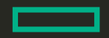
Container Orchestration: Which Conductor?

ContainerCon Europe, Berlin, Oct 2016



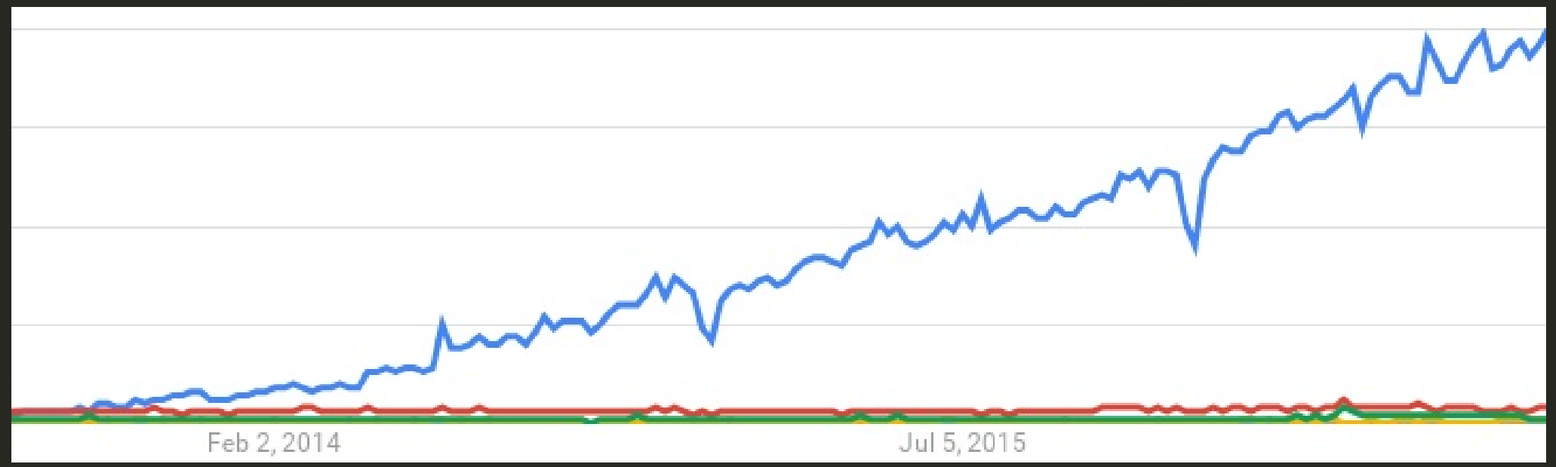
Mike Bright, @mjbright

Haikel Guemar, @hguemar

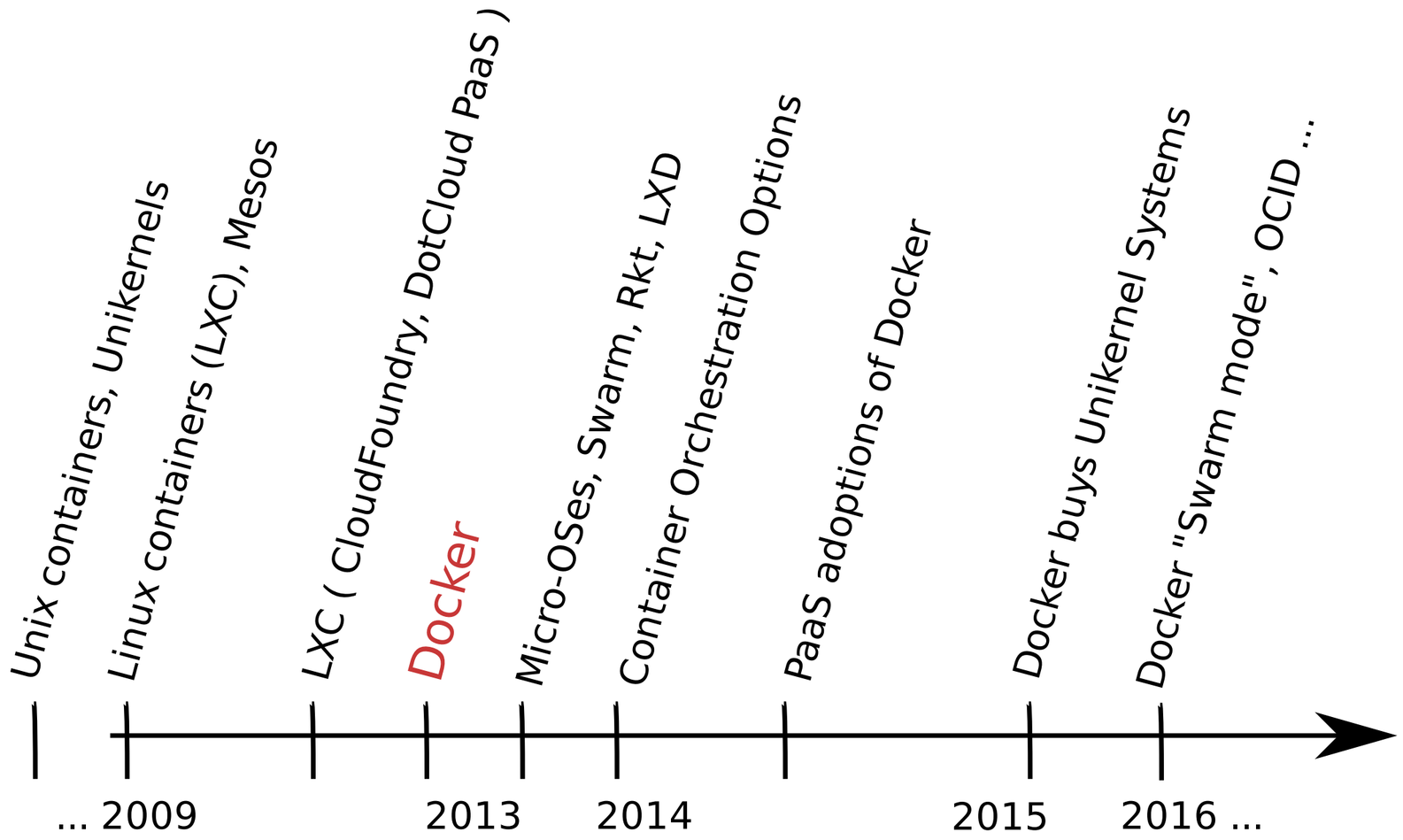
Mario Loriedo, @mariolet

First ...

A little bit of history



So let's first look at recent container history …



History

µ-OSes

Many vendors are developing µ-OSes, small OS (mainly Linux-based) to be the basis for container engine hosts whether they be bare-metal or virtual **host machines**.

