FROM MONOLITH TO DOCKER DISTRIBUTED APPLICATIONS

Carlos Sanchez

@csanchez csanchez.org

cloudbees®

DOP 2016 DEVOPS PRO MOSCOW

ABOUT ME

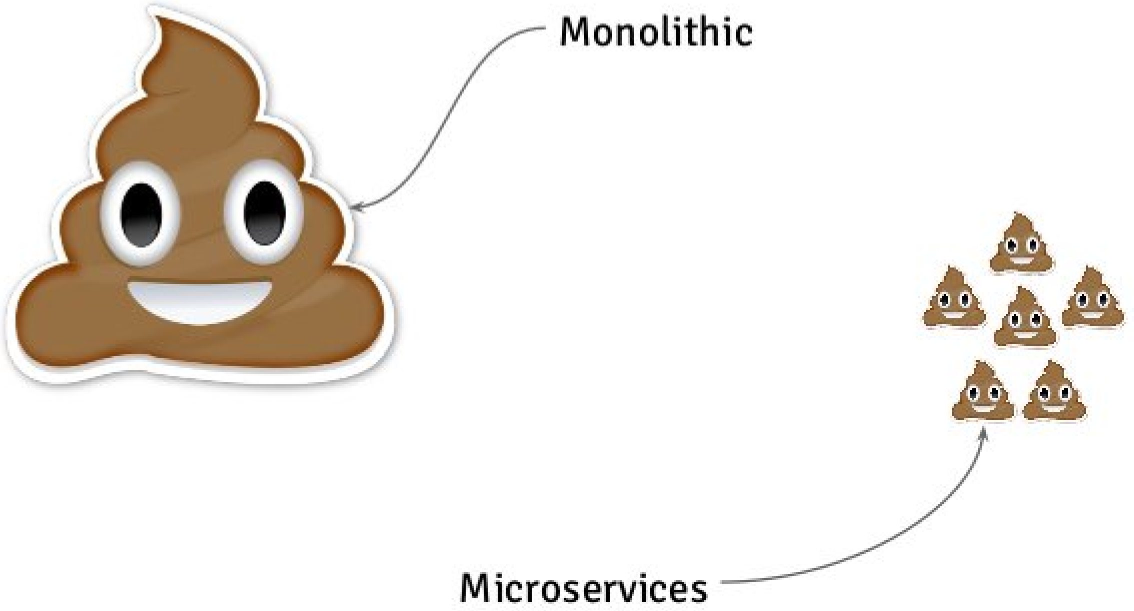
Senior Software Engineer @ CloudBees

Author of Jenkins Kubernetes plugin

Long time OSS contributor at Apache Maven, Eclipse, Puppet,…

DOCKER DOCKER DOCKER

Monolithic vs Microservices



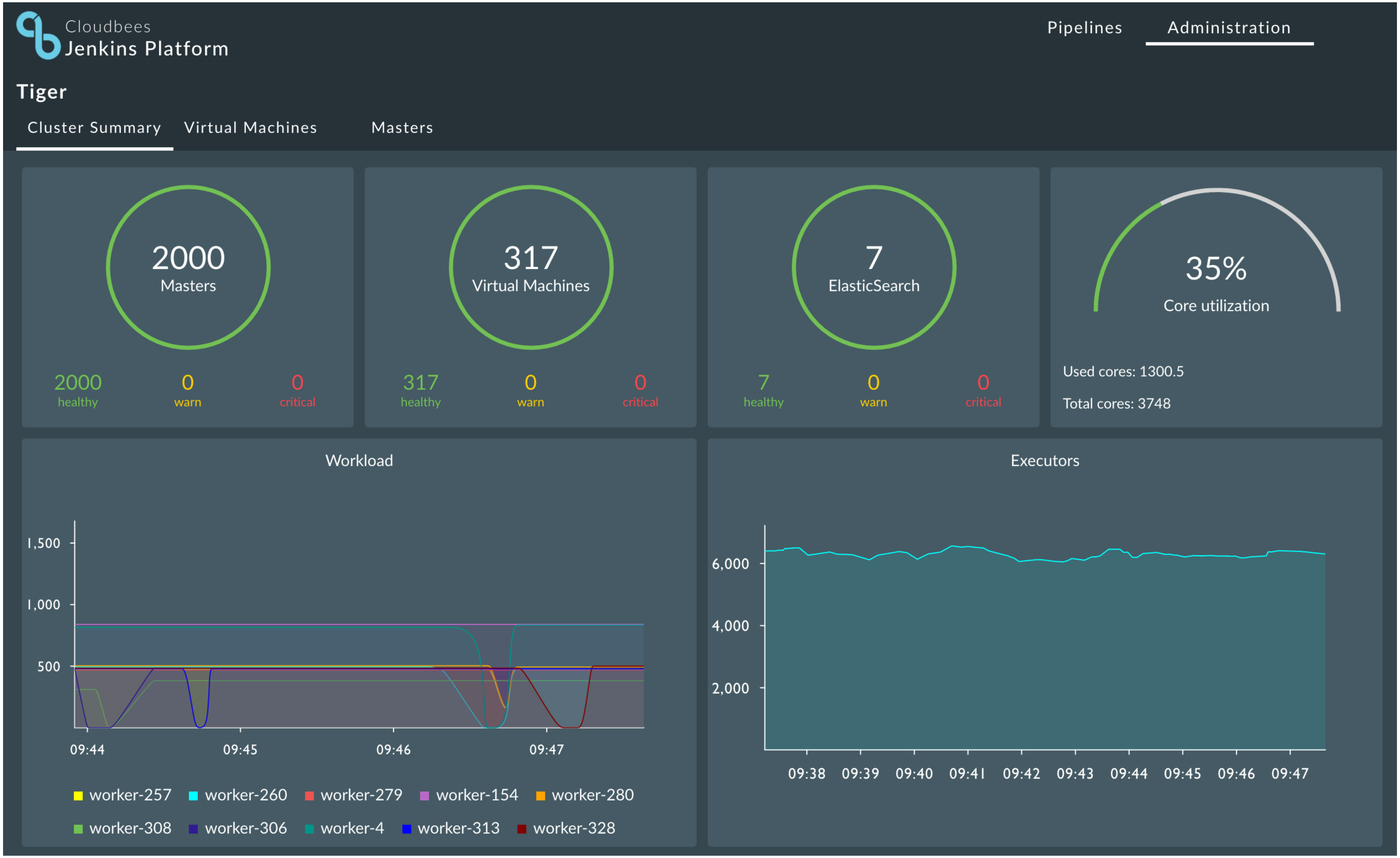
Monolithic

Microservices

OUR USE CASE

Scaling Jenkins

Your mileage may vary



Cloudbees
Jenkins Platform

Pipelines   Administration

Tiger

Cluster Summary   Virtual Machines   Masters

2000
Masters

2000 healthy   0 warn   0 critical

317
Virtual Machines

317 healthy   0 warn   0 critical

7
