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Kubernetes configuration and deployment

A practical look at using Kubernetes

Recapping yesterday

- We looked at some considerations that need to be made when scaling an application
- There are many options to scale a monolith, but at a certain point, you need to redesign the system
- A shift to microservices allows an application to scale
  - It comes with the challenge of redefining the entire application to be distributed
- Kubernetes is a tool that helps manage distributed systems
  - It manages containers for you
- Kubernetes uses a client-server model to communicate is manage itself
- Containers are deployed in pods, which run on nodes and are managed by controllers. With the controller plane being the master.

Overview

- K8s basics
  - Creating a cluster
  - Deployment
  - Peaking inside
  - Services
  - Dns
  - Ingress
- Azure Kubernetes Service
- Securing k8s

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K8s basics

Going through the important aspects

K8s basics

`kubectl - the most important command`

- Kubernetes provides a command line tool for communicating with a Kubernetes cluster's control plane, using the Kubernetes API.
  - This is the *kubectl* command
  - Often pronounced as "kube cuttle“
- For configuration, kubectl looks for a file named config in the *$HOME/.kube* directory.
  - You can specify other *kubeconfig* files by setting the KUBECONFIG environment variable
  - or by setting the *--kubeconfig* flag.

K8s basics

`kubectl template`

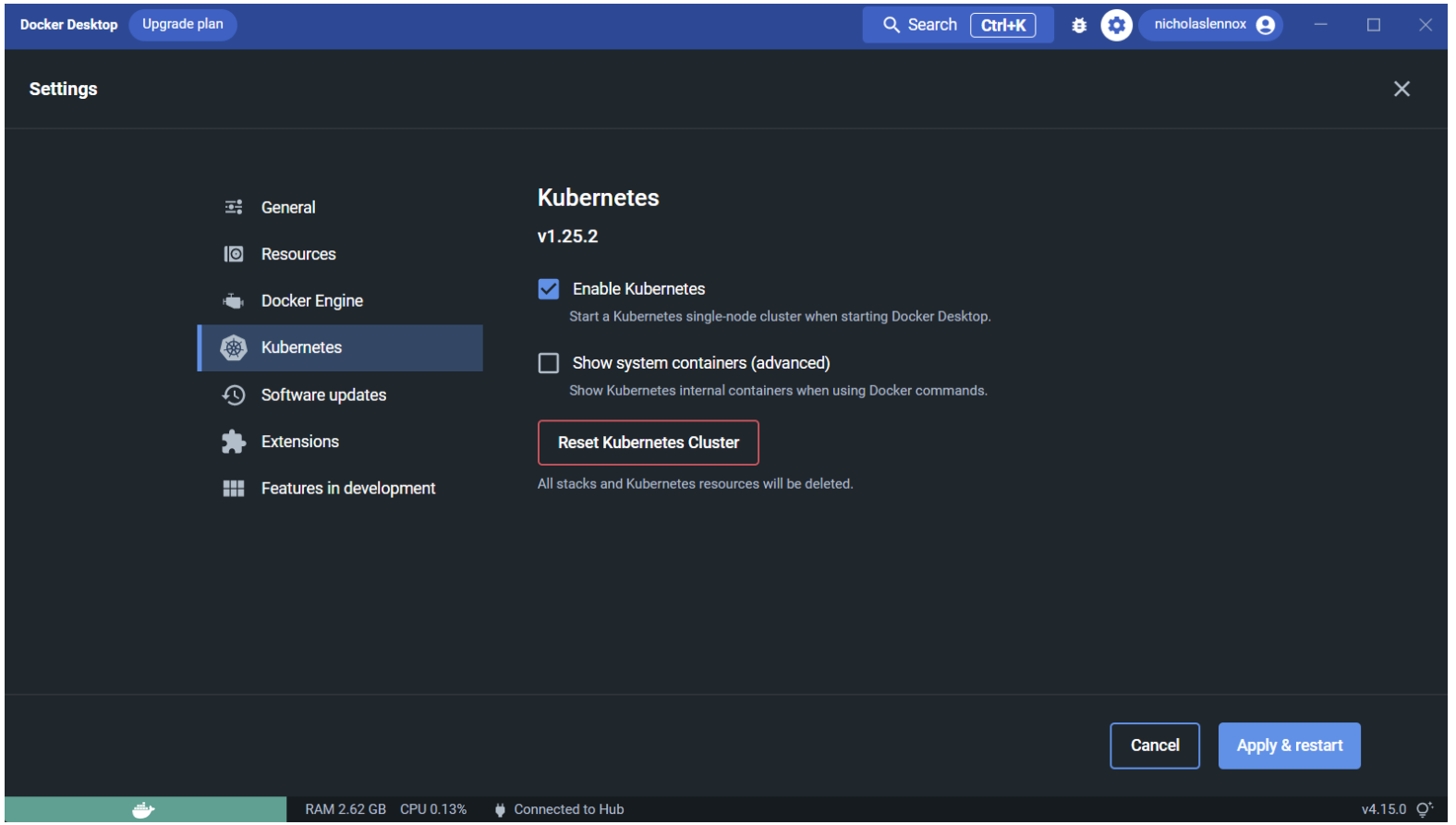
- kubectl [command] [TYPE] [NAME] [flags]
  - **command**: Specifies the operation that you want to perform on one or more resources, for example *create, get, describe, delete*.
  - **TYPE**: Specifies the resource type, for example *pod*
  - **NAME**: Specifies the name of the resource. Can be omitted to show all resources.
  - **flags**: Specifies optional flags.
- There are many commands, we will look at the most important ones as we are going
  - Official reference doc
  - Official cheat sheet
  - “The Ultimate Kubectl Commands Cheat Sheet” article

K8s basics – creating a cluster

How to create a cluster?

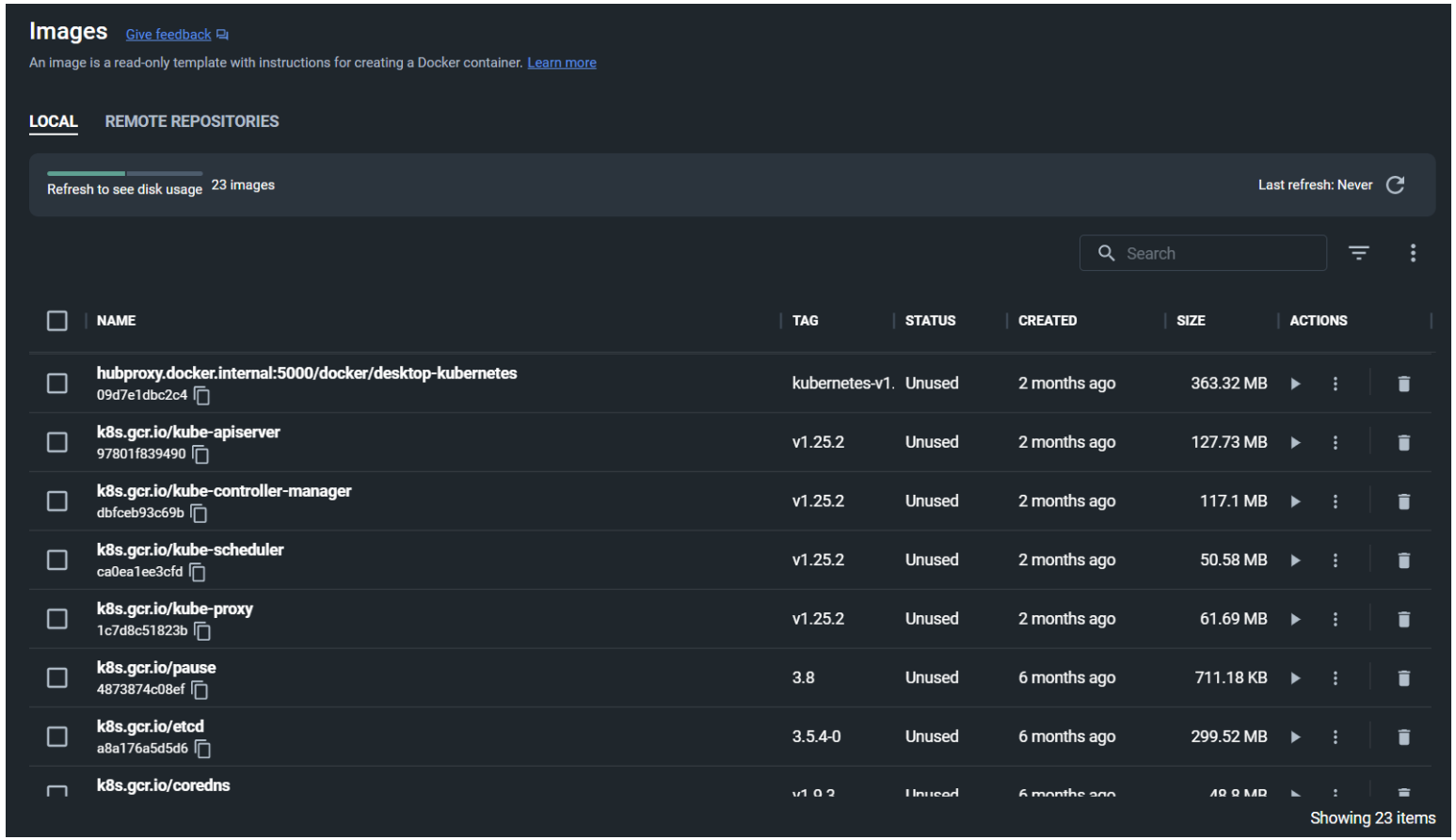
- Recall, a cluster is a set of computers working together as a single system.
- There are multiple ways of creating and deploying clusters
  - *kind* requires Docker and lets you run clusters on your machine (Linux)
  - *minikube* is a standalone tool to run a cluster (Linux VM)
  - *kubeadm* is a tool for self-hosted production deployments (Linux VM)
  - *Docker Desktop* has a built-in cluster that uses your host machine as a node.
    - We will do this, its simpler for windows (link to doc)

K8s basics – creating a cluster



Enabling k8s in Docker Desktop

K8s basics – creating a cluster



Looking at the images

K8s basics – creating a cluster

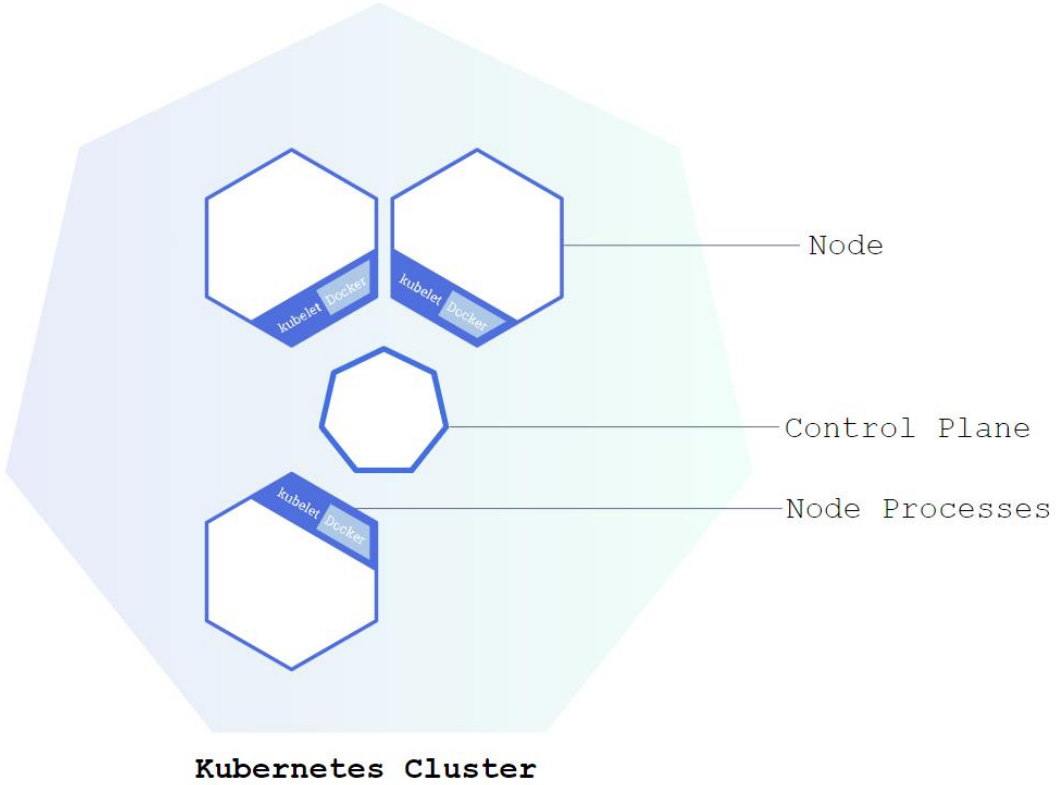
```
MSYS:/c/Users/noro-nle

RES+noro-nle@acc-nlennox MSYS ~
$ kubectl version
WARNING: This version information is deprecated and will be replaced with the output from kubectl version --short.  Use
--output=yaml|json to get the full version.
Client Version: version.Info{Major:"1", Minor:"25", GitVersion:"v1.25.2", GitCommit:"5835544ca568b757a8ecae5c153f317e573
6700e", GitTreeState:"clean", BuildDate:"2022-09-21T14:33:49Z", GoVersion:"go1.19.1", Compiler:"gc", Platform:"windows/a
md64"}
Kustomize Version: v4.5.7
Server Version: version.Info{Major:"1", Minor:"25", GitVersion:"v1.25.2", GitCommit:"5835544ca568b757a8ecae5c153f317e573
6700e", GitTreeState:"clean", BuildDate:"2022-09-21T14:27:13Z", GoVersion:"go1.19.1", Compiler:"gc", Platform:"linux/amd
64"}

RES+noro-nle@acc-nlennox MSYS ~
$
```

Checking if kubectl is installed

K8s basics – creating a cluster



What we have done (src)

K8s basics – creating a cluster

```
RES+noro-nle@acc-nlennox MSYS ~
$ kubectl cluster-info
Kubernetes control plane is running at https://kubernetes.docker.internal:6443
CoreDNS is running at https://kubernetes.docker.internal:6443/api/v1/namespaces/kube-system/services/kube-d
ns:dns/proxy

To further debug and diagnose cluster problems, use 'kubectl cluster-info dump'.
```

```
RES+noro-nle@acc-nlennox MSYS ~
$ kubectl get nodes
NAME             STATUS   ROLES           AGE   VERSION
docker-desktop   Ready    control-plane   13m   v1.25.2
```

Inspecting our cluster

Any questions?

We have just started, but I want to make sure we are on the same page

K8s basics – deployment

`Running a pod`

- The first logical step is to run a container
- Recall, we do this by asking Kubernetes to run a pod for us with a specific image
  - This can be done with or without a file (YAML)
- We will first do it without a file
- Then with a file
- We want to run a simple app that greets the user
  - nicholaslennox/howzit-greeter

K8s basics – deployment

```
RES+noro-nle@acc-nlennox MSYS ~
$ kubectl run howzit-greeter --image=nicholaslennox/howzit-greeter
pod/howzit-greeter created

RES+noro-nle@acc-nlennox MSYS ~
$ kubectl get pods
NAME             READY   STATUS    RESTARTS   AGE
howzit-greeter   1/1     Running   0          8s

RES+noro-nle@acc-nlennox MSYS ~
$ kubectl get pods -o wide
NAME             READY   STATUS    RESTARTS   AGE    IP         NODE             NOMINATED NODE   READINESS
 GATES
howzit-greeter   1/1     Running   0          2m1s   10.1.0.7   docker-desktop   <none>           <none>
```

Asking k8s to run a container

K8s basics – deployment

`The most direct method`

- This is known as creating **imperatively**
- Everything is typed out and done in a single line
  - It needs to be retyped to replicate
- It also wont watch for failed pods
- You also cant make replicas (need a separate ReplicaSet)
- *Do you think this is a good method?*

K8s basics – deployment

Using deployments

- Deployment is a specialized term in the context of Kubernetes
  - A file that defines a pod's desired behaviour or characteristics
  - It can be created imperatively like we did before
- Deployments help manage the pods, and keep them in the desired state with controllers.
  - It helps manage the replicas as well, something you cant do directly
- You shouldn’t make pods directly unless there is a specific reason
  - Kubernetes recommends production to be with deployments and **declarative** (through a file)

K8s basics – deployment

```
RES+noro-nle@acc-nlennox MSYS ~
$ kubectl create deployment howzit-greeter --image=nicholaslennox/howzit-greeter
deployment.apps/howzit-greeter created

RES+noro-nle@acc-nlennox MSYS ~
$ kubectl get deployments
NAME             READY   UP-TO-DATE   AVAILABLE   AGE
howzit-greeter   1/1     1            1           7s

RES+noro-nle@acc-nlennox MSYS ~
$ kubectl get pods
NAME                              READY   STATUS    RESTARTS   AGE
howzit-greeter-8468555d69-b9vg2   1/1     Running   0          12s
```

Imperatively making a deployment

K8s basics – deployment

```
RES+noro-nle@acc-nlennox MSYS ~
$ kubectl describe deployments howzit-greeter
Name:                   howzit-greeter
Namespace:              default
CreationTimestamp:
Labels:                 app=howzit-greeter
Annotations:            deployment.kubernetes.io/revision: 1
Selector:               app=howzit-greeter
Replicas:               1 desired | 1 updated | 1 total | 1 available | 0 unavailable
StrategyType:           RollingUpdate
MinReadySeconds:        0
RollingUpdateStrategy:  25% max unavailable, 25% max surge
Pod Template:
  Labels:  app=howzit-greeter
  Containers:
   howzit-greeter:
    Image:        nicholaslennox/howzit-greeter
    Port:         <none>
    Host Port:    <none>
    Environment:  <none>
    Mounts:       <none>
  Volumes:        <none>
Conditions:
  Type           Status  Reason
  ----           ------  ------
  Available      True    MinimumReplicasAvailable
  Progressing    True    NewReplicaSetAvailable
OldReplicaSets:  <none>
NewReplicaSet:   howzit-greeter-8468555d69 (1/1 replicas created)
Events:
  Type    Reason             Age    From                   Message
  ----    ------             ----   ----                   -------
  Normal  ScalingReplicaSet  4m46s  deployment-controller  Scaled up replica set howzit-greeter-8468555d69 to 1
```

Describing our deployment

K8s basics – deployment

Moving to declarative

- When looking deeper with describe, we saw a template.
- A Kubernetes **manifest** is a YAML file that describes each component or resource of your deployment and the state you want once applied
- For deployments, we describe our desired state and the controller helps reach that state
- All manifests have the same template
  - We differentiate with the *kind* flag

K8s basics – deployment

`Describing our deployment`

- We need to make a YAML file and populate it
- We can take the deployments page in Kubernetes docs as reference
- We wont supply all the arguments yet, but we will start with:
  - Names, replicas, images, ports
  - Just to redo what we did imperatively