They're small, with fast startup, use few resources and have a small attack surface and often *"atomic"* software updates.

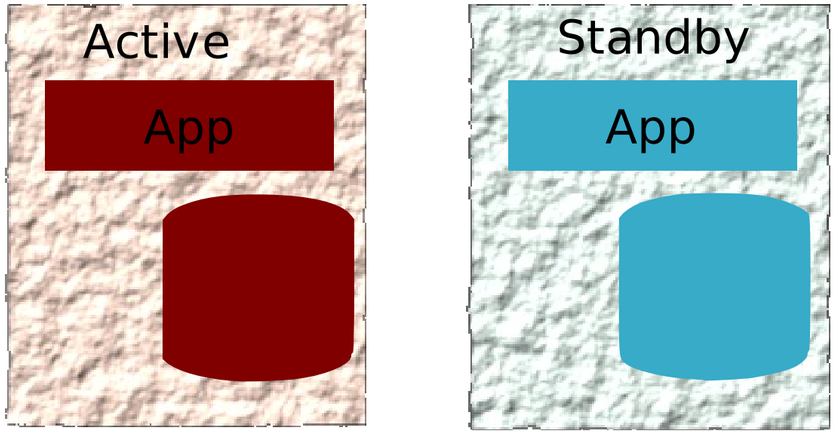
OS	**Vendor**
CoreOS	- (CoreOS)
Project Atomic	- (RedHat)
RancherOS	- (Rancher Labs)
Photon	- (VMWare)
Nano Server OS	- (Microsoft)
Ubuntu Snappy Core	- (Canonical)

…Unikernels

µ-Services

From monoliths to µ-services

Remember when **high availability** meant this …?



