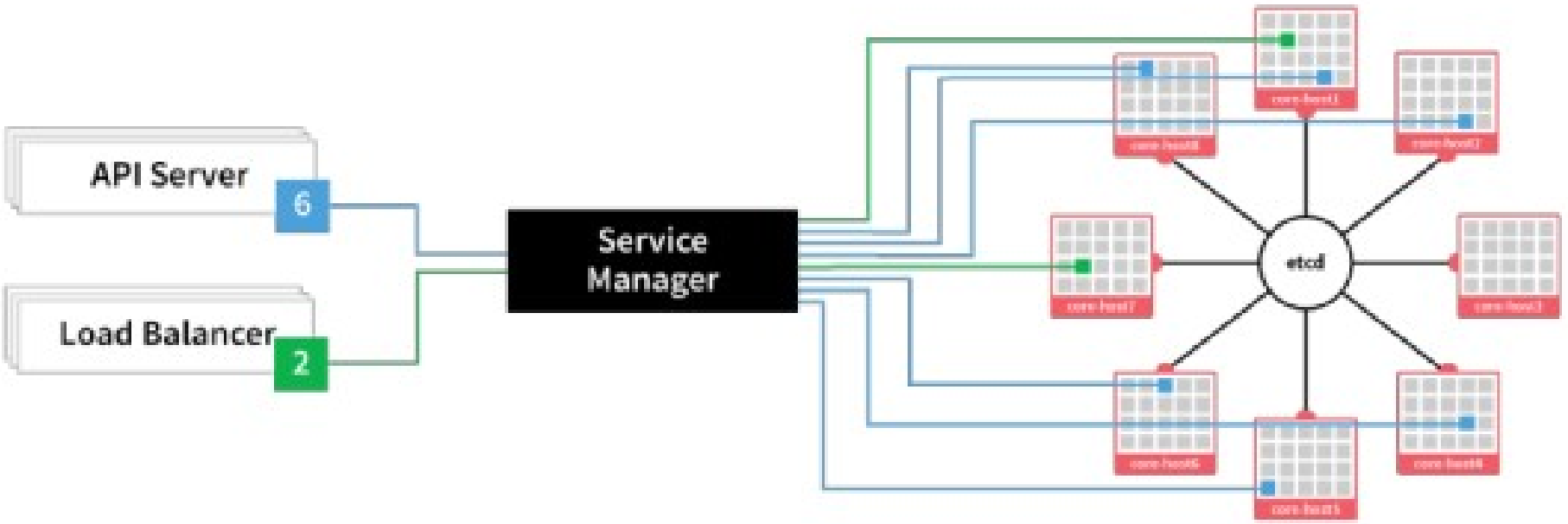
CoreOS

- Designed for massive server deployments
- Support Docker container out of the box
- Available on Linux, Mac, and Windows
- It's a Chrome OS fork
- Consists of couple of components:
  - SystemD – not just a init system ;)
  - Fleet – cluster level manager & scheduler
  - etcd – light & distributed key / value store
  - Docker – the only packaging method in CoreOS