K8s basics – deployment

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ ls -a
./  ../  deployments/

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ cd deployments

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/deployments
$ ls -a
./  ../  howzit-greeter-deployment.yaml

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/deployments
$
```

Our folder structure

K8s basics – deployment

Yes the name is repeated 4 times

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/deployments
$ cat howzit-greeter-deployment.yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: howzit-greeter-deployment
  labels:
    app: howzit-greeter
spec:
  replicas: 3
  selector:
    matchLabels:
      app: howzit-greeter
  template:
    metadata:
      labels:
        app: howzit-greeter
    spec:
      containers:
        - name: howzit-greeter
          image: nicholaslennox/howzit-greeter
          imagePullPolicy: IfNotPresent
          ports:
            - containerPort: 80
```

Our description

K8s basics – deployment

`Creating our deployment`

- *kubectl apply -f howzit-greeter-deployment.yaml*
- We use the **apply** action to declaratively create our deployment
  - Apply is the preferred method as you tell k8s your desired state
  - It will update any existing resources to meet the needs
  - **Create** is you doing it directly, it will throw an error if it already exists
- We use the **-f** flag to say where the file is

K8s basics – deployment

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/deployments
$ kubectl describe deployments howzit-greeter-deployment
Name:                   howzit-greeter-deployment
Namespace:              default
CreationTimestamp:
Labels:                 app=howzit-greeter
Annotations:            deployment.kubernetes.io/revision: 1
Selector:               app=howzit-greeter
Replicas:               3 desired | 3 updated | 3 total | 3 available | 0 unavailable
StrategyType:           RollingUpdate
MinReadySeconds:        0
RollingUpdateStrategy:  25% max unavailable, 25% max surge
Pod Template:
  Labels:  app=howzit-greeter
  Containers:
   howzit-greeter:
    Image:        nicholaslennox/howzit-greeter
    Port:         80/TCP
    Host Port:    0/TCP
    Environment:  <none>
    Mounts:       <none>
  Volumes:        <none>
Conditions:
  Type           Status  Reason
  ----           ------  ------
  Available      True    MinimumReplicasAvailable
  Progressing    True    NewReplicaSetAvailable
OldReplicaSets:  <none>
NewReplicaSet:   howzit-greeter-deployment-66c9bb7d84 (3/3 replicas created)
Events:
  Type    Reason             Age    From                   Message
  ----    ------             ----   ----                   -------
  Normal  ScalingReplicaSet  5m15s  deployment-controller  Scaled up replica set howzit-greeter-deployment-66c9bb7d84 to 3
```

Describing our deployment again

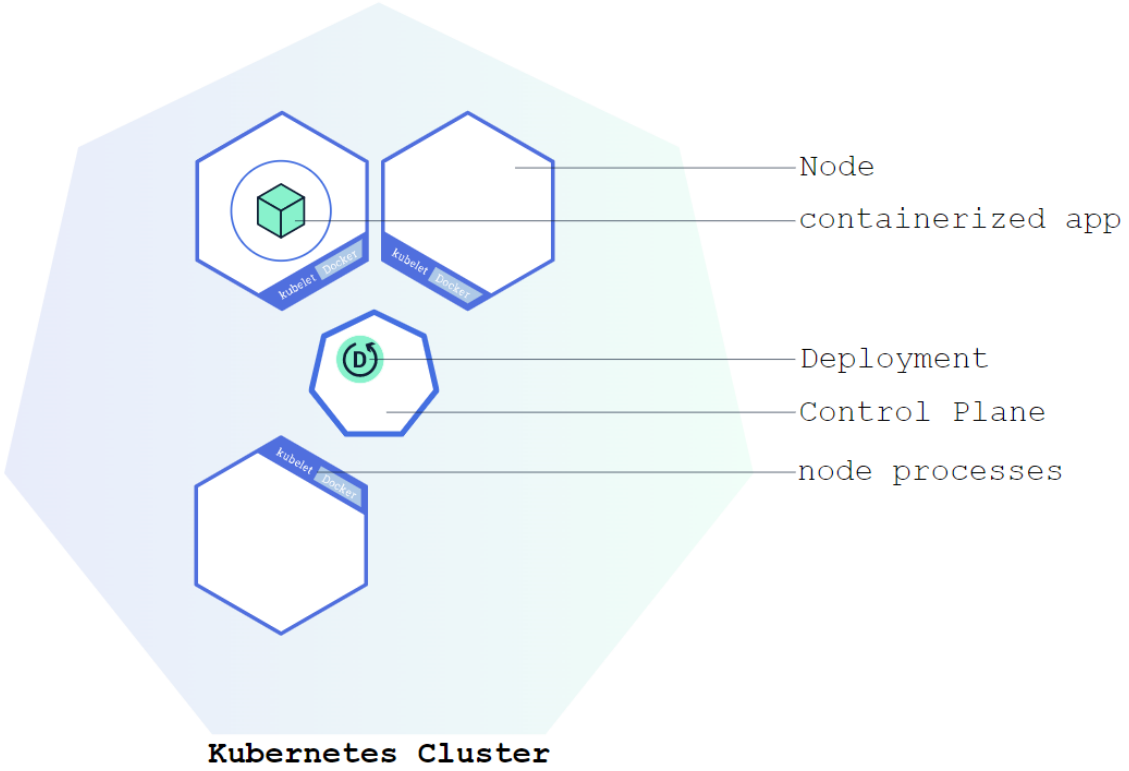
K8s basics – deployment

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/deployments
$ kubectl get deployments
NAME                       READY   UP-TO-DATE   AVAILABLE   AGE
howzit-greeter-deployment   3/3     3            3           7m53s

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/deployments
$ kubectl get pods
NAME                                        READY   STATUS    RESTARTS   AGE
howzit-greeter-deployment-66c9bb7d84-2xjc7   1/1     Running   0          7m58s
howzit-greeter-deployment-66c9bb7d84-59547   1/1     Running   0          7m58s
howzit-greeter-deployment-66c9bb7d84-6v4mb   1/1     Running   0          7m58s
```

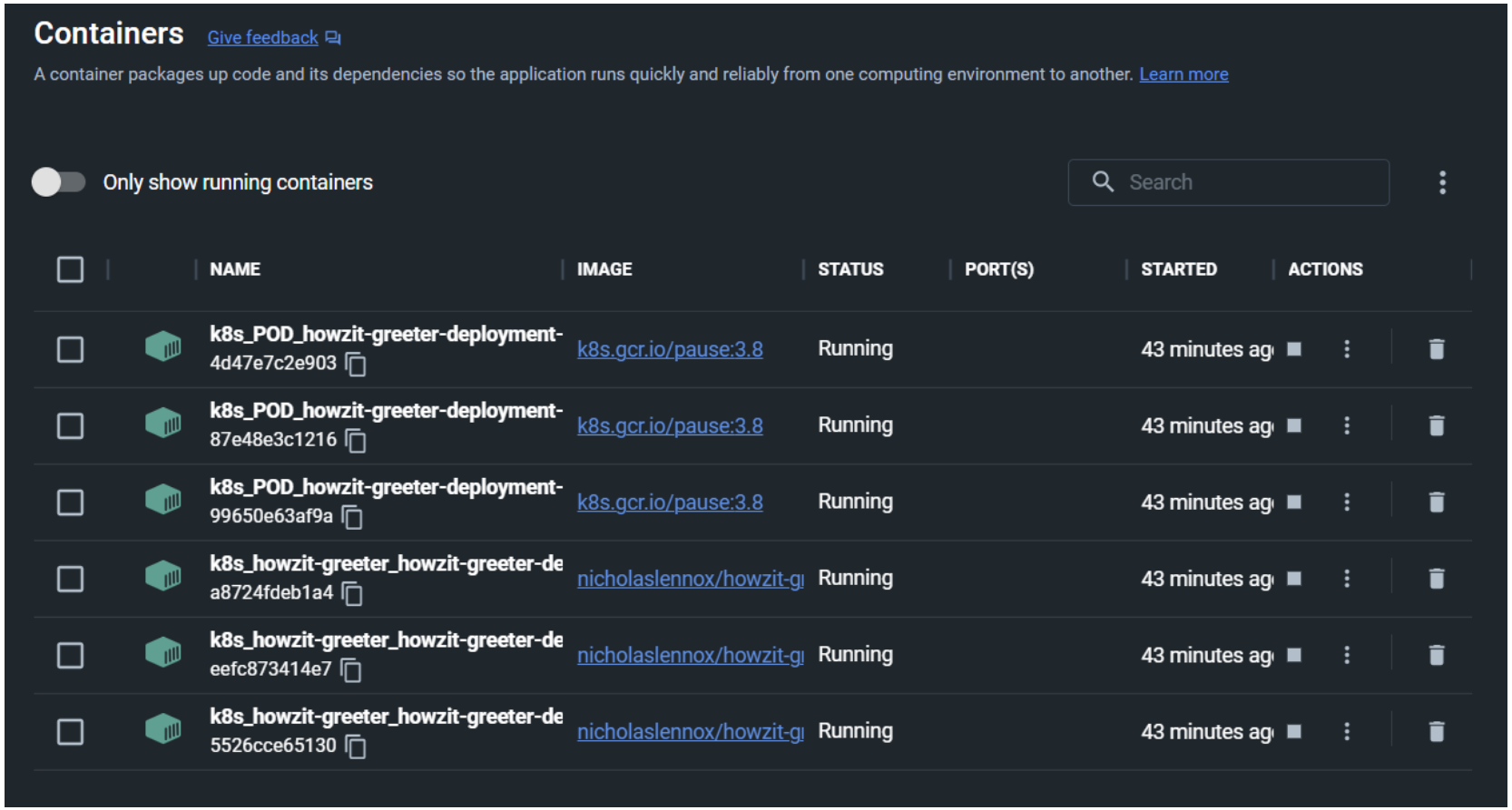
Inspecting our deployment and pods

K8s basics – deployment



Where we currently are (src)

K8s basics – deployment



Herding our cats

K8s basics – deployment

Summary of commands so far

- *kubectl get …*
  - Basic information gathering
- *kubectl get … -o wide*
  - More information
- *kubectl describe …*
  - Verbose details
- *kubectl apply -f …*
  - Creates or updates the cluster with the desired state
  - Can be anything (we did deployments)
  - If you need to update the deployment, change the file and run *apply* again

Any questions?

Before we do our first try it out

⌨ Try it out

1. Enable k8s through Docker Desktop
   a) Check its installed by running *kubectl version*
2. Create a YAML file for a deployment (e.g., in VSCode)
   a) You can deploy the image used in the slides if you want (nicholaslennox/howzit-greeter)
   b) You can use the deployments page to get a template
3. Create the deployment with *kubectl apply -f*
4. Inspect your deployment with *describe*
   a) You can also get deployments and pods

K8s basics – peaking inside

`Invisible by default`

- All our cluster activity happens isolated and we cannot access it without either directly exposing ports or using proxies
- Kubernetes comes with a proxy that allows you to interact with the pods inside
  - This is not the way you should expose your apps, that is later
  - Its just a way to peak in and look at what is going on
- Done via *kubectl proxy*

K8s basics – peaking inside

`Inspecting our cluster`

- Kubernetes uses services to expose applications
  - We will cover this later, we just need a single command now
- The kubectl command is interacting with an API, and we can expose all that
- We can use kubectl get svc to see all services
  - We will just have the one for the entire cluster right now
  - This is what kubectl interacts with

K8s basics – peaking inside

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/deployments
$ kubectl get svc
NAME         TYPE        CLUSTER-IP   EXTERNAL-IP   PORT(S)   AGE
kubernetes   ClusterIP   10.96.0.1    <none>        443/TCP   160m

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/deployments
$ kubectl describe svc kubernetes
Name:              kubernetes
Namespace:         default
Labels:            component=apiserver
                   provider=kubernetes
Annotations:       <none>
Selector:          <none>
Type:              ClusterIP
IP Family Policy:  SingleStack
IP Families:       IPv4
IP:                10.96.0.1
IPs:               10.96.0.1
Port:              https  443/TCP
TargetPort:        6443/TCP
Endpoints:         192.168.65.4:6443
Session Affinity:  None
Events:            <none>
```

Looking at our services

K8s basics – peaking inside

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/deployments
$ curl http://localhost:8001/api/v1/namespaces/default
{
  "kind": "Namespace",
  "apiVersion": "v1",
  "metadata": {
    "name": "default",
    "uid": "0b4ab50d-8e9f-4add-b967-12ef24149a7f",
    "resourceVersion": "191",
    "creationTimestamp": "2022-12-03T11:34:17Z",
    "labels": {
      "kubernetes.io/metadata.name": "default"
    },
    "managedFields": [
      {
        "manager": "kube-apiserver",
        "operation": "Update",
        "apiVersion": "v1",
        "time": "2022-12-03T11:34:17Z",
        "fieldsType": "FieldsV1",
        "fieldsV1": {
          "f:metadata": {
            "f:labels": {
              ".": {},
              "f:kubernetes.io/metadata.name": {}
            }
          }
```

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl proxy
Starting to serve on 127.0.0.1:8001
```

Enabling the proxy

K8s basics – peaking inside

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/deployments
$ curl http://localhost:8001/api/v1/namespaces/default/pods
{
  "kind": "PodList",
  "apiVersion": "v1",
  "metadata": {
    "resourceVersion": "13382"
  },
  "items": [
    {
      "metadata": {
        "name": "howzit-greeter-deployment-66c9bb7d84-2xjc7",
        "generateName": "howzit-greeter-deployment-66c9bb7d84-",
        "namespace": "default",
        "uid": "80525f50-77a9-47a6-b648-c15683c8da0c",
        "resourceVersion": "8607",
        "creationTimestamp": "2022-12-03T13:22:40Z",
        "labels": {
          "app": "howzit-greeter",
          "pod-template-hash": "66c9bb7d84"
        },
        "ownerReferences": [
          {
            "apiVersion": "apps/v1",
            "kind": "ReplicaSet",
            "name": "howzit-greeter-deployment-66c9bb7d84",
            "uid": "c7c8aac8-a85a-4bc8-b2c1-f44ff4f75a38",
            "controller": true,
            "blockOwnerDeletion": true
          }
```

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl proxy
Starting to serve on 127.0.0.1:8001
```

Looking at our pods

K8s basics – services

What is a service in k8s?

- A logical abstraction to expose a set of pods as a network service
- Deployments make sure to have the desired state of the pods
  - E.g., replicas and resources
  - IP addresses change as pods are created and destroyed
- Services create a static IP (and policies) so your pods can be accessed by others via an internal DNS
  - This avoids the challenge of connecting two pods
  - E.g., front-end and back-end
- This is where we start creating the “microservice”

K8s basics – services

What makes a service

- To provide discovery and routing between pods, a service needs to know what pods (or deployments) should be grouped
  - This is done via selectors and labels
  - It can be done without selectors (this is for communication to another cluster or namespace)
- It also needs to control ports
  - Assigned port numbers and mapping to external ports
  - So services can be accessed from outside the cluster as well

K8s basics – services

Service types

- **ClusterIP** (default) - Exposes the Service on an internal IP in the cluster.
  - This type makes the Service only reachable from within the cluster.
- **NodePort** - Exposes the Service on the same port of each selected Node in the cluster using NAT.
  - Makes a Service accessible from outside the cluster using <NodeIP>:<NodePort>.
  - Superset of ClusterIP.

K8s basics – services

`Service types cont.`

- **LoadBalancer** - Creates an external load balancer in the current cloud (if supported) and assigns a fixed, external IP to the Service.
  - Superset of NodePort.
- **ExternalName** - Maps the Service to the contents of the externalName field (e.g. foo.bar.example.com)
  - By returning a CNAME record with its value.
- Note: if you don’t use selectors, you can manually map externalName or manually assign IP addresses

K8s basics – services

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl get deployments
NAME                        READY   UP-TO-DATE   AVAILABLE   AGE
howzit-greeter-deployment   3/3     3            3           21h

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl expose deployment howzit-greeter-deployment --type=NodePort --name=greeter-service
service/greeter-service exposed

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl get services
NAME              TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)        AGE
greeter-service   NodePort    10.100.53.127   <none>        80:31740/TCP   7s
kubernetes        ClusterIP   10.96.0.1       <none>        443/TCP        23h
```

Starting simple with imperative

K8s basics – services

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl describe service greeter-service
Name:                     greeter-service
Namespace:                default
Labels:                   app=howzit-greeter
Annotations:              <none>
Selector:                 app=howzit-greeter
Type:                     NodePort
IP Family Policy:         SingleStack
IP Families:              IPv4
IP:                       10.100.53.127
IPs:                      10.100.53.127
LoadBalancer Ingress:     localhost
Port:                     <unset>  80/TCP
TargetPort:               80/TCP
NodePort:                 <unset>  31740/TCP
Endpoints:                10.1.0.15:80,10.1.0.16:80,10.1.0.17:80
Session Affinity:         None
External Traffic Policy:  Cluster
Events:                   <none>
```

What we labelled our deployment

Recall, we can access via <NodeIP>:<NodePort>

Describing our service

K8s basics – services

Accessing our service

- Because we use Docker Desktop, which creates a single node from our machine
  - We can use localhost ☺
- NodePort services are not really designed for external internet traffic (load balancers are more appropriate)
  - But they are good for local testing
- Lets go see our application
  - curl http://<node ip>:<nodeport>
  - curl http://localhost:31740

K8s basics – services

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ curl http://localhost:31740
{"message":"Howzit!"}
```

Accessing our service

K8s basics – services

Declarative services

- It is preferred to write services so they can be easily replicated
- This is done in the same way as the deployments
  - With a YAML file
- We still use the same syntax, but different variables
- We will rewrite our service from before
  - Simply expose our single deployment

K8s basics – services

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/services
$ cat howzit-greeter-service.yaml
apiVersion: v1
kind: Service
metadata:
  name: greeter-service
spec:
  selector:
    app: howzit-greeter
  ports:
    - protocol: TCP
      port: 80
      targetPort: 80
  type: NodePort
```

Looking at our declaration

K8s basics – services

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/services
$ ls -a
./  ../  howzit-greeter-service.yaml

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/services
$ kubectl apply -f howzit-greeter-service.yaml
service/greeter-service created

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/services
$ kubectl get service/greeter-service
NAME              TYPE       CLUSTER-IP       EXTERNAL-IP   PORT(S)        AGE
greeter-service   NodePort   10.102.145.103   <none>        80:32638/TCP   22s

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/services
$ curl http://localhost:32638
{"message":"Howzit!"}
```

Applying our service

K8s basics – services

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop/services
$ kubectl get all
NAME                                                READY   STATUS    RESTARTS      AGE
pod/howzit-greeter-deployment-66c9bb7d84-2xjc7      1/1     Running   1 (72m ago)   22h
pod/howzit-greeter-deployment-66c9bb7d84-59547      1/1     Running   1 (72m ago)   22h
pod/howzit-greeter-deployment-66c9bb7d84-6v4mb      1/1     Running   1 (72m ago)   22h