Servers running **monolithic applications** in **Active-Standby** modes, as 1+1, N+1, or N+M or split across 3 tiers.

Scaling meant to **"scale up"** by adding CPU, RAM, disk. But there's a limit to this … then you have to **"scale out"**

μ-services

From monoliths to μ-services

Then came μ-services ..

As the industry moved to virtualized micro-services this allowed to obtain greater efficiencies (higher utilisation of resources) and the redesign of applications allows to scale out and achieve high availability.

Containers facilitate this move, allowing faster scaling and even greater efficiencies with less redundancy (no OS to reproduce).

μ-services

How containers help?

Container solutions such as Docker go beyond the isolation capabilities of LXC by providing simple to use tools to enable packaging of apps with their dependencies allowing portable applications between systems.

Containers are lightweight

Versioned images containing all dependancies can be shared

Containers allow to use the same application binaries on development, test and production systems whether that be on a laptop, server or in the cloud.

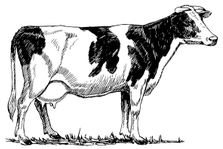
It's a no brainer for developers, who can build and share their own images

µ-services

From monoliths to µ-services

But 1000's of nodes are **unmanageable** … aren't they?

We can't take care of our  ,

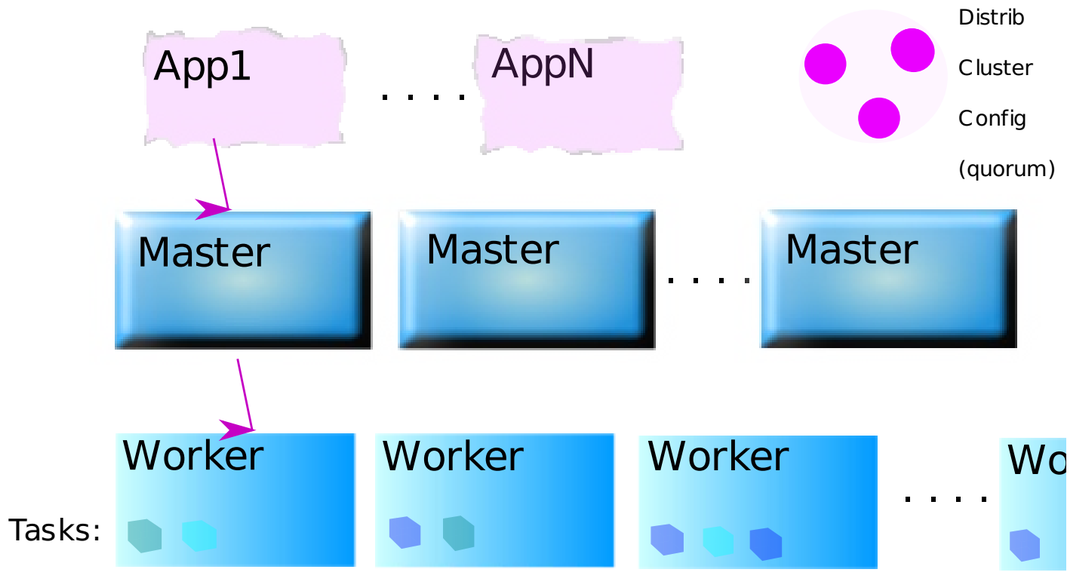
so we have to treat them like 

that's cloud native !

So we need container orchestration

What was Container Orchestration again?

