Kubernetes in 3 Hours

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About your instructor

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Kubernetes in 3 Hours

Sander van Vugt

Agenda

- Understanding Kubernetes
- Kubernetes Installation and Configuration
- Using Kubernetes to Manage Containers

Expectations

- This class is for people new to Kubernetes
- I'll teach you how to set up a test environment based on Minikube
- Don't expect much information about advanced topics

Lab instructions

- This course contains lab instructions which you can follow along or run later at your own convenience
- To get the same experience, use the following recommended minimal settings
  - Linux host (I'm using Fedora 28) with the latest version of VirtualBox installed on it
  - At least 2GB of RAM (more is always better)
  - At least 20 GB of available disk space (more is always better)
- While running labs in this course, do NOT run another hypervisor on the host at the same time

Poll Question 1

- How would you rate your own Linux knowledge and experience?
  - 0
  - 1
  - 2
  - 3
  - 4
  - 5

Poll question 2

- How would you rate your own knowledge about containers
  - 0
  - 1
  - 2
  - 3
  - 4
  - 5

Poll question 3

- How would you rate your own Kubernetes knowledge and experience?
  - 0
  - 1
  - 2
  - 3
  - 4
  - 5

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What is Kubernetes?

What is Kubernetes?

- Kubernetes is rapidly evolving open-source software, written in Go, for automating deployment, scaling, and management (orchestration) of containerized applications
  - See kubernetes.io for more details
  - A new major release every 3 months!
- It is about running multiple connected containers across different hosts, where continuity of service is guaranteed
- The solution is based on technology that Google has been using for many years in their datacenters
  - Google Borg inspired the development of Kubernetes
  - Borg has been used for over 15 years for hosting internal Google applications

Kubernetes Orchestration tasks

- Schedule containers to run on specific hosts using Pods
- Join hosts that are running containers in an etcd cluster
- Connect containers that are running on different hosts
- Make storage available
- Expose containers using a service

Other container management solutions

- Docker Swarm
- Apache Mesos
- Azure Container Service
  - Runs Kubernetes or Docker Swarm in Azure
- Amazon ECS
- Google Container Engine
  - Allows running Kubernetes in Google Cloud
- Red Hat OpenShift
  - Integrated Kubernetes and adds devops workflow services on top of it

What are Containers?

- Containers provide a way to package, ship and run applications
- Docker is a leading solution in containers
  - easily build containers
  - share containers in a simple way by using Docker registries
- Docker Inc offers 2 methods to manage containers in the datacenter
  - Docker swarm
  - Kubernetes
- Notice that Docker isn't the only container solution around, and even if Kubernetes now focusses on Docker, other container platforms will be integrated also

Container needs in the Datacenter

- A methodology to build, test and verify container images
- A cluster of hosts to run the containers
- Monitoring and self-healing of containers
- A solution for updates and rollbacks
- A flexible network that can self-extend if that is needed

About the Kubernetes Host Platform

- Kubernetes can be offered through different host platforms
  - As a service in public cloud
  - As a set of processes in Linux
  - Using a minimized container OS as provided by CoreOS or Atomic

Cloud Native Computing Foundation

- CNCF is a governing body that solves issues faced by any cloud native application (so not just Kubernetes)
- Google donated Kubernetes to the Cloud Native Computing Foundation, which is a foundation in Linux Foundation
- CNCF owns the copyright of Kubernetes
- Kubernetes itself uses an Apache license
- Developers need to sign a Contributor License Agreement with CNCF

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Understanding Kubernetes Resource Types

Understanding Main Kubernetes Resource Types

- Pods: the basic unit in Kubernetes, represents a set of containers that share common resources such as an IP address and persistent storage volumes
- Deployments: standard entity that is rolled out with Kubernetes
- Services: make deployments accessible from the outside by providing a single IP/port combination. Services by default provide access to pods in round-robin fashion
- Persistent Volumes: persistent (networked) storage that can be mounted within a container