CoreOS

CoreOS

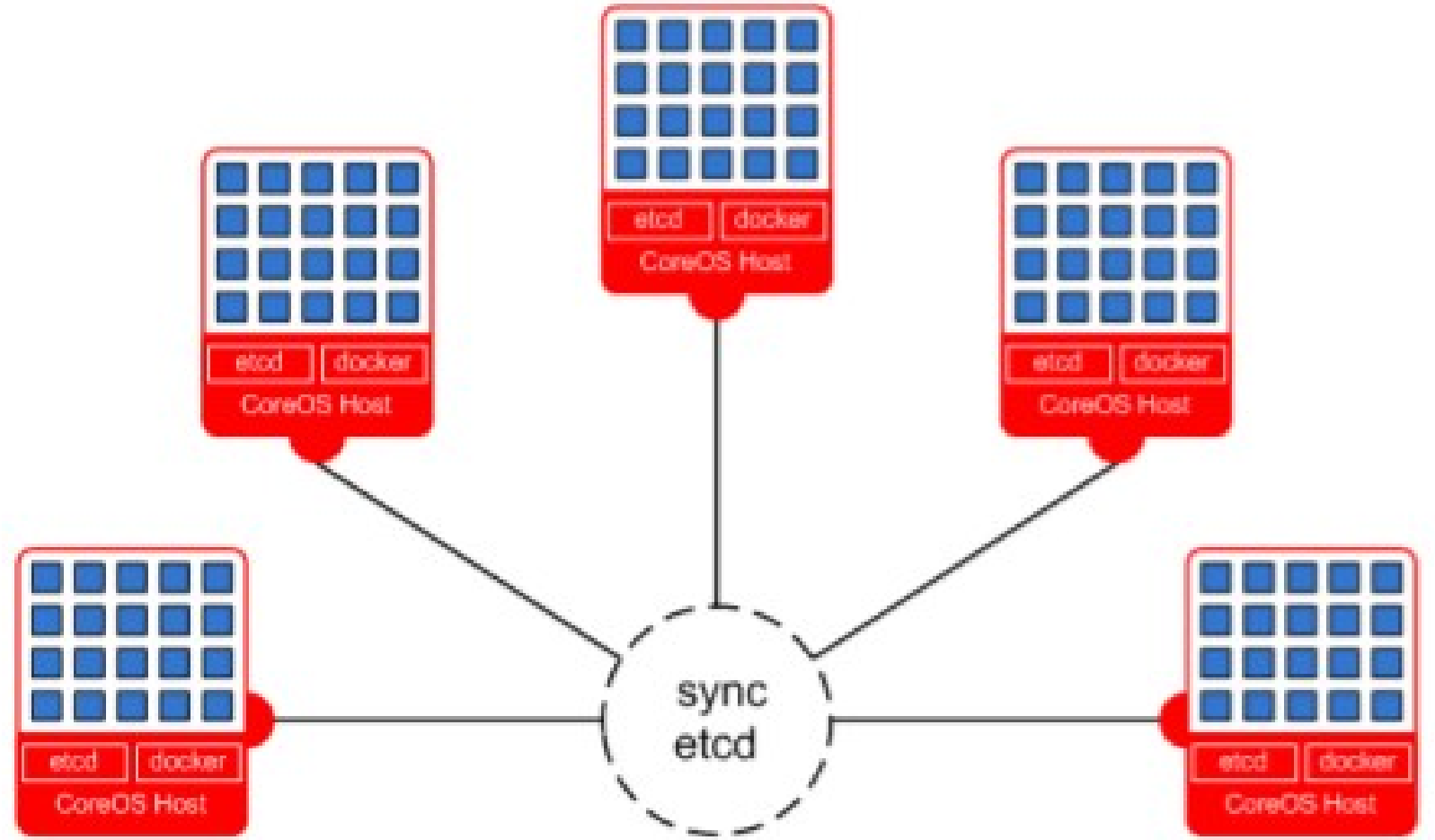
Fleet – cluster level manager & scheduler