- Architecture - Composition & Stitching
- Workflows & Policies to
  - Scale in/out (maybe automatically)
  - Place workloads for
    - load balancing, fault tolerance, resource optimization
  - Adapt to faults



Getting to *"Desired State"*

To manage 100's, 1000's, 10,000's of nodes we need to express *"desired state"* rather than *"do this"*.

	Imperative	**Declarative**
Tell system	Do this *"start a new node"*	desired state *"3 mysql nodes"*
Intelligence	Operator	Orchestration Engine
Flexibility	Best	Least

It is not longer feasible for an operator to

- know the resources available (e.g. SSD/HDD, GPU, …)
- react to failure, know when to scale …

Choice is great - when you know what you want ...

The Big 3 - Main Orchestration Choices

- Docker Swarm ("Swarm Mode")
- Apache Mesos
- Kubernetes

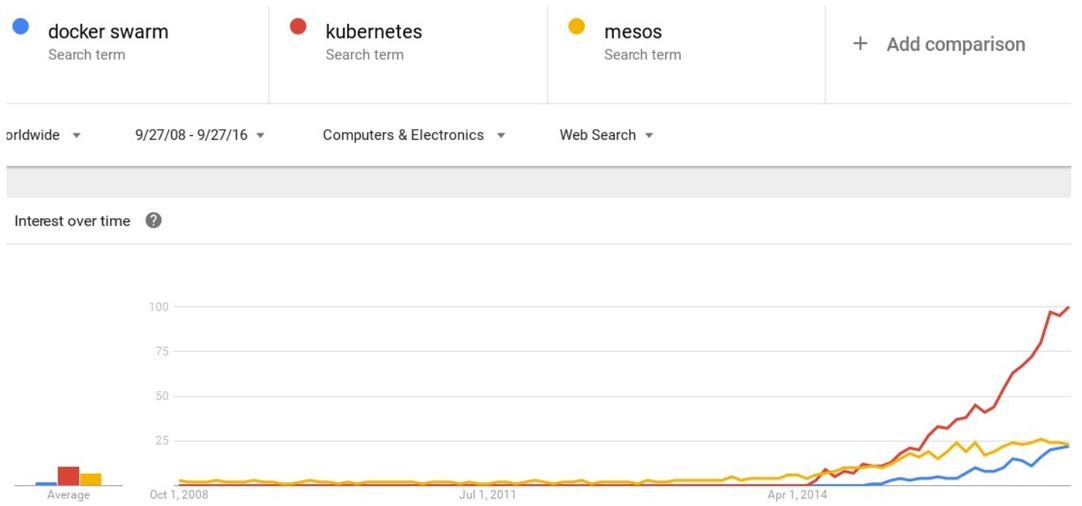
The Big 3 - Main Orchestration Choices

- Docker Swarm ("Swarm Mode")
- Apache Mesos
- Kubernetes

... more Choices ...

- Rancher (Rancher Labs)
- Fleet (CoreOS)
- Nomad (HashiCorp)
- Kontena
- OpenStack Magnum

The Big 3 - What does Google Trends say?



Clearly Kubernetes has a lead in *Google "search trends"*

But we can expect *"Docker Swarm"* to make quick progress thanks to the new *"swarm mode"*

Docker Swarm

Docker Swarm

Dec 2014 … **Docker Swarm** is announced

Orchestration using Docker Compose

Jun 2016 … **Swarm Toolkit** released

OpenSource Orchestration Toolkit

Jun 2016 … **Swarm Mode** announced

Orchestration integrated into Docker Engine

Docker 1.12 is the first release to integrate **"Swarm Mode"** The original *Docker Swarm* is maintained for legacy use.