Understanding the Pod

- Kubernetes manages Pods, not containers
- A Pod is using namespaces to ensure that resources in the Pod can communicate easily
  - In a pre-container environment, containers in a Pod would be implemented as applications on the same computer
- Containers can be put together in a Pod, together with Pod-specific storage
- Pods are exposed through an IP address, not the individual containers inside a Pod
- See here for more information about pods:
  - https://kubernetes.io/docs/concepts/workloads/pods/pod/

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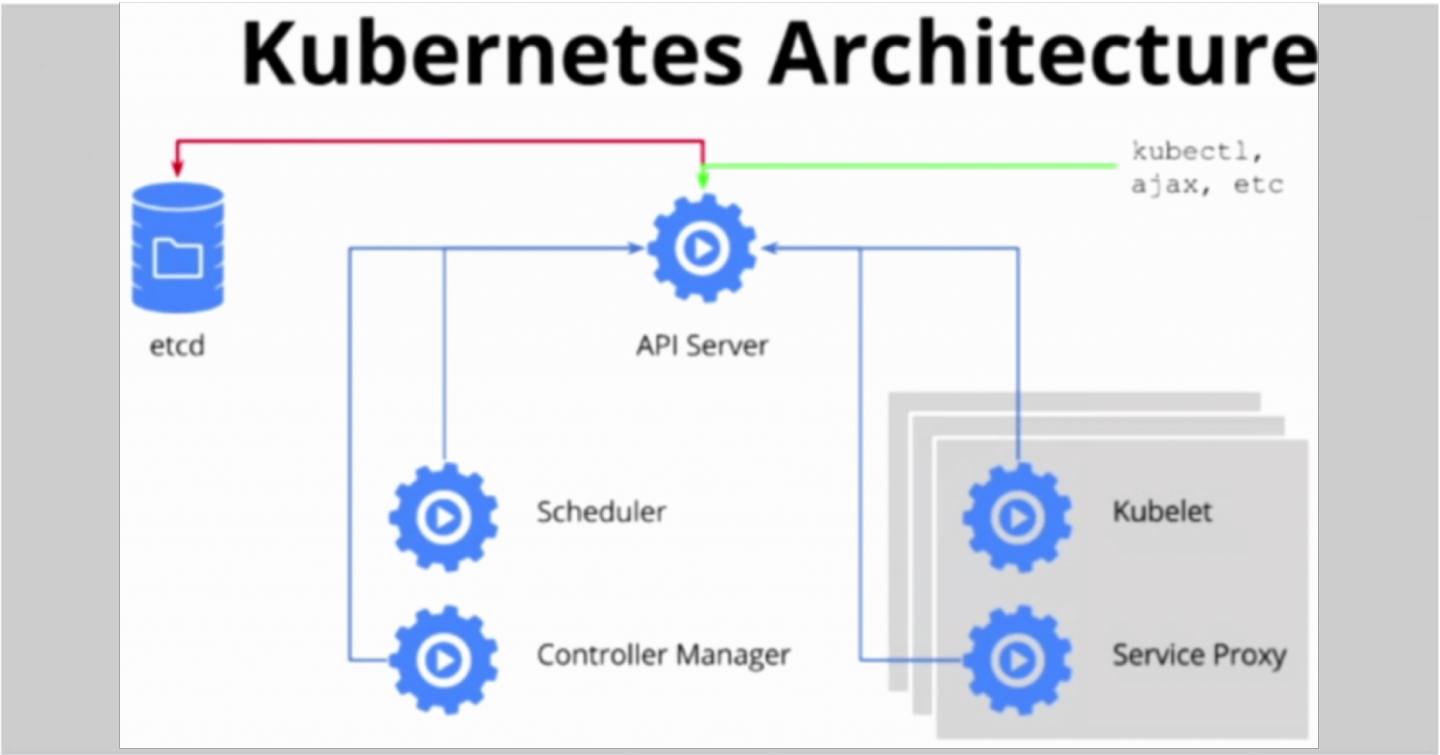
Understanding Kubernetes Architecture