https://coreos.com/using-coreos/clustering/

CoreOS

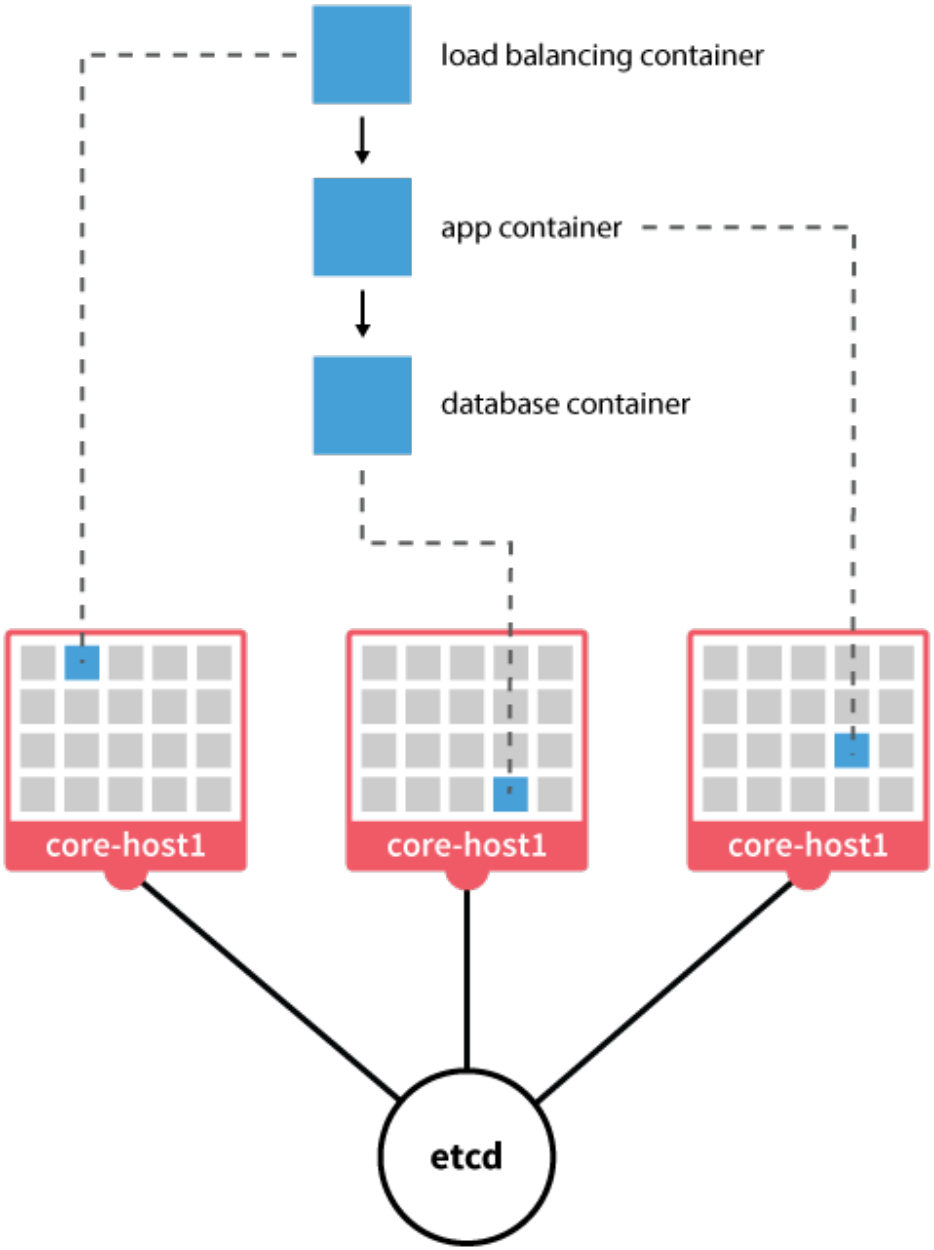
etcd – light & distributed key / value store
(used for configuration store)



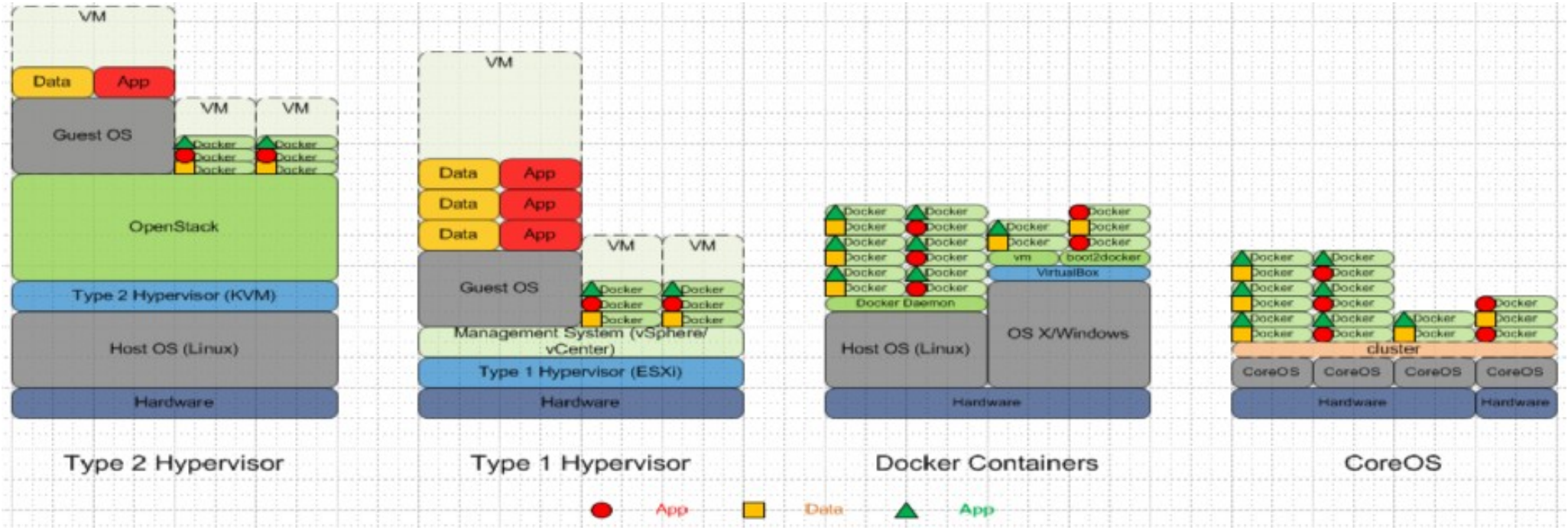
https://coreos.com/docs/#cluster-management