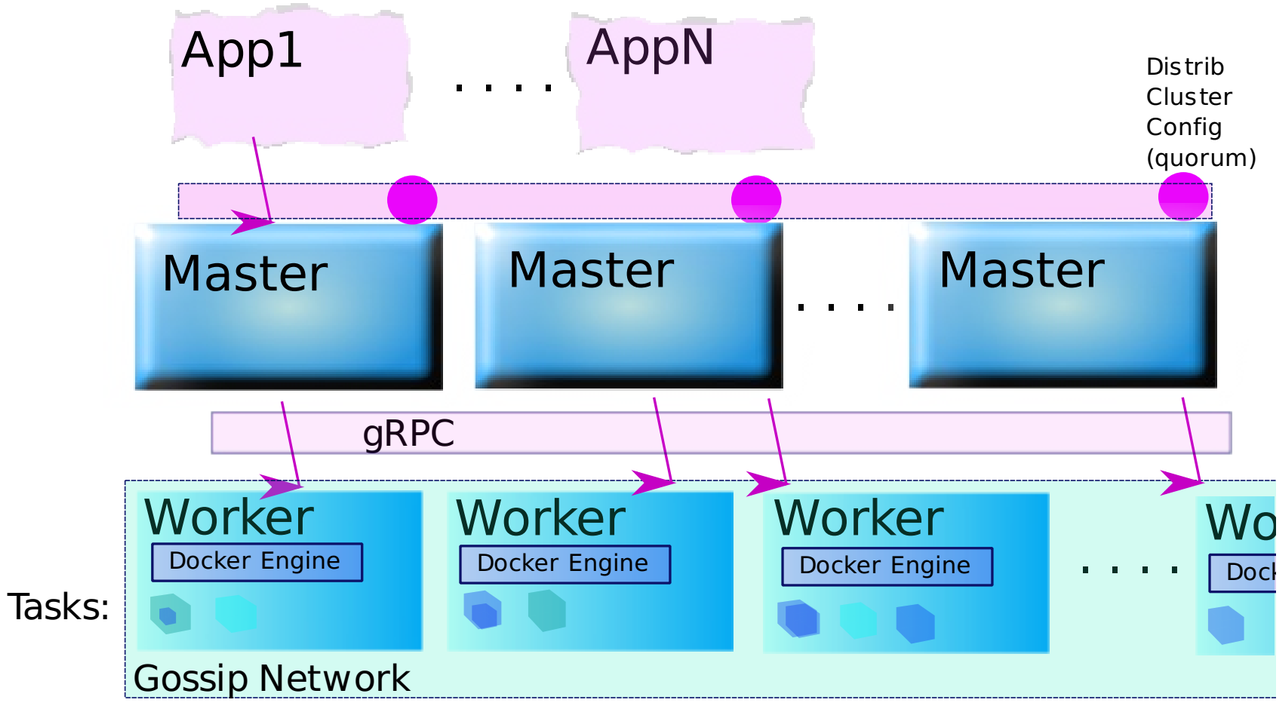
"Swarm Mode" is a revolution bringing:

- Orchestration directly in the Docker Engine
- Advanced networking features
  - mesh network, vxlan
- Load balancing
- Service Discovery
- *Docker* traditional ease of use

docker.com

Architecture

Docker Swarm



Using Docker "Swarm Mode"

Docker Swarm

Create a new swarm by creating the master node:

```
$ docker swarm init --advertise-addr 192.168.2.100
Swarm initialized: current node (dxn1zf6l61qsb1josjja83
```

Join a new Worker node to the swarm:

```
$ docker swarm join --token TOKEN 192.168.2.100:2377
```

Join a new Master node to the swarm:

```
$ docker swarm join-token manager
```

Docker Swarm Demo

Docker Swarm Demo

Docker Swarm

- Creation of a 3 node cluster
- Run a service on the cluster and scale it to 3 replicas
- Make a rolling update of the service
- Drain a node of the cluster

Getting started

Docker Swarm

Bruno Cornecs' Docker 101 Lab
New to Docker? Come to http://sched.co/7oHf

- **Docker 101 Lab, 9am - Friday 7th October**

https://github.com/bcornec/Labs/tree/master/Docker

Followed by ..

