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Using Service Mesh Technology within a Microservice architecture design. Environment Setup

by

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Contents

Environment Setup

The purpose of this document is to provide a development guide which outlines how to install and configure all the different components which went into making this project. Starting with installing Virtualbox, and ansible, provisioning the cluster with vagrant. Install and configure an NFS storage to act as permanent storage for databases and Elk stack. Providing bare-metal load balancing with MetalLb. Installing all the necessary components for Istio. Installing and configuring HAProxy to expose all the necessary endpoint.

Building the base Kubernetes system

The base system consists of the following installation steps:

1. Install curl
2. Install Virtual box
3. Install Vagrant
4. Install Ansible
5. Install a kubernetes cluster, with 1 master and 3 nodes
6. Install the kubernetes Dashboard
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Curl Install

Installing curl through the command line

```
sudo apt install curl
```

Install Virtual box

Installing VirtualBox Through the Command line

```
sudo add-apt-repository multiverse && sudo apt-get update
sudo apt install virtualbox
```

Install the Extension Package

```
sudo apt install virtualbox-ext-pack
```

Check the virtual box version, it should b 6.0 or above

```
vboxmanage --version
$ 6.0.6_Ubuntur129722
```

Run virtual box with

```
virtualbox
```

Install vagrant

Start by updating the package list with:

```
sudo apt update
```

Download the Vagrant package using the following curl command:

```
curl -O
   https://releases.hashicorp.com/vagrant/2.2.6/vagrant_2.2.6_x86_64.deb
```

Once the .deb file is downloaded, install it by typing:

```
sudo apt install ./vagrant_2.2.6_x86_64.deb
```

Verify Vagrant installation To verify that the installation was successful, run the following command which prints the Vagrant version:

```
vagrant --version
```

The output should look something like this:

```
Vagrant 2.2.6
```

Install Ansible

Installing Ansible on the Command line

```
sudo apt update
sudo apt install software-properties-common
sudo apt-add-repository --yes --update ppa:ansible/ansible
sudo apt install ansible -y
```

Check the version of Ansible

```
$ ansible --version

ansible 2.9.6
  config file = /etc/ansible/ansible.cfg
  configured module search path =
    [u'/home/eamonfoy/.ansible/plugins/modules',
    u'/usr/share/ansible/plugins/modules']
  ansible python module location =
    /usr/lib/python2.7/dist-packages/ansible
  executable location = /usr/bin/ansible
  python version = 2.7.17 (default, Nov  7 2019, 10:07:09) [GCC 7.4.0]
```

Install a kubernetes cluster, with 1 master and 3 nodes

This section assumes you have successfully downloaded source code. From the root of the source code folder follow the following commands

```
cd 1_base_system_build/kubernetes-vagrant_cluster
```

This section assumes you have successfully downloaded source code. From the root of the source code folder follow the following commands

```
vagrant up
```

This command will take a while depending on your internet speed and also the capacity of your machine. For me it was around 10 minutes.

This section is inspired by a tutorial found here

We are going to use vagrant to set up the following vm's which will contain the kubernetes cluster:

vm(s)	Description	IP	RAM	vCPU
K8S-M-1	Kubernetes Master	192.168.50.11	4Gb	4
K8S-N-1	Kubernetes Node 1	192.168.50.12	16GB	4
K8S-N-2	Kubernetes Node 2	192.168.50.13	16GB	4
K8S-N-3	Kubernetes Node 3	192.168.50.14	16GB	4

Virtualbox NAT network setting are:

Description	IP
host	10.0.0.45
vboxnet0 virtual iface	192.168.50.1

Virtual box creates routes which you will need to make not of

```
$ route
Kernel IP routing table
Destination     Gateway         Genmask         Flags Metric Ref    Use
    Iface
default         _gateway        0.0.0.0         UG    100    0        0
    eno1
10.0.0.0        0.0.0.0         255.255.255.0   U     100    0        0
    eno1
```

```
link-local      0.0.0.0         255.255.0.0     U     1000   0        0 eno1
192.168.50.0    0.0.0.0         255.255.255.0   U     0      0        0 vboxnet0
```

To ssh in to the master node use the following: “‘bash ssh vagrant@192.168.50.11

Note when it asks for a password type : vagrant “‘bash

Now I am on the kubernetes master

```
ssh vagrant@192.168.50.11
The authenticity of host '192.168.50.11 (192.168.50.11)' can't be established.
ECDSA key fingerprint is SHA256:7ok3hLsAT6RMxwYkoISSQ5Xltpglng6eQ6ZJk/bkOMY.
Are you sure you want to continue connecting (yes/no)? yes
Warning: Permanently added '192.168.50.11' (ECDSA) to the list of known hosts.
vagrant@192.168.50.11's password:
Welcome to Ubuntu 18.04.4 LTS (GNU/Linux 4.15.0-76-generic x86_64)

* Documentation:  https://help.ubuntu.com
* Management:     https://landscape.canonical.com
* Support:        https://ubuntu.com/advantage

System information as of Sat Feb  8 23:46:48 UTC 2020

System load:  1.23              Users logged in:        0
Usage of /:   5.7% of 61.80GB   IP address for eth0:    10.0.2.15
Memory usage: 40%               IP address for eth1:    192.168.50.11
Swap usage:   0%                IP address for docker0: 172.17.0.1
Processes:    146               IP address for tunl0:   192.168.116.0

* Multipass 1.0 is out! Get Ubuntu VMs on demand on your Linux, Windows or
```

```
Mac. Supports cloud-init for fast, local, cloud devops simulation.

    https://multipass.run/

9 packages can be updated.
9 updates are security updates.



This system is built by the Bento project by Chef Software
More information can be found at https://github.com/chef/bento
Last login: Sat Feb  8 21:56:40 2020 from 10.0.2.2
```

While we are on the kubernetes master we can check the status of the cluster:

```
kubectl get all
```

Installing kubectl on host

This will enable us to administer the Kubernetes Cluster from host and not needing to log into the master.