Kubernetes Architecture



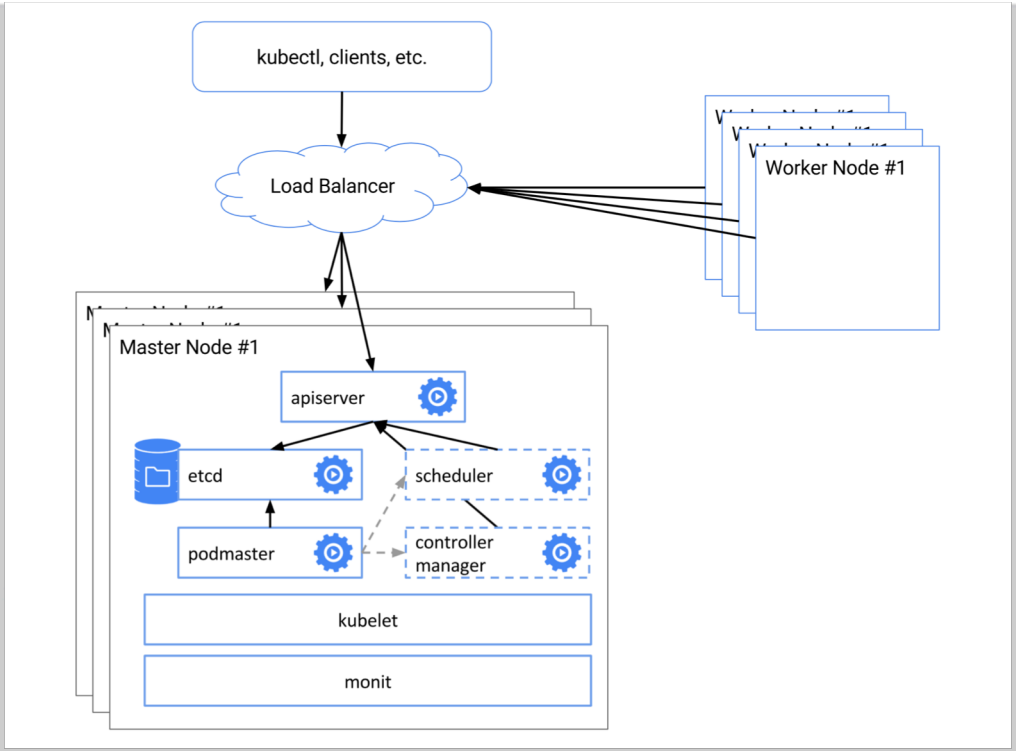
Base Architecture

- Typically, Kubernetes has a master node and multiple worker nodes
- Minikube allows you to run all on one node
  - Great for learning Kubernetes, not for production
- The base Kubernetes components are
  - API server
  - Scheduler
  - Controller Manager
  - Kubelet
  - Kube Proxy
  - etcd
- Each of these can run as a Linux process or as a container

Optional High Availability

- Master node typically is configured in a multi-master HA setup
- Schedulers and Controller managers can elect a leader
- API servers can use a load-balancer as a front end

Kubernetes HA Overview



Worker Nodes

- Worker nodes run the kubelet, kube proxy and container (Docker) engine
- Kubelet receives instructions from the master to run Docker containers on the underlying Docker engine
- Kubernetes can run different Container Engines, including Docker (most common) or Rkt
- The Container Runtime Interface (CRI) offers integration options for different container engines, including Windows containers and Rkt
  - https://kubernetes.io/blog/2016/12/container-runtime-interface-cri-in-kubernetes/

Understanding etcd

- Etcd is the backing store for all cluster data and contains the current state of the cluster
- Etcd is a distributed key-value store
- Etcd elects a leader to ensure that data consistency between different nodes is guaranteed
- It can run on a single node, but that takes away the redundancy of the setup

