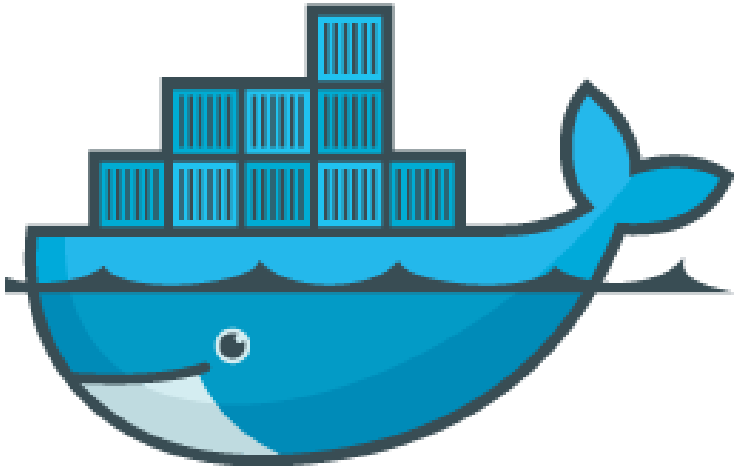


Docker

By
ADITYA PRABHAKARA

Introducing Myself

Aditya S P (sp.aditya@gmail.com)
Freelance trainer and technologist

Boring Stuff about me:

- 14+ years of experience in development and training
- Started with Java, moved to Android and now working on Big Data Technologies

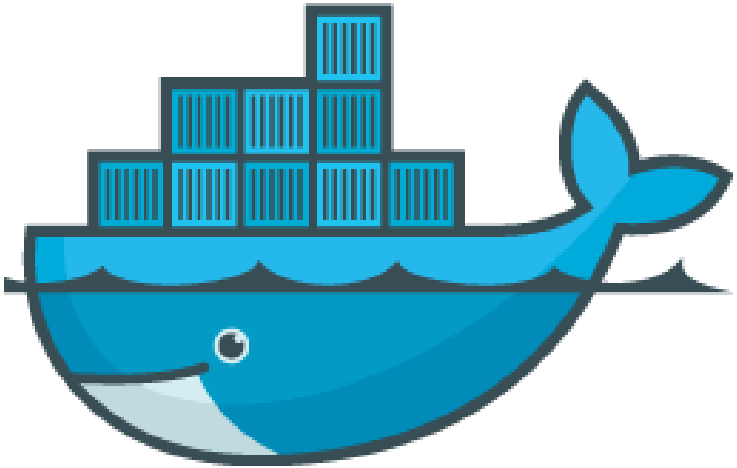
Interesting Things about me:

- Actually Nothing !

Getting to know you

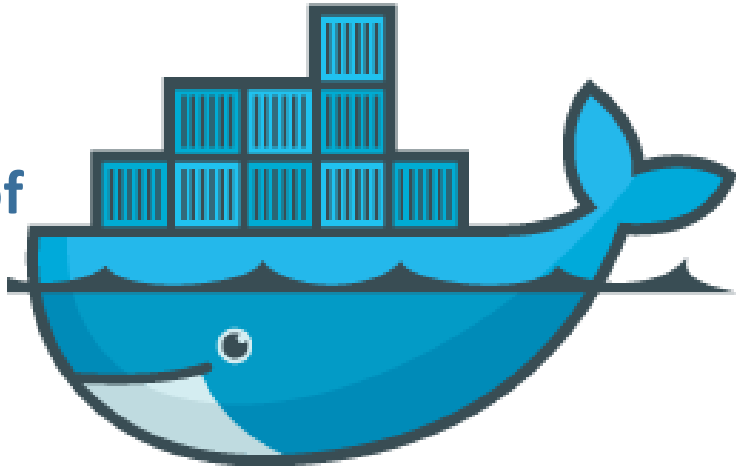
Agenda

- Introduction to DevOps
- Docker

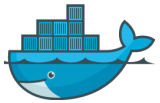


Course Objectives

- A good understanding of DevOps
- A good fundamental understanding of Docker
- Where does docker fit in the DevOps Movement
- Understanding of role of Kubernetes

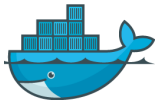


Chapter: Introduction



Docker – Why Now?

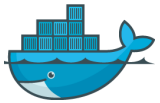
- Speed. Speed. Speed.
- Value movement dev-> test-> prod easier and faster
- Portability
- Reduce complexity of developing code for distributed systems
- Reduce complexity of deploying code to the cloud
- For a later time - Docker's founder and CTO Solomon Hykes
- https://www.youtube.com/watch?v=3N3n9FzebAA



Docker – Different Versions

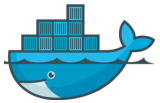
- https://www.docker.com/get-docker
- Community Edition and Enterprise Edition
- Stable and Edge

- Stable vs. Edge Cont.
- Edge (beta) released monthly,
- Stable quarterly
- Edge gets new features first, but only supported for a month
- Stable rolls in three months of Edge features



Docker – Setup

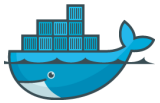
- Docker toolbox install



Docker – initial commands

- docker version
  - verified it's working
- docker info
  - most config values
- docker command line structure
- docker (options)

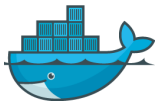
Chapter: Container



Container

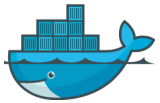
- Basic Building block
- Let us get a container running and then we will connect the dots
- Execute the command

```
docker container run nginx
```

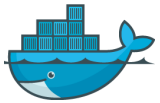


Container

- They are not really mini vms. They are processes
- They get their own logical filepath, process space
- They exit when the process stops
- Some docker container command examples
  - docker top
  - docker container ls
  - docker container stop

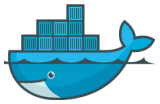


First Container Run:What just happened?