CoreOS

Docker – the only packaging method in CoreOS



CoreOS


VM
Data
App
Guest OS
VM
VM
Docker
OpenStack
Type 2 Hypervisor (KVM)
Host OS (Linux)
Hardware
Type 2 Hypervisor
Management System (vSphere/ vCenter)
Type 1 Hypervisor (ESXi)
Type 1 Hypervisor
Docker Daemon
vm
boot2docker
VirtualBox
OS X/Windows
Docker Containers
cluster
CoreOS
App
Data
App

CoreOS

Cluster management with Fleet & SystemD

```
[Unit]
Description=My Service
After=docker.service

[Service]
TimeoutStartSec=0
ExecStartPre=-/usr/bin/docker kill hello
ExecStartPre=-/usr/bin/docker rm hello
ExecStartPre=/usr/bin/docker pull busybox
ExecStart=/usr/bin/docker run --name hello busybox /bin/sh -c
                                "while true; do echo Hello World; sleep 1; done"
ExecStop=/usr/bin/docker stop hello
```

CoreOS

Cluster management with Fleet & SystemD

```
$ fleetctl load hello.service
Unit hello.service loaded on 8145ebb7.../10.10.1.3
$ fleetctl start hello.service
Unit hello.service launched on 8145ebb7.../10.10.1.3

$ fleetctl list-machines
MACHINE                                 IP          METADATA
148a18ff-6e95-4cd8-92da-c9de9bb90d5a    10.10.1.1   -
491586a6-508f-4583-a71d-bfc4d146e996    10.10.1.2   -
c9de9451-6a6f-1d80-b7e6-46e996bfc4d1    10.10.1.3   -

$ fleetctl list-units
UNIT            MACHINE                     ACTIVE    SUB
hello.service   c9de9451.../10.10.1.3   active    running
```