NAME                       TYPE        CLUSTER-IP       EXTERNAL-IP   PORT(S)        AGE
service/greeter-service    NodePort    10.102.145.103   <none>        80:32638/TCP   4m17s
service/kubernetes         ClusterIP   10.96.0.1        <none>        443/TCP        24h

NAME                                        READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/howzit-greeter-deployment   3/3     3            3           22h

NAME                                                   DESIRED   CURRENT   READY   AGE
replicaset.apps/howzit-greeter-deployment-66c9bb7d84   3         3         3       22h
```

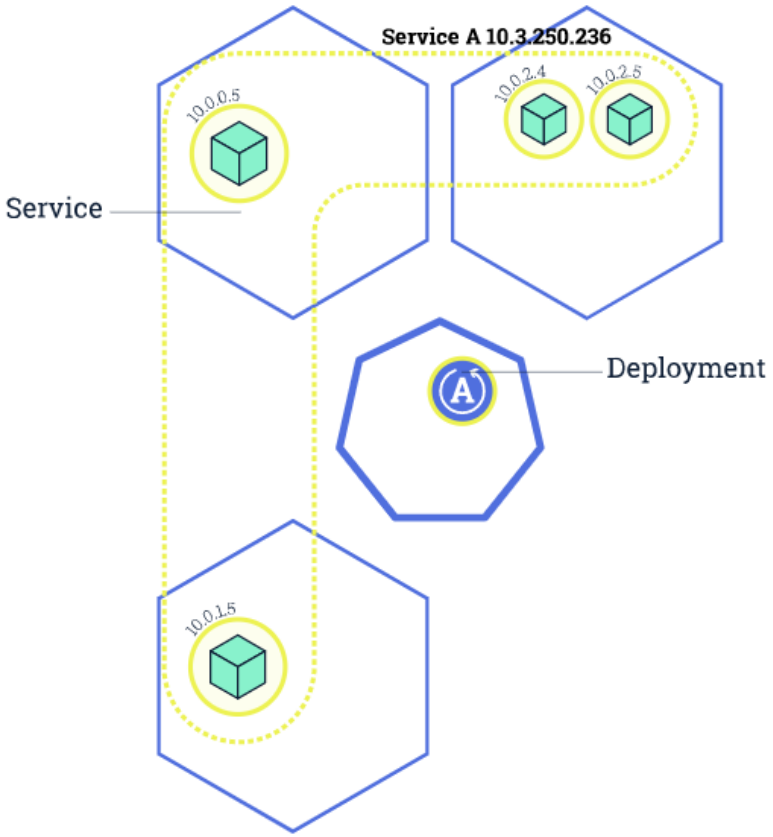
Looking at the bigger picture

K8s basics – services

Rolling updates

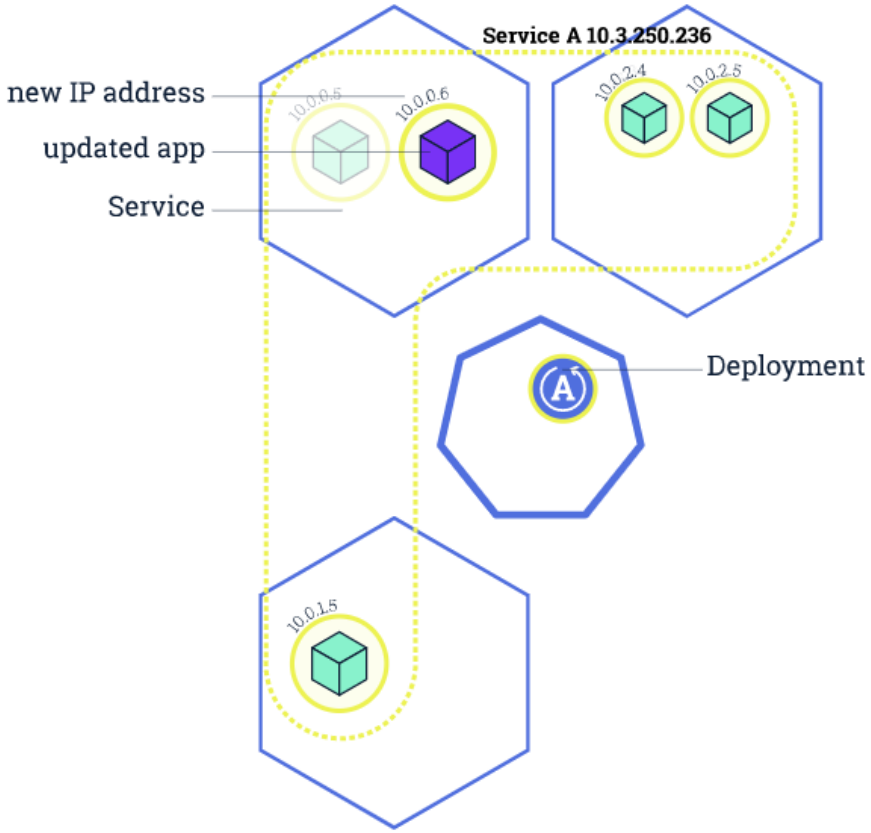
- No matter the resource (pod, deployment, or service), k8s will roll updates out to ensure zero downtime
- This can be for a new version (through CI/CD), moving to a new environment, or altering a resource
  - This also involves new IPs being allocated
- K8s updates individual containers in pods to ensure there is disruptions
  - It also checks to see if the new containers are healthy, if not, you can roll back
- Done by simply writing *kubectl apply -f*

K8s basics – services



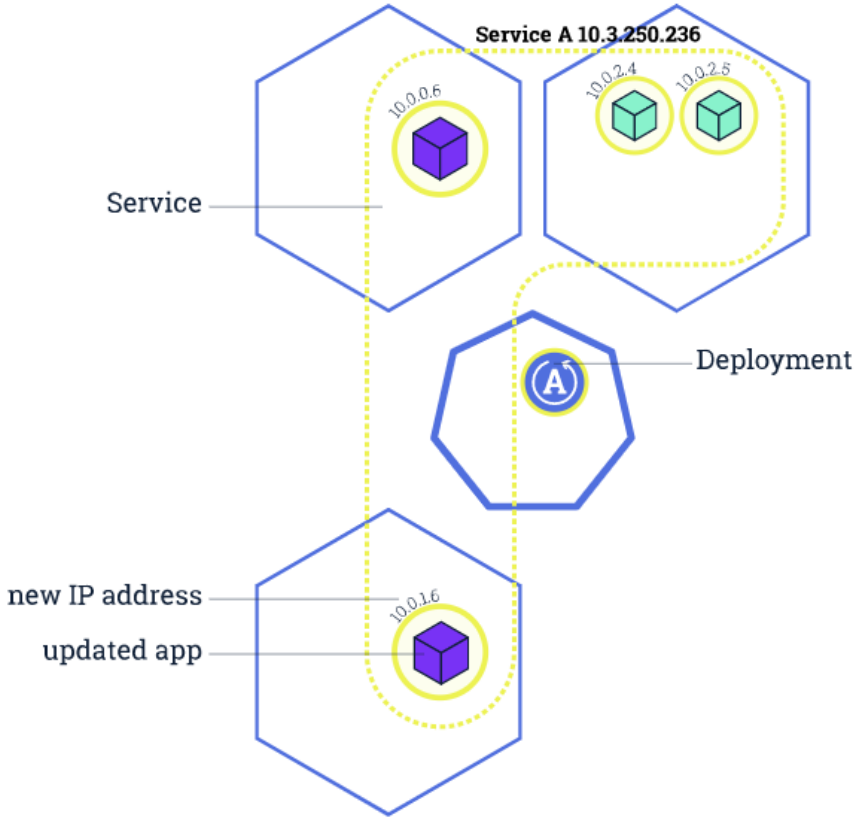
Rolling update 1/4

K8s basics – services



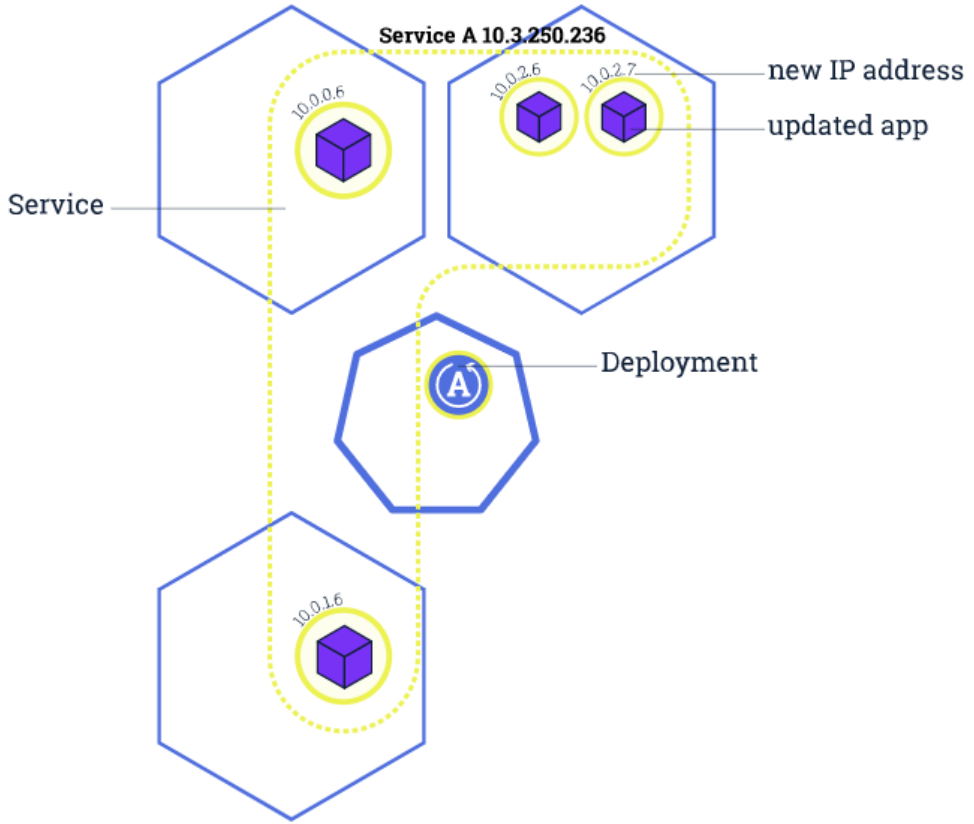
Rolling update 2/4

K8s basics – services



Rolling update 3/4

K8s basics – services



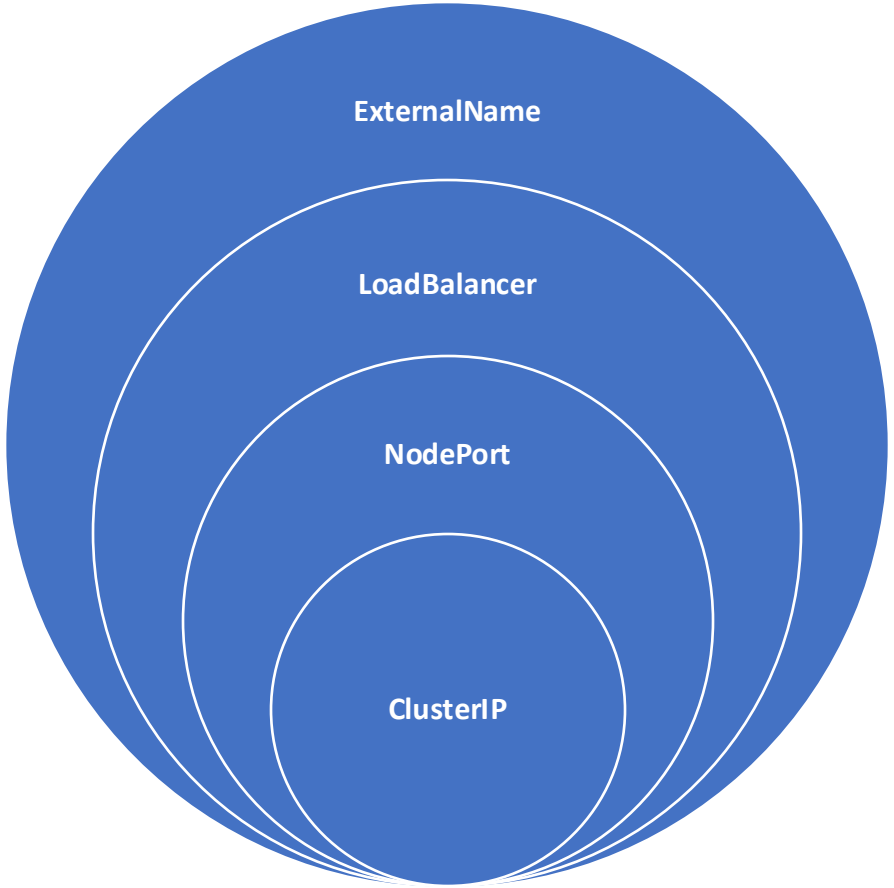
Rolling update 4/4 (src)

K8s basics – services

Visibility levels of service types

- When a service is NodePort it can be seen inside the node through statically exposing a port
- By default, ClusterIP doesn't let this happen
  - Unless kubectl proxy – we saw this to access our cluster
- Load balancers control outside traffic into your cluster
  - They can route internet traffic
  - Normally link up to cloud load balancers (Azure)
- DNS helps resolve names both internally and externally
  - Via ExternalName, or kube-dns internally

K8s basics – services



Different types of services

⌨ Try it out

1. Write a service manifest (yaml) to expose your previous deployment as a NodePort service
   a) Can use this link as a starting template
2. Find its exposed node port with *kubectl get service*
3. Visit localhost:<nodeport> to view your running application

K8s basics – services

Taking a step back

- Now that we have exposed a service and accessed it, lets put it into perspective
- From a functional point of view (user interaction), what do you think is different than if we just did this all with docker (built and run)?
  - What about docker-compose?
  - How would replicas be handled?

K8s basics – services

`Kubernetes learning curve (perspective)`

- It is an insanely complicated tool, we just did the base basics to get a service running
- The strength it has is managing complex systems
  - Not our single stateless container
- We will look at some more complex features in this workshop
  - But cannot cover everything (even in a month course)
- K8s has a really high skill floor and ceiling
  - Making it a highly desired skill for developers

K8s basics – services

`Service types resources`

- The following are links to the k8s documentation in relation to service types
  - ClusterIP (default)
  - NodePort
  - LoadBalancer
  - ExternalName
- Note: most articles you will read (including most of these slides :D) use the official docs, so may as well go straight to the source.

K8s basics – dns

A method of discovery

- Simply put, a DNS turns IP addresses into searchable names
- There is a popular addon called **kube-dns** (Docker enables it by default) that performs the role of a cluster aware DNS
- It watches the Kubernetes API for new Services and creates a set of DNS records for each one.
  - This allows you to refer to a service by its label and not IP
  - It solves the issues that arise from deployment controllers
  - Yes, it's the same as *docker-compose*
- Internally, we can say http://greeting-service to refer to our created service and not worry about its actual IP
  - Similar to how we used localhost through the exposed docker node to access it

K8s basics – dns

`Inspecting kube-dns`

- It is important to remember: *k8s is just a bunch of containers*
  - It is not a single conductor, its many conductors all playing their part
- Why don’t we see this?
  - When we look at docker, we see our pods.
  - When we say *kubectl get all* we just see our resources
- *Its actually being hidden from you*
  - For a very good reason, it’s a lot of bloat
  - We live in the default namespace, there are others

K8s basics – dns

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl get all --all-namespaces
NAMESPACE     NAME                                                 READY   STATUS    RESTARTS         AGE
default       pod/howzit-greeter-deployment-66c9bb7d84-2xjc7       1/1     Running   1 (3h38m ago)    24h
default       pod/howzit-greeter-deployment-66c9bb7d84-59547       1/1     Running   1 (3h38m ago)    24h
default       pod/howzit-greeter-deployment-66c9bb7d84-6v4mb       1/1     Running   1 (3h38m ago)    24h
kube-system   pod/coredns-95db45d46-mc7wf                          1/1     Running   1 (3h38m ago)    26h
kube-system   pod/coredns-95db45d46-s7cnl                          1/1     Running   1 (3h38m ago)    26h
kube-system   pod/etcd-docker-desktop                              1/1     Running   1 (3h38m ago)    26h
kube-system   pod/kube-apiserver-docker-desktop                    1/1     Running   1 (3h38m ago)    26h
kube-system   pod/kube-controller-manager-docker-desktop           1/1     Running   1 (3h38m ago)    26h
kube-system   pod/kube-proxy-j5wcl                                 1/1     Running   1 (3h38m ago)    26h
kube-system   pod/kube-scheduler-docker-desktop                    1/1     Running   1 (3h38m ago)    26h
kube-system   pod/storage-provisioner                              1/1     Running   2 (3h37m ago)    26h
kube-system   pod/vpnkit-controller                                1/1     Running   30 (12m ago)     26h

NAMESPACE     NAME                       TYPE        CLUSTER-IP       EXTERNAL-IP   PORT(S)                  AGE
default       service/greeter-service    NodePort    10.102.145.103   <none>        80:32638/TCP             149m
default       service/kubernetes         ClusterIP   10.96.0.1        <none>        443/TCP                  26h
kube-system   service/kube-dns           ClusterIP   10.96.0.10       <none>        53/UDP,53/TCP,9153/TCP   26h
```

A peak behind the curtain

K8s basics – dns

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl describe service kube-dns --namespace=kube-system
Name:              kube-dns
Namespace:         kube-system
Labels:            k8s-app=kube-dns
                   kubernetes.io/cluster-service=true
                   kubernetes.io/name=CoreDNS
Annotations:       prometheus.io/port: 9153
                   prometheus.io/scrape: true
Selector:          k8s-app=kube-dns
Type:              ClusterIP
IP Family Policy:  SingleStack
IP Families:       IPv4
IP:                10.96.0.10
IPs:               10.96.0.10
Port:              dns  53/UDP
TargetPort:        53/UDP
Endpoints:         10.1.0.18:53,10.1.0.20:53
Port:              dns-tcp  53/TCP
TargetPort:        53/TCP
Endpoints:         10.1.0.18:53,10.1.0.20:53
Port:              metrics  9153/TCP
TargetPort:        9153/TCP
Endpoints:         10.1.0.18:9153,10.1.0.20:9153
Session Affinity:  None
Events:            <none>
```

A detailed look at kube-dns

K8s basics – dns

Checking visibility

- To see if our service is discoverable, we can drill into a pod and execute a command
  - Specifically, **nslookup.**
- *kubectl exec* lets you start a shell session to containers running in your Kubernetes cluster.
  - Use a -- to separate kubectl commands from arguments
  - Link to docs
- So, we want to start a shell on a container in a pod, then see if we can see our service through the internal network

K8s basics – dns

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl get pods
NAME                                          READY   STATUS    RESTARTS        AGE
howzit-greeter-deployment-66c9bb7d84-2xjc7    1/1     Running   1 (3h50m ago)   25h
howzit-greeter-deployment-66c9bb7d84-59547    1/1     Running   1 (3h50m ago)   25h
howzit-greeter-deployment-66c9bb7d84-6v4mb    1/1     Running   1 (3h50m ago)   25h

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl exec howzit-greeter-deployment-66c9bb7d84-2xjc7 -- ls -a
.
..
Microsoft.OpenApi.dll
Swashbuckle.AspNetCore.Swagger.dll
Swashbuckle.AspNetCore.SwaggerGen.dll
Swashbuckle.AspNetCore.SwaggerUI.dll
appsettings.Development.json
appsettings.json
howzit-api.deps.json
howzit-api.dll
howzit-api.pdb
howzit-api.runtimeconfig.json
web.config
```

Inspecting the folder structure

K8s basics – dns

`Checking on our services`

- Our pod wont have **nslookup** installed
  - We could install it, but that's a bit silly as the pod will be destroyed
- Its easier to make a utility pod, specifically for DNS
  - You can do the same for *logging* or any other utility/addon
- We will follow the Debugging DNS Resolution docs to do this
- It's a simple pod that has nothing but some utility commands installed
  - It has no processes either

K8s basics – dns

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl apply -f https://k8s.io/examples/admin/dns/dnsutils.yaml
pod/dnsutils created

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl get pod dnsutils
NAME       READY   STATUS    RESTARTS   AGE
dnsutils   1/1     Running   0          14s

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl exec -i -t dnsutils -- nslookup kubernetes.default
Server:         10.96.0.10
Address:        10.96.0.10#53

Name:   kubernetes.default.svc.cluster.local
Address: 10.96.0.1
```

Running our dns util pod

K8s basics – dns

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl get svc
NAME              TYPE        CLUSTER-IP       EXTERNAL-IP   PORT(S)        AGE
greeter-service   NodePort    10.102.145.103   <none>        80:32638/TCP   3h11m
kubernetes        ClusterIP   10.96.0.1        <none>        443/TCP        27h

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl exec -i -t dnsutils -- nslookup greeter-service.default
Server:         10.96.0.10
Address:        10.96.0.10#53

Name:   greeter-service.default.svc.cluster.local
Address: 10.102.145.103


RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl exec -i -t dnsutils -- nslookup greeter-service
Server:         10.96.0.10
Address:        10.96.0.10#53

Name:   greeter-service.default.svc.cluster.local
Address: 10.102.145.103
```

Seeing if our service is discoverable

Any questions?