ElasticSearch

7 healthy   0 warn   0 critical

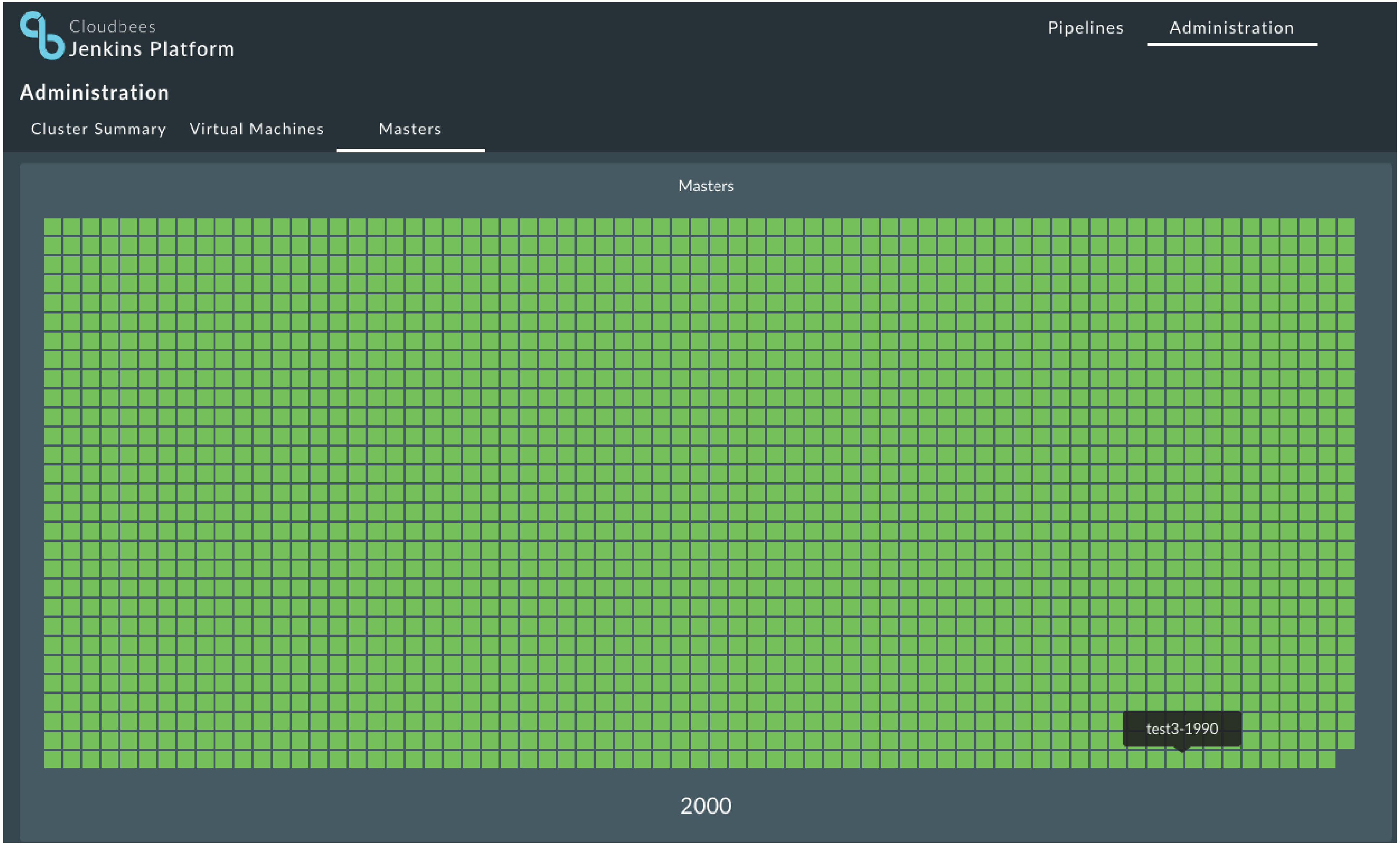
35%
Core utilization

Used cores: 1300.5

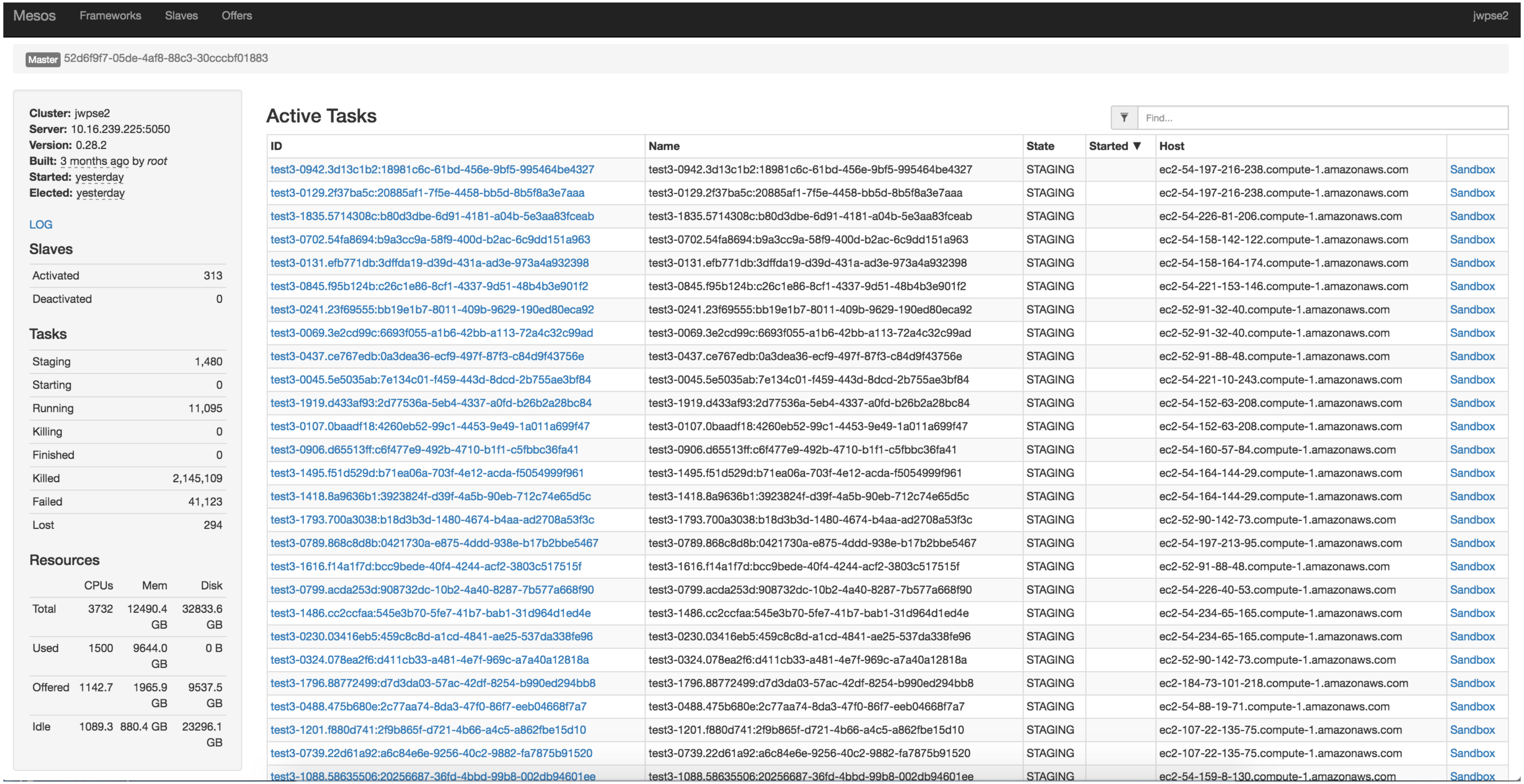
Total cores: 3748

Workload

Executors



Cloudbees
Jenkins Platform
Pipelines
Administration
Administration
Cluster Summary
Virtual Machines
Masters
Masters
test3-1990
2000



Master 52d6f9f7-05de-4af8-88c3-30cccbf01883

Cluster: jwpse2
Server: 10.16.239.225:5050
Version: 0.28.2
Built: 3 months ago by *root*
Started: yesterday
Elected: yesterday

LOG

Slaves

Activated	313
Deactivated	0

Tasks

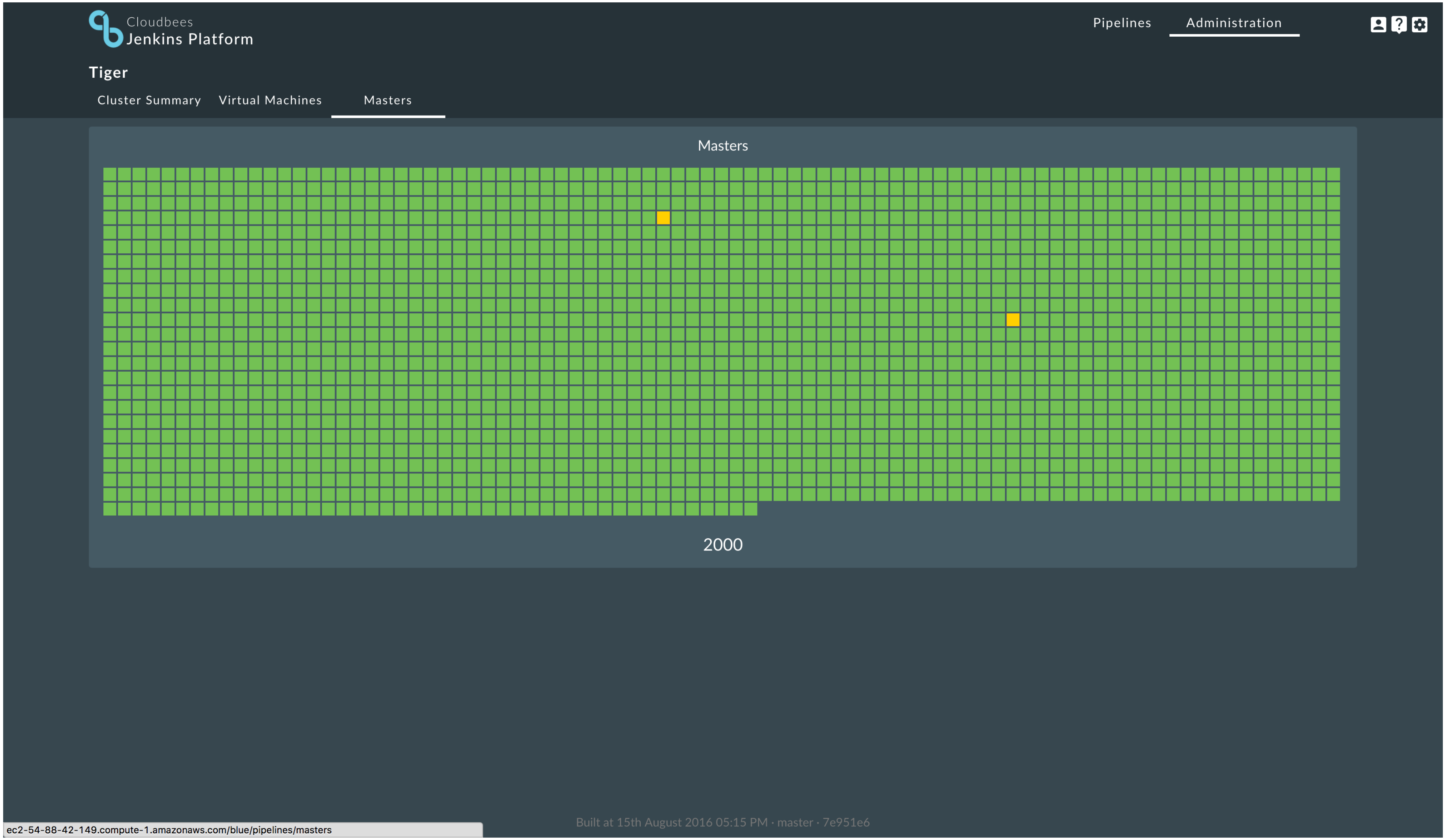
Staging	1,480
Starting	0
Running	11,095
Killing	0
Finished	0
Killed	2,145,109
Failed	41,123
Lost	294