Knowing more about a Container

- docker container stats <container id>
- docker container inspect <container id>
- docker container top <container id>

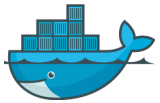


Interactive Container

- docker container run –it nginx bash
- docker container exec –it <container id>

Try this out !
“alpine” is light weight linux distribution , run an alpine container interactively

Chapter: Images



What is an image

- Application binaries
- Application dependencies
- Some meta data about what to run and how to run
- Not a full fledged OS – No kernel No drivers
- Where are these images stored?

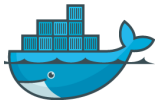
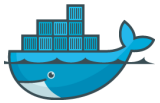


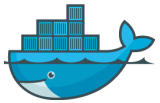
Image vs Container

- An image is an application we want to run
- A container is an instance of the image running as a process
- Multiple containers can run using the same image
- A bad analogy but helps to get the point across : an image is like a “.exe” file
  Container is application that runs when we click on that “.exe”



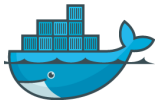
Introduction to docker hub

- What is Docker Hub
- How to find images
- How do we say an image is good!
- Versions of images
- What are official images
- Download images



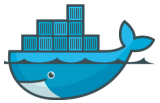
docker container run

- Look for image locally in image cache
- If nothing exists, then look in image repository
- Downloads the image related to the tag
- Creates a new container based on that image
- Provides a virtual ip on a private network inside docker engine
- Publishes a port if specified
- Starts the process in the container using the CMD in the image Dockerfile



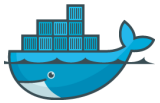
Working with images

- Pull an image
- Pull based on a tag



Images and layers

- Union file system concept
  - Layers of files and meta data
  - docker image history nginx
  - Saves space as it reuses the layers



Layered Visualization

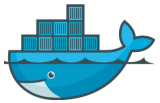
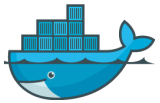


Image and push

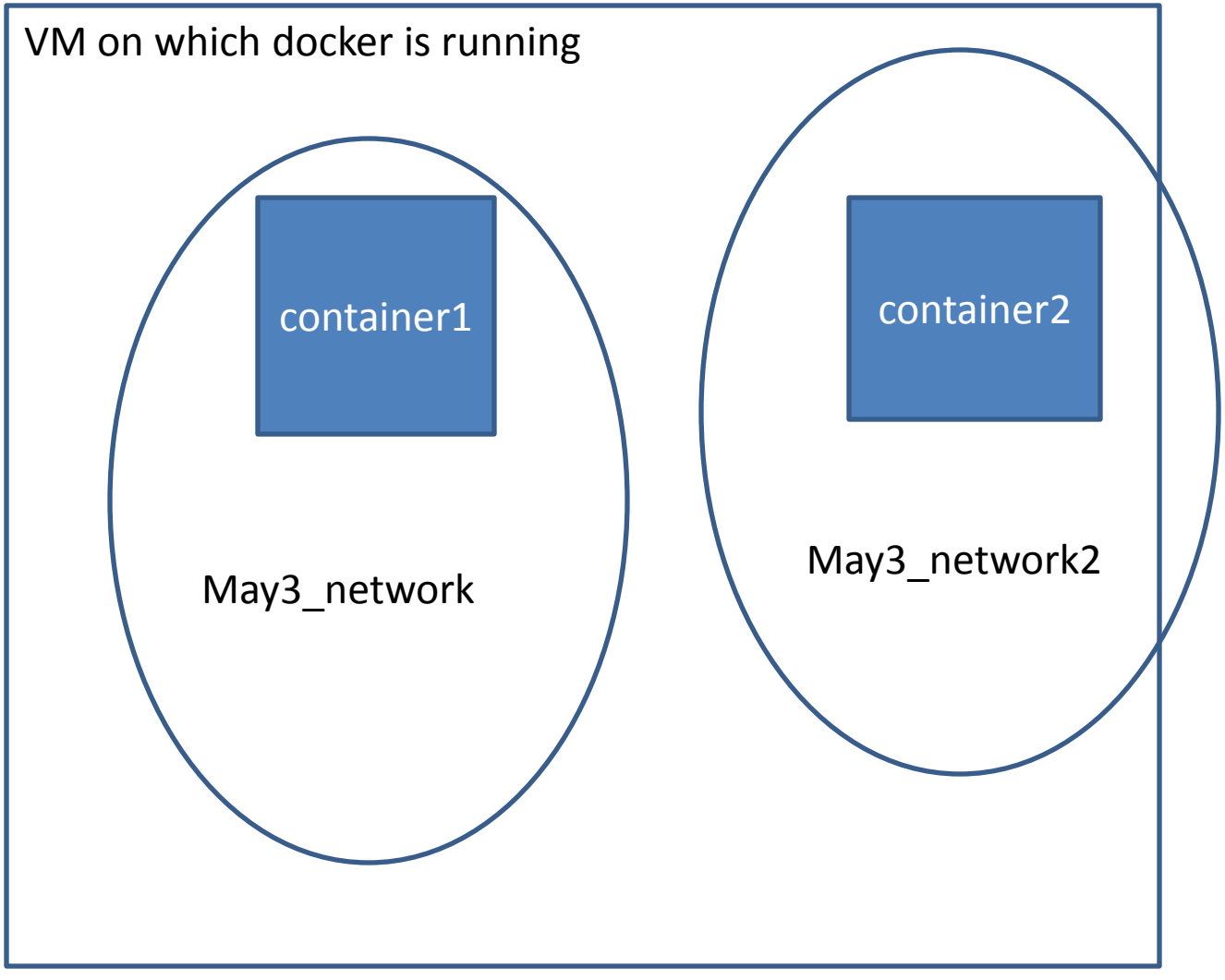
- An image has no real name as such
- It is uniquely identified through user/image:tag
- I can retag an existing image and push to my repository
- Only official images do not have username every other image has a user id behind it