Understanding Networking

- Networking is very similar to any IaaS networking
- The lowest unit in networking is a pod
- A pod is a group of containers that share the same IP address
  - As such, from the networking perspective it looks like a virtual machine or physical host
- The network needs to assign IP addresses to pods and take care of routing
- By using pods, Kubernetes requires 3 levels of networking to be taken care of

Kubernetes levels of networking

- Container-to-container: this is take care of within the Pod, which allows containers to be coupled
  - Often POSIX IPCs is used for container-to-container traffic
- Pod-to-pod: this is taken care of by regular networking
  - Recommended: use physical networking
  - No NAT allowed between pods
  - Software defined overlay networking solutions may be used (Weave, Flannel and others)
  - Overlay networking solutions can easily be integrated with Kubernetes using the **kubectl** command
- External-to-pod: is taken care of by the services concept (covered later)

Understanding the CNI

- Kubernetes networking is pluggable
- CNI is the Container Network Interface
- It allows for writing plugins that configure container networking
  - See for an example on the next slide
- The plugins themselves are files that are written to /opt/cni/bin
- CNI network configurations are distributed using the Kubernetes cluster bootstrapping tool **kubeadm**
- See here for more information about Kubernetes networking
  - https://kubernetes.io/docs/concepts/cluster-administration/networking/

CNI Networking Example

```
{
     "cniVersion": "0.2.0",
     "name": "testnet",
     "type": "bridge",
     "bridge": "cni0",
     "isGateway": true,
     "ipMasq": true,
     "ipam": {
          "type": "host-local",
          "subnet": "10.10.0.0/16",
          "routes": [
               { "dst": "0.0.0.0/0" }
          ]
     }
}
```

Understanding Pod Networking

- A pod is group of collocated containers which may have some associated data volumes as well
- Containers in a pod communicate through localhost networking
- A pod has one single IP address and containers use a pause container to communicate to one another
- The containers in a pod share the same network namespace
- The pause container holds the network namespace for the Pod, as well as the Pod IP address

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Installing a Kubernetes
Minikube Test Cluster

Configuration Options Overview

- Minikube offers a complete test environment that runs on Linux, OS-X or Windows
- In this course we'll focus on Minikube as it is easy to setup and has no further dependencies
- In all cases, you'll need to have the **kubectl** client on your management platform
- Install kubectl *before* minikube

Installing **kubectl**

- There are many ways to install the kubectl client
  - From your cloud specific client
  - Compiled from source
  - Directly from the release binaries
  - Use the **kubernetes-client** package from your Linux distro repository
- **curl -LO https://storage.googleapis.com/kubernetes-releases/release/$(curl -s https://storage.googleapis.com/kubernetes-release/release/stable.txt)/bin/linux/amd64/kubectl**
- **sudo chmod +x kubectl**
- **sudo mv kubectl /usr/local/bin**

Installing minikube

- Install VirtualBox (or another Hypervisor)
  - Ensure that gcc, make, elfutils-libelf-devel, perl and kernel-devel packages are installed for adding required drivers to your kernel
  - Run **vboxconfig** to configure your current kernel
- Download minikube using **curl -Lo minikube https://storage.googleapis.com/minikube/releases/v0.30.0/minikube-linux-amd64**
  - Google for current version

Installing minikube - 2

- **chmod +x minikube**
- **sudo mv minikube /usr/local/bin**
- **minikube start**: may take over 15 minutes to complete
- **kubectl cluster-info**
- **kubectl get nodes**

Testing Minikube

- **minikube ssh**: logs in to the Minikube host
- **docker ps**: shows all Docker processes on the MK host
- **ps aux | grep localkube**: shows the localkube process on MK host

Managing minikube

- The **minikube** command has different options
  - **dashboard**: opens the K8s dashboard in the local browser
  - **delete**: deletes a cluster
  - **ip**: show the currently used IP address
  - **service *nn***: gets the kubernetes URL for the specific service
  - **start**: starts a cluster
  - **stop**: stops a cluster
  - **status**: gives current status
  - **version**: shows current version
  - **ssh**: connect to the minikube cluster