Resources

	CPUs	Mem	Disk
Total	3732	12490.4 GB	32833.6 GB
Used	1500	9644.0 GB	0 B
Offered	1142.7	1965.9 GB	9537.5 GB
Idle	1089.3	880.4 GB	23296.1 GB

Active Tasks

ID	Name	State	Started ▼	Host	
test3-0942.3d13c1b2:18981c6c-61bd-456e-9bf5-995464be4327	test3-0942.3d13c1b2:18981c6c-61bd-456e-9bf5-995464be4327	STAGING		ec2-54-197-216-238.compute-1.amazonaws.com	Sandbox
test3-0129.2f37ba5c:20885af1-7f5e-4458-bb5d-8b5f8a3e7aaa	test3-0129.2f37ba5c:20885af1-7f5e-4458-bb5d-8b5f8a3e7aaa	STAGING		ec2-54-197-216-238.compute-1.amazonaws.com	Sandbox
test3-1835.5714308c:b80d3dbe-6d91-4181-a04b-5e3aa83fceab	test3-1835.5714308c:b80d3dbe-6d91-4181-a04b-5e3aa83fceab	STAGING		ec2-54-226-81-206.compute-1.amazonaws.com	Sandbox
test3-0702.54fa8694:b9a3cc9a-58f9-400d-b2ac-6c9dd151a963	test3-0702.54fa8694:b9a3cc9a-58f9-400d-b2ac-6c9dd151a963	STAGING		ec2-54-158-142-122.compute-1.amazonaws.com	Sandbox
test3-0131.efb771db:3dffda19-d39d-431a-ad3e-973a4a932398	test3-0131.efb771db:3dffda19-d39d-431a-ad3e-973a4a932398	STAGING		ec2-54-158-164-174.compute-1.amazonaws.com	Sandbox
test3-0845.f95b124b:c26c1e86-8cf1-4337-9d51-48b4b3e901f2	test3-0845.f95b124b:c26c1e86-8cf1-4337-9d51-48b4b3e901f2	STAGING		ec2-54-221-153-146.compute-1.amazonaws.com	Sandbox
test3-0241.23f69555:bb19e1b7-8011-409b-9629-190ed80eca92	test3-0241.23f69555:bb19e1b7-8011-409b-9629-190ed80eca92	STAGING		ec2-52-91-32-40.compute-1.amazonaws.com	Sandbox
test3-0069.3e2cd99c:6693f055-a1b6-42bb-a113-72a4c32c99ad	test3-0069.3e2cd99c:6693f055-a1b6-42bb-a113-72a4c32c99ad	STAGING		ec2-52-91-32-40.compute-1.amazonaws.com	Sandbox
test3-0437.ce767edb:0a3dea36-ecf9-497f-87f3-c84d9f43756e	test3-0437.ce767edb:0a3dea36-ecf9-497f-87f3-c84d9f43756e	STAGING		ec2-52-91-88-48.compute-1.amazonaws.com	Sandbox
test3-0045.5e5035ab:7e134c01-f459-443d-8dcd-2b755ae3bf84	test3-0045.5e5035ab:7e134c01-f459-443d-8dcd-2b755ae3bf84	STAGING		ec2-54-221-10-243.compute-1.amazonaws.com	Sandbox
test3-1919.d433af93:2d77536a-5eb4-4337-a0fd-b26b2a28bc84	test3-1919.d433af93:2d77536a-5eb4-4337-a0fd-b26b2a28bc84	STAGING		ec2-54-152-63-208.compute-1.amazonaws.com	Sandbox
test3-0107.0baadf18:4260eb52-99c1-4453-9e49-1a011a699f47	test3-0107.0baadf18:4260eb52-99c1-4453-9e49-1a011a699f47	STAGING		ec2-54-152-63-208.compute-1.amazonaws.com	Sandbox
test3-0906.d65513ff:c6f477e9-492b-4710-b1f1-c5fbbc36fa41	test3-0906.d65513ff:c6f477e9-492b-4710-b1f1-c5fbbc36fa41	STAGING		ec2-54-160-57-84.compute-1.amazonaws.com	Sandbox
test3-1495.f51d529d:b71ea06a-703f-4e12-acda-f5054999f961	test3-1495.f51d529d:b71ea06a-703f-4e12-acda-f5054999f961	STAGING		ec2-54-164-144-29.compute-1.amazonaws.com	Sandbox
test3-1418.8a9636b1:3923824f-d39f-4a5b-90eb-712c74e65d5c	test3-1418.8a9636b1:3923824f-d39f-4a5b-90eb-712c74e65d5c	STAGING		ec2-54-164-144-29.compute-1.amazonaws.com	Sandbox
test3-1793.700a3038:b18d3b3d-1480-4674-b4aa-ad2708a53f3c	test3-1793.700a3038:b18d3b3d-1480-4674-b4aa-ad2708a53f3c	STAGING		ec2-52-90-142-73.compute-1.amazonaws.com	Sandbox
test3-0789.868c8d8b:0421730a-e875-4ddd-938e-b17b2bbe5467	test3-0789.868c8d8b:0421730a-e875-4ddd-938e-b17b2bbe5467	STAGING		ec2-54-197-213-95.compute-1.amazonaws.com	Sandbox
test3-1616.f14a1f7d:bcc9bede-40f4-4244-acf2-3803c517515f	test3-1616.f14a1f7d:bcc9bede-40f4-4244-acf2-3803c517515f	STAGING		ec2-52-91-88-48.compute-1.amazonaws.com	Sandbox
test3-0799.acda253d:908732dc-10b2-4a40-8287-7b577a668f90	test3-0799.acda253d:908732dc-10b2-4a40-8287-7b577a668f90	STAGING		ec2-54-226-40-53.compute-1.amazonaws.com	Sandbox
test3-1486.cc2ccfaa:545e3b70-5fe7-41b7-bab1-31d964d1ed4e	test3-1486.cc2ccfaa:545e3b70-5fe7-41b7-bab1-31d964d1ed4e	STAGING		ec2-54-234-65-165.compute-1.amazonaws.com	Sandbox
test3-0230.03416eb5:459c8c8d-a1cd-4841-ae25-537da338fe96	test3-0230.03416eb5:459c8c8d-a1cd-4841-ae25-537da338fe96	STAGING		ec2-54-234-65-165.compute-1.amazonaws.com	Sandbox
test3-0324.078ea2f6:d411cb33-a481-4e7f-969c-a7a40a12818a	test3-0324.078ea2f6:d411cb33-a481-4e7f-969c-a7a40a12818a	STAGING		ec2-52-90-142-73.compute-1.amazonaws.com	Sandbox
test3-1796.88772499:d7d3da03-57ac-42df-8254-b990ed294bb8	test3-1796.88772499:d7d3da03-57ac-42df-8254-b990ed294bb8	STAGING		ec2-184-73-101-218.compute-1.amazonaws.com	Sandbox
test3-0488.475b680e:2c77aa74-8da3-47f0-86f7-eeb04668f7a7	test3-0488.475b680e:2c77aa74-8da3-47f0-86f7-eeb04668f7a7	STAGING		ec2-54-88-19-71.compute-1.amazonaws.com	Sandbox
test3-1201.f880d741:2f9b865f-d721-4b66-a4c5-a862fbe15d10	test3-1201.f880d741:2f9b865f-d721-4b66-a4c5-a862fbe15d10	STAGING		ec2-107-22-135-75.compute-1.amazonaws.com	Sandbox
test3-0739.22d61a92:a6c84e6e-9256-40c2-9882-fa7875b91520	test3-0739.22d61a92:a6c84e6e-9256-40c2-9882-fa7875b91520	STAGING		ec2-107-22-135-75.compute-1.amazonaws.com	Sandbox
test3-1088.58635506:20256687-36fd-4bbd-99b8-002db94601ee	test3-1088.58635506:20256687-36fd-4bbd-99b8-002db94601ee	STAGING		ec2-54-159-8-130.compute-1.amazonaws.com	Sandbox



Masters

2000

Built at 15th August 2016 05:15 PM · master · 7e951e6

ec2-54-88-42-149.compute-1.amazonaws.com/blue/pipelines/masters

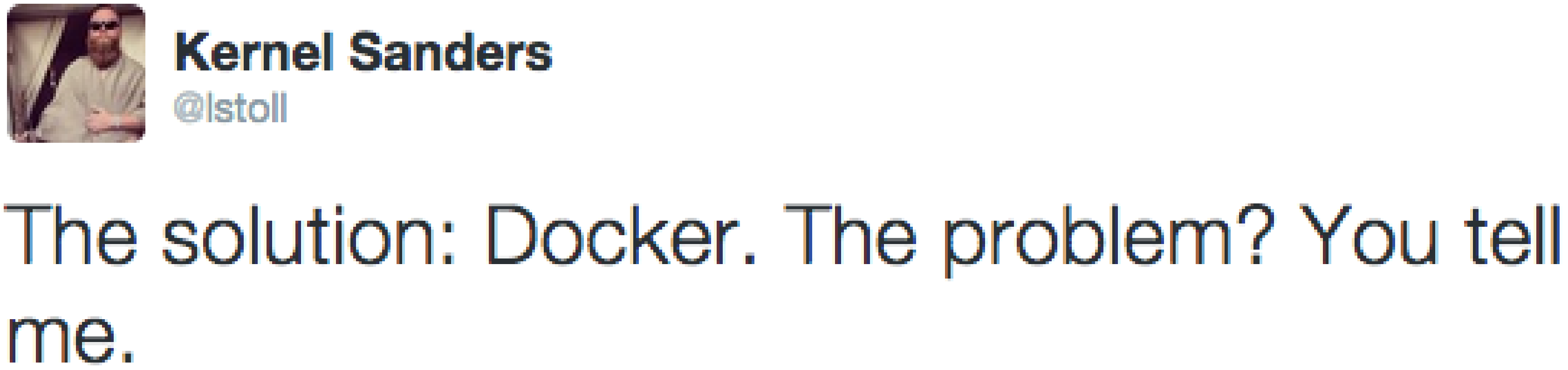
A 2000 JENKINS MASTERS CLUSTER

- 3 Mesos masters (m3.xlarge: 4 vCPU, 15GB, 2x40 SSD)
- 317 Mesos slaves (c3.2xlarge, m3.xlarge, m4.4xlarge)
- 7 Mesos slaves dedicated to ElasticSearch: (c3.8xlarge: 32 vCPU, 60GB)