Jerome Petazzoni's Orchestration Workshop
or more advanced? Come to http://sched.co/7oHx

- **Orchestrating Containers in Production at Scale with Docker Swarm, Friday 7th October**

https://github.com/jpetazzo/orchestration-workshop

Kubernetes

From the Greek: "Steersman, helmsman, sailing master"

Kubernetes

Google created based on extensive experience running containers internally ~ billions of containers a year

Started Oct 2014, reached v1.0 in July 2015, now at v1.4

Managed by the Cloud Native Computing Foundation
https://cncf.io/

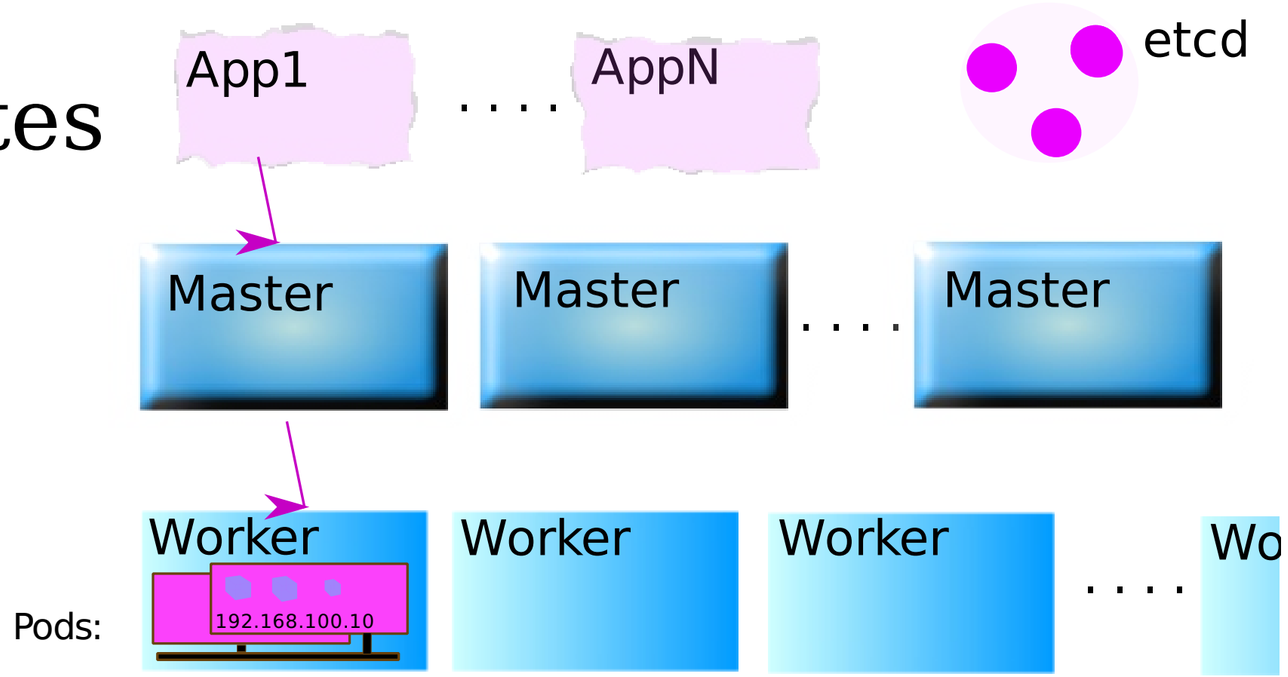
Commercial offerings from CoreOS (Tectonic) and Canonical

Integrated in:

- GKE (Google Container Engine)
- OpenStack above Kubernetes
  - Stackanetes (CoreOS, uses Tectonic)
    - Self healing OpenStack demo
  - Mirantis (OpenStack CI/CD based on Kolla)
- Various PaaS:
  - RedHat OpenShift CP
  - HPE Stackato v.40
  - Deis

Architecture

Kubernetes



Services
Labels, Selectors

Apache Mesos

Apache Mesos

The most proven orchestrator today, exists since 2009.

Can scale to ~ 10,000 nodes.