CoreOS

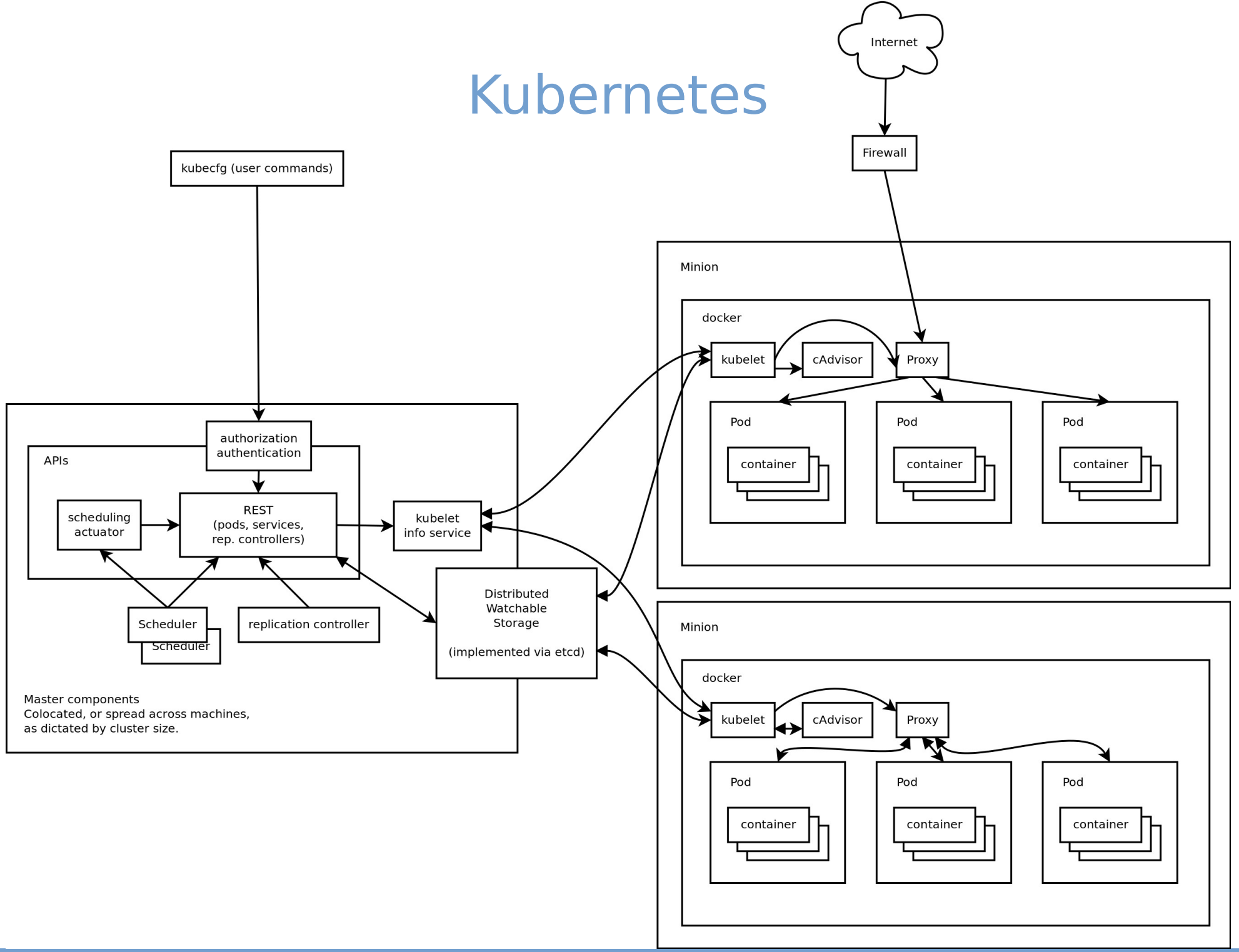
- scheduler
- HA
- dependencies

https://coreos.com/docs/launching-containers/launching/launching-containers-fleet/

Kubernetes

- https://github.com/GoogleCloudPlatform/kubernetes
- Advanced cluster manager (more than 1k hosts is a fit)
- Architecture:
    - master
    - minion
    - pod
    - replication controller
    - label

Kubernetes


Internet
Firewall
kubecfg (user commands)
Minion
docker
kubelet
cAdvisor
Proxy
Pod
container
Pod
container
Pod
container
authorization
authentication
APIs
scheduling
actuator
REST
(pods, services,
rep. controllers)
kubelet
info service
Scheduler
Scheduler
replication controller
Distributed
Watchable
Storage
(implemented via etcd)
Master components
Colocated, or spread across machines,
as dictated by cluster size.
Minion
docker
kubelet
cAdvisor
Proxy
Pod
container
Pod
container
Pod
container

Kubernetes

SmartStack

- automated service discovery and registration framework
- ideal for SOA architectures
- ideal for continuous integration & delivery
- solves “works on my machine” problem