Run the following commands from the host machine:

```

sudo apt-get update && sudo  apt-get install -y apt-transport-https

curl -s https://packages.cloud.google.com/apt/doc/apt-key.gpg | sudo apt-key add -

echo "deb https://apt.kubernetes.io/ kubernetes-xenial main" | sudo tee -a /etc/apt/sources.list.d/kubernetes.list

sudo apt-get update

sudo apt-get install -y kubectl
```

Copy the Kubernetes config

This series of steps will copy the Kubernetes config to your local home .kube dir

Create the configuration directory

```
$ mkdir -p ~/.kube
```

Find the SSH port of the k8s-m-1 server

```
$ vagrant port k8s-m-1

The forwarded ports for the machine are listed below. Please note that
these values may differ from values configured in the Vagrantfile if the
provider supports automatic port collision detection and resolution.
    22 (guest) => 2222 (host)
```

Copy the file using scp (ssh password is vagrant)

```
$ scp -P 2222 vagrant@127.0.0.1:/home/vagrant/.kube/config
   ~/.kube/config

vagrant@127.0.0.1's password: vagrant
config
      100% 5449   118.7KB/s   00:00
```

Check is kubectl working

List the Kubernetes cluster nodes using kubectl from your development host:

```
$ kubectl cluster-info

Kubernetes master is running at https://192.168.50.11:6443
KubeDNS is running at
   https://192.168.50.11:6443/api/v1/namespaces/kube-system/services/kube-dns:dns/pro
```

Check the status of the nodes

```
$ kubectl get nodes --all-namespaces
```

```
NAME      STATUS   ROLES    AGE   VERSION
k8s-m-1   Ready    master   49m   v1.17.2
k8s-n-1   Ready    <none>   46m   v1.17.2
k8s-n-2   Ready    <none>   43m   v1.17.2
```

Check the status of all the pods

```
$ kubectl get pods --all-namespaces
NAMESPACE     NAME                                       READY   STATUS
      RESTARTS   AGE
kube-system   calico-kube-controllers-6895d4984b-jbg6r   1/1
   Running   0          52m
kube-system   calico-node-pftj4                          1/1
   Running   0          52m
kube-system   calico-node-vdshc                          1/1
   Running   0          6m
kube-system   calico-node-w7s7v                          1/1
   Running   0          49m
kube-system   coredns-6955765f44-6qk9z                   1/1
   Running   0          52m
kube-system   coredns-6955765f44-tqll4                   1/1
   Running   0          52m
kube-system   etcd-k8s-m-1                               1/1
   Running   0          52m
kube-system   kube-apiserver-k8s-m-1                     1/1
   Running   0          52m
kube-system   kube-controller-manager-k8s-m-1            1/1
   Running   0          52m
kube-system   kube-proxy-6f692                           1/1
   Running   0          52m
kube-system   kube-proxy-6fhzt                           1/1
   Running   0          46m
kube-system   kube-proxy-h72z6                           1/1
   Running   0          49m
```

```
kube-system   kube-scheduler-k8s-m-1                     1/1
   Running   0          52m
```

Deploy a test app to check if the cluster is working

This section assumes you have successfully downloaded source code.

From the root of the source code folder follow the following commands

```
cd 1_base_system_build/kubernetes-vagrant_cluster
```

Deploy nginx to the cluster

```
$ kubectl apply -f nginx.yaml
deployment.apps/nginx-deployment created
service/nginx-service-np created
```

We need to check the application has been deployed correctly.

To do this we will now check the two nodes using curl to check that nginx got deployed correctly.

Check Node 1

```
$ curl http://192.168.50.12:30000/

Hostname: nginx-deployment-569b77699b-lvstv

Pod Information:
    -no pod information available-

Server values:
    server_version=nginx: 1.13.3 - lua: 10008

Request Information:
    client_address=192.168.122.0
    method=GET
    real path=/
    query=
    request_version=1.1
    request_uri=http://192.168.50.12:8080/

Request Headers:
    accept=*/*
    host=192.168.50.12:30000
    user-agent=curl/7.64.0

Request Body:
    -no body in request-
```

Check Node 2

```
$ curl http://192.168.50.13:30000/

Hostname: nginx-deployment-569b77699b-lvstv

Pod Information:
    -no pod information available-

Server values:
    server_version=nginx: 1.13.3 - lua: 10008

Request Information:
    client_address=192.168.122.0
    method=GET
    real path=/
    query=
    request_version=1.1
    request_uri=http://192.168.50.13:8080/

Request Headers:
    accept=*/*
    host=192.168.50.13:30000
    user-agent=curl/7.64.0

Request Body:
    -no body in request-
```

Install the kubernetes Dashboard

The Kubernetes Dashboard provides a web-based user interface to deploy applications, troubleshoot and manage resources. The same functionality is provided through the command line tools but under a very nice web application with charts and beautiful screens.

To deploy the Web UI (Dashboard) or Kubernetes Dashboard run the following command:

```
kubectl apply -f
   https://raw.githubusercontent.com/kubernetes/dashboard/v2.0.0-beta8/aio/deploy/rec
```

The deployment file will publish the Kubernetes Dashboard using a ClusterIP service as shown below using TargetPort 8443:

```
$ kubectl -n kubernetes-dashboard describe service kubernetes-dashboard
```

response:

```
Name:              kubernetes-dashboard
Namespace:         kubernetes-dashboard
Labels:            k8s-app=kubernetes-dashboard
Annotations:       kubectl.kubernetes.io/last-applied-configuration:

   {"apiVersion":"v1","kind":"Service","metadata":{"annotations":{},"labels":{"k8s-ap
Selector:          k8s-app=kubernetes-dashboard
Type:              ClusterIP
IP:                10.109.172.25
Port:              <unset>  443/TCP
TargetPort:        8443/TCP
```

```
Endpoints:          192.168.122.129:8443
Session Affinity:   None
Events:             <none>
```

In order to access the Kubernetes Dashboard from our workstation, a NodePort will be created to publish the kubernetes-dashboard following the Publish an Application Outside Kubernetes Cluster instructions.