Used in production by:

- Uber
- Twitter
- Paypal
- Hubspot
- Airbnb
- eBay
- Groupon
- Netflix

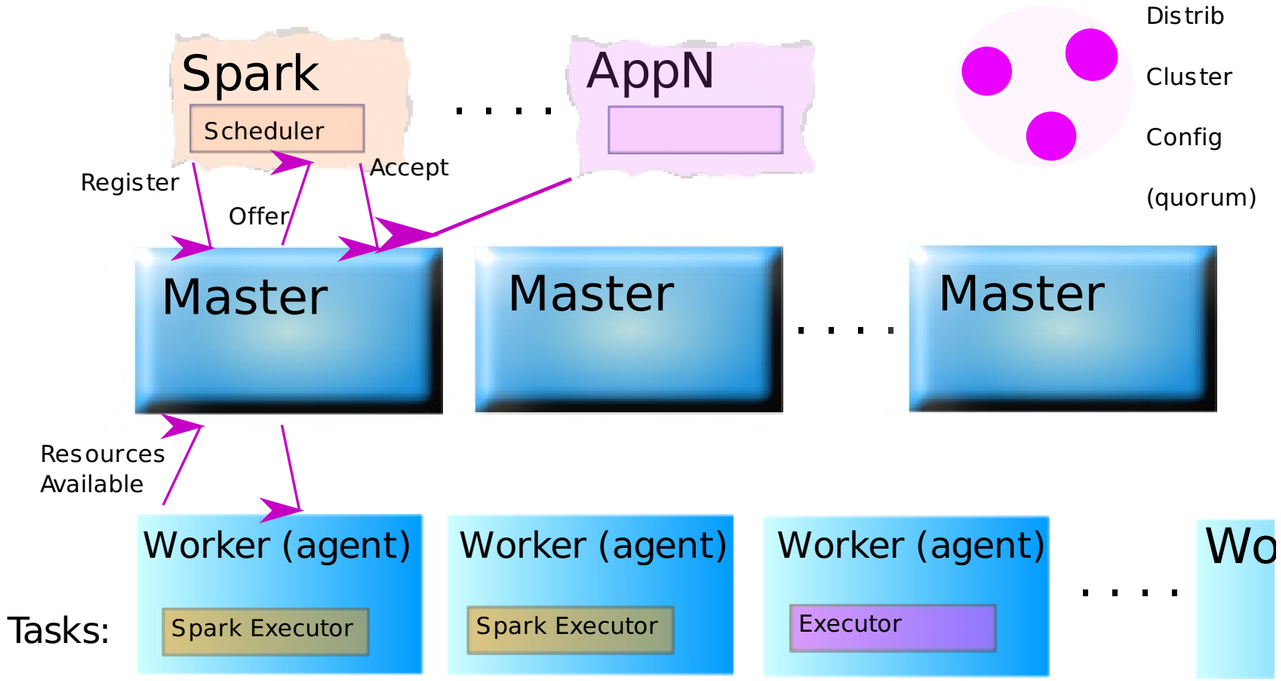
Supports Containerizers to isolate tasks

mesos.apache.org

MESOS

Apache Mesos

Architecture



mesos.apache.org

MESOS

Apache Mesos

Mesos is used in conjunction with Frameworks such as

- For long running tasks:
  - **Marathon** (Mesosphere), Aurora or Singularity
- For job orchestration:
  - Chronos "cron", Jenkins
- For Big Data Processing:
  - Hadoop, Spark, Storm
  - Cassandra, ElasticSearch, …

So isn't it time we told you what to choose?

... let's just compare them ...

What's common

Docker Swarm and Kubernetes are creating rich Orchestration stacks with integrated runtimes.

They're moving incredibly quicky …

They are adding features such as networking capabilities, load balancing, services, labels.

They have a more 'declarative' approach

They support or are looking to support different runtime engines (*)

What advantages?

Docker "Swarm Mode"

Simple to use (despite underlying complexity)

All-in-one container engine plus orchestration

Uses Docker API and familiar docker commands

Advanced networking

- mesh networking
- Load Balancing and Service Discovery

Replication

What advantages of Kubernetes?