Importing Images into Kubernetes

- To start using Kubernetes, you'll need to pull a container image
- You can create your Docker image and push it to a registry before referring to it in a Kubernetes pod
- Or you can use public container registries to pull images from
  - Use Docker Hub or any public cloud container registry
  - Docker Hub images make sense in a small private deployment
  - Public cloud container registries make sense if you're running Kubernetes from a Public cloud

Running an Application

- From **minikube dashboard**, click +CREATE in the upper right corner
- Specify **httpd** as the container image as well as the container name
- This will pull the Docker container and run it in the minikube environment

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Kubernetes Beyond Minikube

K8s in Public Cloud

- Kubernetes is commonly used in public cloud
  - AWS
  - Azure
  - Google Cloud
- Installation in private cloud (OpenStack and others) is also common
- Alternatively, Kubernetes can be installed in local datacenter

Kubernetes Deployment

- K8s can be deployed in many different ways
- According to the scale you need, different Kubernetes deployments can be used
  - single node: good for learning, not for production
  - single head node with multiple workers
  - multiple head nodes in HA with multiple workers
  - multiple head nodes in HA with etcd in HA and multiple workers
- Also, you need to decide where to run Kubernetes: public cloud, virtual machines, physical machines?
- And if you want to run Kubernetes as systemd unit files from a Linux host, or as containers
  - Hyperkube is a nice solution that's doing just that

Installing a Physical Cluster

- **kubeadm** helps you building a physical cluster, running in your local datacenter
- The documentation is here: https://kubernetes.io/docs/setup/independent/create-cluster-kubeadm/
- Rough procedure outline
  - Run **kubeadm init** on the head node
  - Create a network
    - **kubectl apply -f "https://cloud.weave.works/k8s/net?k8s-version=$(kubectl version | base64 | tr -d '\n')"**
  - Run **kubeadm join --token <token> <head-node-IP-address>** to join worker nodes

Accessing and Using the Cluster

Methods to access the cluster

- The **kubectl** command line utility provides convenient administrator access, allowing you to run many tasks against the cluster
- Direct API access allows developers to address the cluster using API calls from custom scripts
- The Kubernetes Console by default is available and accessible on port 30000 of the Kubernetes master

Using kubectl

- The **kubectl** command is the generic command that allows you to manage all aspects of pods and containers
  - It provides functionality that normally is provided through the **docker** command, but talks to pods instead of containers
- Use **kubectl create** to create pods
- Or **kubectl get ...** or one of the many other options to get information about pods
- **kubectl** works with subcommands, type just **kubectl** for a list of these, and use **kubectl <subcommand> --help** for more information about any of the subcommands
  - Notice the nice examples section on top of the --help output

Connecting to the API

- The API server exposes its functionality through REST
- Assuming that minikube is running, connect to it by running a local proxy first (on your workstation for instance), after which you can connect using curl
  - **kubectl proxy --port=8001&**
  - **curl http://localhost:8001**
- This shows all of the available API paths and groups, providing access to all exposed functions
- Using a proxy allows you to use **curl** and send API calls directly
- Read the documentation for more info about the API groups
- Every API is built according to strict specifications and always contains specific elements

Connecting to the API: demo

- On the host that runs kubectl: **kubectl proxy --port=8001 &**
- **curl http://localhost:8001/version**
- **curl http://localhost:8001/api/v1/namespaces/default/pods**-> shows the pods
- **curl http://localhost:8001/api/v1/namespaces/default/pods/httpd/** shows direct API access to a pod
- **curl -XDELETE http://localhost:8001/api/v1/namespaces/default/pods/httpd** will delete the hpptd pod

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Managing Pods

What is a Pod?