The file kubernetes-dashboard-service-np.yaml:

Creates an admin-user Assigns the cluster-admin role Creates a new NodePort service that publishes TargetPort 8443 as NodePort 30002:

```
---
apiVersion: v1
kind: ServiceAccount
metadata:
  name: admin-user
  namespace: kubernetes-dashboard
---
apiVersion: rbac.authorization.k8s.io/v1
kind: ClusterRoleBinding
metadata:
  name: admin-user
roleRef:
  apiGroup: rbac.authorization.k8s.io
  kind: ClusterRole
  name: cluster-admin
subjects:
- kind: ServiceAccount
  name: admin-user
  namespace: kubernetes-dashboard
---
kind: Service
apiVersion: v1
metadata:
  namespace: kubernetes-dashboard
  name: kubernetes-dashboard-service-np
  labels:
    k8s-app: kubernetes-dashboard
spec:
  type: NodePort
  ports:
  - port: 8443
    nodePort: 30002
    targetPort: 8443
    protocol: TCP
  selector:
    k8s-app: kubernetes-dashboard
```

Apply the changes:

```
kubectl apply -f kubernetes-dashboard-service-np.yaml
```

Obtain an authentication token to use on the Kubernetes Dashboard authentication realm:

```
kubectl -n kubernetes-dashboard describe secret $(kubectl -n kubernetes-dashboard get secret | grep admin-user | awk '{print $1}')
```

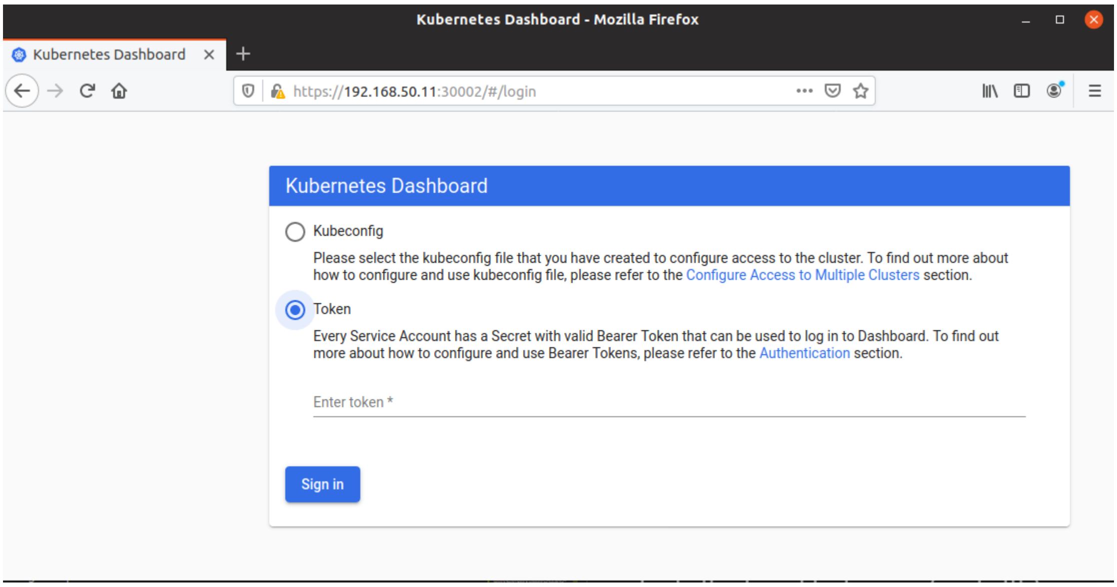
The command will print out the token, yours will be different than mine

```
kubectl -n kubernetes-dashboard describe secret $(kubectl -n kubernetes-dashboard get secret | grep admin-user | awk '{print $1}')
Name:         admin-user-token-vjh27
Namespace:    kubernetes-dashboard
Labels:       <none>
Annotations:  kubernetes.io/service-account.name: admin-user
              kubernetes.io/service-account.uid: ab754545-5c40-463a-9ce7-0f8d19279d23

Type:  kubernetes.io/service-account-token
```

```

Data
====
ca.crt:      1025 bytes
namespace:   20 bytes
token:
    eyJhbGciOiJSUzI1NiIsImtpZCI6Ik4xeGprVGNuMzBWRGtLamhVRGRYZl9YaTY3TWNBTlByQWFaei1YeU
```

Copy the token part on to the cipboard for later

Access the Kubernetes Dashboard using the URL https://192.168.50.11:30002/#/login


Kubernetes Dashboard - Mozilla Firefox
Kubernetes Dashboard
https://192.168.50.11:30002/#/login

Kubernetes Dashboard

○ Kubeconfig

Please select the kubeconfig file that you have created to configure access to the cluster. To find out more about how to configure and use kubeconfig file, please refer to the Configure Access to Multiple Clusters section.

● Token

Every Service Account has a Secret with valid Bearer Token that can be used to log in to Dashboard. To find out more about how to configure and use Bearer Tokens, please refer to the Authentication section.

Enter token *

Sign in

FIGURE 1: login

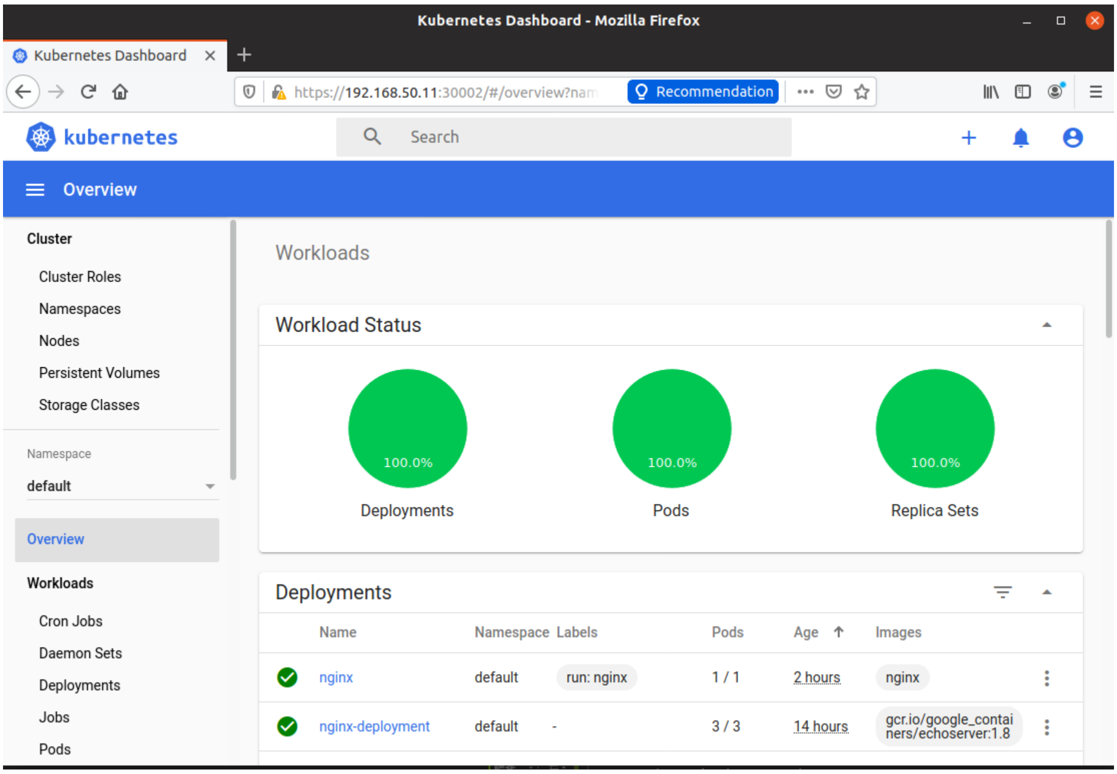
Using the token copied to the cipboard, paste in and click signin. This will allow you to login in to the Dasboard:

Install a Load balancer (metallb)

Background

Because Kubernetes does not offer an implementation of network load-balancers (Services of type LoadBalancer) for bare metal clusters.

The implementations of Network LB that Kubernetes does ship with are all glue code that calls out to various IaaS platforms (GCP, AWS, Azure…). If you're not running



Name	Namespace	Labels	Pods	Age	Images
nginx	default	run: nginx	1 / 1	2 hours	nginx
nginx-deployment	default	-	3 / 3	14 hours	gcr.io/google_containers/echoserver:1.8

Figure 2: login

on a supported IaaS platform (GCP, AWS, Azure…), LoadBalancers will remain in the "pending" state indefinitely when created.

Bare metal cluster operators are left with two lesser tools to bring user traffic into their clusters, "NodePort" and "externalIPs" services. Both of these options have significant downsides for production use, which makes bare metal clusters second class citizens in the Kubernetes ecosystem.

MetalLB aims to redress this imbalance by offering a Network LB implementation that integrates with standard network equipment, so that external services on bare metal clusters also "just work" as much as possible.

To install MetalLB, apply the following manifest:

```
kubectl apply -f
    https://raw.githubusercontent.com/google/metallb/v0.8.3/manifests/metallb.yaml
```

To configure metal lb we need ti find out more about the addressing which is being used within the cluster:

```
$ kubectl get nodes -o wide
```

```
NAME      STATUS   ROLES    AGE   VERSION   INTERNAL-IP     EXTERNAL-IP
     OS-IMAGE            KERNEL-VERSION      CONTAINER-RUNTIME
k8s-m-1   Ready    master   12h   v1.17.2   192.168.50.11   <none>
     Ubuntu 18.04.4 LTS   4.15.0-76-generic   docker://19.3.5
k8s-n-1   Ready    <none>   12h   v1.17.2   192.168.50.12   <none>
     Ubuntu 18.04.4 LTS   4.15.0-76-generic   docker://19.3.5
k8s-n-2   Ready    <none>   12h   v1.17.2   192.168.50.13   <none>
     Ubuntu 18.04.4 LTS   4.15.0-76-generic   docker://19.3.5
```

Metallb is configured using the following command

Note: - The ip **addresss** range below will need to be changed depending on you kubernetes deployment. The previous command will advise you on which network range to use

```
cat <<EOF | kubectl create -f -
apiVersion: v1
kind: ConfigMap
metadata:
  namespace: metallb-system
  name: config
data:
  config: |
    address-pools:
    - name: default
      protocol: layer2
      addresses:
      - 192.168.50.240-192.168.50.250
EOF
```

**** ONLY REQUIRED IF YOUR RUN IN TO BOTHER *** Check that the configuration is set by using the following command

```
kubectl get configmap -n metallb-system config -o json
```

Just in case you need to delete this configuration and strat over, here is the command:

```
kubectl delete configmap -n metallb-system config
```

Testing the load balancer

Deploy a simple nginx container

```
kubectl run nginx --image nginx
```

Create a loadbalancer service to expose the service on port 80

```
kubectl expose deploy nginx --port 80 --type LoadBalancer
```

list all to see

```
kubectl get all -o wide
```

See below the service is exposed on ip 192.168.50.240 port 80:32049

```
NAME                                    READY   STATUS    RESTARTS
    AGE   IP                NODE      NOMINATED NODE   READINESS GATES
pod/nginx-6db489d4b7-6mbm2              1/1     Running   0
    81s   192.168.122.133   k8s-n-2   <none>           <none>
pod/nginx-deployment-569b77699b-44hs4   1/1     Running   1
    12h   192.168.122.2     k8s-n-1   <none>           <none>
pod/nginx-deployment-569b77699b-6t4z7   1/1     Running   1
    12h   192.168.122.132   k8s-n-2   <none>           <none>
pod/nginx-deployment-569b77699b-lvstv   1/1     Running   1
    12h   192.168.122.131   k8s-n-2   <none>           <none>

NAME                       TYPE           CLUSTER-IP      EXTERNAL-IP
       PORT(S)          AGE   SELECTOR
service/kubernetes         ClusterIP      10.96.0.1       <none>
       443/TCP          13h   <none>
service/nginx              LoadBalancer   10.104.202.13
    192.168.50.240   80:32049/TCP     27s   run=nginx
service/nginx-service-np   NodePort       10.103.144.87   <none>
       8082:30000/TCP   12h   app=nginx

NAME                               READY   UP-TO-DATE   AVAILABLE   AGE
      CONTAINERS   IMAGES                                     SELECTOR
```

```
deployment.apps/nginx              1/1     1            1           81s
     nginx        nginx                                          run=nginx
deployment.apps/nginx-deployment   3/3     3            3           12h
     my-echo      gcr.io/google_containers/echoserver:1.8   app=nginx

NAME                                          DESIRED   CURRENT   READY
     AGE    CONTAINERS   IMAGES
   SELECTOR
replicaset.apps/nginx-6db489d4b7              1         1         1
     81s    nginx        nginx
   pod-template-hash=6db489d4b7,run=nginx
replicaset.apps/nginx-deployment-569b77699b   3         3         3
     12h    my-echo      gcr.io/google_containers/echoserver:1.8
   app=nginx,pod-template-hash=569b77699b
```

Test that everything is working by using curl as follows:

```
$ curl 192.168.50.240:80
```