12.5 TB - 3748 CPU

Running 2000 masters and ~8000 concurrent jobs

ARCHITECTURE



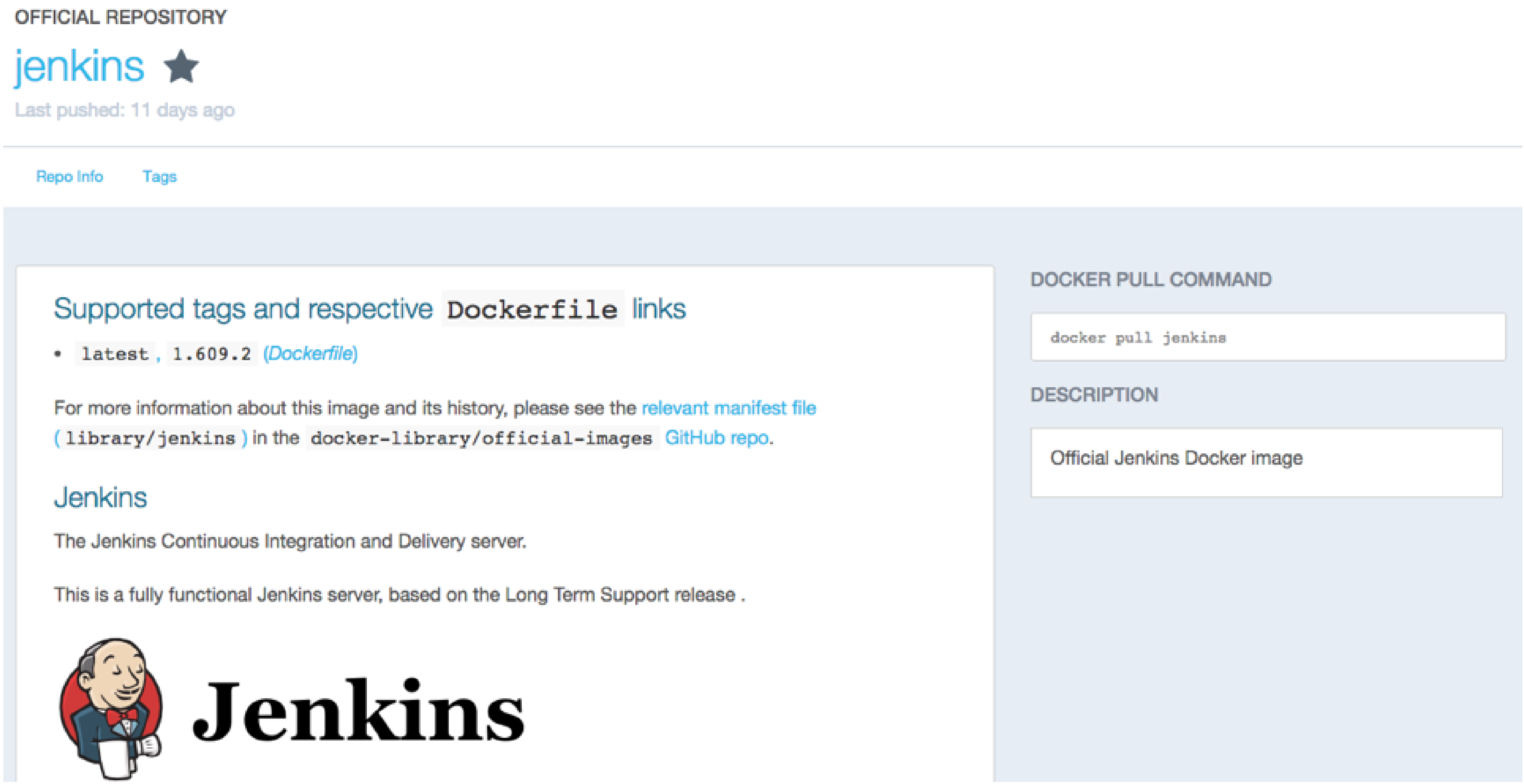
Kernel Sanders
@lstoll

The solution: Docker. The problem? You tell me.

Isolated Jenkins masters

Isolated build agents and jobs

Memory and CPU limits



OFFICIAL REPOSITORY

jenkins ★

Last pushed: 11 days ago

Supported tags and respective `Dockerfile` links

- `latest`, `1.609.2` (*Dockerfile*)

For more information about this image and its history, please see the relevant manifest file (`library/jenkins`) in the `docker-library/official-images` GitHub repo.

Jenkins

The Jenkins Continuous Integration and Delivery server.

This is a fully functional Jenkins server, based on the Long Term Support release .

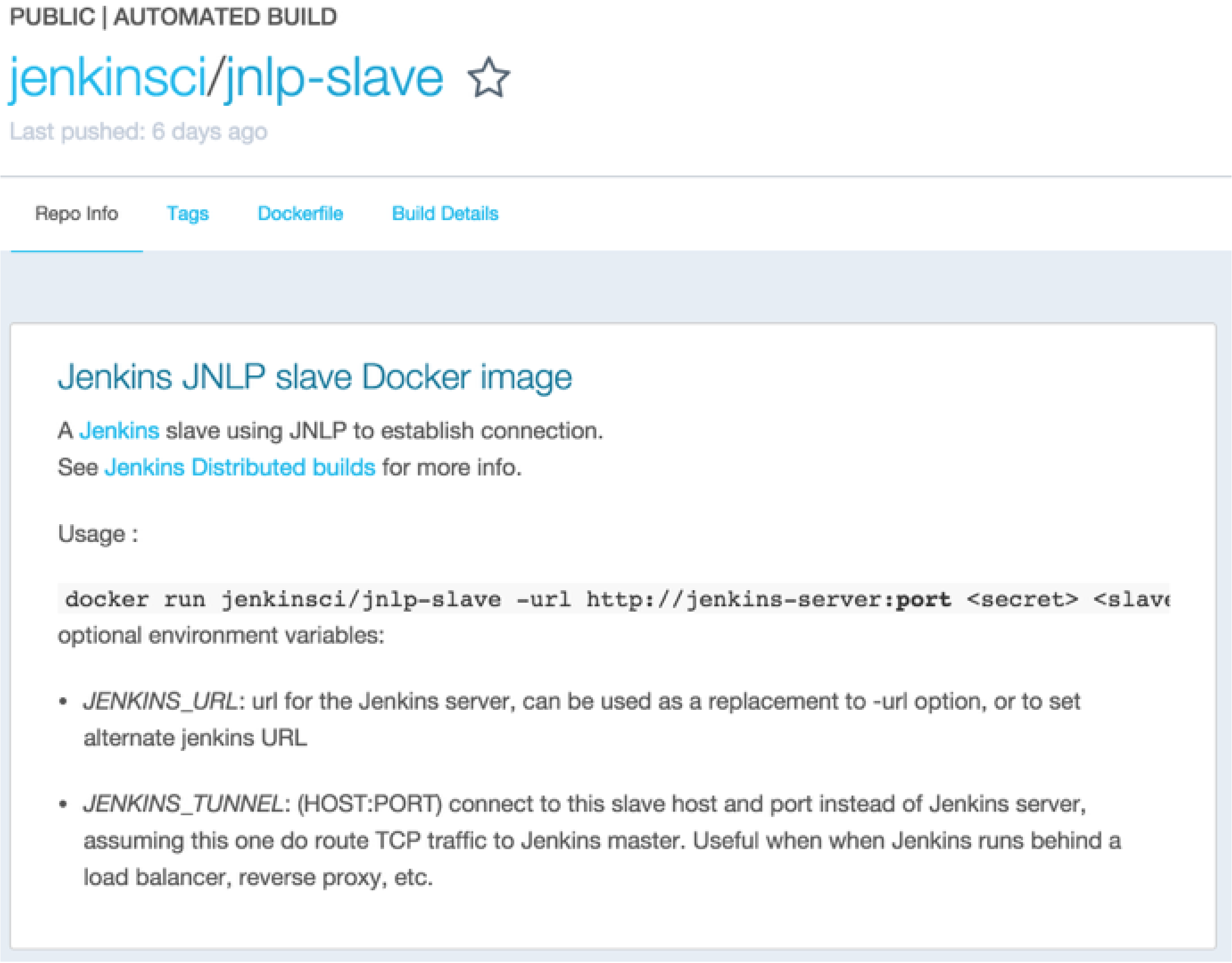
Jenkins

DOCKER PULL COMMAND

```
docker pull jenkins
```

DESCRIPTION

Official Jenkins Docker image



PUBLIC | AUTOMATED BUILD

jenkinsci/jnlp-slave ☆

Last pushed: 6 days ago

Jenkins JNLP slave Docker image

A Jenkins slave using JNLP to establish connection.
See Jenkins Distributed builds for more info.