Maybe a break?

K8s basics – ingress

`Providing access from outside`

- Exposing individual services at random ports is not a good idea
  - Ports can change
  - We are breaking the “cohesive whole”
  - Each service needs its own certificate for TLS
- It's better to have a dedicated load balancer that routes traffic from outside to services
  - This way our cluster is hidden, and exposed through a single service

K8s basics – ingress

What is ingress?

- Dictionary definition – “the action or fact of going in or entering”
- Ingress exposes HTTP and HTTPS routes from outside the cluster to services within the cluster.
- Traffic routing is controlled by rules defined on the Ingress resource.
- These ingress rules (just called ingresses) are fulfilled with an ingress controller which acts as a load balancer

K8s basics – ingress

Ingress controllers

- Controllers abstract away complexities of k8s traffic
- For ingress resources to work, a controller needs to be running
- By default, k8s does not run one. However, it’s a very common addon and there are many templated options
- The most commonly used is **nginx**
  - There is one maintained and supported by k8s
- Link to quick start (link to general nginx ingress docs)

K8s basics – ingress

```
RES+noro-nle@acc-nlennox MSYS ~
$ kubectl apply -f https://raw.githubusercontent.com/kubernetes/ingress-nginx/controller-v1.5.1/deploy/static/provider/c
loud/deploy.yaml
namespace/ingress-nginx created
serviceaccount/ingress-nginx created
serviceaccount/ingress-nginx-admission created
role.rbac.authorization.k8s.io/ingress-nginx created
role.rbac.authorization.k8s.io/ingress-nginx-admission created
clusterrole.rbac.authorization.k8s.io/ingress-nginx created
clusterrole.rbac.authorization.k8s.io/ingress-nginx-admission created
rolebinding.rbac.authorization.k8s.io/ingress-nginx created
rolebinding.rbac.authorization.k8s.io/ingress-nginx-admission created
clusterrolebinding.rbac.authorization.k8s.io/ingress-nginx created
clusterrolebinding.rbac.authorization.k8s.io/ingress-nginx-admission created
configmap/ingress-nginx-controller created
service/ingress-nginx-controller created
service/ingress-nginx-controller-admission created
deployment.apps/ingress-nginx-controller created
job.batch/ingress-nginx-admission-create created
job.batch/ingress-nginx-admission-patch created
ingressclass.networking.k8s.io/nginx created
validatingwebhookconfiguration.admissionregistration.k8s.io/ingress-nginx-admission created
```

After following quick start 1/3

K8s basics – ingress

```
NAMESPACE       NAME                                       TYPE           CLUSTER-IP       EXTERNAL-IP   PORT(S)                      AGE
default         service/kubernetes                         ClusterIP      10.96.0.1        <none>        443/TCP                      2d5h
ingress-nginx   service/ingress-nginx-controller           LoadBalancer   10.103.199.218   localhost     80:32688/TCP,443:30433/TCP   79s
ingress-nginx   service/ingress-nginx-controller-admission ClusterIP      10.107.127.44    <none>        443/TCP                      79s
kube-system     service/kube-dns                           ClusterIP      10.96.0.10       <none>        53/UDP,53/TCP,9153/TCP       2d5h

NAMESPACE     NAME                        DESIRED   CURRENT   READY   UP-TO-DATE   AVAILABLE   NODE SELECTOR
AGE
kube-system   daemonset.apps/kube-proxy   1         1         1       1            1           kubernetes.io/os=linux   2d5h

NAMESPACE       NAME                                   READY   UP-TO-DATE   AVAILABLE   AGE
ingress-nginx   deployment.apps/ingress-nginx-controller   1/1     1            1           79s
kube-system     deployment.apps/coredns                2/2     2            2           2d5h

NAMESPACE       NAME                                              DESIRED   CURRENT   READY   AGE
ingress-nginx   replicaset.apps/ingress-nginx-controller-8574b6d7c9   1         1         1       79s
kube-system     replicaset.apps/coredns-95db45d46                 2         2         2       2d5h

NAMESPACE       NAME                                   COMPLETIONS   DURATION   AGE
ingress-nginx   job.batch/ingress-nginx-admission-create   1/1           9s         79s
ingress-nginx   job.batch/ingress-nginx-admission-patch    1/1           10s        79s
```

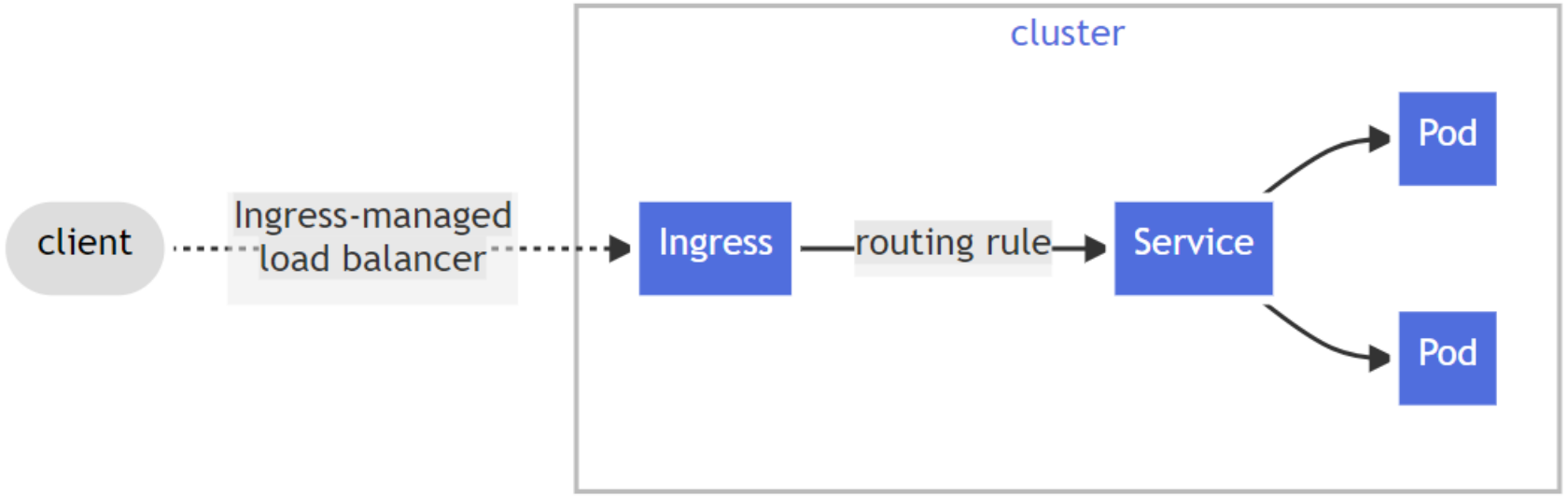
After following quick start 2/3

K8s basics – ingress

```
RES+noro-nle@acc-nlennox MSYS ~
$ curl localhost
<html>
<head><title>404 Not Found</title></head>
<body>
<center><h1>404 Not Found</h1></center>
<hr><center>nginx</center>
</body>
</html>
```

After following quick start 3/3

K8s basics – ingress



Basic illustration (src)

K8s basics – ingress

Now what?

- We added the production ready ingress controller
  - If you look at the manifest its quite scary
  - Also all the extra roles and configuration it added
- We can start adding ingress resources to create maps
- Lets start by mapping */greeting* to our greeting service
- First lets change our current service and deployments to be a little clearer and completely hidden from outside traffic
  - We can do both deployment and service in one file (---)

K8s basics – ingress

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ cat howzit-greeter.yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: greeter
  labels:
    app: greeter
spec:
  replicas: 2
  selector:
    matchLabels:
      app: greeter
  template:
    metadata:
      labels:
        app: greeter
    spec:
      containers:
        - name: greeter
          image: nicholaslennox/howzit-greeter
          imagePullPolicy: IfNotPresent
          ports:
            - containerPort: 80
---
```

Our cleaned up resource 1/2

K8s basics – ingress

```
---
apiVersion: v1
kind: Service
metadata:
  name: greeter
spec:
  selector:
    app: greeter
  ports:
    - protocol: TCP
      port: 80
      targetPort: 80
      name: http
  type: ClusterIP
```

Will select deployment.app/greeter

We gave the port a name, so we can refer to it as http

Our service is fully internal

Our cleaned up resource 2/2

K8s basics – ingress

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl apply -f howzit-greeter.yaml
deployment.apps/greeter created
service/greeter created

RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl get all
NAME                           READY   STATUS    RESTARTS   AGE
pod/greeter-d4644f8c8-4qx77    1/1     Running   0          5s
pod/greeter-d4644f8c8-f4xp7    1/1     Running   0          5s

NAME                 TYPE        CLUSTER-IP      EXTERNAL-IP   PORT(S)   AGE
service/greeter      ClusterIP   10.110.155.37   <none>        80/TCP    5s
service/kubernetes   ClusterIP   10.96.0.1       <none>        443/TCP   2d5h

NAME                       READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/greeter    2/2     2            2           5s

NAME                                  DESIRED   CURRENT   READY   AGE
replicaset.apps/greeter-d4644f8c8     2         2         2       5s
```

Applying our resource

K8s basics – ingress

Adding an ingress resource

- Once again, it’s a template. So we can just follow the k8s docs

K8s basics – ingress

```yaml
---
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: greeting
  annotations:
    nginx.ingress.kubernetes.io/rewrite-target: /
spec:
  ingressClassName: nginx
  rules:
  - http:
      paths:
      - path: /greeting
        pathType: Prefix
        backend:
          service:
            name: greeter
            port:
              name: http
```

Lets you create a different URL representation if you want

Ingress class?

Referring to our service port by name

Our ingress resource

K8s basics – ingress

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl apply -f howzit-greeter.yaml
deployment.apps/greeter unchanged
service/greeter unchanged
ingress.networking.k8s.io/greeting created
```

```
$ kubectl get ingress
NAME       CLASS   HOSTS   ADDRESS     PORTS   AGE
greeting   nginx   *       localhost   80      66m
```

```
$ curl localhost/greeting
{"message":"Howzit!"}
```

Applying our resource

K8s basics – ingress

`ingressClass?`

- Clusters can have multiple ingress controllers
  - Yours, and one for the cloud provider (Azure, AWS, and so on)
- You need to say which controller is going to implement your ingress resource
  - We just want our default ingress-nginx (comes with it)
  - Creating your own default ingress-nginx class

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl get ingressClass
NAME    CONTROLLER             PARAMETERS   AGE
nginx   k8s.io/ingress-nginx   <none>       91m
```