Response will be as follows:

```
<!DOCTYPE html>
<html>
<head>
<title>Welcome to nginx!</title>
<style>
    body {
        width: 35em;
        margin: 0 auto;
        font-family: Tahoma, Verdana, Arial, sans-serif;
    }
</style>
</head>
<body>
<h1>Welcome to nginx!</h1>
```

```
<p>If you see this page, the nginx web server is successfully installed and
working. Further configuration is required.</p>

<p>For online documentation and support please refer to
<a href="http://nginx.org/">nginx.org</a>.<br/>
Commercial support is available at
<a href="http://nginx.com/">nginx.com</a>.</p>

<p><em>Thank you for using nginx.</em></p>
</body>
</html>
```

Once your done with nginx you can remove as follows

```
 kubectl delete deployment,pod,service nginx
```

Install NFS Server on the host

Install the Ubuntu needed packages

```
sudo apt install -y nfs-kernel-server
```

Make the neccessary directories and ownerships

```
sudo mkdir -p /mnt/vagrant-kubernetes
sudo mkdir -p /mnt/vagrant-kubernetes/data
sudo mkdir -p /mnt/vagrant-kubernetes/aodb
sudo mkdir -p /mnt/vagrant-kubernetes/flight
sudo mkdir -p /mnt/vagrant-kubernetes/weather
sudo mkdir -p /mnt/vagrant-kubernetes/elastic
sudo chown nobody:nogroup /mnt/vagrant-kubernetes
sudo chmod 777 /mnt/vagrant-kubernetes
```

Edit the /etc/exports file to add the exported local directory and limit the share to the CIDR 192.168.50.0/24 of our Kubernetes Vagrant Cluster VirtualBox machines.

```
/mnt/vagrant-kubernetes
    *(rw,sync,no_subtree_check,insecure,no_root_squash)
```

Start the nfs server

```
sudo exportfs -a
sudo systemctl restart nfs-kernel-server
sudo exportfs -v
```

This is the response you should see

```
/mnt/vagrant-kubernetes
*(rw,wdelay,insecure,no_root_squash,no_subtree_check,sec=sys,rw,insecure,no_root_squa
```

showmount –e

Install Dynamic Storage Volume Creation

The youtube video Dynamically provision NFS persistent volumes in Kubernetes is my inspiration

First of all make sure your in the following directory

```
cd
    01_system_build/kubernetes-vagrant_cluster/dynamic_nfs_persistant_volume_creation
```

This directory holds all the yamls neccessary to install dynamic NFS storage provisioning

- class.yaml
- default-sc.yaml
- deployment.yaml
- rbac.yaml

We are going to create create the following items - ServiceAccount - Role - RoleBinding - ClusterRole - ClusterRoleBinding

by issueing the following command

```
kubctl create -f rbac.yaml
```

Next we are going to create the StorageClass and we are going to call this **managed-nfs-storage**. This is created by the following command:

```
kubctl create -f class.yaml
```

Next we will create a deployment for the nfs client provisioner.

Make sure to update the “server” and “path” within the deployment.yml to point to your own nfs server setup and addationally NFS_SERVER and NFS_PATH.

The following **deployment.yaml** represents my own setup and will be different in every situation.

```
kind: Deployment
apiVersion: apps/v1
metadata:
  name: nfs-client-provisioner
spec:
  replicas: 1
  strategy:
    type: Recreate
  selector:
    matchLabels:
      app: nfs-client-provisioner
  template:
    metadata:
      labels:
        app: nfs-client-provisioner
    spec:
      serviceAccountName: nfs-client-provisioner
      containers:
        - name: nfs-client-provisioner
          image: quay.io/external_storage/nfs-client-provisioner:latest
          volumeMounts:
            - name: nfs-client-root
              mountPath: /persistentvolumes
          env:
            - name: PROVISIONER_NAME
              value: example.com/nfs
            - name: NFS_SERVER
              value: 10.0.0.23
            - name: NFS_PATH
              value: /mnt/vagrant-kubernetes/data
      volumes:
        - name: nfs-client-root
          nfs:
            server: 10.0.0.23
            path: /mnt/vagrant-kubernetes/data
```

By issueing the following command we will create the deployment:

```
kubctl create -f deployment.yaml
```

Install HA Proxy

This is the install process for HAProxy 1.7

```
sudo add-apt-repository ppa:vbernat/haproxy-1.7
```

Confirm adding the new PPA by pressing the Enter key.

Next, update your sources list.

```
sudo apt update
```

Then install HAProxy as you normally would.

```
sudo apt install -y haproxy
```

Afterwards, you can double check the installed version number with the following command.

```

haproxy -v
```

```
HA-Proxy version 1.7.8-1ppa1~xenial 2017/07/09
Copyright 2000-2017 Willy Tarreau <willy@haproxy.org>
```

The installation is then complete. Continue below with the instructions for how to configuring the load balancer to redirect requests to your web servers.

HA Proxy Configuration

Once installed HAProxy should already have a template for configuring the load balancer. Open the configuration file, for example, using nano with the command underneath.

```
sudo nano /etc/haproxy/haproxy.cfg
```

Add the following sections to the end of the file. Replace the with whatever you want to call your servers on the statistics page and the with the private IPs for the servers you wish to direct the web traffic to. You can check the private IPs at your UpCloud Control Panel and Private network tab under Network menu.

```
frontend http_front
   bind *:80
   stats uri /haproxy?stats
   default_backend http_back

backend http_back
   balance roundrobin
   server <server1 name> <private IP 1>:80 check
   server <server2 name> <private IP 2>:80 check
```

Here is my specific configuration

```
defaults
    timeout connect 5000
    timeout client  50000
    timeout server  50000

###############################################
```

```
# Proxy for accessing the web front end and rest endpoints
###############################################
frontend http_front
   bind *:81
   stats uri /haproxy?stats
  default_backend http_back

backend http_back
   balance roundrobin
   server node1 192.168.50.240:8080 check
   server node1 192.168.50.240:8080 check

###############################################
# Proxy for accessing the kubernetes dashboard
###############################################
frontend http_front2
   bind *:30002
   stats uri /haproxy?stats
  default_backend http_back2

backend http_back2
   balance roundrobin
   server node1 192.168.50.11:30002 check
   server node1 192.168.50.11:30002 check

###############################################
# Proxy for accessing the Kibana dashboard
###############################################
frontend http_front3
   bind *:5601
   stats uri /haproxy?stats
  default_backend http_back3

```

```
backend http_back3
   balance roundrobin
   server node1 192.168.50.241:5601 check
   server node1 192.168.50.241:5601 check
```

After making the configurations, save the file and restart HAProxy with the next command.

```
sudo systemctl restart haproxy
```

If you get any errors or warnings at startup, check the configuration for any mistypes and then try restarting again.