SmartStack

- automated service discovery and registration framework
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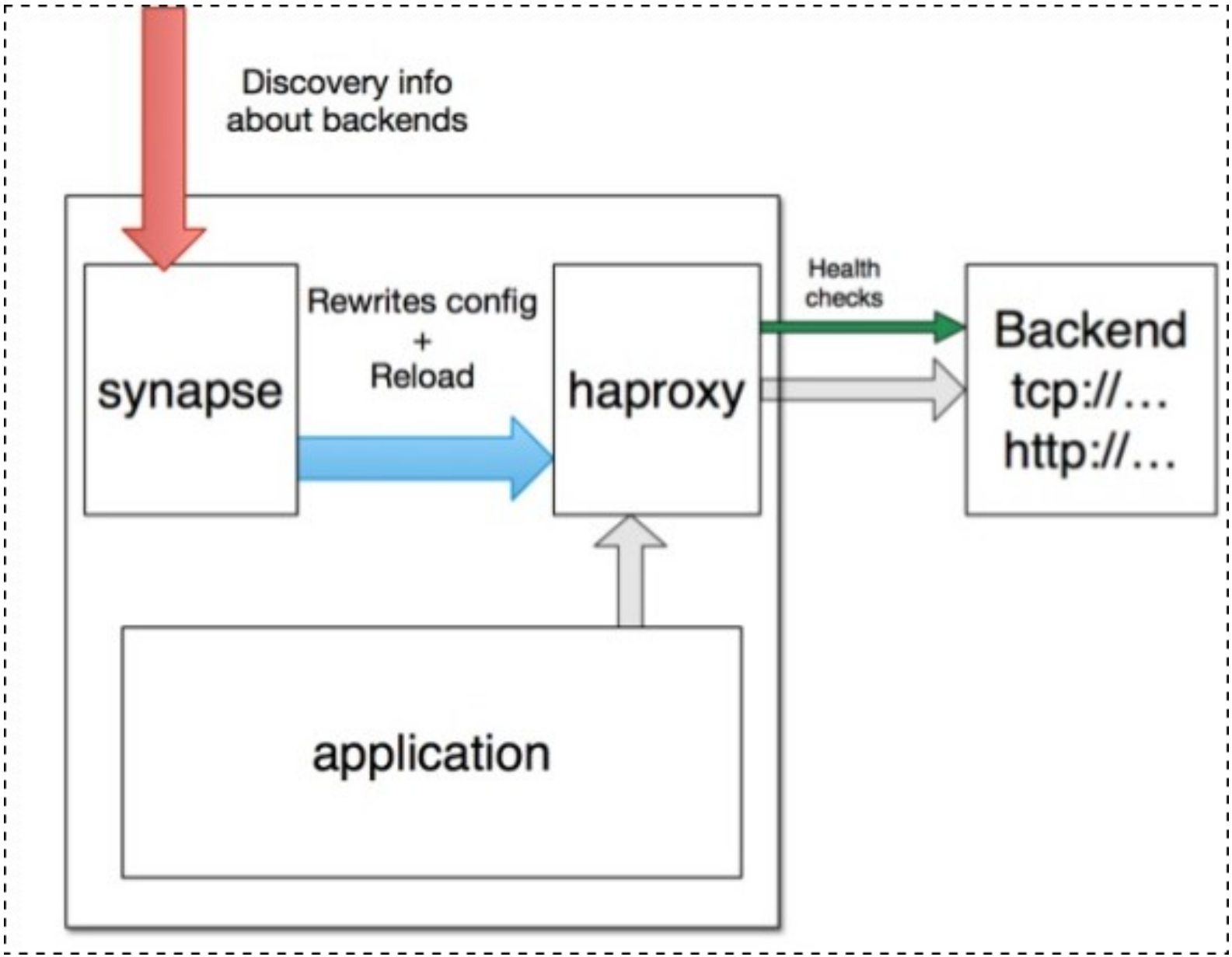
haproxy + nerve + synapse + zookeper = smartstack

SmartStack

Synapse
- discovery service (via zookeeper or etcd)
- installed on every node
- writes haproxy configuration
- application doesn't have to be aware of this
- works same on bare / VM / docker
- https://github.com/airbnb/nerve