K8s basics – ingress

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl describe ingressClass/nginx
Name:         nginx
Labels:       app.kubernetes.io/component=controller
              app.kubernetes.io/instance=ingress-nginx
              app.kubernetes.io/name=ingress-nginx
              app.kubernetes.io/part-of=ingress-nginx
              app.kubernetes.io/version=1.5.1
Annotations:  <none>
Controller:   k8s.io/ingress-nginx
Events:       <none>
```

Describing our ingressClass

K8s basics – ingress

What else?

- It can help manage egress (outgoing) traffic
- It also is commonly used as a TLS terminator
  - Meaning, HTTPS to the ingress controller, HTTP from it to the services
  - This is fine because all the services are not exposed and any validation can happen in the ingress controller
  - We just need to get a certification for a hostname and then we can route TLS traffic and quite efficiently secure our cluster

⌨ Try it out

1. Make sure you have your service running as ClusterIP (NodePort wont register with ingress)
   a) You can just alter the yaml and re-apply
2. Install the ingress controller from nginx (link in slides)
   a) Make sure its running by checking kubectl get all --namespace=ingress-nginx
3. Create an ingress resource to map a url to your service
   a) Don’t forget ingressClassName
4. Check it out by visiting localhost/your-url ☺

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and digital media

Azure Kubernetes Service

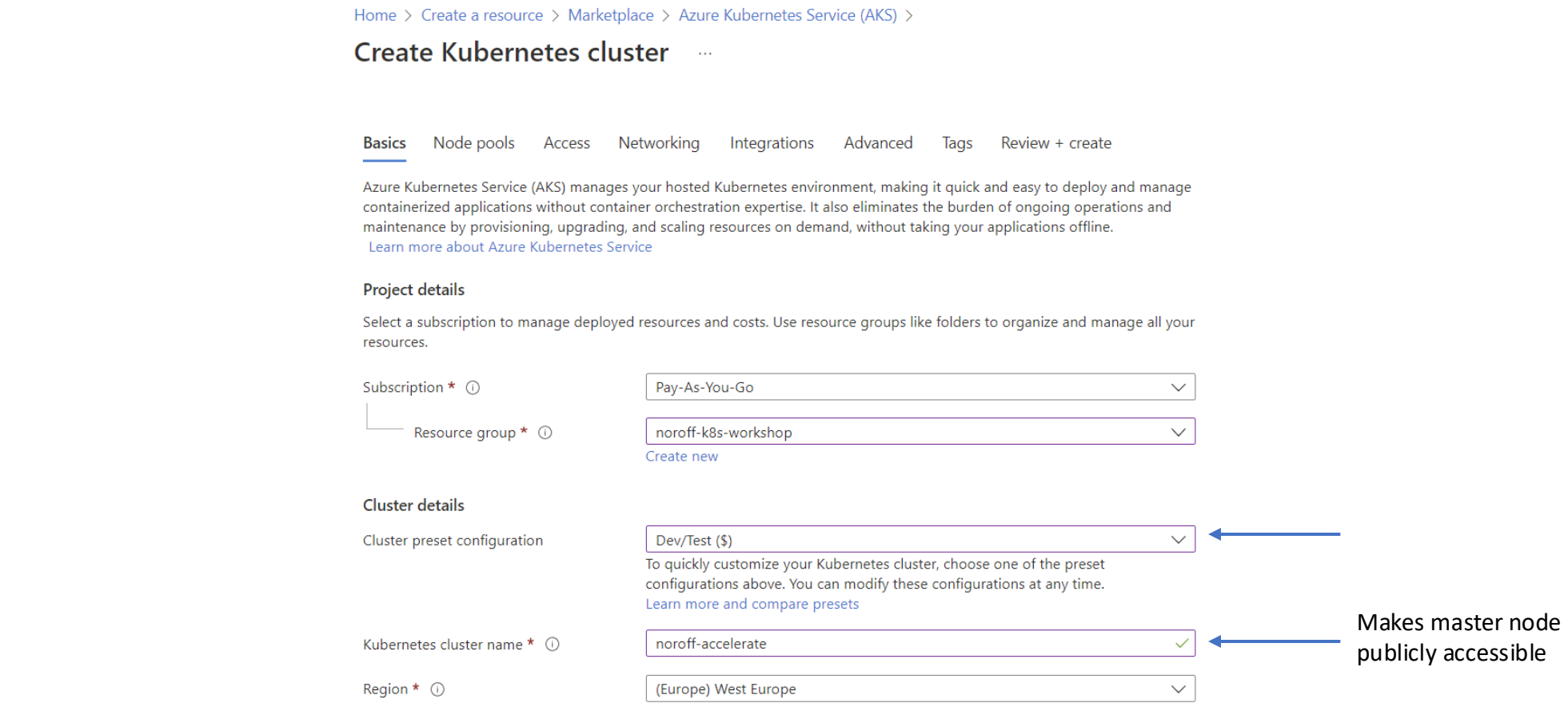
Using Azure to help deploy to production

Azure Kubernetes Service

What is it?

- A manager Kubernetes cluster on Azure
  - It handles critical tasks, like health monitoring and maintenance.
  - You don’t pay for the cluster itself, only the VMs running nodes
- When you deploy an AKS cluster, you specify the number and size of the nodes
  - AKS deploys and configures the Kubernetes control plane and nodes
- It provides Authentication and RBAC with Azure AD