Allow other machines to access the cluster:

First of all find out which machines you would like to provides access to and get their IP address in my case I have one machine which I would like to give access

Finding Your Network Details

To get the details of your own systems, begin by finding your network interfaces. You can find the interfaces on your machines and the addresses associated with them by typing:

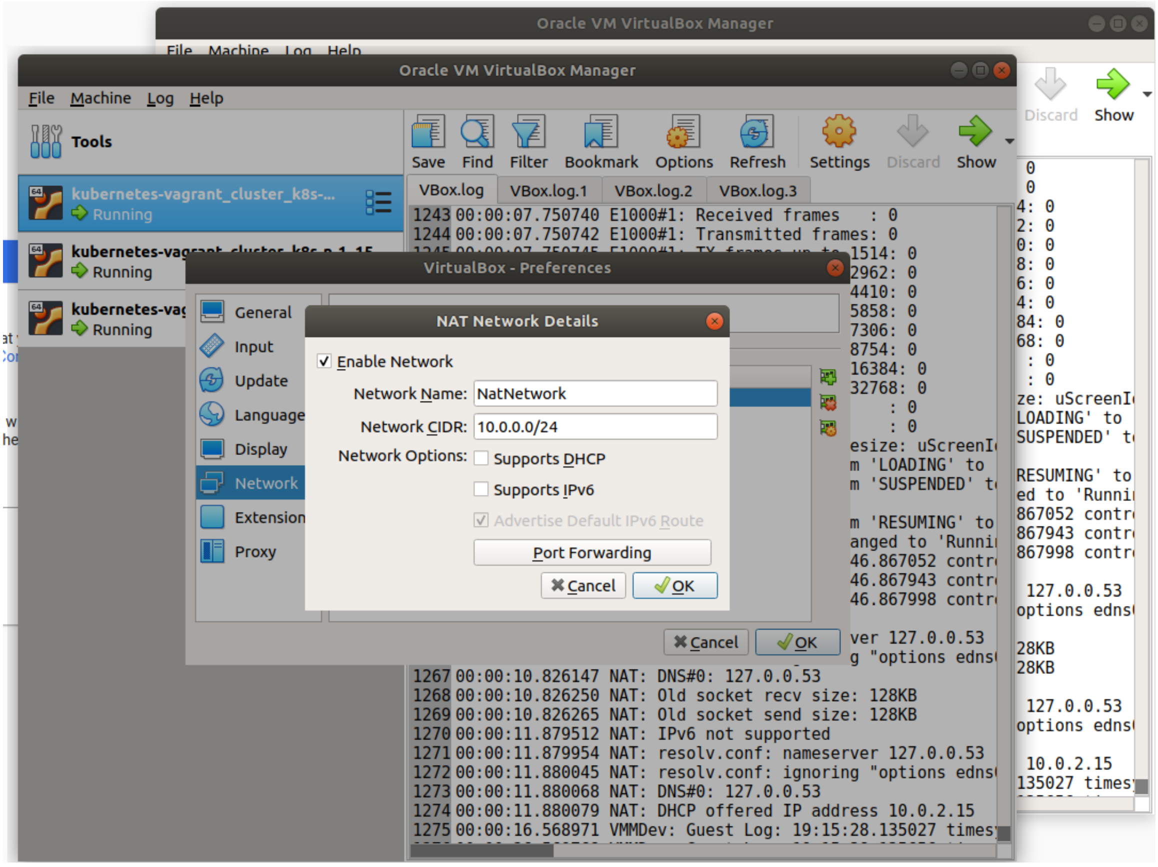
```
ip -4 addr show scope global
```

Output:

```


3: enp1s0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel state UP group default qlen 1000
    inet 10.0.0.23/24 brd 10.0.0.255 scope global dynamic noprefixroute enp1s0
       valid_lft 47753sec preferred_lft 47753sec
4: docker0: <NO-CARRIER,BROADCAST,MULTICAST,UP> mtu 1500 qdisc noqueue state DOWN group default
    inet 172.17.0.1/16 brd 172.17.255.255 scope global docker0
```

```
       valid_lft forever preferred_lft forever
7: vboxnet2: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc fq_codel
    state UP group default qlen 1000
    inet 192.168.50.1/24 brd 192.168.50.255 scope global vboxnet2
       valid_lft forever preferred_lft forever
```

My exposed private service is available on http://192.168.50.240:8080/ if I want to expose this outside of the VM's I will need to add a port forwarding NAT rule on virtual box. To do this add a NAT which is on the same network as your host 10.0.0.23 in our case this will be 10.0.0.0/24: See figure 3.