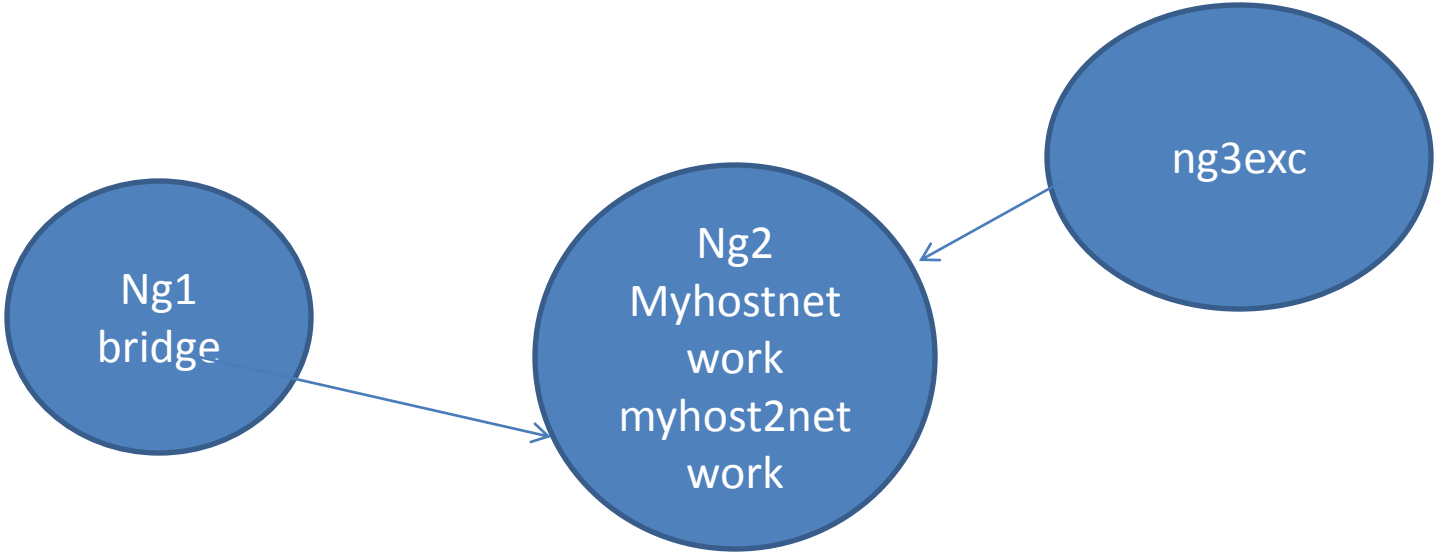
Chapter: Networking



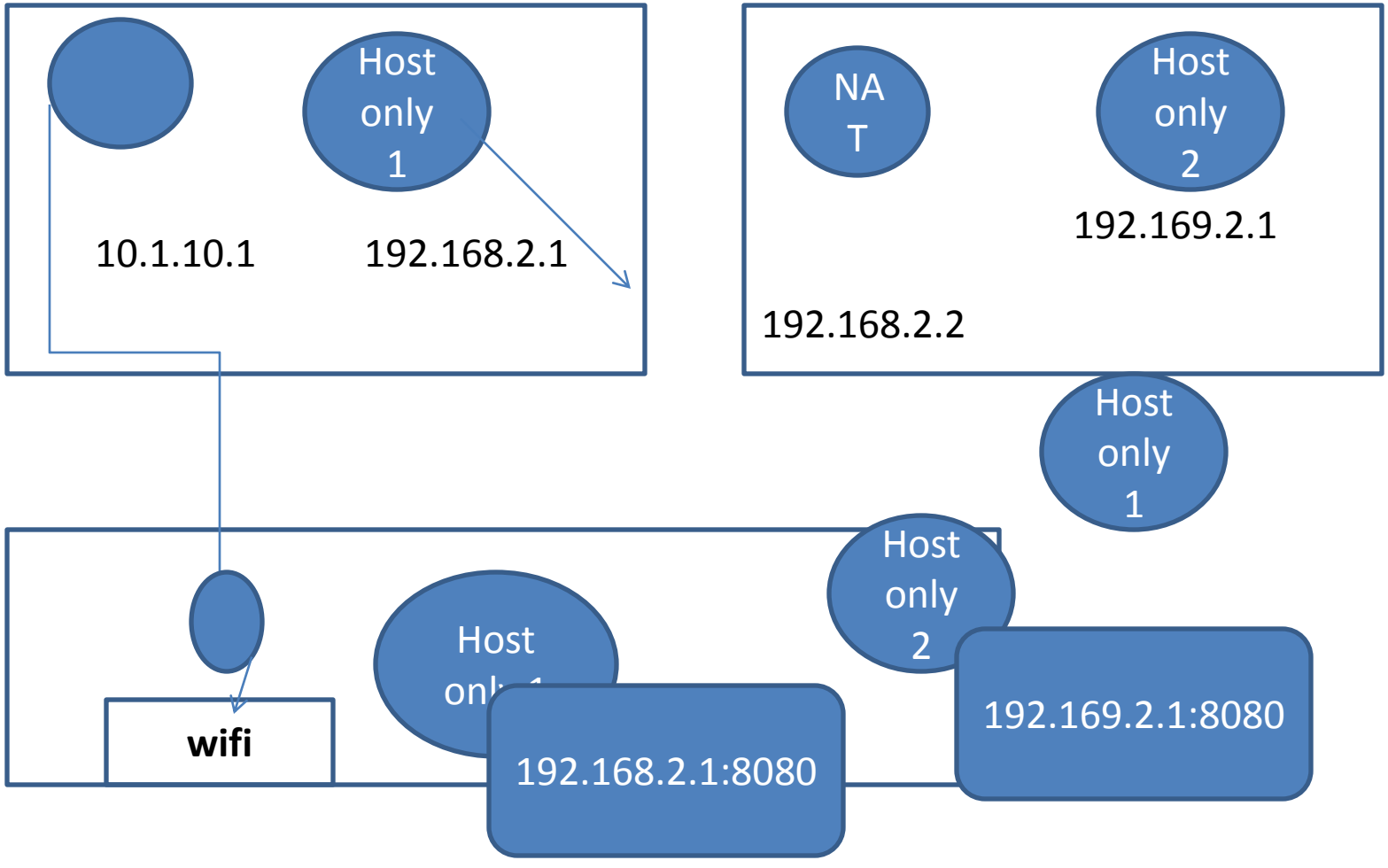
Container Network

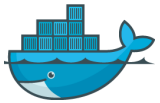
- An image has no real name as such
- Each container connected to a private virtual network "bridge"
- Each virtual network routes through NAT firewall on host IP
- All containers on a virtual network can talk to each other without -p
- Best practice is to create a new virtual network for each app:
  - network “my_weblayer" for mysql and php/apache containers
  - network “my_mongo_rest" for mongo and nodejs containers