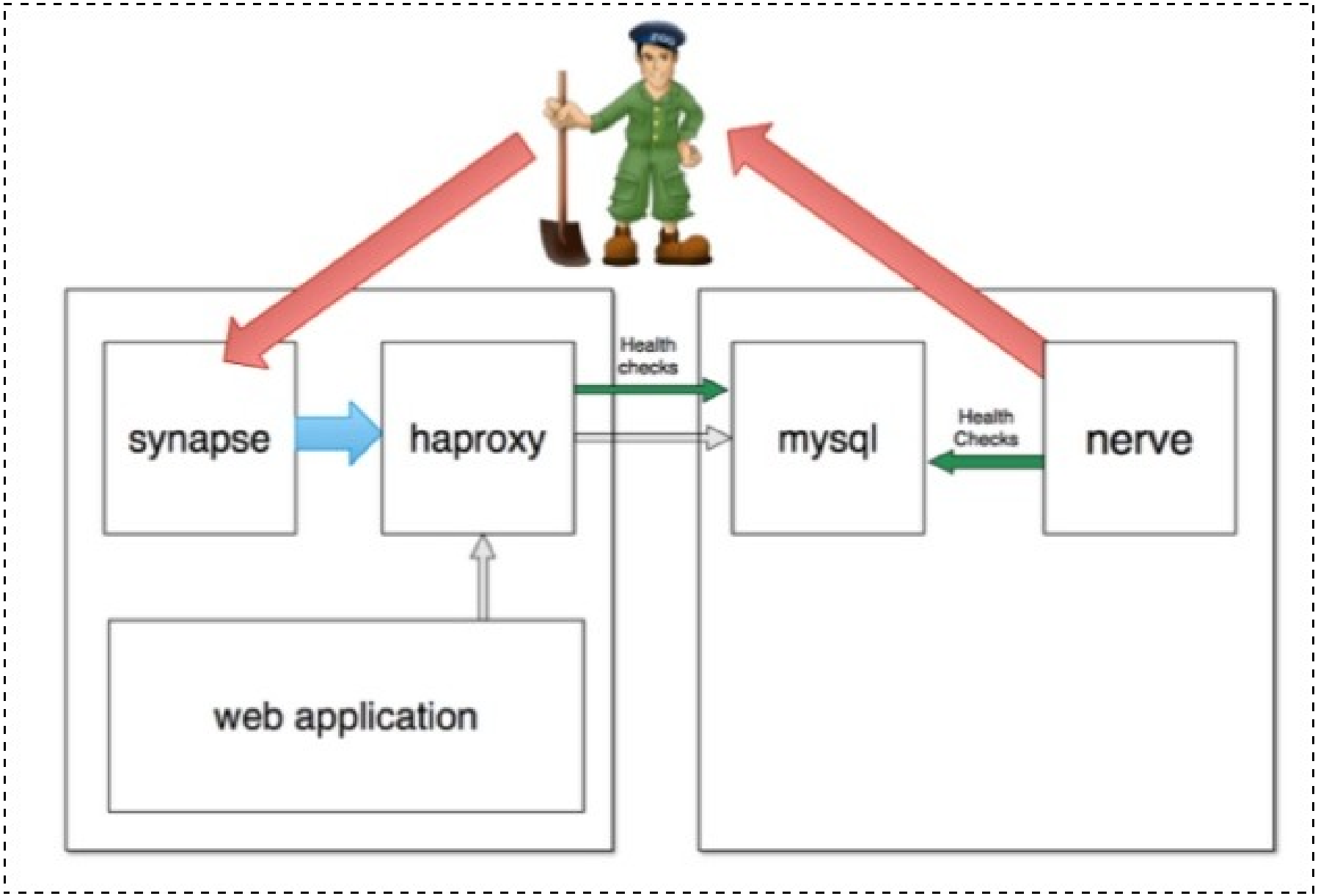
SmartStack


Discovery info
about backends
synapse
Rewrites config
+
Reload
haproxy
Health
checks
Backend
tcp://...
http://...
application

SmartStack

Nerve
- health checks (pluggable)
- register service info to zookeper (or etcd)
- https://github.com/airbnb/synapse

SmartStack


synapse
haproxy
Health checks
mysql
Health Checks
nerve
web application

SmartStack

Smartstack + Docker = <3

Summary

Summary

w/ Docker Sky is the limit!

Freenode #docker
Krk DevOPS meetups (http://www.meetup.com/Krakow-DevOps/)
https://github.com/docker/docker

sources?

- docker.io documentation
- dockerbook.com
- slideshare!
- zounds of blogposts (urls provided)
- and some experience ;)

Thank you :)

Orchestrating Docker containers at scale

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