☑ Enable Network

Network Name: NatNetwork

Network CIDR: 10.0.0.0/24

Network Options: □ Supports DHCP

□ Supports IPv6

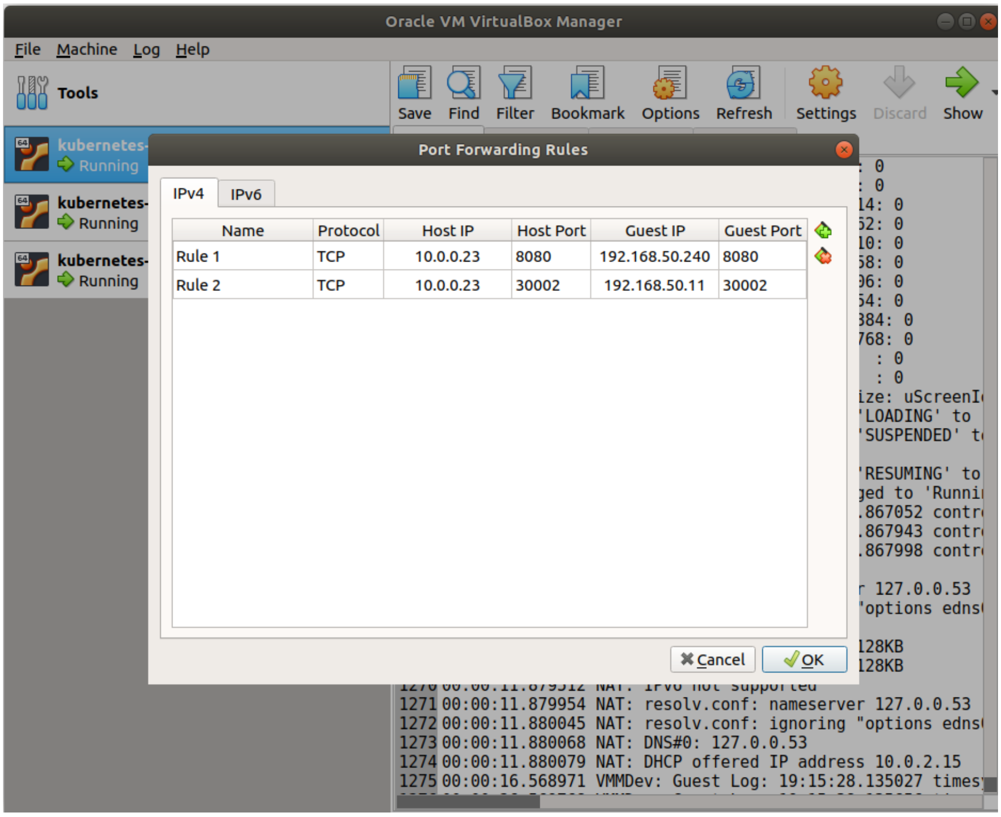
☑ Advertise Default IPv6 Route

```
1243 00:00:07.750740 E1000#1: Received frames    : 0
1244 00:00:07.750742 E1000#1: Transmitted frames: 0
1267 00:00:10.826147 NAT: DNS#0: 127.0.0.53
1268 00:00:10.826250 NAT: Old socket recv size: 128KB
1269 00:00:10.826265 NAT: Old socket send size: 128KB
1270 00:00:11.879512 NAT: IPv6 not supported
1271 00:00:11.879954 NAT: resolv.conf: nameserver 127.0.0.53
1272 00:00:11.880045 NAT: resolv.conf: ignoring "options edns
1273 00:00:11.880068 NAT: DNS#0: 127.0.0.53
1274 00:00:11.880079 NAT: DHCP offered IP address 10.0.2.15
1275 00:00:16.568971 VMMDev: Guest Log: 19:15:28.135027 times
```

FIGURE 3: Virtualbox NAT Configuration

Add a NAT rule which maps the internal metallb external cluster IP 192.168.50.240 port 8080 and maps to the local host 10.0.0.23 port 8080: See figure 4.

Follow this guide to add nginx proxy https://www.hostinger.com/tutorials/how-to-set-up-nginx-reverse-proxy/



Name	Protocol	Host IP	Host Port	Guest IP	Guest Port
Rule 1	TCP	10.0.0.23	8080	192.168.50.240	8080
Rule 2	TCP	10.0.0.23	30002	192.168.50.11	30002

```
1271 00:00:11.879954 NAT: resolv.conf: nameserver 127.0.0.53
1272 00:00:11.880045 NAT: resolv.conf: ignoring "options edns
1273 00:00:11.880068 NAT: DNS#0: 127.0.0.53
1274 00:00:11.880079 NAT: DHCP offered IP address 10.0.2.15
1275 00:00:16.568971 VMMDev: Guest Log: 19:15:28.135027 times
```

FIGURE 4: Virtualbox NAT port forwarding rule Configuration

Troubleshooting Issues:

1. Virtualbox failed with the following error:

   This error means that you need to go in to the bios of your computer and enable virtualization first before running vagrant

```
==> k8s-m-1: Booting VM...
There was an error while executing `VBoxManage`, a CLI used by Vagrant
for controlling VirtualBox. The command and stderr is shown below.

Command: ["startvm", "74415e44-a015-48dc-ab71-74d47a816739", "--type",
    "headless"]

Stderr: VBoxManage: error: VT-x is disabled in the BIOS for all CPU
    modes (VERR_VMX_MSR_ALL_VMX_DISABLED)
VBoxManage: error: Details: code NS_ERROR_FAILURE (0x80004005),
    component ConsoleWrap, interface IConsole
```

Useful commands

Deploy a nginx container for quick testing of the cluster

```
kubectl run nginx --image nginx
```

Creating service for nginx on port 80.

- This service requires the cluster to support load balancing

- For this to work you will need a bare metal loadbalancer like metallb

```
kubectl expose deploy nginx --port 80 --type LoadBalancer
```

Deleting a service

```
kubectl delete svc nginx
```

Vagrant commands

- General vagrant commands
- Vagrant snapshots

Taking vagrant snapshots

- The following is the scnapshot technioque I will use when rollback is requried to a good kubernetes state.
- This is especially usefull for when experiements are being run and the unexpected happens.
- Using restore on a snapshot will quickly reduce rebuild time.

```
vagrant snapshot save k8s-m-1 k8s-m-1--v0.3

==> k8s-m-1: Snapshotting the machine as 'k8s-m-1--v0.1'...
==> k8s-m-1: Snapshot saved! You can restore the snapshot at any time by
==> k8s-m-1: using `vagrant snapshot restore`. You can delete it using
==> k8s-m-1: `vagrant snapshot delete`.

vagrant snapshot save k8s-n-1 k8s-n-1--v0.3

==> k8s-n-1: Snapshotting the machine as 'k8s-n-1--v0.1'...
==> k8s-n-1: Snapshot saved! You can restore the snapshot at any time by
==> k8s-n-1: using `vagrant snapshot restore`. You can delete it using
==> k8s-n-1: `vagrant snapshot delete`.

vagrant snapshot save k8s-n-2 k8s-n-2--v0.3
==> k8s-n-2: Snapshotting the machine as 'k8s-n-2--v0.1'...
==> k8s-n-2: Snapshot saved! You can restore the snapshot at any time by
==> k8s-n-2: using `vagrant snapshot restore`. You can delete it using
==> k8s-n-2: `vagrant snapshot delete`.

vagrant snapshot save k8s-n-3 k8s-n-3--v0.3
==> k8s-n-2: Snapshotting the machine as 'k8s-n-2--v0.1'...
==> k8s-n-2: Snapshot saved! You can restore the snapshot at any time by
==> k8s-n-2: using `vagrant snapshot restore`. You can delete it using
==> k8s-n-2: `vagrant snapshot delete`.
```

Suspending the vagrant virtual machines

To suspend all virtual machines within the vagrant file do:

```
vagrant suspend
```