VM on which docker is running
container1
May3_network
container2
May3_network2



Link ng2 myhost2network ng1

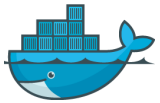

Host only 1
10.1.10.1
192.168.2.1
NA T
Host only 2
192.169.2.1
192.168.2.2
Host only 1
Host only 2
Host
wifi
192.168.2.1:8080
192.169.2.1:8080



Docker network commands

- docker network ls
- docker network inspect bridge
  - Check the containers running
  - Check the ip address
- docker network create my_own_network

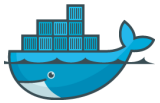
Chapter: Docker File



Docker Building Images

- Dockerfile basics
- FROM (base image)
- ENV (environment variable)
- RUN (any arbitrary shell command)
- EXPOSE (open port from container to virtual network)
- CMD (command to run when container starts)
- docker image build (create image from Dockerfile)

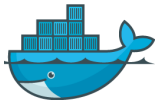
Chapter: Persistent Data



Container lifetime and data

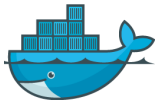
- Containers are usually meant to be immutable and ephemeral
- Immutable == unchanging
- Ephemeral == temporary or throwable
- Immutable infra – only redeploy containers

- Currently data is present as long as the container is not destroyed
- Persistent data can be achieved by two ways
  - 1. Volume
  - 2. Bind Mounts



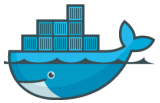
Volume and Bind Mounts

- Volumes : special location outside of container UFS
- Bind Mounts :
  - Sharing or
  - Link container path to host path



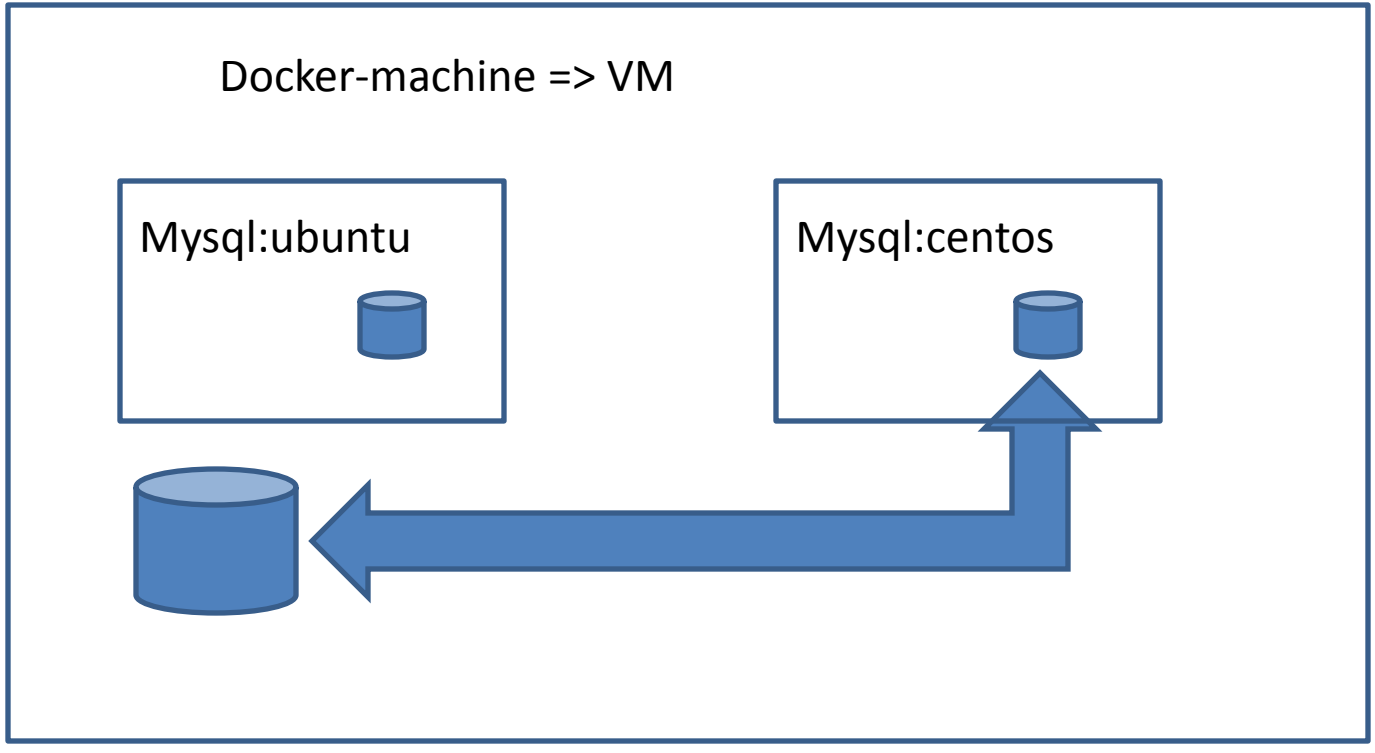
Volume

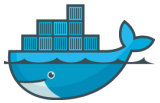
- VOLUME command in the Dockerfile
- Override with docker run –v /path/in/container
- Bypasses the Union File System and stores in the alt location on host
- Includes its own management commands under docker volume
- Connect to none, one or multiple containers at once
- Not subject to commit, save or export commands
- They have a unique id. But if you assign a name its then a named volume



Bind mounting

- Mapsa host file or directory to a container file or directory
- Basically just two locations pointing to the same file
- Skips UFS and host files overwrite any in container
- Not a Dockerfile code. It has to be mentioned during the container run


Docker-machine => VM
Mysql:ubuntu
Mysql:centos



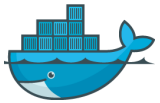
Volume and Bind Mounts

- docker container run -d --name mysql -e MYSQL_ALLOW_EMPTY_PASSWORD=True mysql
- docker volume ls
- docker volume inspect
- docker container run -d

--name mysql -e MYSQL_ALLOW_EMPTY_PASSWORD=True

-v mysql-db:/var/lib/mysql mysql

Chapter: Docker Compose

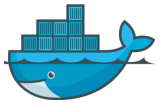


Why?