Usage :

```
docker run jenkinsci/jnlp-slave -url http://jenkins-server:port <secret> <slave
```

optional environment variables:

- *JENKINS_URL*: url for the Jenkins server, can be used as a replacement to -url option, or to set alternate jenkins URL
- *JENKINS_TUNNEL*: (HOST:PORT) connect to this slave host and port instead of Jenkins server, assuming this one do route TCP traffic to Jenkins master. Useful when when Jenkins runs behind a load balancer, reverse proxy, etc.

CLUSTER SCHEDULING

Distribute tasks across a cluster of hosts

Running in public cloud, private cloud, VMs or bare metal

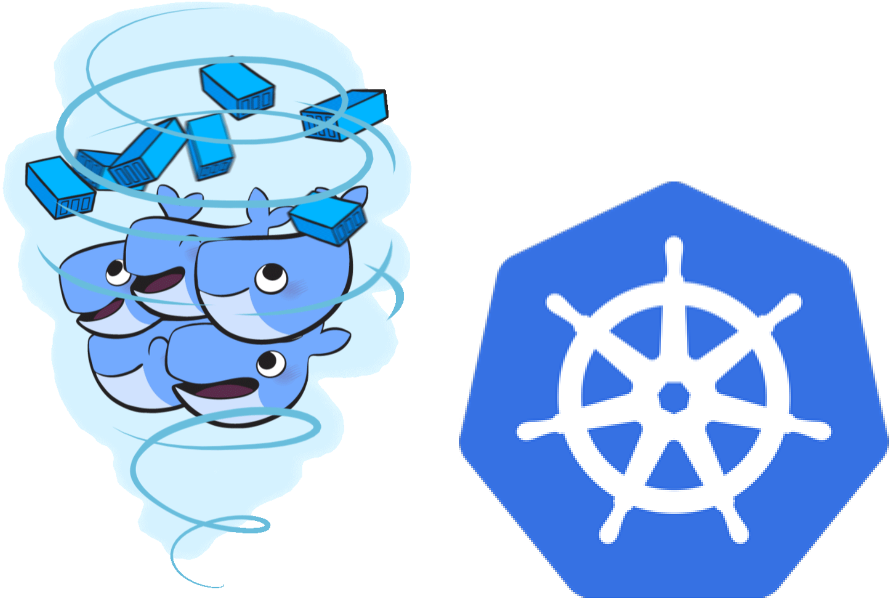
HA and fault tolerant

With Docker support of course

APACHE MESOS

A distributed systems kernel

ALTERNATIVES



Docker Swarm / Kubernetes

MESOSPHERE MARATHON

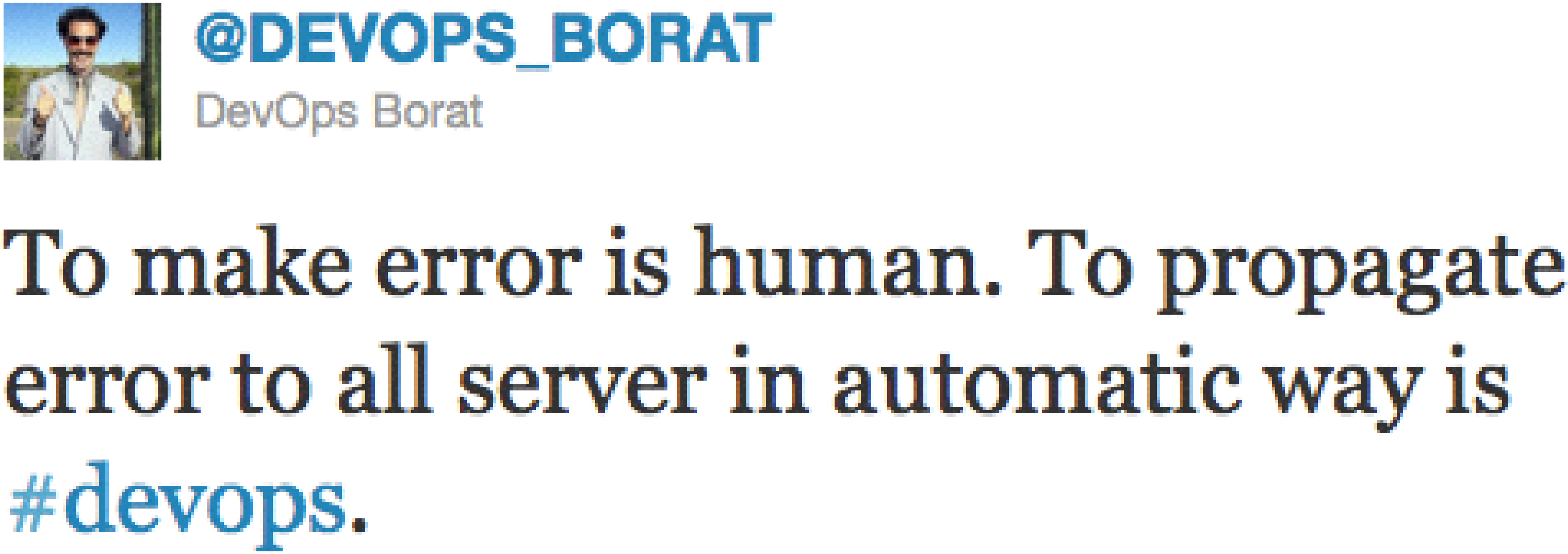
TERRAFORM

TERRAFORM

```
resource "aws_instance" "worker" {
    count = 1
    instance_type = "m3.large"
    ami = "ami-xxxxxx"
    key_name = "tiger-csanchez"
    security_groups = ["sg-61bc8c18"]
    subnet_id = "subnet-xxxxxx"
    associate_public_ip_address = true
    tags {
        Name = "tiger-csanchez-worker-1"
        "cloudbees:pse:cluster" = "tiger-csanchez"
        "cloudbees:pse:type" = "worker"
    }
    root_block_device {
        volume_size = 50
    }
}
```

TERRAFORM

- State is managed
- Runs are idempotent
  - `terraform apply`
- Sometimes it is too automatic
  - Changing image id will restart all instances



@DEVOPS_BORAT

DevOps Borat

To make error is human. To propagate error to all server in automatic way is #devops.

IF YOU HAVEN'T AUTOMATICALLY DESTROYED SOMETHING BY MISTAKE,

YOU ARE NOT AUTOMATING ENOUGH

STORAGE

Handling distributed storage

Servers can start in any host of the cluster

And they can move when they are restarted

DOCKER VOLUME PLUGINS

- Flocker
- GlusterFS
- NFS
- EBS

KUBERNETES

- GCE disks
- Flocker
- GlusterFS
- NFS
- EBS

PERMISSIONS

Containers should not run as root

Container user id != host user id

i.e. `jenkins` user in container is always 1000 but matches `ubuntu` user in host

MEMORY

Scheduler needs to account for container memory requirements and host available memory

Prevent containers for using more memory than allowed

Memory constrains translate to Docker `--memory`

WHAT DO YOU THINK HAPPENS WHEN?

Your container goes over memory quota?

WHAT ABOUT THE JVM?

WHAT ABOUT THE CHILD PROCESSES?

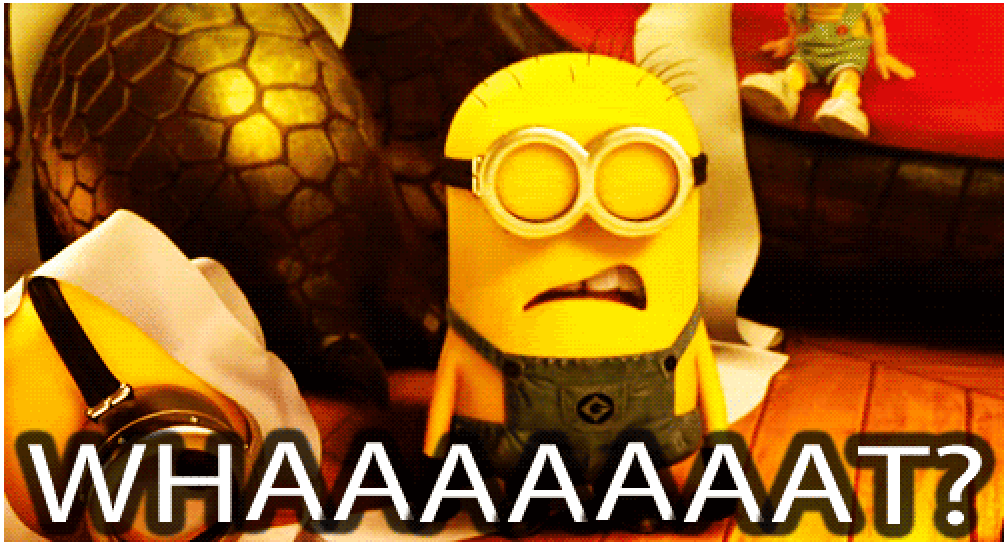
CPU

Scheduler needs to account for container CPU requirements and host available CPUs

WHAT DO YOU THINK HAPPENS WHEN?