- It provides logging and monitoring as well

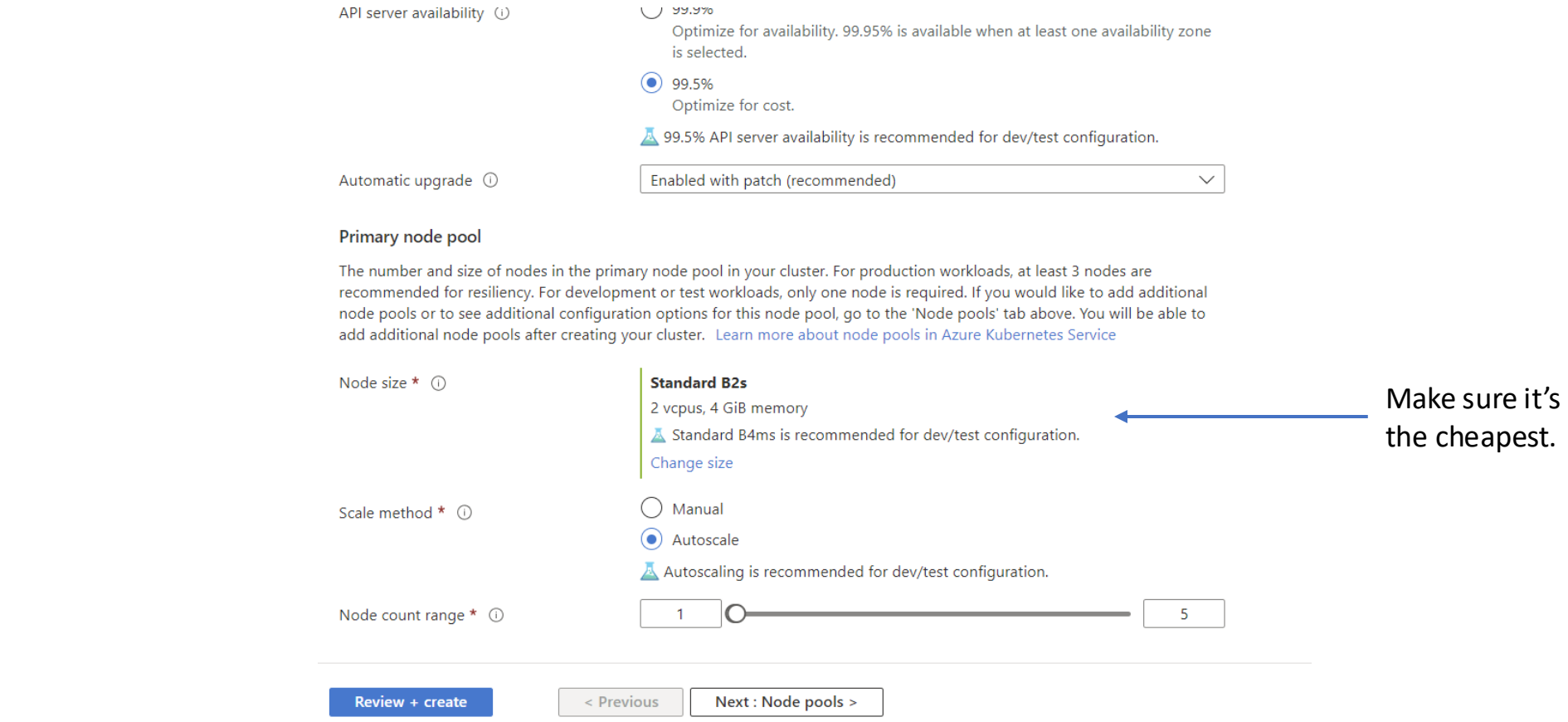
Azure Kubernetes Service



Makes master node publicly accessible

Creating our cluster

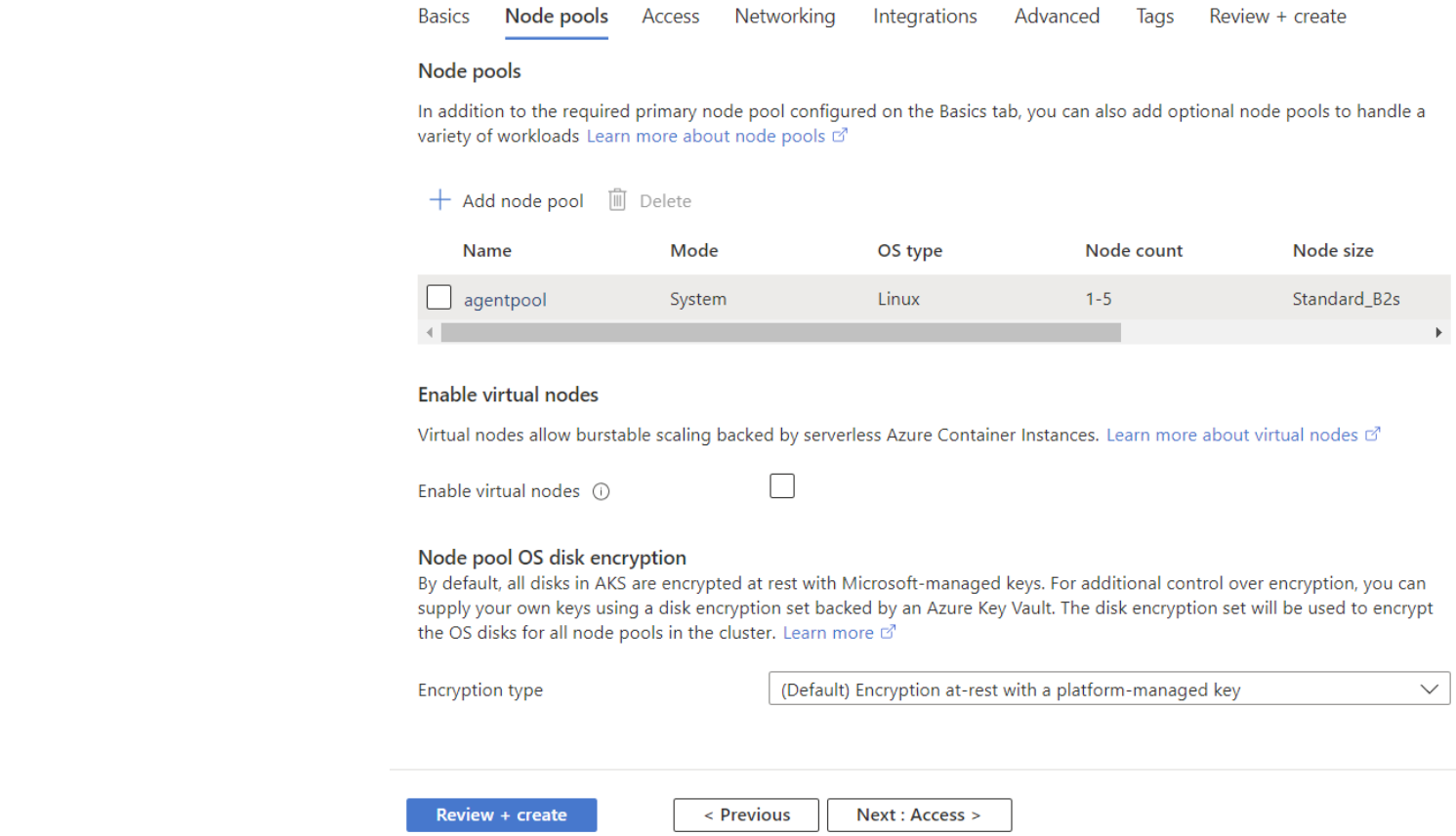
Azure Kubernetes Service



Make sure it's the cheapest.

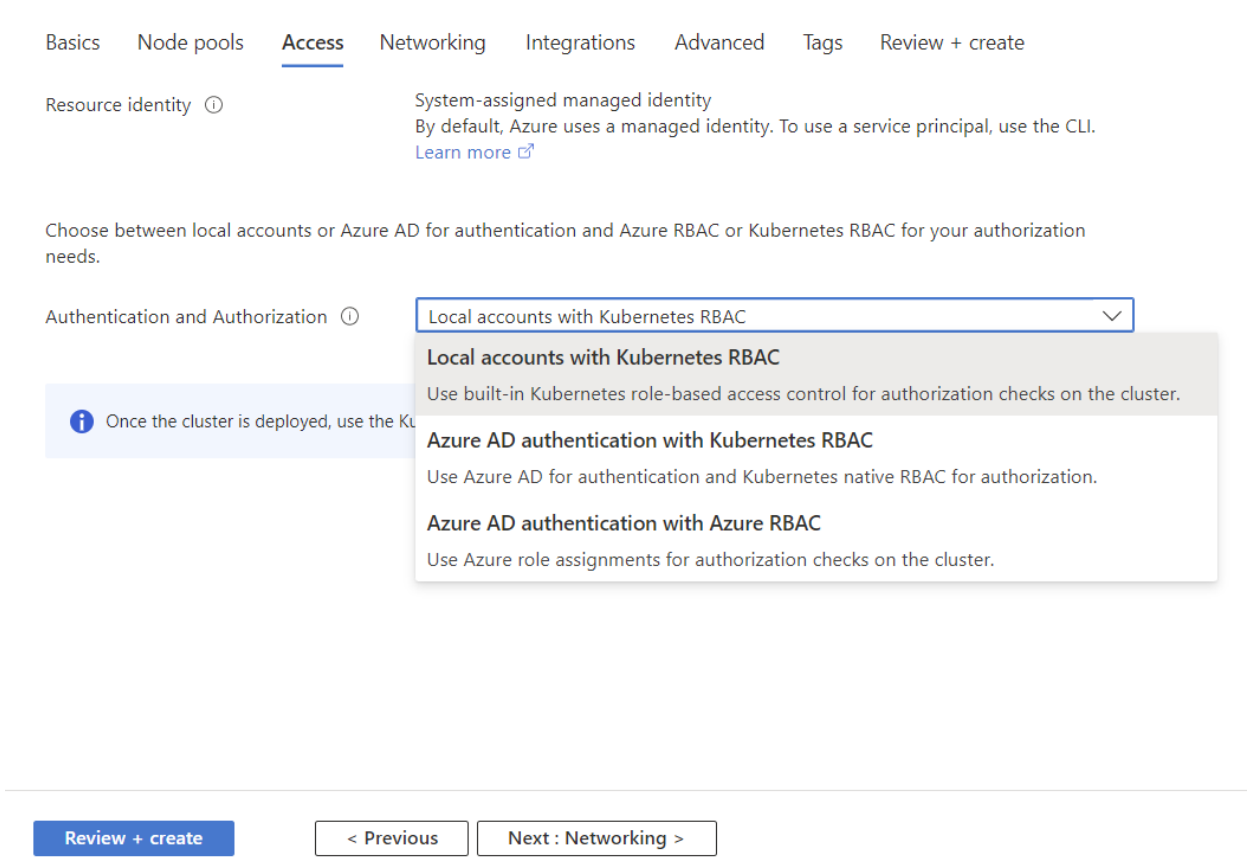
Trying to keep costs down

Azure Kubernetes Service



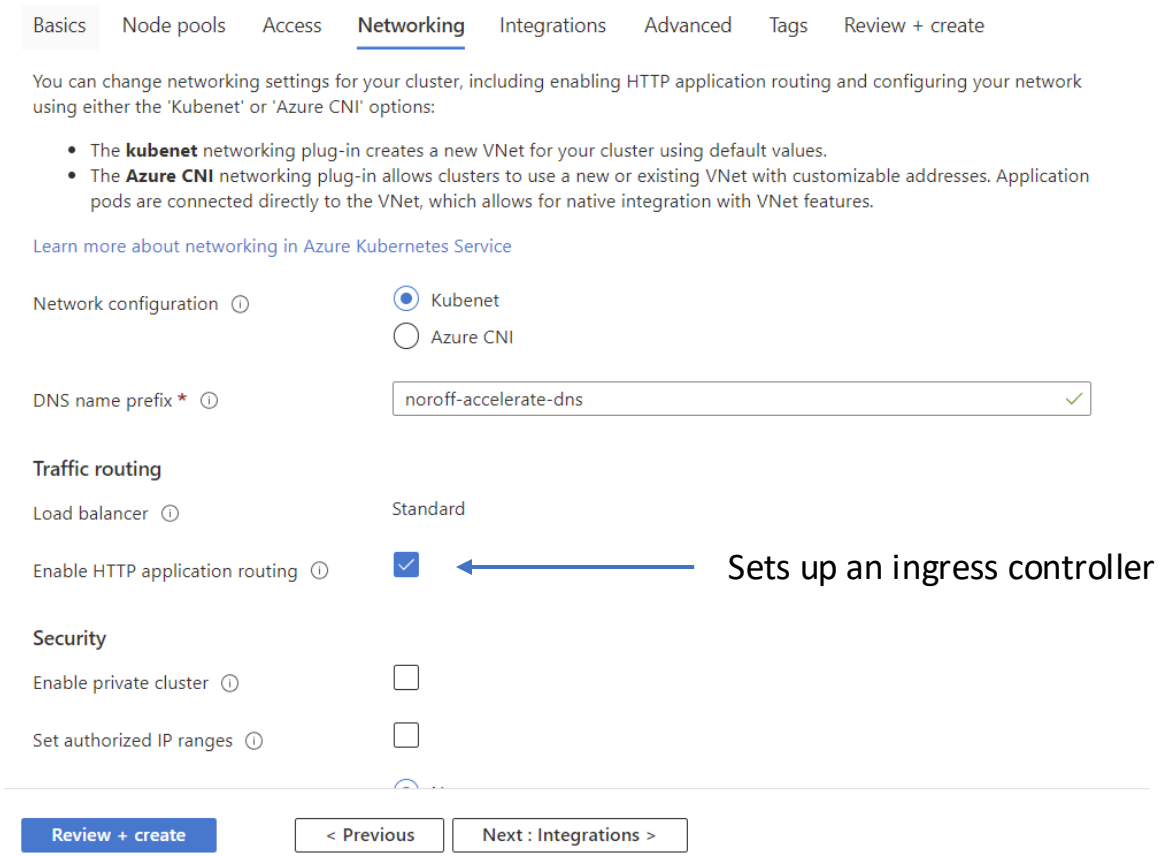
Node pools group nodes

Azure Kubernetes Service



We will just use local accounts for now

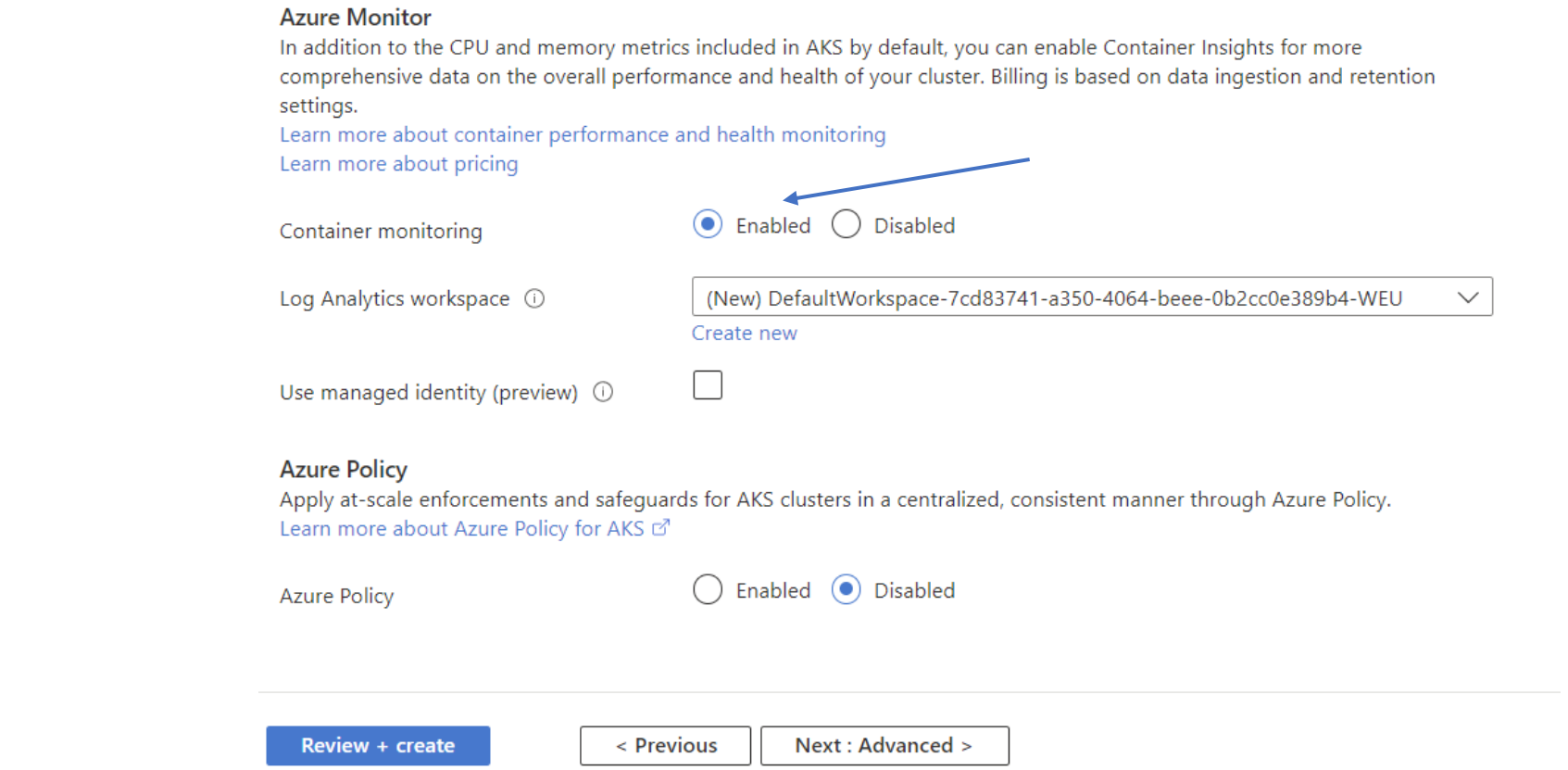
Azure Kubernetes Service



Sets up an ingress controller for us (only for dev)

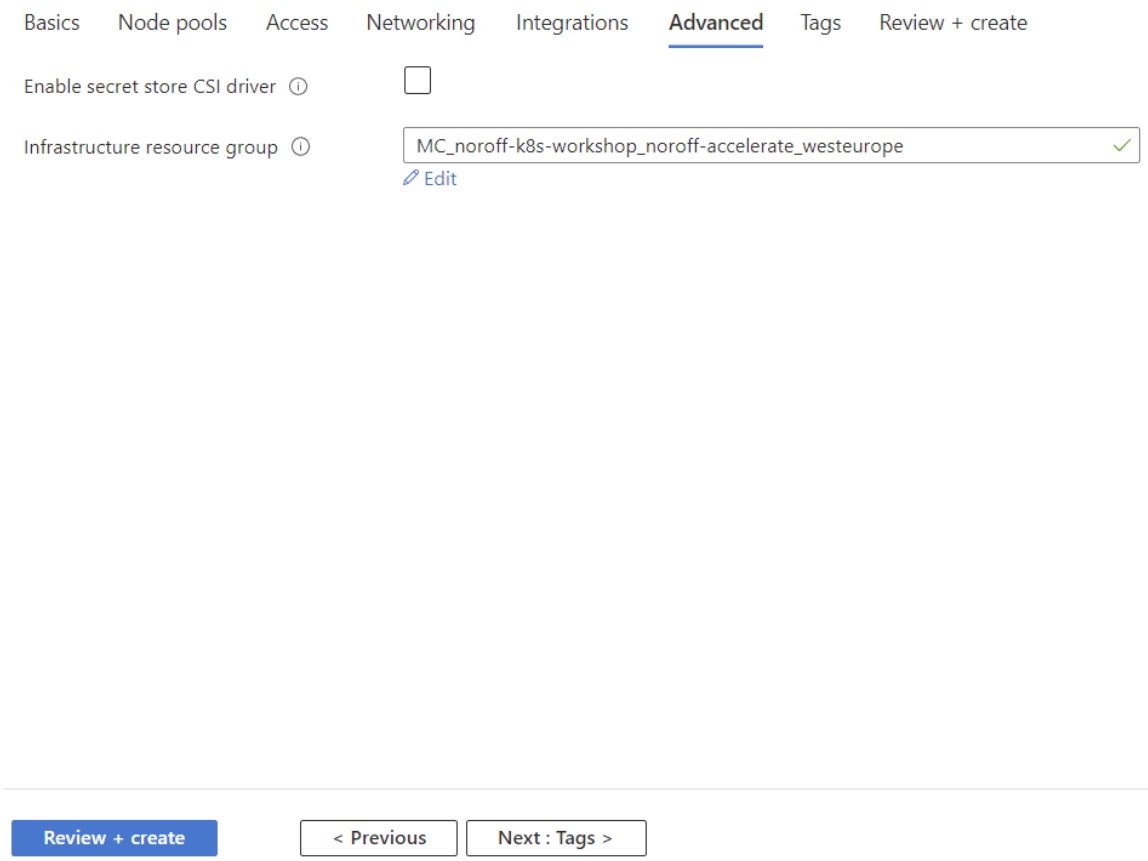
We will just enable HTTP routing

Azure Kubernetes Service



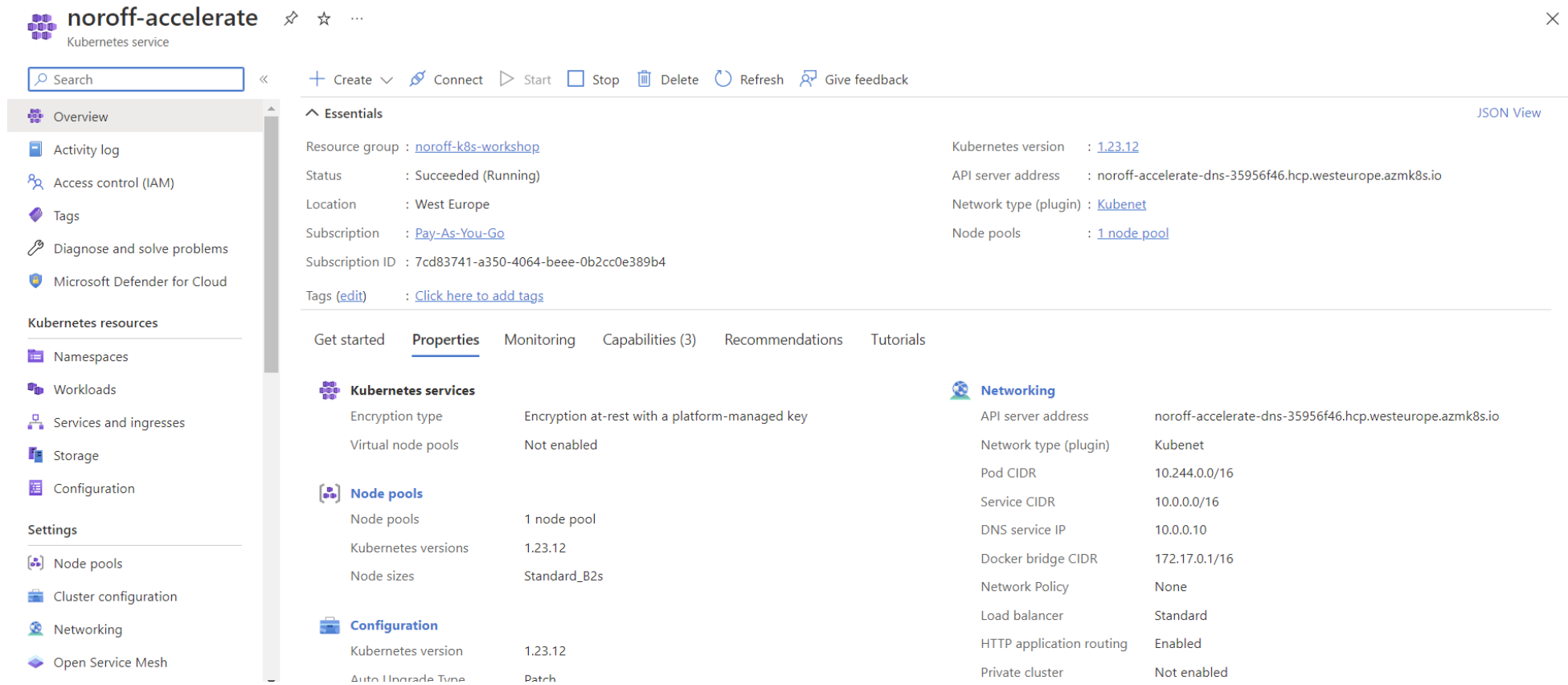
We want to include monitoring

Azure Kubernetes Service



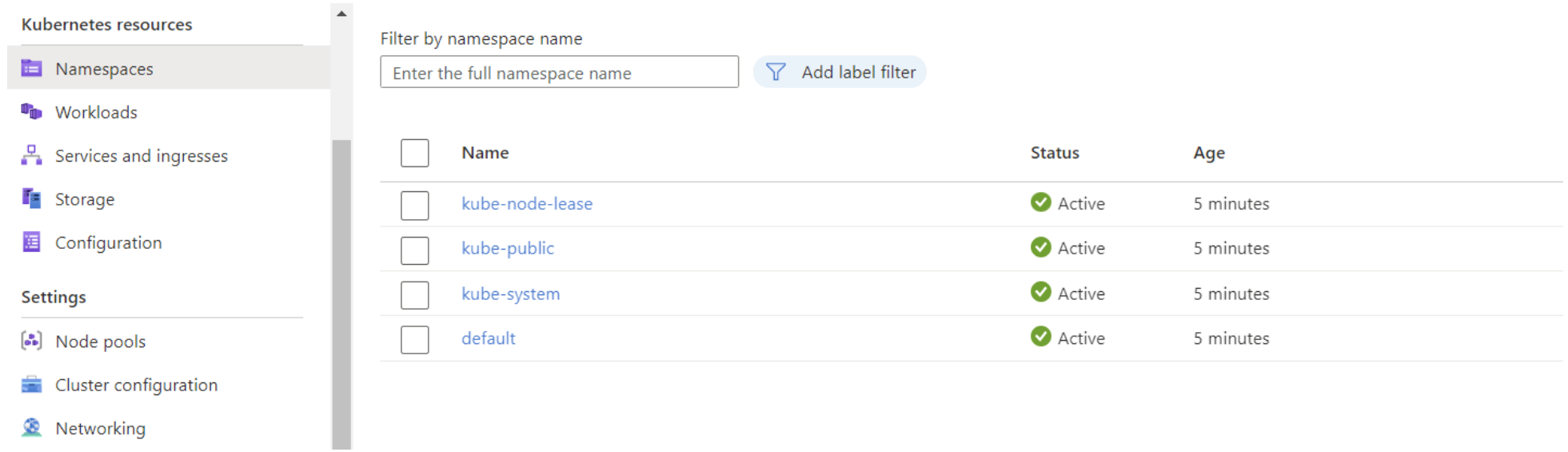
We wont include the Key Vault

Azure Kubernetes Service



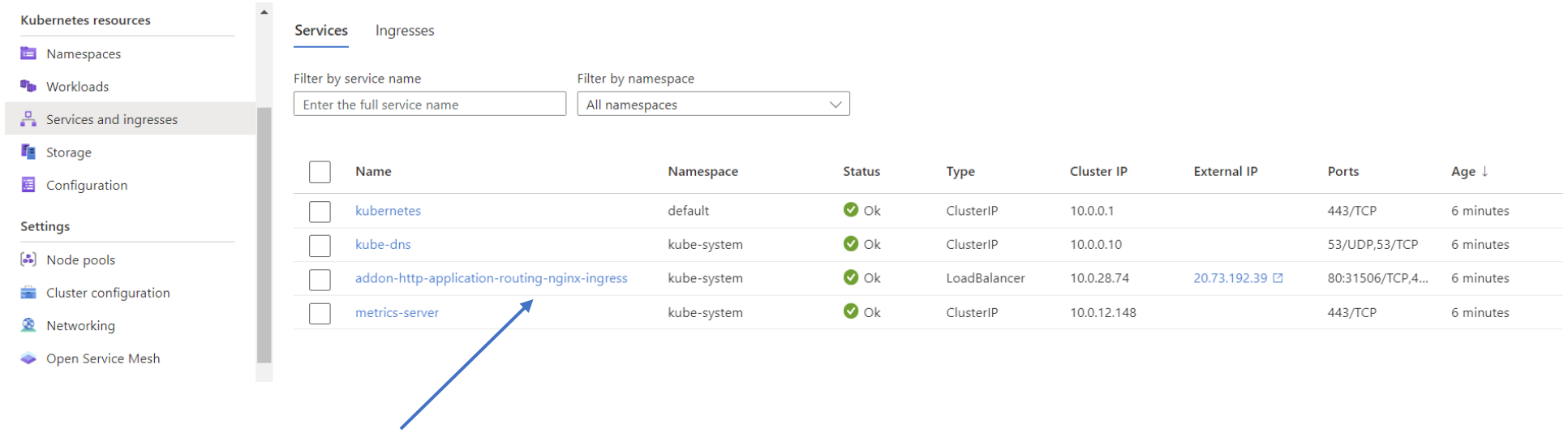
Finally deployed.

Azure Kubernetes Service



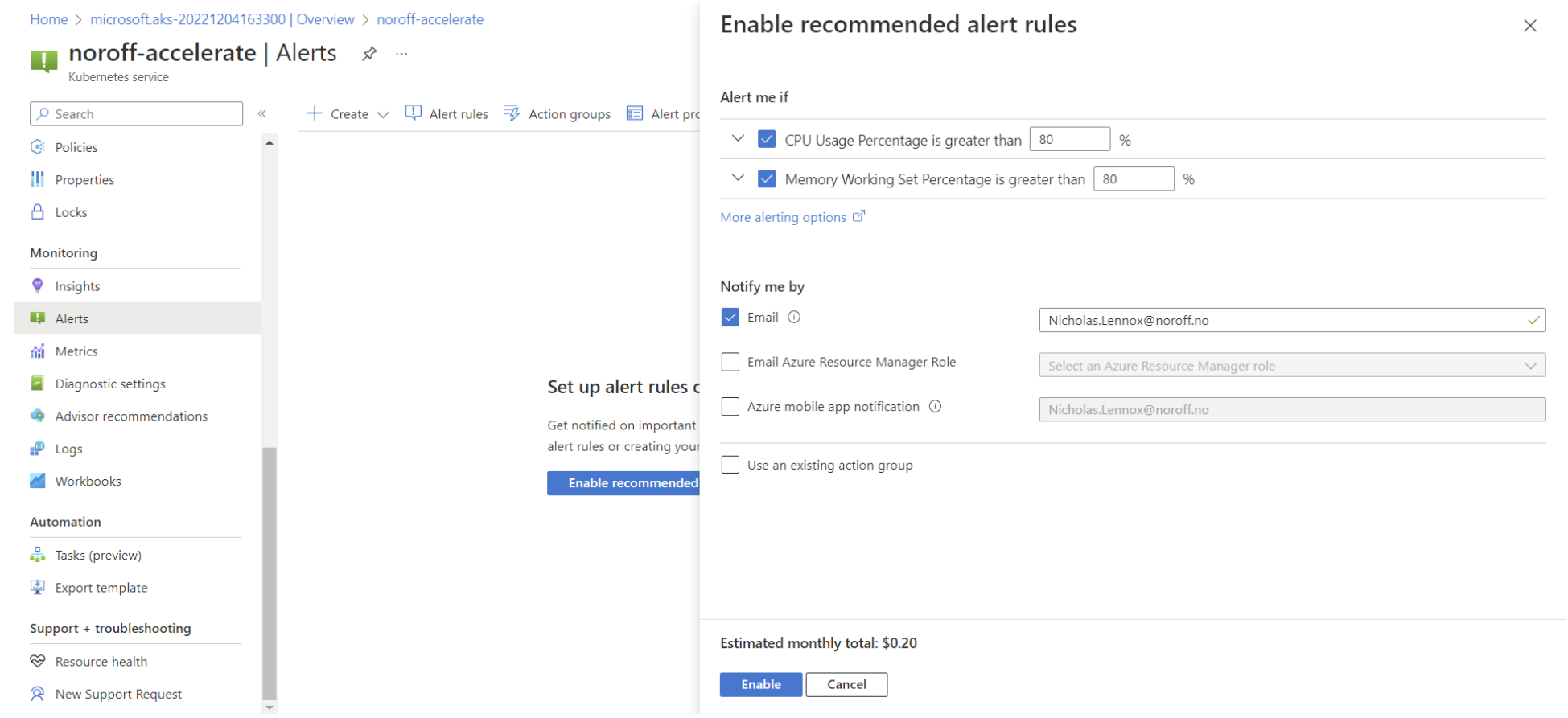
Our namespaces

Azure Kubernetes Service



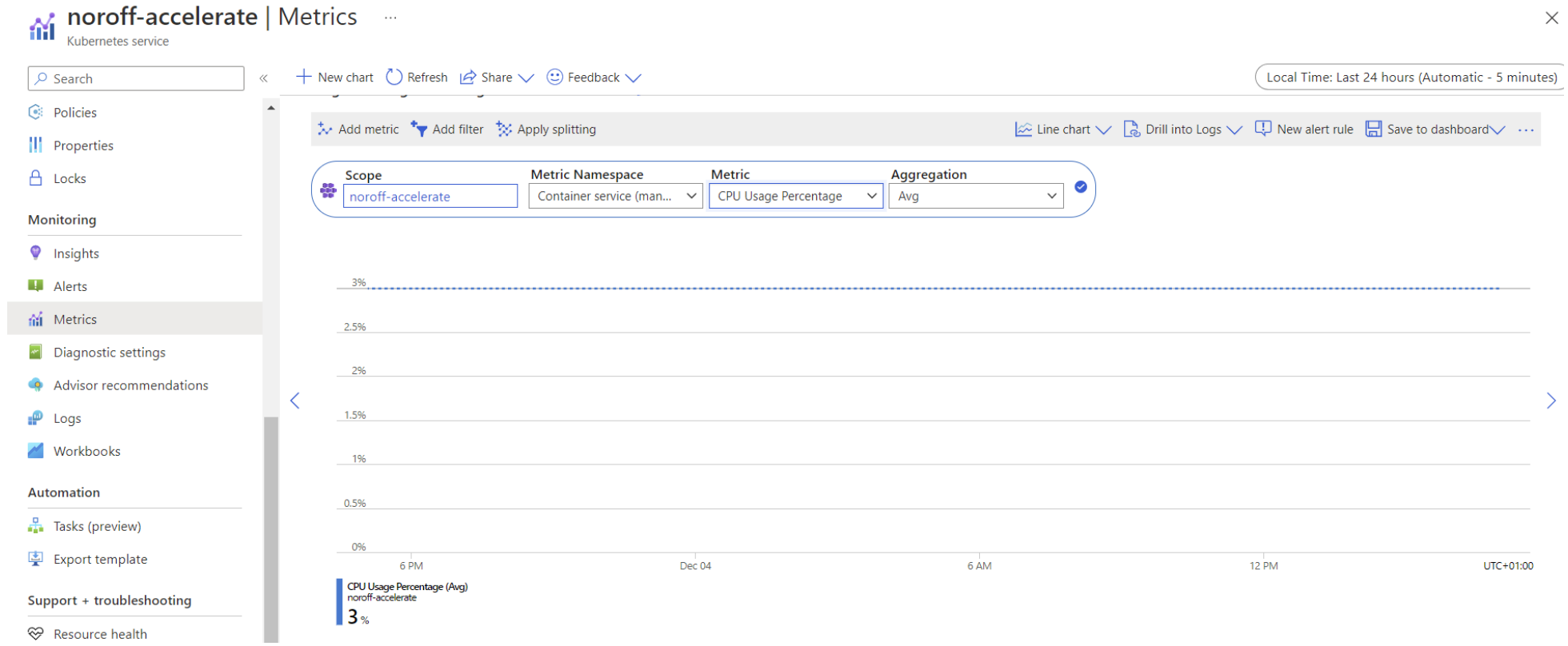
Our services

Azure Kubernetes Service



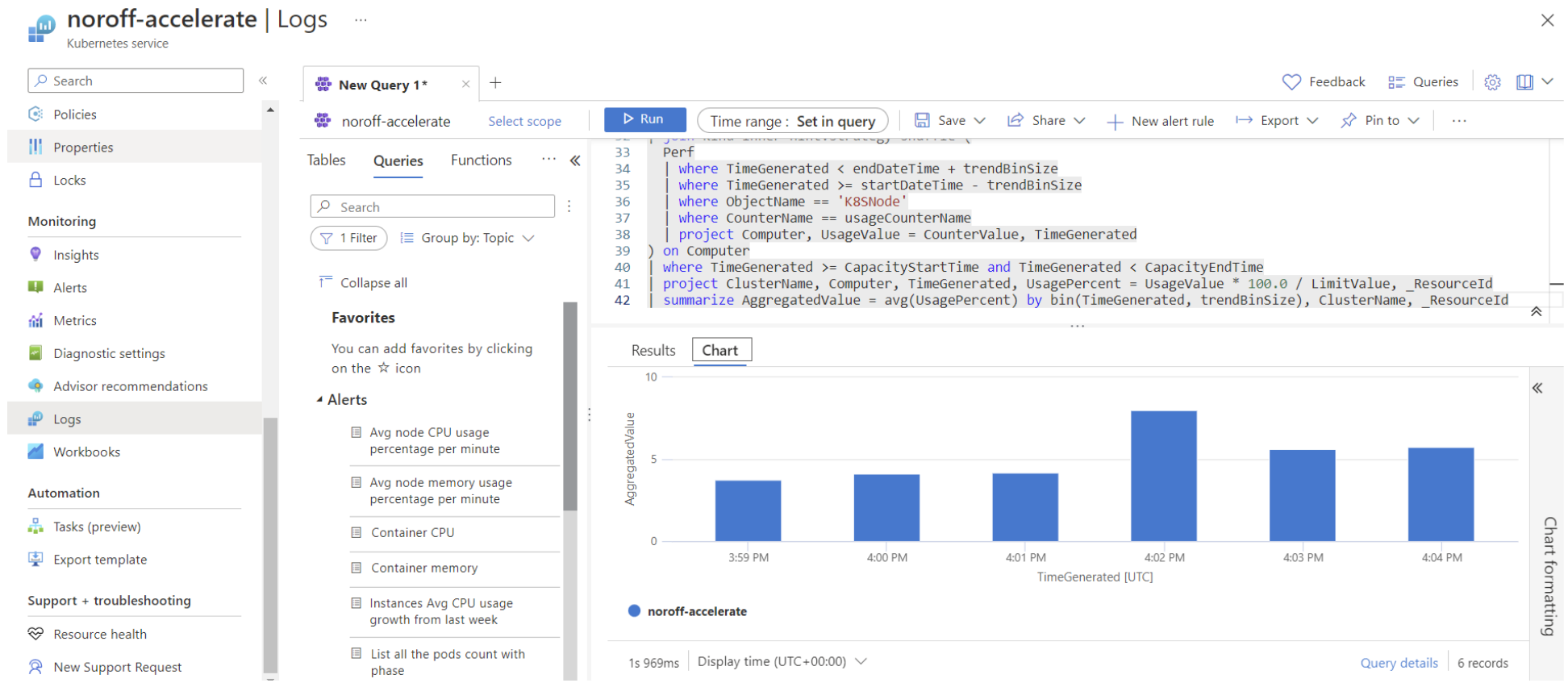
Looking at alerts

Azure Kubernetes Service



Looking at metrics

Azure Kubernetes Service



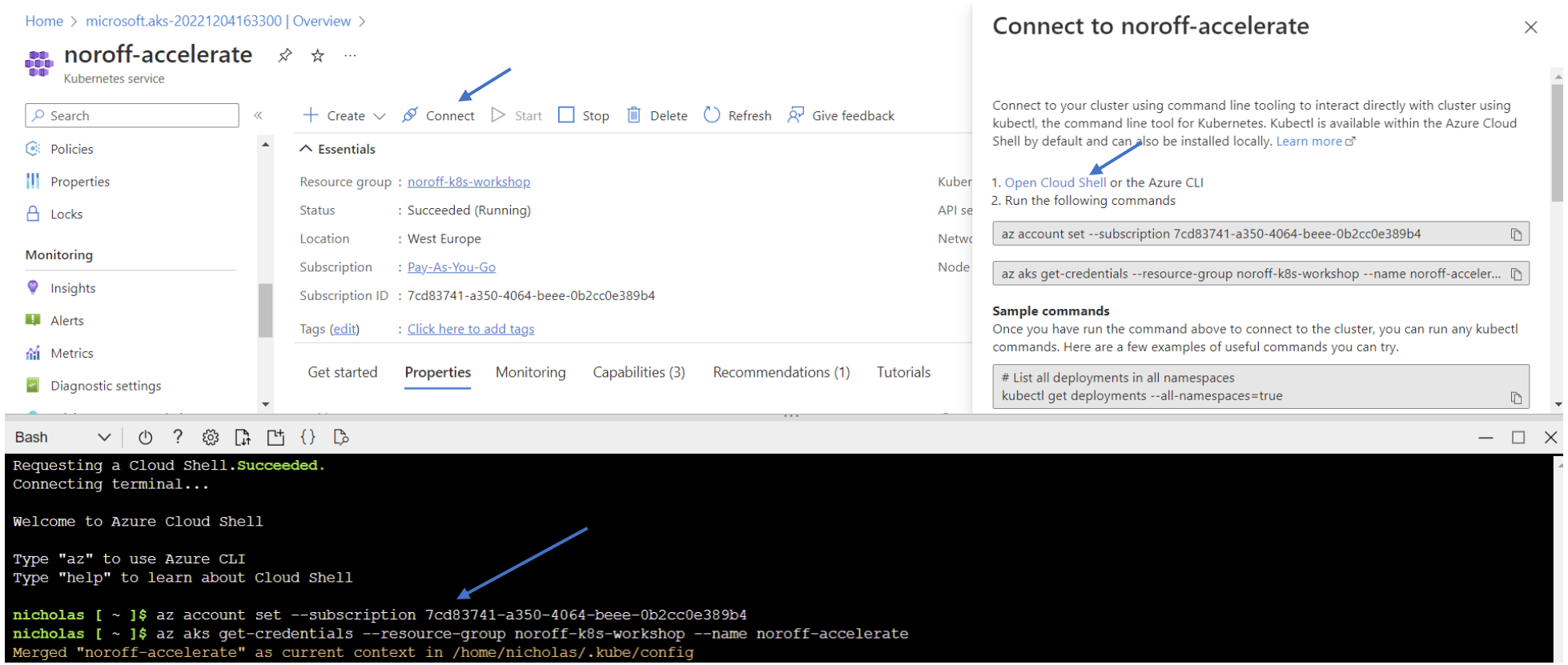
Looking at logs of CPU usage

Azure Kubernetes Service

`Okay now what?`

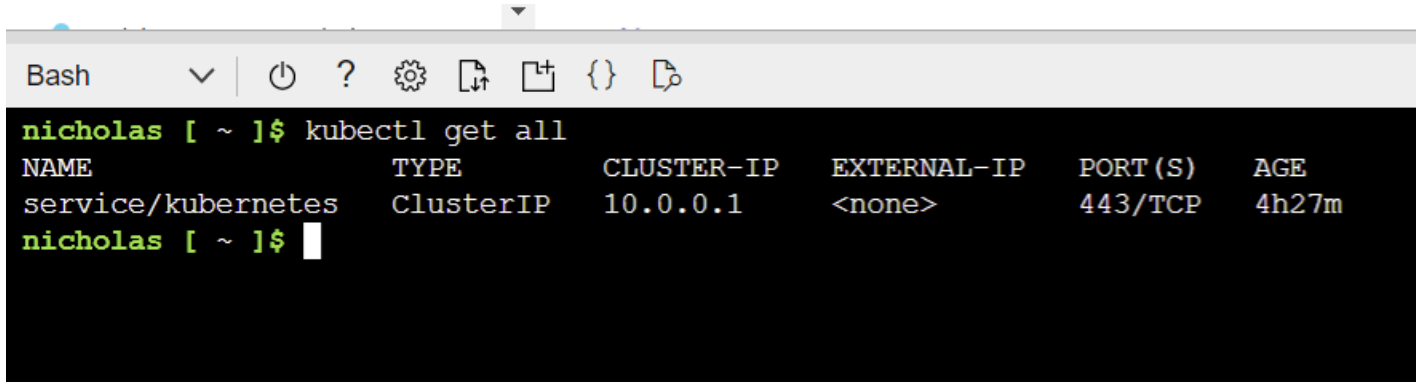
- We can interact with *kubectl* through the azure cli
  - Or directly copy paste yaml contents
- Lets use *kubectl* to replicate some of the things we did locally
- Then use the “add” tool to copy paste deployments and services

Azure Kubernetes Service



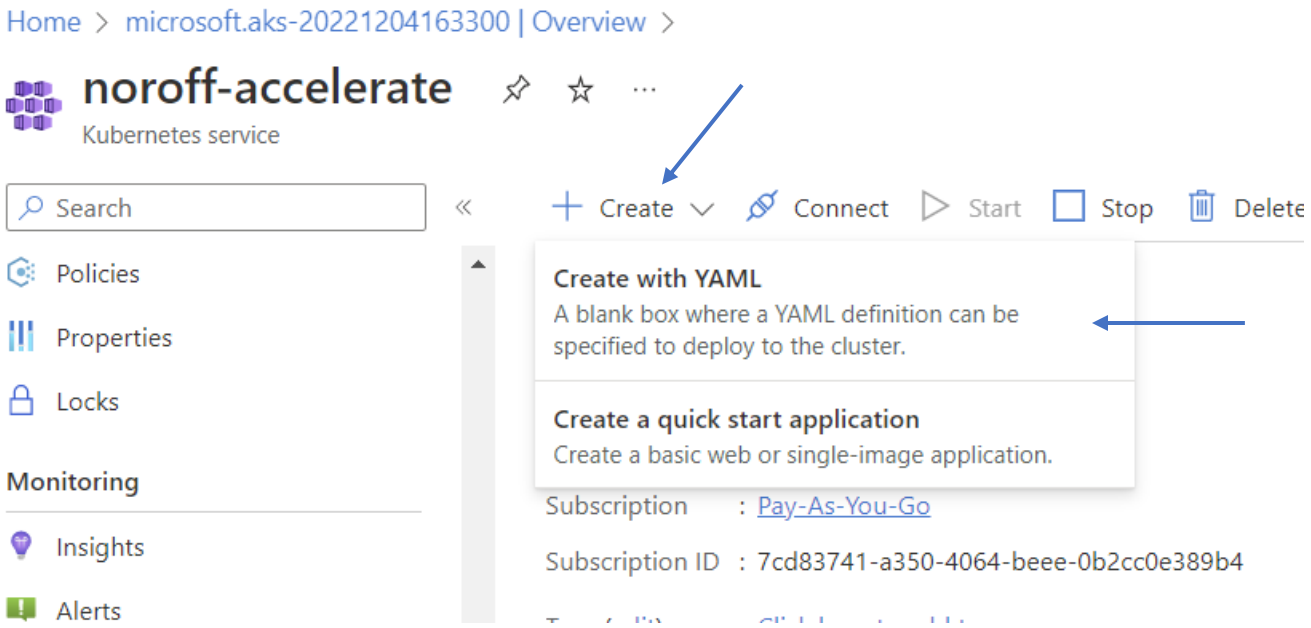
Opening cloud shell

Azure Kubernetes Service



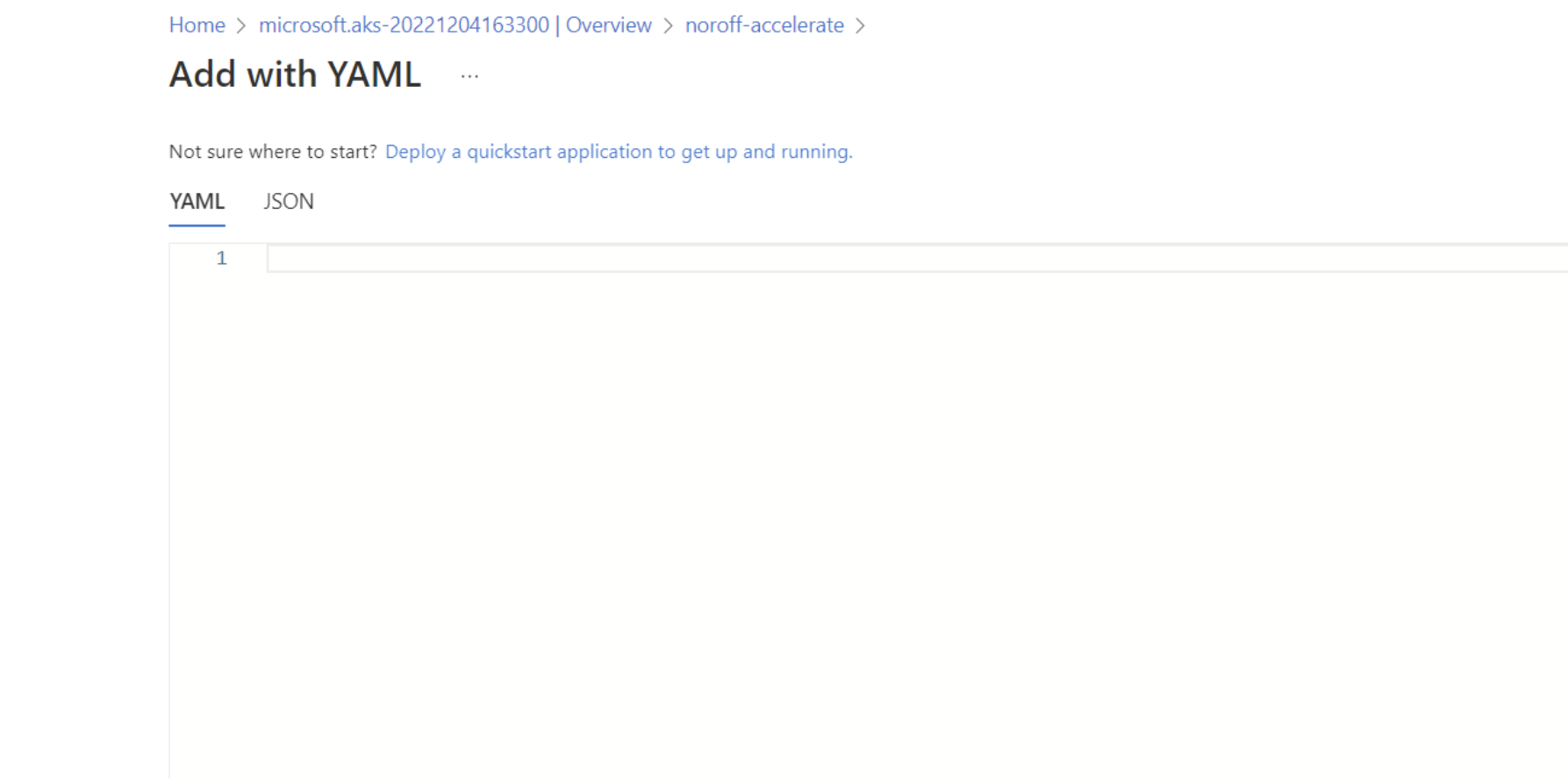
Our current cluster status

Azure Kubernetes Service



Opening the create screen

Azure Kubernetes Service



Copy paste the manifests in

Azure Kubernetes Service