- Configure relationships between containers
- Save our docker container run settings in easy to read file
- Create one-liner developer environment startups
- Comprised of
  - A YAML formatted file that describes
    - Containers
    - Networks
    - Volumes
  - A CLI took docker-compose used for local dev/test automation with YAML files

docker-compose.yml

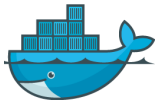
- Its own versions, 1,2,2.1,3,3.1
- YAML file can be used with docker-compose command for local docker sutomation
- docker-compose.yml is default name but can be changed



docker-compose CLI

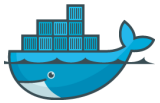
- CLI tool comes with docker (has to be downloaded for linux)
- Not really production grade but ideal for dev and test
- Two most common commands
  - docker-compose up
  - docker-compose down
- Very easy for developer onboarding

Docker



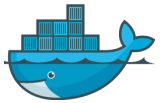
```
version: '3.1'

services:
  servicename: nginx
    image: nginx
    volumes:
        - .:/usr/share/nginx/html
    ports:
        - '8095:80'
```

Chapter: Swarm - Introduction



Swarm

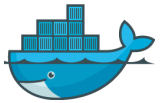
- Automate container lifecycle
- Scale out/in/up/down
- Recreate containers if they fail –resilience
- Blue/green deploy
- Cross-node virtual networks
- Run containers on trusted servers
- Ability to store secrets, keys, passwords



Swarm Mode

- Clustering solution built inside docker
- Not enabled by default
- New commands once enabled
  - Docker swarm
  - Docker node
  - Docker service
  - Docker stack
  - Docker secret
- docker swarm init => to enable swarm

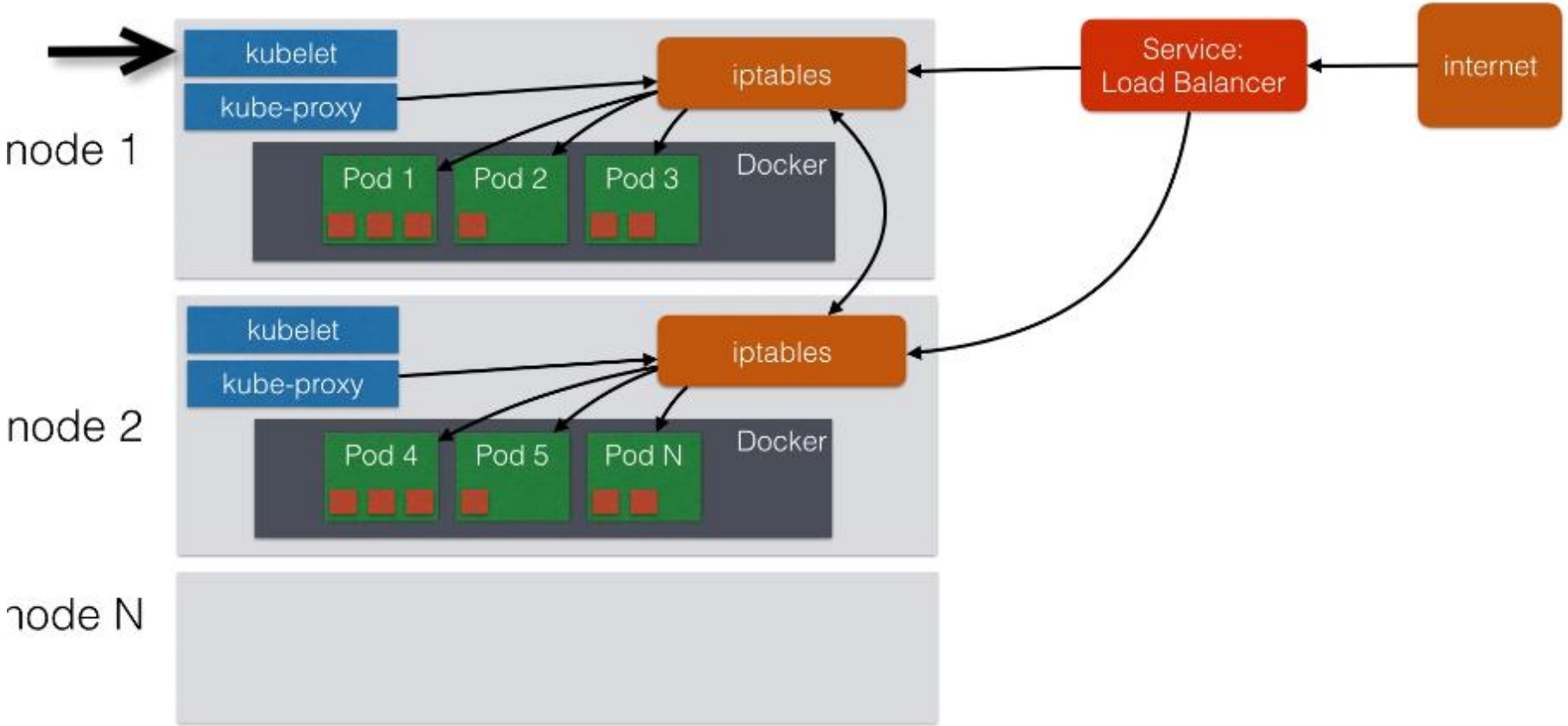
Chapter: Kubernetes

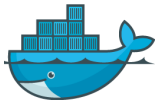


Kubernetes

- Opensource orchestration system for Docker containers
- Schedule containers on a cluster of machines
- Run multiple containers
- Run long running services
- Kubernetes will manage the state of these containers
  - Start on specific nodes
  - Restart a container when it gets killed
- Can manage one to 1000’s of nodes

