Agenda: Services and Ingress

- Kubernetes Services
- Service Types
  - ClusterIP Service
  - NodePort Service
  - LoadBalancer Service
  - External Service
- Deployment Patterns
  - Blue-Green Deployment
  - Canary Deployment

Kubernetes Services

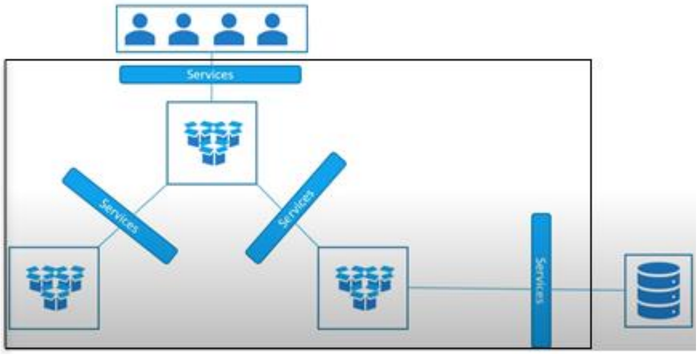
The Problem:

- In Kubernetes, if you use a Deployment to run your app, it can create and destroy Pods dynamically. Each Pod gets its own IP address, however in a Deployment, the set of Pods running in one moment in time could be different from the set of Pods running that application a moment later.
- This can lead to a problem: if some set of Pods (call them "backends") provides functionality to other Pods (call them "frontends") inside our cluster, how do the frontends find out and keep track of which IP address to connect to, so that the frontend can use the backend part of the workload?

This is where **Services** can be helpful.

Service Resources:

- Kubenetes Service is an abstract way to **expose** an application(Microservice) running on a **logical set of Pods** and a **policy** by which to access them.
- Services enable a **loose coupling** between dependent Pods. Frontend Pods don't need to know the direct IP address of the Backend Pods.



- A **Service** in Kubernetes is a **REST object**, similar to a Pod.
- Like all of the REST objects, you can POST a Service definition to the **API server** to create a new instance.
- The name of a Service object must be a valid **DNS label name**.

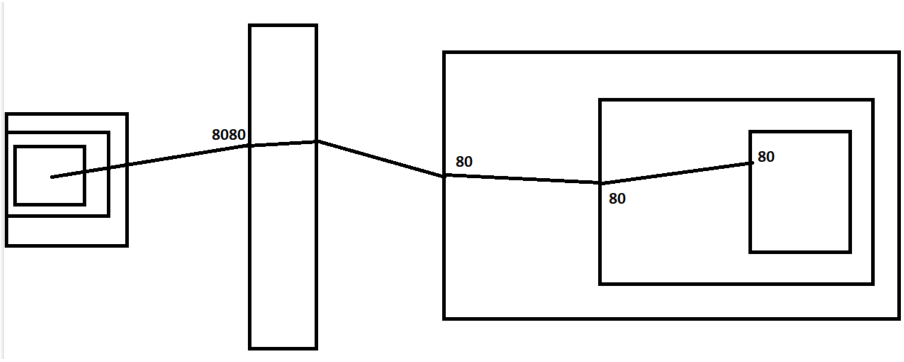
```
apiVersion: apps/v1
```

```
kind: Deployment
metadata:
  name: nginx-deployment
spec:
  replicas: 10
  selector:
    matchLabels:
      app: nginx-app
  template:
    metadata:
      labels:
        app: nginx-app
    spec:
      containers:
      - name: mynginx-container
        image: nginx
        ports:
        - containerPort: 80

---

apiVersion: v1
kind: Service
metadata:
  name: my-service-cip
spec:
  type: ClusterIP
  selector:
    app: nginx-app
  ports:
    - protocol: TCP
      port: 8080
      targetPort: 80
```

- This specification creates a new Service object named “**my-service-cip**”, which targets TCP port **80** on any Pod with the **app=nginx-app** label.
- Kubernetes assigns this Service an IP address (sometimes called the "cluster IP").
- The controller for the Service selector continuously scans for Pods that match its selector, and then POSTs any updates to an **Endpoint object** also named “my-service”.