- A Pod is an abstraction of a server
  - It runs multiple containers within a single name space, exposed by a single IP address
- The Pod is the minimal entity that can be managed by Kubernetes

Managing pods with kubectl

- Use **kubectl run** to run a *deployment* based on a default image
  - **kubectl run ghost --image=ghost:0.9**
- Use **kubectl** combined with instructions in a YAML file to do anything you'd like
- **kubectl create -f <name>.yaml --validate=false**
- **kubectl get pods**
- (see sample code on next slide)
- **kubectl describe pods** shows all details about a pod, including information about containers running within
  - For instance, **kubectl describe pods newhttpd**
- **kubectl edit pod mypod** allows editing of live pods

Using kubectl in a declarative way

- The recommended way to work with kubectl, is by writing your manifest files and using **kubectl apply -f manifest.yaml** to the current objects in your cluster
- This declarative methodology is giving you much more control than the imperative methodology where you create all from the CLI
  - Get current state of an object: **kubectl get deployments nginx --export -n nginx -o yaml**
  - Push settings from a new manifest: **kubectl replace -f nginx.yaml -n nginx**
  - Apply settings from a manifest: **kubectl apply -f nginx.yaml**

Example yaml Input File

```
apiVersion: v1
kind: Pod
metadata:
  name: mypod
  namespace: default
spec:
  containers:
  - name: busybox
    image: busybox
    command:
      - sleep
      - "3600"
  - name: nginx
    image: nginx
```

Understanding Namespaces

- When creating pods, namespaces are used
- Deployments/services that need to communicate to one another may be created in the same namespace, if no communication is needed, it's recommended to use separate namespaces
- A namespace is a strict isolation that occurs on Linux kernel level
  - Names need to be unique within a namespace, but the same name may exist in multiple name spaces
- Every **kubectl** request uses namespaces to ensure that resources are strictly separated and names don't have to be unique

Using Namespaces

- The following commands allow you to work with namespaces
  - **kubectl get ns**
  - **kubectl create ns demo**
  - **kubectl get ns/demo -o yaml**
  - **kubectl delete ns/demo**
- As seen in the previous slide, you can add namespaces when creating a pod, thus ensuring that a pod is available in a specific namespace only

Getting information about Pods

- The API exposes lots of useful information about pods
- Request this information using **kubectl** or API calls
- **kubectl logs <podname>**
- **kubectl exec -ti <podname> <command>**
- **kubectl port-forward**
- **kubectl attach**
- Tip: use **kubectl nnn -h** for usage information about the -h option

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Working with Deployments

Understanding Replica Sets

- The pod is the most basic entity in Kubernetes
- To determine how many instances of a pod you want to run, you need replica sets
  - In older versions, replication controllers were used instead
  - Old commands like **kubectl get rc** won't work anymore
- Replica sets are using labels to determine how many pods are running
  - While defining the replica set, set the label using labels:
  - In the replicaset, use matchlabels to find the labels
  - From deployments, labels are automatically set

Understanding Deployments

- Deployments are used to create and automate replica sets
- Deployments instruct the cluster how to create and scale applications
- The deployment controller will monitor instances of an application
- Use deployments to create replica sets
- Deployments allow for the creation of multiple replica sets for rolling upgrades or rollbacks
- Request information about these different levels
  - **kubectl run nginx --image=nginx**
  - **kubectl get deployments**
  - **kubectl get rs**
  - **kubectl get pods**

Understanding Deployments versus Replica Sets

- Management should happen at the deployment level, not at the replica sets level
- This demo shows why
  - **kubectl get rs**
  - **kubectl delete rs <name>**
  - **kubectl get rs** it has been recreated automatically!
  - **kubectl get deployments**: because there are still deployments!
  - **kubectl delete deployment <name>** will finally remove it

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Using Scaling and Rollback

Scaling deployments

- **kubectl scale deployment nginx --replicas=3**
  - Notice that scaling deployments may fail because of limited availability of resources
- **kubectl get deployments nginx -o json**
  - Notice that different output formats are available, use **-o yaml** if you prefer seeing it in yaml, or **-o json** for json
  - In the output look for the labels; a run label is automatically added
- **kubectl get pods -Lrun** filters on pods with the label running
  - The run label is used to determine if sufficient replicas are available
  - Remove one "run" label and you'll notice that a new pod will be created immediately
  - Use **kubectl label pods <name> run-** to remove the label run