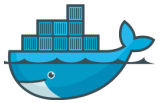
Kubernetes – arch overview





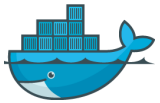
Running Kubernetes

- Minikube – is a tool that makes it easy to run Kubernetes locally
- Minikube runs a single node k-cluster inside a linux vm
- Its aimed for dev and testing



Kubernetes - Pod

- A pod is an application running on Kubernetes
- A pod can contain one or more tightly coupled containers
- The app can communicate easily with each other using their local port numbers

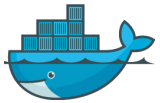


Kubernetes - Pod

Command	Description
kubectl get pod	Get information about all running pods
kubectl describe pod <pod>	Describe one pod
kubectl expose pod <pod> --port=444 --name=frontend	Expose the port of a pod (creates a new service)
kubectl port-forward <pod> 8080	Port forward the exposed pod port to your local machine
kubectl attach <podname> -i	Attach to the pod
kubectl exec <pod> -- command	Execute a command on the pod
kubectl label pods <pod> mylabel=awesome	Add a new label to a pod
kubectl run -i --tty busybox --image=busybox --restart=Never -- sh	Run a shell in a pod - very useful for debugging

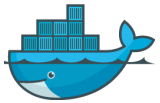
Kubernetes - Deployments

Command	Description
kubectl get deployments	Get information on current deployments
kubectl get rs	Get information about the replica sets
kubectl get pods --show-labels	get pods, and also show labels attached to those pods
kubectl rollout status deployment/helloworld-deployment	Get deployment status
kubectl set image deployment/helloworld-deployment k8s-demo=k8s-demo:2	Run k8s-demo with the image label version 2
kubectl edit deployment/helloworld-deployment	Edit the deployment object
kubectl rollout status deployment/helloworld-deployment	Get the status of the rollout
kubectl rollout history deployment/helloworld-deployment	Get the rollout history
kubectl rollout undo deployment/helloworld-deployment	Rollback to previous version
kubectl rollout undo deployment/helloworld-deployment --to-revision=n	Rollback to any version version



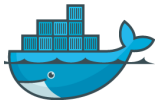
Kubernetes – Replication Controller

- If application is stateless it can be easily horizontally scaled
  - Stateless => doesn’t write local files or keep local sessions
  - Databases for instance are stateful and cant be split over multiple instances
- Web applications can be made stateless
  - Session management needs to be done outside the container
- Scaling can be done using replicatin controller
- Replication contrller will ensure a specified number of pod replicas will run at all times
- Pods created with rc will automatically be replced if they fail
- Using rc is also a way to make sure atleast one pod is running by setting the replica to 1



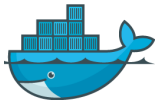
Kubernetes – RS

- Deployments make use of replication set
  - RS => next gen RC
  - Supports a new selector that can do selection based on filtering according to a set of values



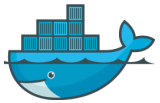
Kubernetes – Deployments

- A deployment declaration in k8s allows you to do app deployments and updates
- Define the state of the application
- K8s will make sure the cluster matches the desired state
- Just using RC or RS makes the deployment cumbersome
- With a Deployment you can
  - Create a deployment (deploy an app)
  - Update a deployment (deploy a new version)
  - Do rolling updates (zero downtime)
  - Roll back to previous version
  - Paue or resume



Kubernetes – Services

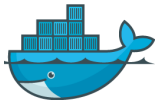
- Pods are disposable entities. They come and go
  - RC and RS will create/terminate pods during scaling operations
- Pods should never be accessed directly but always through a service
- A service is the logical bridge between the pods and other services or end-users



Kubernetes – Services

- Creating a service will create an endpoint for the pods
  - A cluster ip: A vertual IP address only reachabled from within the cluster
  - A NodePort: a port that is the same on each node that is also reachable externally
  - A load balancer: created by the cloud provider that will route external traffic to every node on the NodePort (ELB on AWS)

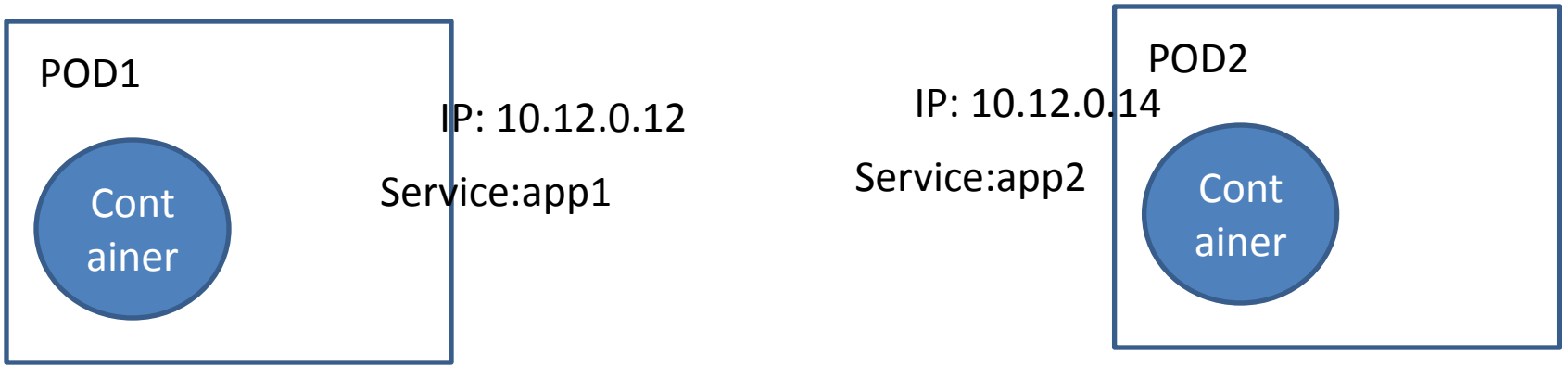
By default a service can run between ports 30000-32767 but this can be changed by Adding –service-node-port-range argument to the kube-apiserver