```
Bash
nicholas [ ~ ]$ kubectl get all
NAME                                                READY   STATUS    RESTARTS   AGE
pod/howzit-greeter-deployment-6b8dddd497-2n6d4      1/1     Running   0          112s
pod/howzit-greeter-deployment-6b8dddd497-9xbh2      1/1     Running   0          112s
pod/howzit-greeter-deployment-6b8dddd497-l4sm5      1/1     Running   0          112s

NAME                        TYPE        CLUSTER-IP     EXTERNAL-IP   PORT(S)        AGE
service/greeter-service     NodePort    10.0.60.133    <none>        80:30263/TCP   112s
service/kubernetes          ClusterIP   10.0.0.1       <none>        443/TCP        4h30m

NAME                                        READY   UP-TO-DATE   AVAILABLE   AGE
deployment.apps/howzit-greeter-deployment   3/3     3            3           112s

NAME                                                   DESIRED   CURRENT   READY   AGE
replicaset.apps/howzit-greeter-deployment-6b8dddd497   3         3         3       112s
nicholas [ ~ ]$
```

Our state after adding manifests

Azure Kubernetes Service

Accessing our service

- Right now, we cant access anything
  - Previously we could with a NodePort service, because we were on the host machine (node)
- Azure locks all that off, and the only way to access the services is through ingress
- The “enable http application routing” gives us an easy ingress controller to use
- We just need to write an ingress rule for it

Azure Kubernetes Service

Using HTTP application routing

- NB: This is only for dev/testing. Production should have a configured ingress controller.
  - Link to relevant doc
- To follow what we are doing in the next few slides with more detail, see this article on http application routing

Azure Kubernetes Service

What does HTTP application routing do

- Makes it easy to access applications that are deployed to your AKS cluster.
- When the solution's enabled, it configures an Ingress controller in your AKS cluster.
- As applications are deployed, the solution also creates publicly accessible DNS names for application endpoints.
- When the add-on is enabled, it creates a DNS Zone in your subscription.
- Note: Doing this yourself can get really complicated and expensive (links in a slide further down)

Azure Kubernetes Service

What it adds

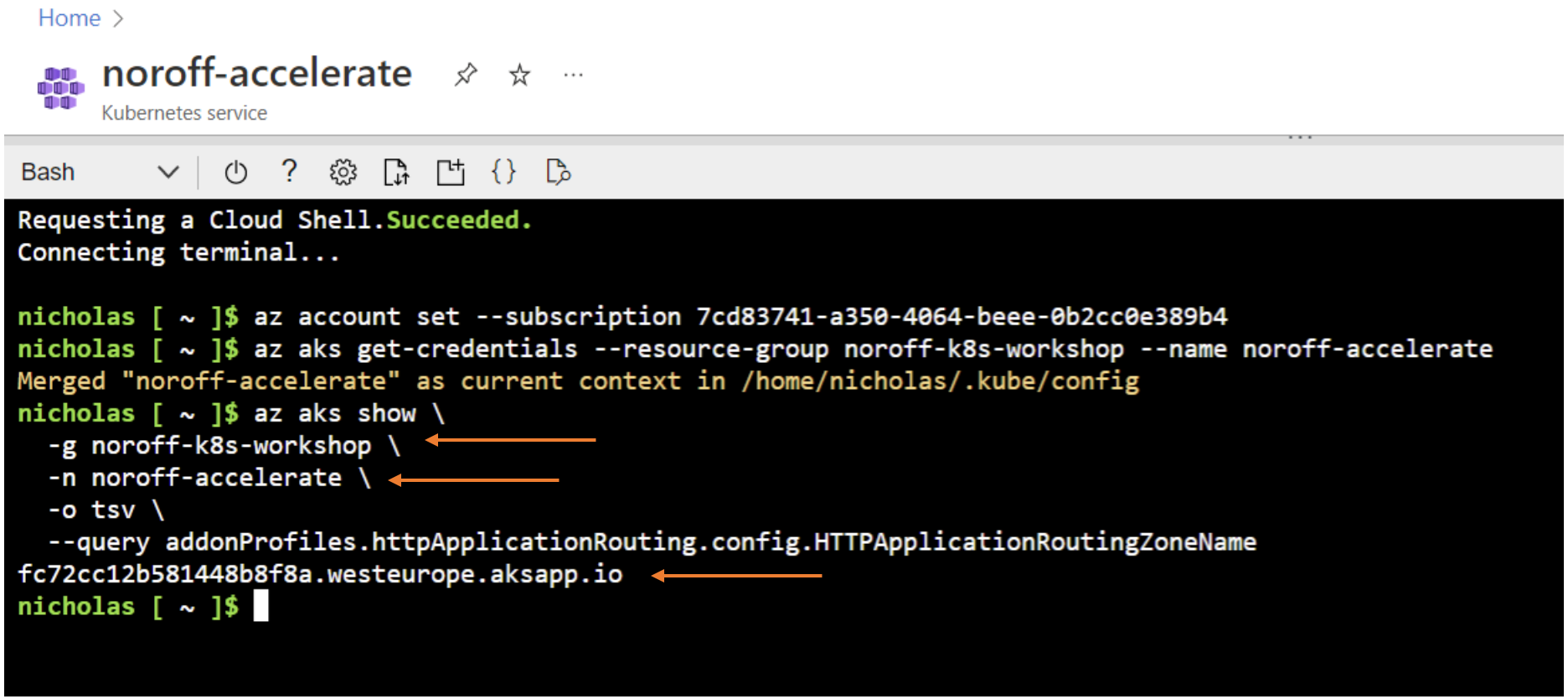
- The add-on deploys two components: a **Kubernetes Ingress controller** and an **External-DNS controller**.
- Ingress controller: The Ingress controller is exposed to the internet by using a Kubernetes service of type LoadBalancer.
- External-DNS controller: Watches for Kubernetes Ingress resources and creates DNS A records in the cluster-specific DNS zone.

Azure Kubernetes Service

Getting the host name

- We didn’t have to consider hostname locally (because it was localhost)
  - However, we now need to say which hosts our ingress resource is for
- We can get our assigned host name through the Azure Cloud shell or Azure cli
- az aks show \
  -g $RESOURCE_GROUP \
  -n $CLUSTER_NAME \
  -o tsv \
  --query addonProfiles.httpApplicationRouting.config.HTTPApplicationRoutingZoneName

Azure Kubernetes Service



Getting our domain

Azure Kubernetes Service