Your container tries to access more than one CPU

Your container goes over CPU limits



Totally different from memory

Mesos/Kubernetes CPU translates into Docker `--cpu-shares`

NETWORKING

Multiple services running in the same ports

Must redirect from random ports in the host

Services running in one host need to access services in other hosts

NETWORKING: SOFTWARE DEFINED NETWORKS

Create new custom networks on top of physical networks

Allow grouping containers in subnets

NETWORKING: SOFTWARE DEFINED NETWORKS

Battlefield: Calico, Flannel, Weave and Docker Overlay Network

http://chunqi.li/2015/11/15/Battlefield-Calico-Flannel-Weave-and-Docker-Overlay-Network/

SCALING

New and interesting problems

AWS

Resource limits: VPCs, S3 snapshots, some instance sizes

Rate limits: affect the whole account

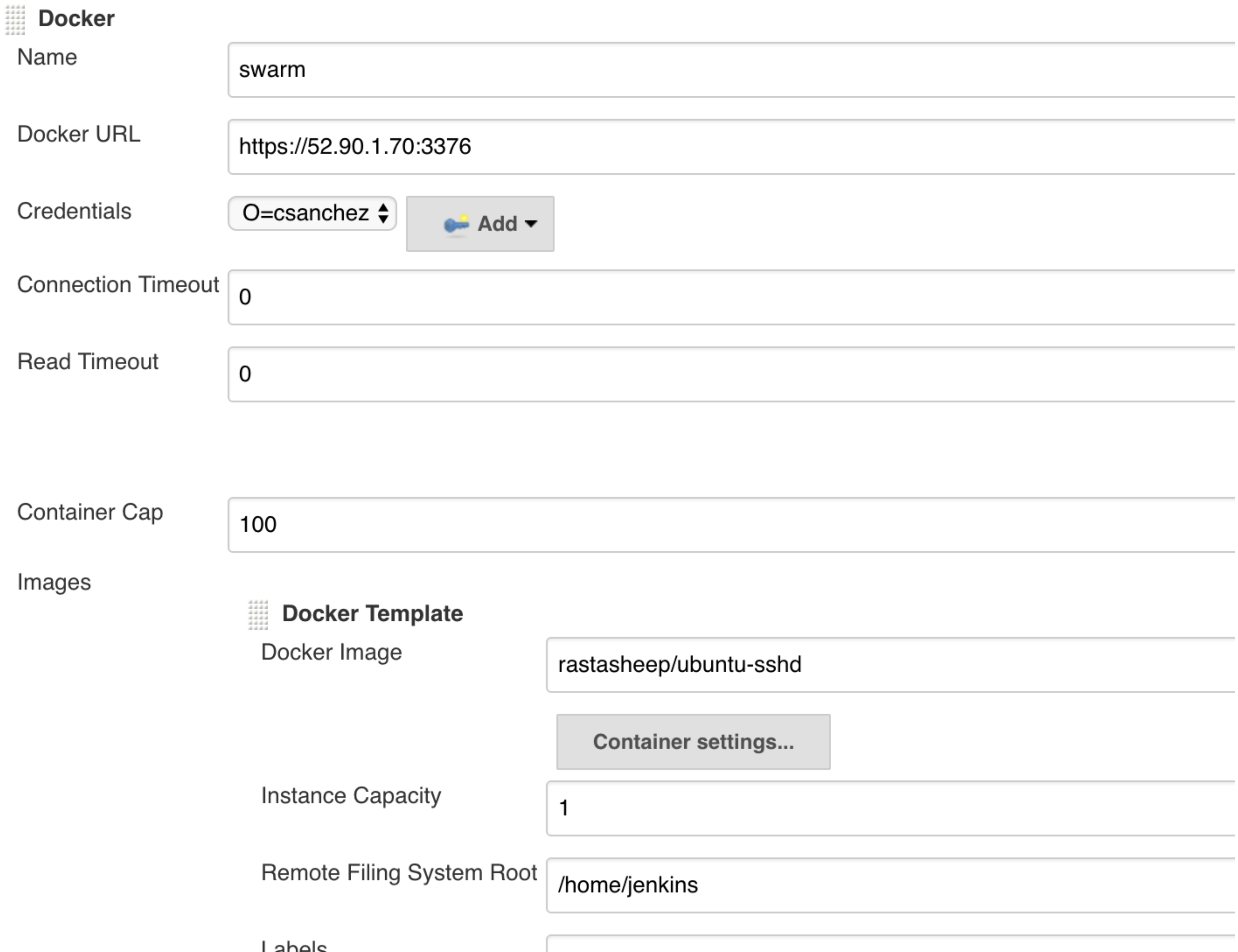
Retrying is your friend, but with exponential backoff

EMBRACE FAILURE!

JENKINS PLUGINS

JENKINS DOCKER PLUGINS

- Dynamic Jenkins agents with Docker plugin or Yet Another Docker Plugin
  - No support yet for Docker 1.12 Swarm mode
- Agent image needs to include Java, downloads slave jar from Jenkins master
- Multiple plugins for different tasks
  - Docker build and publish
  - Docker build step plugin
  - CloudBees Docker Hub/Registry Notification
  - CloudBees Docker Traceability
- Great pipeline support



Docker

Name: swarm

Docker URL: https://52.90.1.70:3376

Credentials: O=csanchez

Connection Timeout: 0

Read Timeout: 0

Container Cap: 100

Images

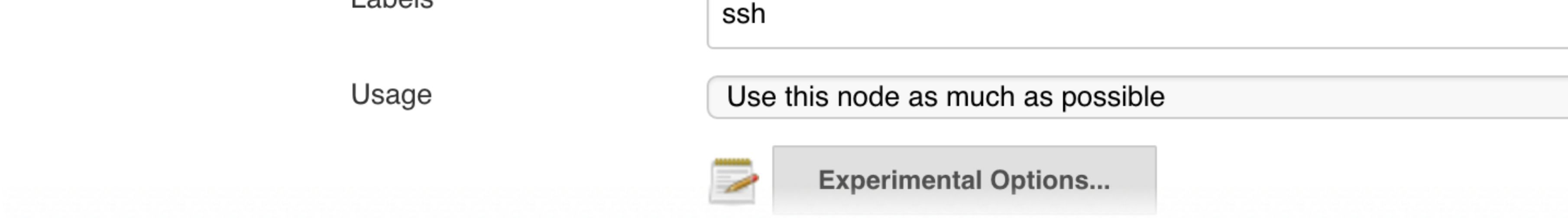
Docker Template

Docker Image: rastasheep/ubuntu-sshd

Instance Capacity: 1

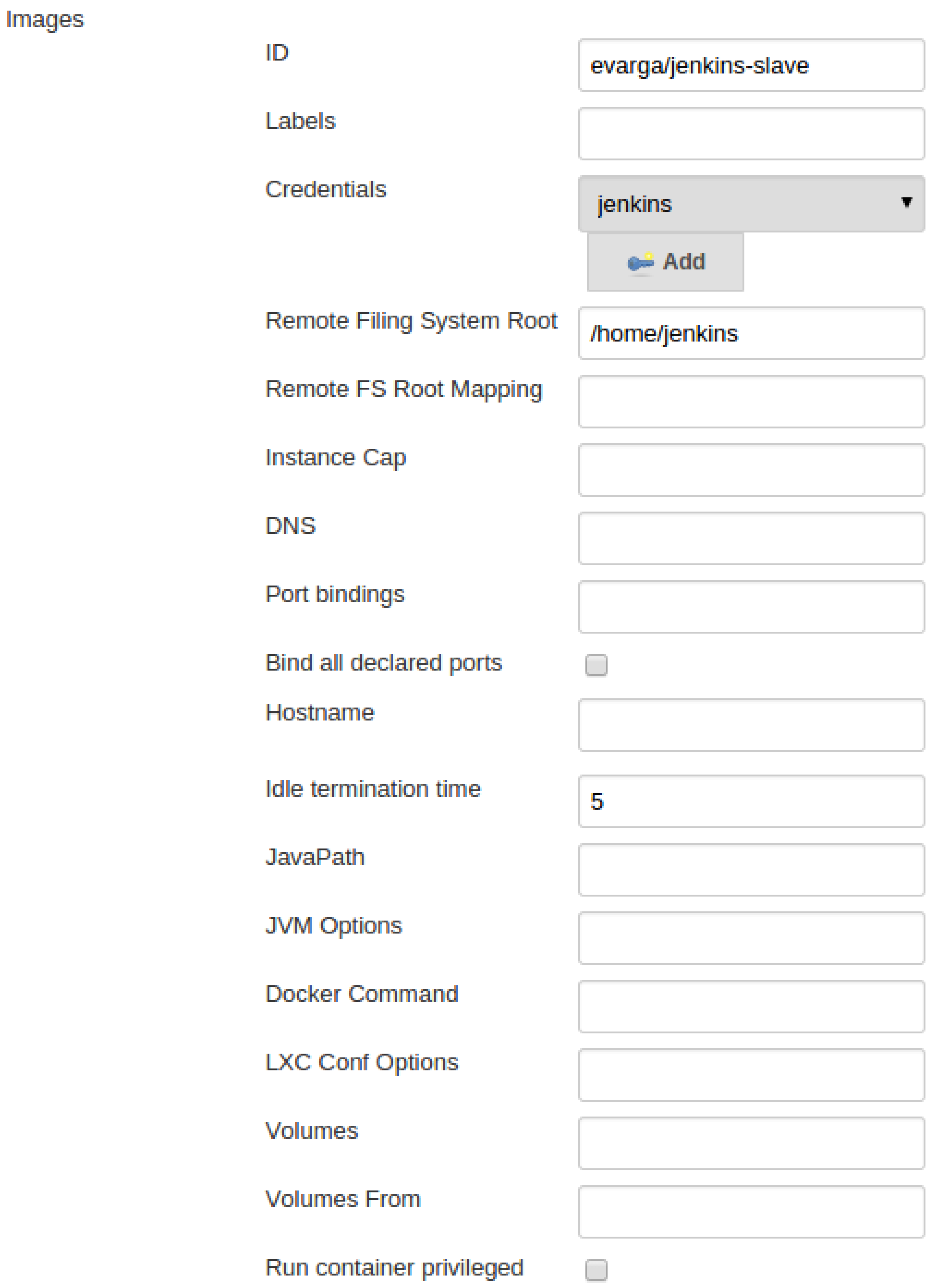
Remote Filing System Root: /home/jenkins