Multi-Port Services

For some Services, you need to expose more than one port. Kubernetes lets you configure multiple port definitions on a Service object. When using multiple ports for a Service, you must give all of your ports names so that these are unambiguous. For example:

```
apiVersion: v1
kind: Service
metadata:
  name: my-service-cip
spec:
  type: ClusterIP
  selector:
    app: MyApp
  ports:
    - name: http-port
      protocol: TCP
      port: 8080
      targetPort: 80
    - name: https-port
      protocol: TCP
      port: 44433
      targetPort: 443
```

ServiceTypes:

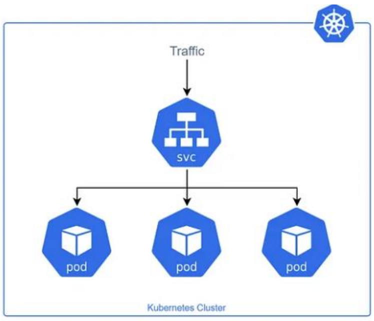
- Pod IP address are not exposed outside the cluster without a Service. Services allow our applications to receive traffic from outside the cluster.
- For some parts of our application (for example, frontends) we may want to expose a Service on to an external IP address, i.e. outside of our cluster.
- Kubernetes ServiceTypes allow us to specify what kind of Service we want.
  1. ClusterIP
  2. LoadBalancer
  3. NodePort

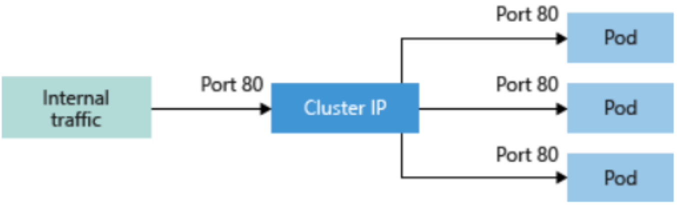
4. ExternalName

NodePort
ClusterIP
LoadBalancer

CLUSTER-IP SERVICE

- Exposes the Service on a **cluster-internal IP**. Choosing this value makes the Service **only reachable** from within the cluster.
- This is the **default** ServiceType.
- ClusterIP is the preferred option for internal/backend service access and uses an internal/private IP address to access the service.
- You can optionally set cluster IP in the service definition file.





Steps to create a ClusterIP Service:

1) kubectl **create** deployment nginx-deployment --image nginx
2) kubectl **expose** deploy/nginx-deployment --name my-service-cip **--type=ClusterIP** --port 8080 --target-port=80

Note: Expose uses service creating generator to create the service.

If the service name is not mentioned, it uses the name of deployment. In this case, it would be **nginx-deployment**

3) **kubectl get all** OR **kubectl get services**

Note the ClusterIP for further use (eg: 10.99.158.232)

Testing if the service is forwarding the traffic to Pods

4) kubectl get services
5) kubectl get pods -o wide
6) kubectl get endpoints
7) kubectl get endpoints-oyaml
8) kubectl describe endpoints my-service-cip #Notice that it lists IP addresses of all Pods
9) kubectl **run** myubuntu -it --rm --image=ubuntu -- sh

   # apt update

   # apt upgrade

```
# apt install curl -Y
# curl http://my-service-cip:8080
# exit
```

10) **kubectl run -it --rm mypod --image=nginx --restart=Never -- curl http://**my-service-cip**:8080**

kubectl run -it --rm mypod --image=nginx --restart=Never -- curl http://10.99.158.232**:8080**

We can use nslookup to get the fully qualified domain name (FQDN) of the service.

To install nslookup:

- apt update
- apt install dnsutils
- **nslookup my-service-cip** #This will show the FQDN
- curl http://my-service-cip.default.svc.cluster.local:8080 #[default] is the namespace in the url

To access the Service from a different namespace. It is mandatory to use the Fully Qualifed Name (FQN) of a service.