Understanding Labels

- Labels are name tags that can be set on objects
- Replicasets use labels to monitor the availability of a sufficient amount of pods
- Services use them to define network traffic
- Labels can be set on nodes, and combines with nodeSelector to run specific pods on specific nodes

Using Labels

- **kubectl get pods --show-labels** will show labels
- **kubectl get pods -Lstatus** adds a column based on the label "status" and will show all pods that have a value set for that label
- **kubectl get pods -l status=ok** will show all pods that match a specific label
- **kubectl label pods <somepod> status=failing --overwrite** will reset the label on a pod that already has a label
- Notice that if a label is changed on a pod that is a member of a replicaset, changing the label will trigger the replicaset to start a new pod!
- When using **kubectl run ...** the label automatically is set to run, and the value to the name of the deployment

Doing Rolling Updates

- To start: **kubectl run nginx**
- Verify current image version: **kubectl describe deployment nginx**
- Check replica sets: **kubectl get rs**
- Change the version: **kubectl set image deployment nginx nginx=nginx:0.9**
- Now verify: **kubectl get rs --watch**
  - The --watch option refreshes, you'll notice a new replica set that has all of the running pods, and the old replica set that is going to be empty after a while
- And see how this shows in the deployment

Rollback

- The **kubectl rollout history deployment nginx** command will show revision history
  - Notice that it will show <none> in the CHANGE-CAUSE field. If you want to see something in there, use the **--record** option while using **kubectl run**
    - **kubectl run nginx --image=nginx --record**
- To rollback, use **kubectl rollout undo deployment nginx**
  - Use **--to-deployment=1** to get back to a specific deployment version
- Verify using **kubectl get rs --watch**

Accessing Services from Outside

Accessing Applications in a pod

- To access an application running in a pod, port-forward can be used
- Run the port-forward argument to **kubectl** as a background process, this will export the pod port locally
  - **kubectl port-forward httpd 8000:80 &** where
  - **curl localhost:8000**

Understanding Services

- Anything running in a pod is for internal use only. To expose containers in a pod to the outside world, you'll need services
- Also, services provide a more flexible way of making sure that containers are available
- A default Kubernetes services is created automatically, custom services can be created using **kubectl expose**
- Which pods are added to a service is normally determined by using a label selector
- Using labels makes services very flexible: you don't rely on the existence of a specific pod, but of a pod that caries a specific label, which makes it easy to replace pods

Creating Services

- Before you can put a pod in a service, it needs a label
- Use **kubectl describe pod httpd** and look for the label section
- Set a label, using **kubectl label pod httpd app=v1**
- Expose it, using **kubectl expose pod httpd --type="NodePort" --port=80**
- Use **kubectl get services** to verify that the pod has been exposed
- Use **kubectl delete service httpd** to remove the service
- Notice that removing a service does NOT remove the pod, it just un-exposes it

Managing Services: demo

- **kubectl get deployment**
- **kubectl expose deployment httpd --port=80 --type=NodePort**
- **kubectl get svc**
  - Note the random port that has been assigned and is listening at the Kubernetes cluster to provide access to the service
- **kubectl get svc httpd -o yaml**
  - Have a look at the label and the selector that are used in the YAML output
- **curl http://192.168.99.100:<NODEPORT>** ## Note that the IP address is the IP of the minikube host!

Understanding Service Types

- Different service types determine how services are accessed
  - **ClusterIP** is the default and provides internal access only
  - **NodePort** assigns a random port ID, you'll need to open a firewall port to get it working
  - **LoadBalancer** is available in public cloud. May be used in private cloud, if Kubernetes provides a plugin for that cloud type
- To access a cluster IP service locally (without exposing it), you may also use **kubectl proxy**
  - After starting kubectl proxy, the service is accessible on the host where **kubectl proxy** was started