```yaml
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: greeter
  annotations:
    kubernetes.io/ingress.class: addon-http-application-routing
    nginx.ingress.kubernetes.io/rewrite-target: /
spec:
  rules:
  - host: greeter.fc72cc12b581448b8f8a.westeurope.aksapp.io
    http:
      paths:
      - path: /greeting
        pathType: Prefix
        backend:
          service:
            name: greeter
            port:
              number: 80
```

Cant use ingressClassName (addons fault)

Format of host: <ingress-name>.<domain-name>

Writing our ingress rule

Azure Kubernetes Service

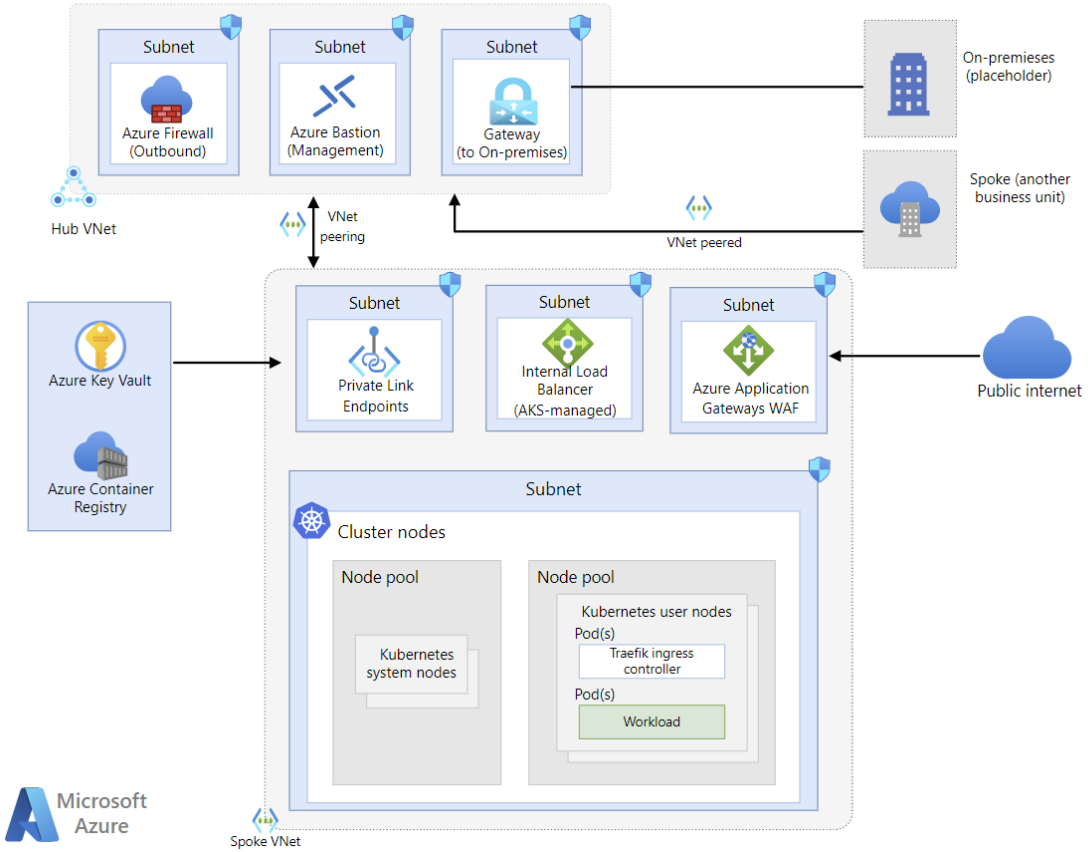
Name	Namespace	Class	Hosts	Address	Ports
howzit-greeting	default	addon-http-application-...	howzit-greeting.fc72cc12b5	20.73.192.39	80
greeter	default	addon-http-application-...	greeter.fc72cc12b581448b8	20.73.192.39	80

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ curl http://greeter.fc72cc12b581448b8f8a.westeurope.aksapp.io/
{"message":"Howzit!"}
```

Our ingress (it may take ~10 mins)

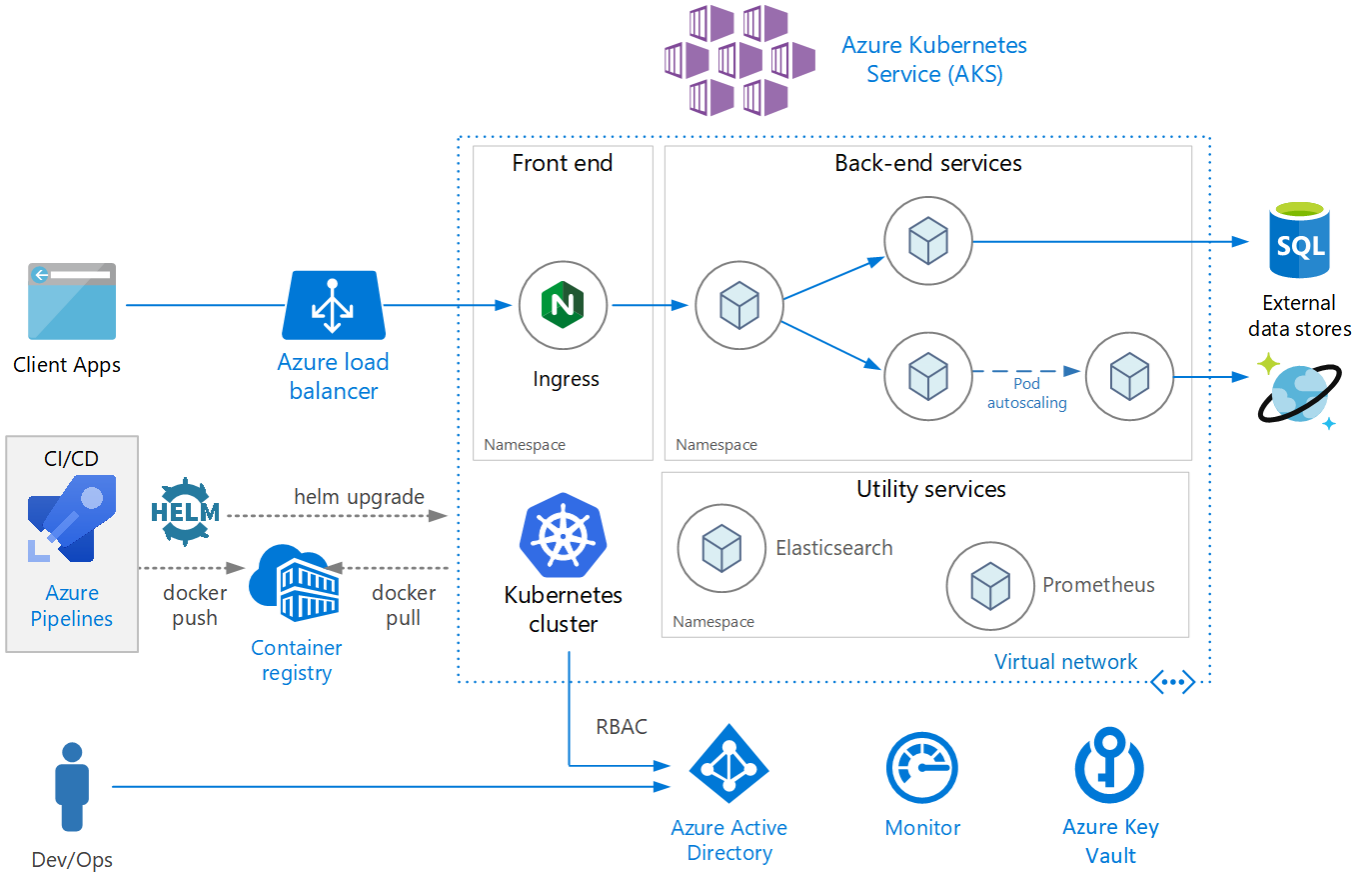
Any questions?

Azure Kubernetes Service



Looking at baseline AKS architecture

Azure Kubernetes Service



Looking at AKS + microservices

⌨ Try it out

1. Create a resource for AKS
   a) Remember to enable HTTP application routing (if you forget, you can change it afterwards ☺)
2. Add your deployment and service from the previous try it out
   a) You can check them in the Workloads and Services blades
3. Add an ingress resource
   a) Follow the HTTP application routing guide linked, or the slides
   b) You can see it in Kubernetes Resources>Services and ingresses>ingresses
   c) Remember you cant use ingressClassName in spec
   d) You also need to have / as a path (this requires some investigating)

Securing k8s

Securing traffic and access to a k8s cluster

Securing k8s

How can we protect k8s?

- There are a few ways in which security can be brought into k8s
- The most common is access control
  - We saw this with Azure AD in our AKS
  - It restricts which users can access your cluster and control panel
- There is also secret management (encrypted configuration)
  - Used to store tokens, certs, and other sensitive information
- Then there is secure traffic over TLS (https://...)

Securing k8s

`What we will do`

- We will just do a local self signed TLS certificate for our ingress controller
- Doing it on azure is very pricy (app gateways and so on) and quite complicated without *helm* and *azure cli*
- Will follow this guide
  - There is this guide from nginx
  - And supported with this doc in k8s
- We need to have a host name
  - Docker exposes localhost through k8s as: **kubernetes.docker.internal**
  - We can use this hostname for the cert

Securing k8s

`Get a cert`

- We will create our own one using openssl
- This required us to be a certificate authority and create a public private key pair
  - as well as a certification with our domain
- Part of the previously linked guide, I wont show the steps
  - Link to the relevant steps
- NOTE: This certificate will not be trusted by our browser
  - We aren't on the trusted CA list, there are links to solve this after the demonstration

Securing k8s

Adding to k8s secrets

- Recall, k8s stores its configuration internally.
  - This includes all manifests, env variables, secrets, and more.
- We can use the *kubectl secret* command to tap into the secrets
- We will do this to add our fake certificate to the secret store
- We follow the template:
  - kubectl create secret tls ${CERT_NAME} --key ${KEY_FILE} --cert ${CERT_FILE}

Securing k8s

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl create secret tls howzit-tls     --namespace default     --key server.key     --cert server.crt
```

```
RES+noro-nle@acc-nlennox MSYS ~/Documents/k8-workshop
$ kubectl get secret
NAME          TYPE                DATA   AGE
howzit-tls    kubernetes.io/tls   2      8m11s
```

Adding our fake certs

Securing k8s

Now what?

- We need to use the secret in our ingress resource
- We do this to specify the TLS requirements
  - We specify which hosts this applies to
  - And which secret to use

Securing k8s

New spec to define tls

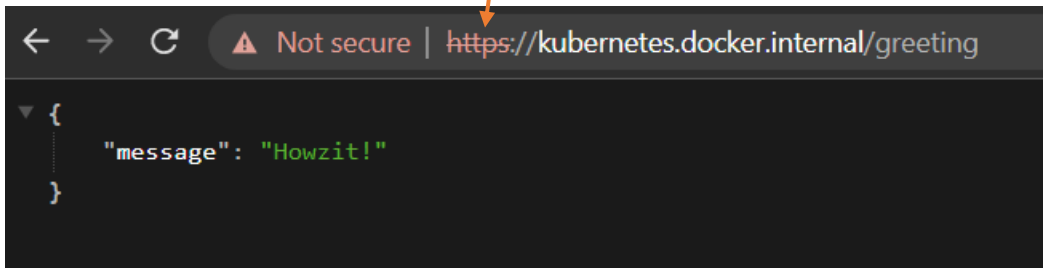
We need to define host, otherwise it wont pass the cert

```yaml
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: greeting
  annotations:
    nginx.ingress.kubernetes.io/rewrite-target: /
spec:
  ingressClassName: nginx
  tls:
  - hosts:
      - kubernetes.docker.internal
    secretName: howzit-tls
  rules:
  - host: kubernetes.docker.internal
    http:
      paths:
      - path: /greeting
        pathType: Prefix
        backend:
          service:
            name: greeter
            port:
              name: http
```

Our updated ingress

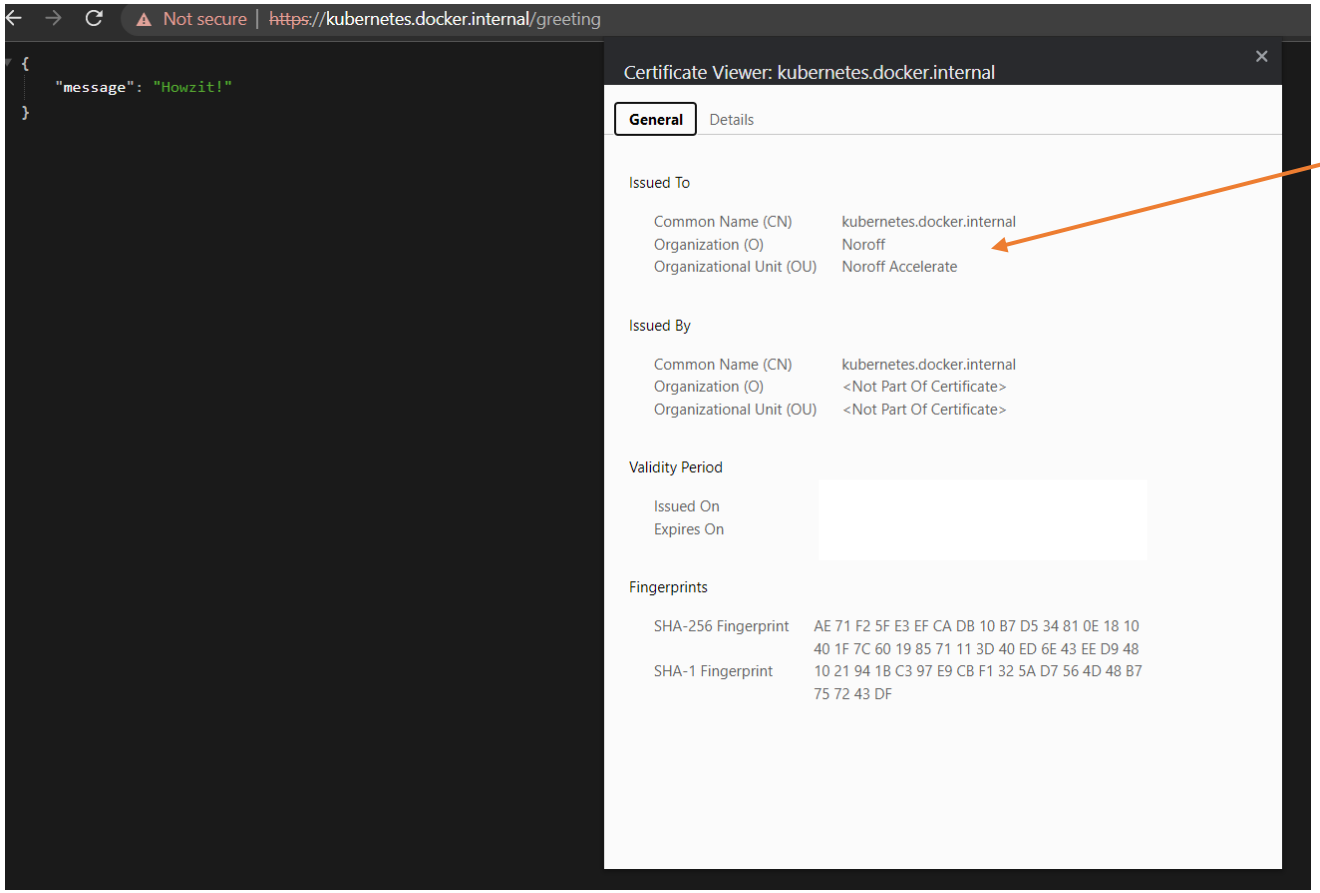
Securing k8s

Saying insecure, lets inspect



Going to https

Securing k8s



Inspecting the cert

Securing k8s

How to get a trusted cert?

- You need to get it from a proper cert provider (not self signed), normally https://letsencrypt.org/
- This is a bit too long for us to do in this workshop
- Nginx page on cert managers
  - Link to full example (requires helm)
- The process of adding secrets and using them as TLS spec is the same.

Any questions?

I know the securing part feels a bit meh, we would need another workshop to actually cover certs, authentication and TLS properly

Securing k8s

Relevant security documentation

- Controlling access in k8s
- RBAC on k8s
- Secrets on k8s
- TLS in k8s
- HTTPS/TLS on ingress-nginx
- Expose an AKS service over HTTP or HTTPS using Application Gateway
  - Enabling ingress controller
- Use TLS with an ingress controller on Azure Kubernetes Service (AKS)

In Conclusion

Key takeaways

- Kubernetes is a very complicated set of tools. It has a very high skill floor and the highest skill ceiling. You can work with it for years and still be confused most of the time.
- The fundamental resources are:
  - Deployments manage pods
  - Services abstract deployments and provide a way of interacting with dns
  - Ingress helps expose your services to the outside with rules
- AKS throws a lot at you, but its not that difficult to get some thing basic working – with some limitations.
- K8s is secured through access control, secrets, and TLS termination in the ingress controllers

In Conclusion

Looking Ahead

- We touched the surface of Kubernetes and distributed computing.
- It is a insanely complex field, but an interesting one at that.
  - It requires networking, and security knowledge (more, but these are the largest)
- If you want to continue with k8s, my biggest suggestion is to learn more about security (cryptography, certs, etc.) and networking. It will help when learning the more complex parts.
- Helm is a great resource to learn, its basically a mandatory tool with k8s in production.

Additional Resources

Hungry for more?

- The next few slides provide links to useful resources we also use from time to time:
  - Reference guides
    - A must have for any developer
  - Video demonstrations
    - Quality videos explaining selected topics or demonstrating skills
  - Articles, sample code and hands-on tutorials
    - Interesting articles
    - Additional code examples
    - Step-by-step guides for extra practice

Additional Resources

Articles, Sample Code & Tutorials

- Kubernetes docs
- Ingress Nginx docs
- Azure AKS docs
- Kubernetes Ingress 101 video by nginx
- Helm docs