Expected Result

```
==> k8s-m-1: Saving VM state and suspending execution...
==> k8s-n-1: Saving VM state and suspending execution...
==> k8s-n-2: Saving VM state and suspending execution...
```

Install Helm

Download Helm

```
wget https://get.helm.sh/helm-v2.16.5-linux-amd64.tar.gz
tar -zxvf helm-v2.16.5-linux-amd64.tar.gz
sudo mv linux-amd64/helm /usr/local/bin/helm
```

Create service account for tiller

```
kubectl -n kube-system create serviceaccount tiller
```

Create a cluster role binding for tiller

```
kubectl create clusterrolebinding tiller --clusterrole cluster-admin
    --serviceaccount=kube-system:tiller
```

Initilize Helm and install tiller

```
helm init --service-account=tiller
```

Initialize a helm chart repository

Once you have helm ready, you can add a chart repository. One popular starting location is the official Helm stable charts:

```
helm repo add stable https://kubernetes-charts.storage.googleapis.com/
```

you should see the following response if all is ok

```
"stable" has been added to your repositories
```

Install Istio []

Download Istio

```
curl -L https://git.io/getLatestIstio | ISTIO_VERSION=1.5.1 sh -
cd istio-1.5.1
echo 'export PATH=~/istio-1.5.1/bin:$PATH' >>~/.bash_profile
source ~/.bash_profile
cd ..
```

Verify istio can be installed on the cluster

```

istioctl verify-install
```

You shoow see a response like below with a passed response

```
Checking the cluster to make sure it is ready for Istio installation...

#1. Kubernetes-api
-----------------------
Can initialize the Kubernetes client.
Can query the Kubernetes API Server.

#2. Kubernetes-version
-----------------------
Istio is compatible with Kubernetes: v1.17.4.

#3. Istio-existence
-----------------------
Istio will be installed in the istio-system namespace.

#4. Kubernetes-setup
-----------------------
Can create necessary Kubernetes configurations: Namespace,ClusterRole,ClusterRoleBinding,CustomResourceDefinition,Role,ServiceAcco

#5. SideCar-Injector
-----------------------
This Kubernetes cluster supports automatic sidecar injection. To enable automatic sidecar injection see https://istio.io/docs/setup/kubernetes/additional-setup/sidecar-injection/#deploy

-----------------------
Install Pre-Check passed! The cluster is ready for Istio installation.
```

Prepare for installing issue the following commands

Enter a Kiali username “admin” when prompted:

```
KIALI_USERNAME=$(read -p 'Kiali Username: ' uval && echo -n $uval |
    base64)
```

Enter a Kiali passphrase of “admin” when prompted:

```
KIALI_PASSPHRASE=$(read -sp 'Kiali Passphrase: ' pval && echo -n $pval
    | base64)
```

Make sure the istio namespace exists

```
NAMESPACE=istio-system
kubectl create namespace $NAMESPACE
```

To create a secret, run the following commands: “‘bash cat <<EOF | kubectl apply -f - apiVersion: v1 kind: Secret metadata: name: kiali namespace: $NAMESPACE labels: app: kiali type: Opaque data: username: $KIALI_USERNAME passphrase: $KIALI_PASSPHRASE EOF

Install the istio components on the cluster

```
istioctl manifest apply \
  --set profile=default \
  --set addonComponents.grafana.enabled=true \
  --set addonComponents.tracing.enabled=true \
  --set addonComponents.kiali.enabled=true
```

You should see the following the following response

```
Detected that your cluster does not support third party JWT
    authentication. Falling back to less secure first party JWT. See
    https://istio.io/docs/ops/best-practices/security/#configure-third-party-service-a
    for details.
- Applying manifest for component Base...
   Finished applying manifest for component Base.
- Applying manifest for component Pilot...
   Finished applying manifest for component Pilot.
  Waiting for resources to become ready...
  Waiting for resources to become ready...
  Waiting for resources to become ready...
- Applying manifest for component IngressGateways...
- Applying manifest for component AddonComponents...
    Finished applying manifest for component IngressGateways.
    Finished applying manifest for component AddonComponents.

    Installation complete
```

Determine the external IP for the gateway

```
kubectl get svc istio-ingressgateway -n istio-system
```

The res[ponse should look like

```
kubectl get svc istio-ingressgateway -n istio-system
NAME                   TYPE           CLUSTER-IP     EXTERNAL-IP
   PORT(S)


      AGE
istio-ingressgateway   LoadBalancer   10.97.104.37   192.168.50.240
   15020:32345/TCP,80:30392/TCP,443:31393/TCP,15029:31067/TCP,15030:30459/TCP,15031:3
     13m
```

In my case I can see that the external ip address is **192.168.50.240**

Install Kubernetes Cert Manager

Installing with regular manifests All resources (the CustomResourceDefinitions, cert-manager, namespace, and the webhook component) are included in a single YAML manifest file:

Install the CustomResourceDefinitions and cert-manager itself

```
# Kubernetes 1.15+
$ kubectl apply --validate=false -f
   https://github.com/jetstack/cert-manager/releases/download/v0.14.1/cert-manager.ya
```

Verifying the installation Once you've installed cert-manager, you can verify it is deployed correctly by checking the cert-manager namespace for running pods:

```
$ kubectl get pods --namespace cert-manager

NAME                                       READY   STATUS    RESTARTS
    AGE
cert-manager-5c6866597-zw7kh               1/1     Running   0
    2m
cert-manager-cainjector-577f6d9fd7-tr77l   1/1     Running   0
    2m
cert-manager-webhook-787858fcdb-nlzsq      1/1     Running   0
    2m
```

Enable Remote access to the telemetery Addons

Follow this guide to enable external access to Graphana, Kiali, Prometheus and tracing

Visit the telemetry addons via your browser.

Kiali: http://<IP ADDRESS OF CLUSTER INGRESS>:15029/
Prometheus: http://<IP ADDRESS OF CLUSTER INGRESS>:15030/
Grafana: http://<IP ADDRESS OF CLUSTER INGRESS>:15031/
Tracing: http://<IP ADDRESS OF CLUSTER INGRESS>:15032/

Delete istio

The uninstall deletes the RBAC permissions, the istio-system namespace, and all resources hierarchically under it. It is safe to ignore errors for non-existent resources because they may have been deleted hierarchically.

```
$ istioctl manifest generate --set profile=demo | kubectl delete -f -
```