Understanding Services and DNS

- With services exposing themselves on dynamic ports, resolving service names can be challenging
- As a solution, a DNS service is included by default in Kubernetes and this DNS service is updated every time a new service is added
- So DNS name lookup from within one pod to any exposed service happens automatically

Understanding Endpoints

- Service expose Pods in a deployment to the outside world
- In the backing cluster, the traffic needs to be forwarded to a real pod that is running in the cluster
- To do this, an endpoint is created by the kubeproxy for each pod
- The kubeproxy writes an iptables rule to capture incoming traffic on that port, and forward it to the endpoint
- Use **kubectl get endpoints** for a list of endpoints

Understanding Ingress

- Ingress offers service access at a specific URL
- This is useful to make sure services can be accessed in a predicted way, instead of using a random high port
- Ingress is using a proxy in the backend to provide access to the deployments
- Ingress controller must be deployed for your platform

Managing Ingress

- Ingress controllers can use a host definition. If defined, traffic addressed to that specific URL only will be redirected to what the Ingress controller defines
- If host is not set (as in nginx-in.yaml) it hits all

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Working with Volumes

Understanding Volumes

- A pod typically is a couple of containers with one or more volumes attached
- Volumes can be mounted in a specific location in the container
- Different types of volumes are available, according to storage needs
- Volumes typically are created using YAML files while creating the VMs

Understanding Volume Types

- Many volume types are supported
  - emptyDir
  - azureDisk
  - cephfs
  - awsElasticBlockStore
  - fc: fibrechannel
  - gcePersistentDisk: Google cloud
  - iscsi
  - nfs
  - rbd
  - gitrepo
  - hostPath: connects to host in minikube environment
- And more: choose what fits your specific needs

Volume YAML File Example

```
apiVersion: v1
kind: Pod
metadata:
 name: morevol
spec:
 containers:
 - name: centos
   image: centos:7
   command:
     - sleep
     - "3600"
   volumeMounts:
     - mountPath: /centos
       name: test
   name: centos
...
- name: centos
  image: centos:7
  command:
    - sleep
    - "3600"
  volumeMounts:
    - mountPath: /centos2
      name: test
  name: centos2
volumes:
  - name: test
    emptyDir: {}
```

Managing Volumes (demo)

- Creating the Volume
  - **kubectl create -f volumes.yaml --validate=false**
  - **kubectl get pods**
- After creation, test that you can use it
  - **kubectl exec -ti vol -c centos -- touch /test/myfile**
  - **kubectl exec -ti vol -c centos -- ls -l /test**
  - Note: try this command without --

Understanding Persistent Volumes

- A Persistent Volume is a storage abstraction that is used to store persistent data
  - Use **persistentVolume** to define it
  - Different types (NFS, iSCSI, CephFS and many more) are available
- Using claims with Persistent Volumes creates portable Kubernetes storage that allow you to use volumes, regardless of the specific storage provider
  - Use **persistentVolumeClaims**
  - The persistent volume claim talks to the available backend storage provider and dynamically uses volumes that are available on that storage type

Understanding ConfigMap

- A ConfigMap is a file that is available on the kubectl host which is mapped into the Pod
- Use **kubectl create configmap blah --from-file /etc/hosts** to create
- When defining the Pod, include a configMap section to mount it

```
...
  volumeMounts
  - name: hostfile
    mount: /etc/hosts
volumes:
- name: hostfile
  configMap:
    name: blah
```

Additional Features

Interesting Kubernetes Features not in this course

- Quota set resource limitations at a namespace level
- Secrets: like configMaps, to work with sensitive data in a way that the data is not readable
- Helm: the Kubernetes Package Manager, applications are packages in a chart and published in a repository as a tarball, allows to group all the different object types that make up an app into one package
- Custom Resource Definitions: the option to create your own objects in the API

Kubernetes in 3 Hours

Summary

Summary

- In this course you've learned about Kubernetes essentials
- Kubernetes is a rapidly evolving environment and there's much more that can be learned
- For additional information, see my videocourse on safari: https://www.safaribooksonline.com/library/view/getting-started-with/9780135237823/