Kubernetes – Services Discovery

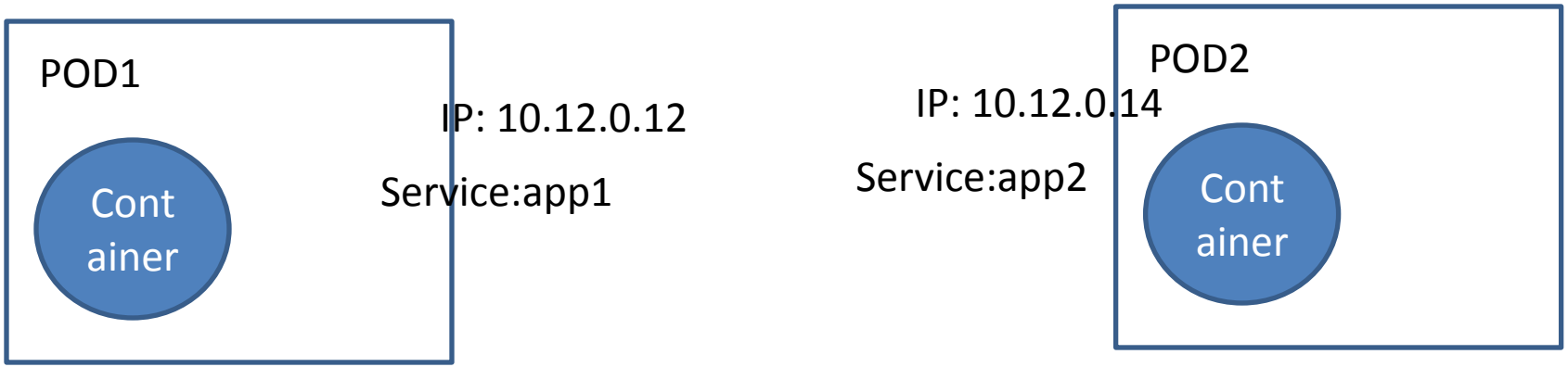
- DNS is a built-in service launched automatically using the addon manager
- DNS service can be used within pods to find other services running on the same cluster
- Multiple containers within 1 pod don’t need this service as they can contact directly
- A container in the same pod can connect using localhost:port
- We require a Service definition to make the DNS work

Kubernetes – DNS working

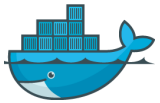


App1-service has address 10.12.0.12
App2-service has address 10.12.0.14
app2-service gets a fqdn as app2-service.default.svc.cluster.local
app1-service gets a fqdn as app1-service.default.svc.cluster.local
“default” is the namespace . Pods can be launched in different namespaces

Kubernetes – DNS working



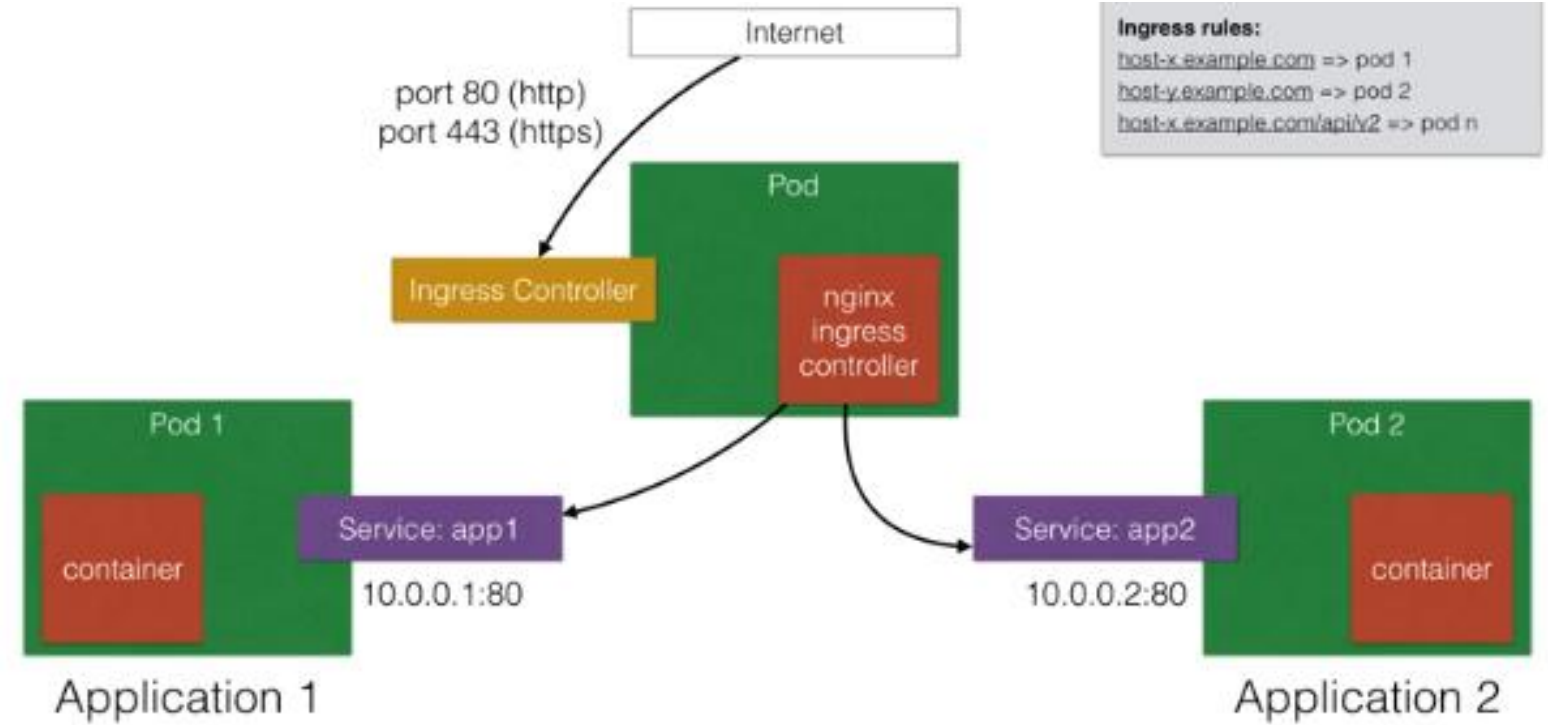
/etc/reolv.conf on pods has a way to reach services