Labels



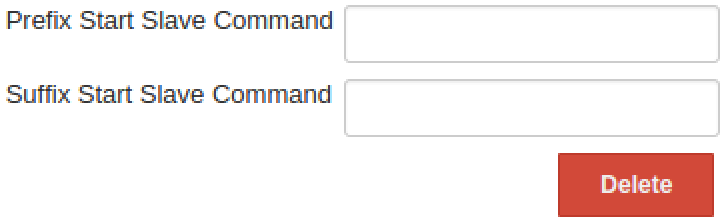
Labels ssh

Usage Use this node as much as possible



Images

ID	evarga/jenkins-slave
Labels	
Credentials	jenkins ▾ Add
Remote Filing System Root	/home/jenkins
Remote FS Root Mapping	
Instance Cap	
DNS	
Port bindings	
Bind all declared ports	☐
Hostname	
Idle termination time	5
JavaPath	
JVM Options	
Docker Command	
LXC Conf Options	
Volumes	
Volumes From	
Run container privileged	☐



Prefix Start Slave Command

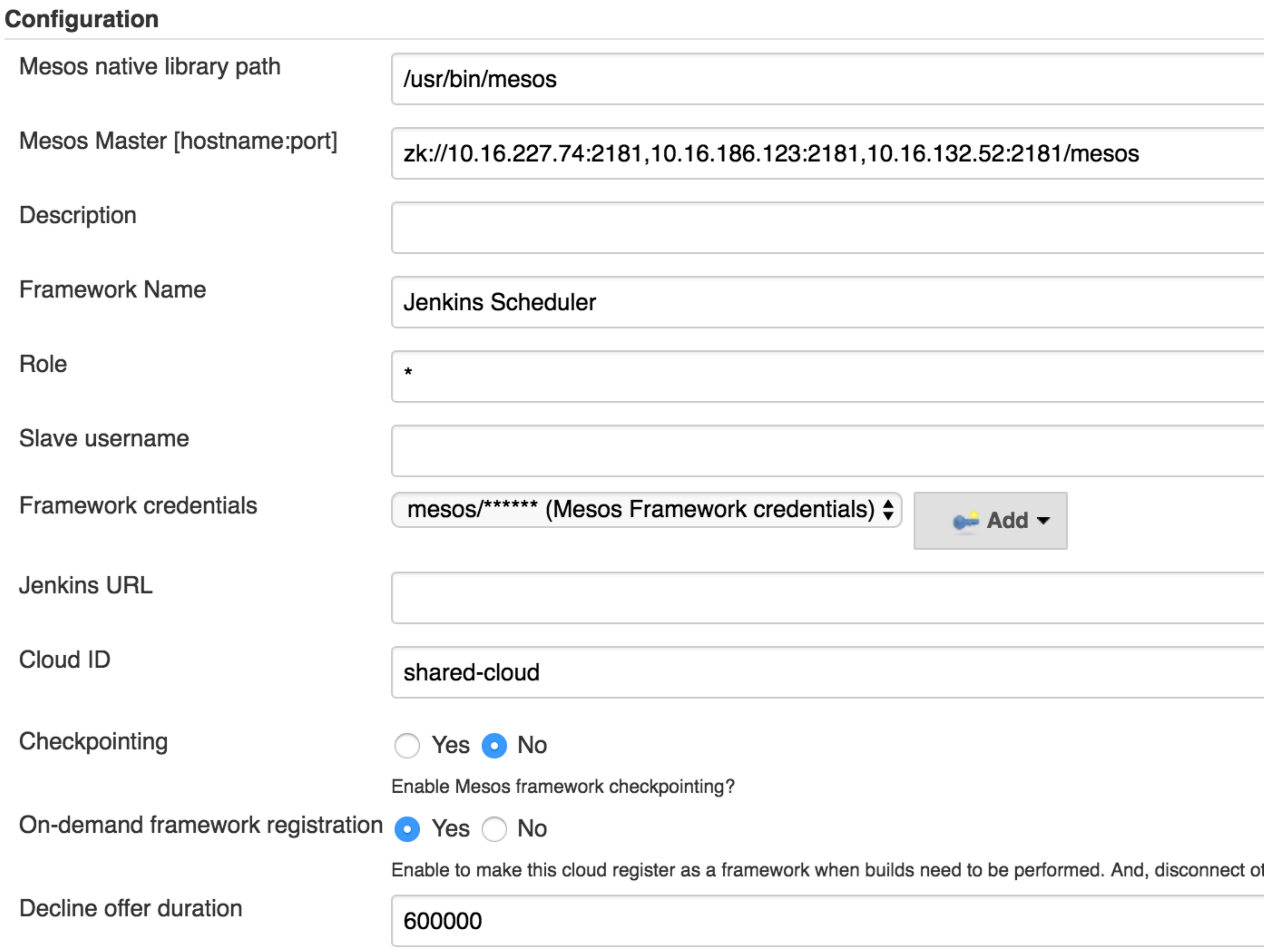
Suffix Start Slave Command

JENKINS DOCKER PIPELINE

```
def maven = docker.image('maven:3.3.9-jdk-8');

stage 'Mirror'
maven.pull()
docker.withRegistry('https://secure-registry/', 'docker-registry-logi

  stage 'Build'
  maven.inside {
    sh "mvn -B clean package"
  }

  stage 'Bake Docker image'
  def pcImg = docker.build("examplecorp/spring-petclinic:${env.BUILD_

  pcImg.push();
}
```

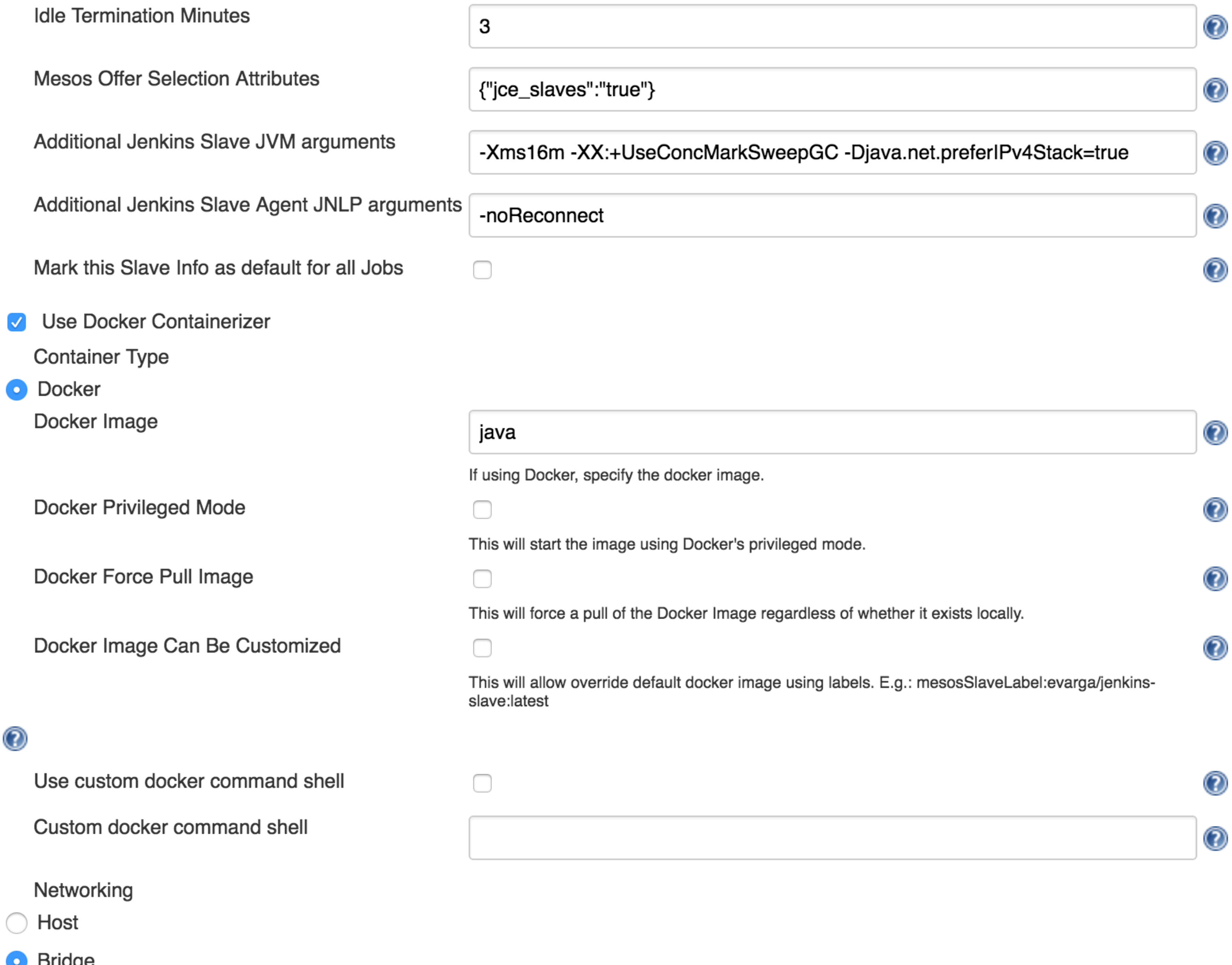
JENKINS MESOS PLUGIN

- Dynamic Jenkins agents, both Docker and isolated processes
- Agent image needs to include Java, grabs slave jar from Mesos sandbox
- Can run Docker commands on the host, outside of Mesos



Configuration

Mesos native library path	/usr/bin/mesos
Mesos Master [hostname:port]	zk://10.16.227.74:2181,10.16.186.123:2181,10.16.132.52:2181/mesos
Description	
Framework Name	Jenkins Scheduler
Role	*
Slave username	
Framework credentials	mesos/****** (Mesos Framework credentials) ⬍ Add ▾
Jenkins URL	
Cloud ID	shared-cloud
Checkpointing	○ Yes ● No Enable Mesos framework checkpointing?
On-demand framework registration	● Yes ○ No Enable to make this cloud register as a framework when builds need to be performed. And, disconnect o
Decline offer duration	600000



Idle Termination Minutes: 3

Mesos Offer Selection Attributes: {"jce_slaves":"true"}

Additional Jenkins Slave JVM arguments: -Xms16m -XX:+UseConcMarkSweepGC -Djava.net.preferIPv4Stack=true

Additional Jenkins Slave Agent JNLP arguments: -noReconnect

Mark this Slave Info as default for all Jobs ☐

☑ Use Docker Containerizer

Container Type

● Docker

Docker Image: java

If using Docker, specify the docker image.