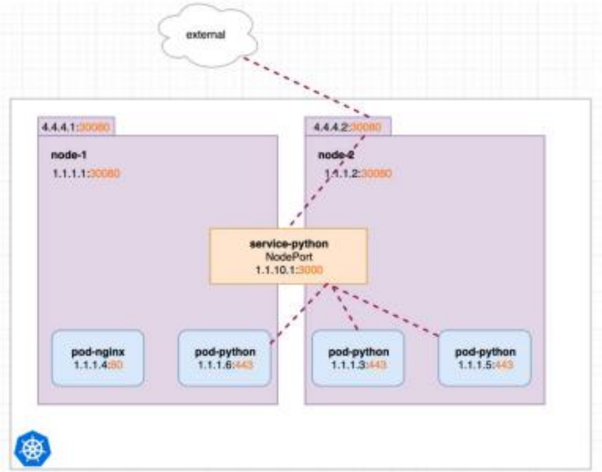
11) kubectl create ns demo-namespace

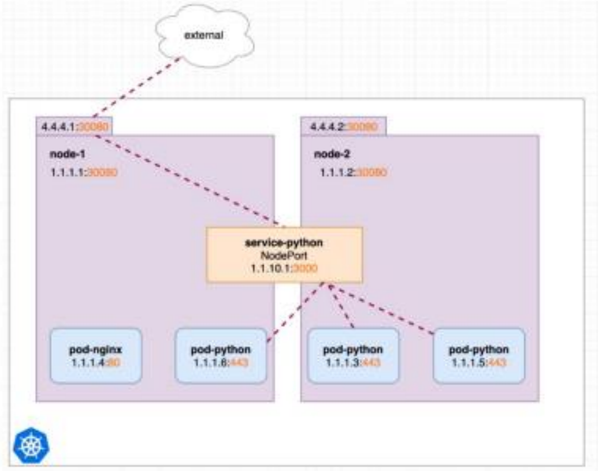
12) kubectl **run** mynginx -it --rm --image=nginx **-n demo-namespace** -- sh

```
# curl http://my-service-cip.default.svc.cluster.local:8080
# curl http://my-service-cip.default:8080
# exit
```

NODEPORT SERVICE:

- Exposes the Service on each Node's IP at a static port (the NodePort [**Hi Range Port**]). High range port (30000 to 32767) used for exposing NodePort.
- Each node proxies that port (the same port number on every Node) into your Service
- A ClusterIP Service, to which the NodePort Service routes, is automatically created.
- Useful when front-end pods are to be exposed outside the cluster for users to access it.
- We will be able to contact the NodePort Service, **from outside the cluster**, by requesting **<NodeIP>:<NodePort>.**
- Same NodePort will be used across all the nodes in a multi node cluster. Also, same service (single instance) can be used to access container in any Pod or any Node in the cluster.





Create NodePort type of Service:

1.

```
kubectl expose deployment nginx-deployment --target-port=80 --port=8080 --type=NodePort --name=my-service-np --selector="app=nginx-deployment"
```

Note: the above command **doesn't have option** to provide node-port and it will be randomly picked up from range of 30000 to 32767

OR

```
apiVersion: v1
kind: Service
metadata:
  name: my-service-np
spec:
  type: NodePort
  selector:
    app: nginx-app
  ports:
  - protocol: TCP
    nodePort: 30001          #Port of Node
    port: 8080               #Port of Service
    targetPort: 80           #Port of Container
```

Note: 3 ports are involved:

a) 30001 (High Port) is of NodePort Service

b) 8080 is of ClusterIP

c) 80 is Application port in container

2. kubectl get service

Note the High Port under PORT(S) section (Eg: 30001)

3. For Docker Desktop

curl http://localhost:30001 or **open in web browser**

OR

For Minikube:

```
minikube ip  #Returns the IP address of Minikube Container
curl http://<minikube-ip>:30001
```

We can access the service through localhost without getting into the cluster. This works only in Docker and not in minicube.