Rich conceptual model

Pods as groupings of containers

Labels and Selectors (for all components)

Large ecosystem

Networking

- Load Balancing and Service Discovery

Replication

What advantages? Apache Mesos

Most mature

Battle tested by many service providers

Scales to 10,000 nodes

DataCenter OS - appears as 1 resource

Not just containers

Many frameworks available

Difficult ramp-up

Hands on ...

@hguemar @mjbright @mariolet

Hands-on

Come along

This afternoon's tutorial session led by Mario:
Tuesday, October 4 - 15:30 - 16:20

5 Containers for 5 Languages: Patterns for Software Development Using Containers - Mario Loriedo, Red Hat

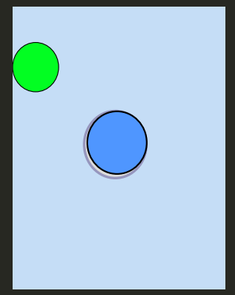
Tomorrow's lab session led by Haikel:
Wednesday, October 5 - 11:00 - 12:50

Container Orchestration Lab: Swarm, Mesos, Kubernetes - Haïkel Guémar, Fedora Project

Lab setup instructions here

- Docker Swarm
- Kubernetes
- Apache Mesos

Questions?
Thank you



@hguemar @mjbright @mariolet

Resources

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Resources

Books

Publisher	Title	Author
OReilly	Docker Cookbook	Sébastien Goasguen
OReilly	Docker Up & Running	Karl Matthias, Sean P. Kane
OReilly	Using Docker	Adrian Mouat
OReilly	[Early Access] Kubernetes Up & Running	Kelsey Hightower
Manning	[MEAP] CoreOS in Action	Matt Bailey
Manning	[MEAP] Kubernetes in Action	Marko Lukša

Resources

Articles/Organisms

Cloud Native Computing Foundation - Kubernetes, Prometheus https://cncf.io/

"Kubernetes the Hard Way, Kelsey Hightower" - https://github.com/kelseyhightower/kubernetes-the-hard-way

"Kubernetes User Guide, Walkthrought" - http://kubernetes.io/docs/user-guide/walkthrough/

Resources

Videos

- June 2016 - Container Orchestration Wars, Karl Isenberg, Mesosphere
- Mar 2016 - Container Orchestration with Kubernetes, Docker Swarm & Mesos-Marathon - Adrian Mouat, Container Solutions
- Jan 2016 - Docker, Kubernetes, and Mesos: Compared.,,Adrian Otto, Southern California Linux Expo

Repos

Documentation

Kubernetes

- **Getting started guides**
  - Creating a Kubernetes Cluster
  - port Kubernetes to a new environment
    - in Getting Started from Scratch
- **User documentation**
  - to run programs on an existing Kubernetes cluster
    - Kubernetes User Guide: Managing Applications
  - the Kubectl Command Line Interface is a detailed reference on the `kubectl` CLI
  - User FAQ

Kubernetes

Documentation - 2

- **Cluster administrator documentation**
  - for people who want to create a Kubernetes cluster and administer it
  - in the Kubernetes Cluster Admin Guide
- **Developer and API documentation**
  - to write programs using the Kubernetes API, write plugins or extensions, or modify core code
  - Kubernetes Developer Guide
  - notes on the API
  - API object documentation, a detailed description of all fields found in the core API objects
- **Walkthroughs and examples**
  - hands-on introduction and example config files
  - in the user guide
  - in the docs/examples directory
- **Contributions from the Kubernetes community**
  - in the docs/contrib directory

Documentation 3

Kubernetes

- **Design documentation and design proposals**
  - to understand the design of Kubernetes, and feature proposals
  - Kubernetes Design Overview and the docs/design director y
  - docs/proposals directory
- **Wiki/FAQ**
  - the wiki
  - troubleshooting guide

Community, discussion, contribution, and support

Consider joining the Cloud Native Computing Foundation. For details ab out who's involved and how Kubernetes plays a role, read their announcement.