Docker Privileged Mode ☐

This will start the image using Docker's privileged mode.

Docker Force Pull Image ☐

This will force a pull of the Docker Image regardless of whether it exists locally.

Docker Image Can Be Customized ☐

This will allow override default docker image using labels. E.g.: mesosSlaveLabel:evarga/jenkins-slave:latest

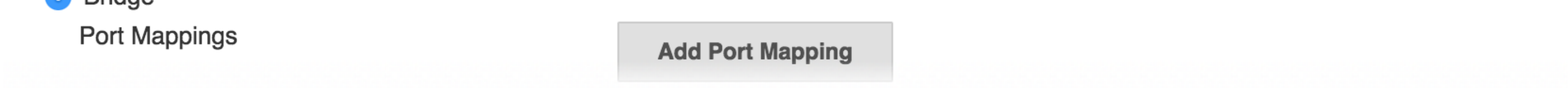
Use custom docker command shell ☐

Custom docker command shell:

Networking

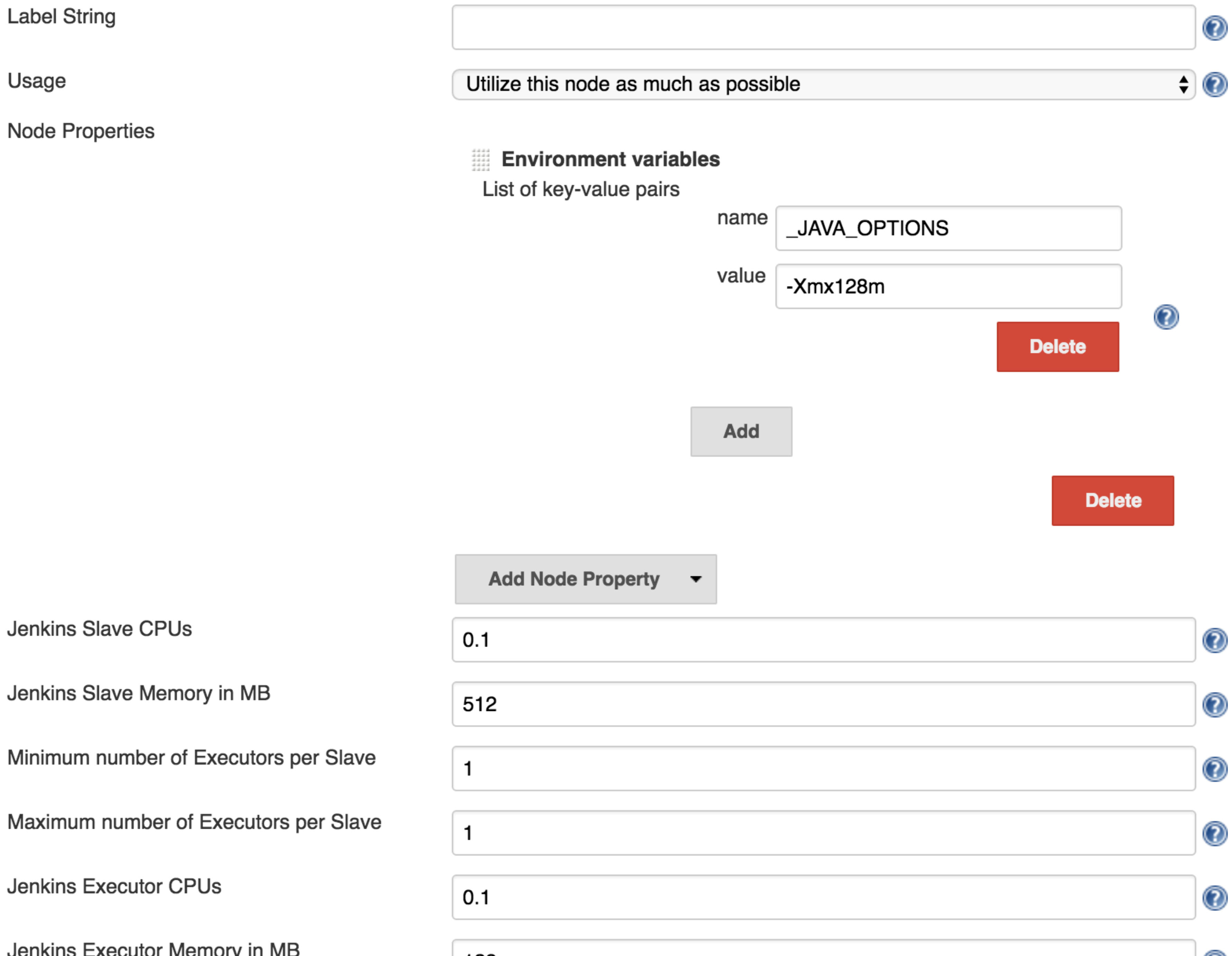
○ Host

● Bridge



● Bridge

Port Mappings



Label String

Usage: Utilize this node as much as possible

Node Properties

Environment variables

List of key-value pairs

name: _JAVA_OPTIONS

value: -Xmx128m

Jenkins Slave CPUs: 0.1

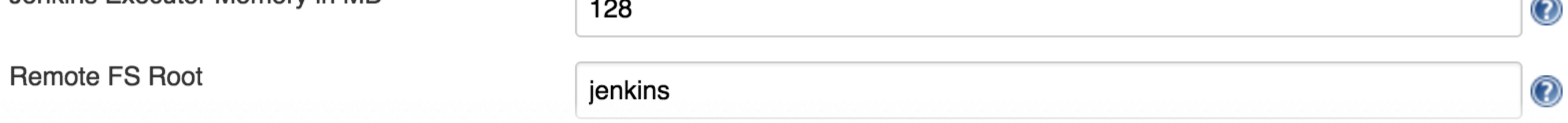
Jenkins Slave Memory in MB: 512

Minimum number of Executors per Slave: 1

Maximum number of Executors per Slave: 1

Jenkins Executor CPUs: 0.1

Jenkins Executor Memory in MB



Jenkins Executor Memory in MB: 128

Remote FS Root: jenkins

JENKINS MESOS PLUGIN

Can use Docker pipelines with some tricks

- Need Docker client installed
- Shared docker.sock from host
- Mount the workspace in the host, visible under same dir

MESOS PLUGIN AND PIPELINE

```
node('docker') {
    docker.image('golang:1.6').inside {

        stage 'Get sources'
        git url: 'https://github.com/hashicorp/terraform.git', tag: '

        stage 'Build'
        sh """#!/bin/bash -e
        mkdir -p /go/src/github.com/hashicorp
        ln -s `pwd` /go/src/github.com/hashicorp/terraform
        pushd /go/src/github.com/hashicorp/terraform
        make core-dev plugin-dev PLUGIN=provider-aws
        popd
        cp /go/bin/terraform-provider-aws .
        """

        stage 'Archive'
        archive "terraform-provider-aws"
    }
}
```

JENKINS KUBERNETES PLUGIN

- Dynamic Jenkins agents, running as Pods
- Multiple container support
  - One jnlp image, others custom
- Pipeline support for both agent Pod definition and execution will be in next version

JENKINS KUBERNETES PIPELINE

```
podTemplate(label: 'mypod', containers: [
        [name: 'jnlp', image: 'jenkinsci/jnlp-slave:alpine', args: '$
        [name: 'maven', image: 'maven:3-jdk-8', ttyEnabled: true, com
        [name: 'golang', image: 'golang:1.6', ttyEnabled: true, comma
    ]) {

    node ('mypod') {
        stage 'Get a Maven project'
        git 'https://github.com/jenkinsci/kubernetes-plugin.git'
        container('maven') {
            stage 'Build a Maven project'
            sh 'mvn clean install'
        }

        stage 'Get a Golang project'
        git url: 'https://github.com/hashicorp/terraform.git'
        container('golang') {
            stage 'Build a Go project'
            sh """
            mkdir -p /go/src/github.com/hashicorp
            ln -s `pwd` /go/src/github.com/hashicorp/terraform
            cd /go/src/github.com/hashicorp/terraform && make core-de
            """
        }
```

JENKINS PLUGINS RECAP

- Dynamic Jenkins agent creation
- Using JNLP slave jar
  - In complex environments need to use the `tunnel` option to connect internally
- Using the Cloud API
  - Not ideal for containerized workload
  - Agents take > 1 min to start provision and are kept around
  - Agents can provide more than one executor

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