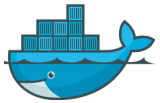


Kubernetes – Ingress

- Ingress is a solution that allows inbound connections to the cluster
- An alternative to external locadbalancer on nodeports
  - Ingress allows you to easily eexpose services that need to be accessible from outsid
- We can run our own ingress controller within the kubernetes cluster
- There are default ingress controllers available or we can write out own

Kubernetes – Ingress





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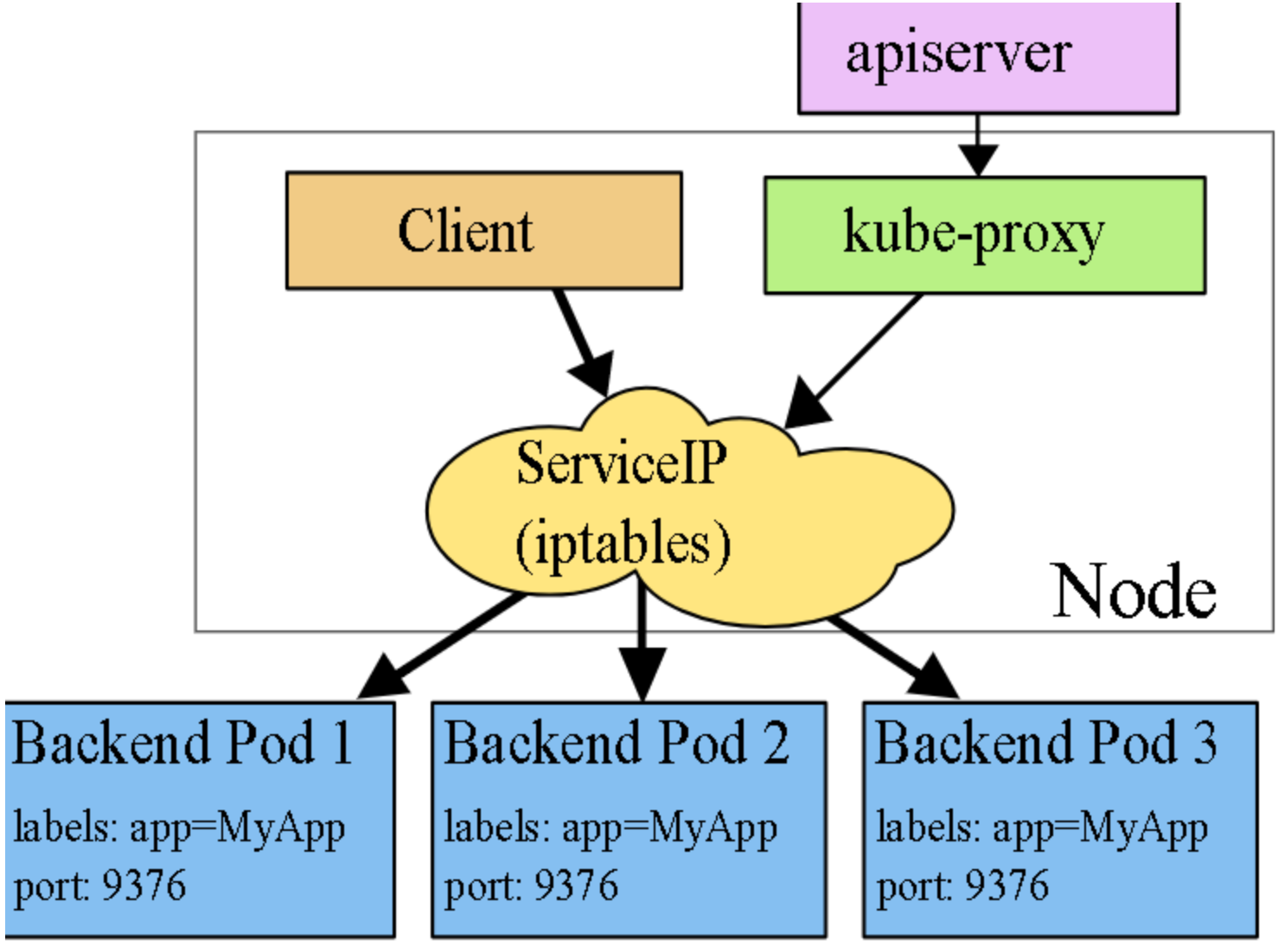
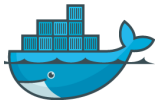
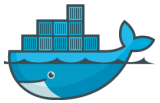

apiserver
Client
kube-proxy
ServiceIP
(iptables)
Node
Backend Pod 1
labels: app=MyApp
port: 9376
Backend Pod 2
labels: app=MyApp
port: 9376
Backend Pod 3
labels: app=MyApp
port: 9376



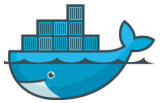
Docker 12 factor

12factor.net



DockerDevOps

Implementing Docker is not DevOps
Docker sits with the rest of automation and enables the DevOps Process
You will still require Cloud or VM provisioning
Use Docker with Agile’s iterative style of development



Docker - downside

Docker is not a fix all
Bare metal is always faster than VM is faster than container
Patterns of development have begun and takes time to evolve and mature
Best used for REST Api's and stateless machines
Persistent data storage is complicated