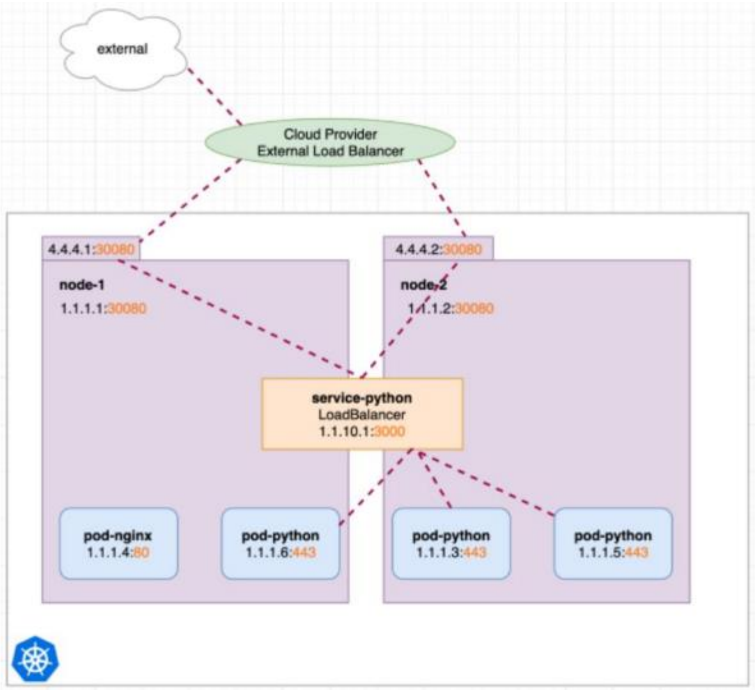
4. kubectl get svc **my-service-np** -o yaml

LOAD BALANCER SERVICE

Exposes the Service externally using a **cloud provider's load balancer**. NodePort and ClusterIP Services, to which the external load balancer routes, are automatically created and are hidden from us. It assigns a fixed external IP to the Service. It is superset of NodePort.

There is no filtering, no routing, etc. This means you can send almost any kind of traffic to it, like HTTP, TCP, UDP or WebSocket's

This works at **Layer4** of OSI layers.



Create LoadBalancer type of Service:

1. kubectl expose **deployment nginx-deployment** --port 8080 --target-port=80 --type=**LoadBalancer** --name my-service-lb **--selector="app=nginx-deployment"**
2. **For Docker Desktop:**

   curl http://localhost:8080

   For Minikube:

   ```
   minikube tunnel
   kubectl get services my-service-lb   #Note the External-IP
   ```

```
curl http://<External-IP>:8080
```

We can access the service through localhost without getting into the cluster.

```
apiVersion: v1
kind: Service
metadata:
 name: my-service-lb
spec:
 type: LoadBalancer
 selector:
   app: nginx-app
 ports:
   - name: http
     protocol: TCP
     port: 8080
     targetPort: 80
```

Minikube with LoadBalancer:

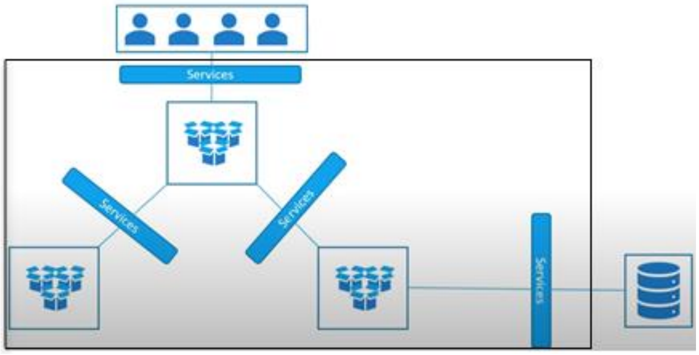
https://minikube.sigs.k8s.io/docs/handbook/accessing/

Downside of LoadBalancer:

- Every LoadBalancer service exposed will gets it's own Public IP address.
- It gets very expensive to have external IP for each of the service (application)

ExternalName Service

Maps the Service to the contents of the externalName field (e.g. abc.example.com), by returning a CNAME record with its value. No proxying of any kind is needed. Services of type ExternalName map a Service to a DNS name, not to a typical selector.



```
apiVersion: v1
kind: Service
metadata:
 name: my-service-ext
```

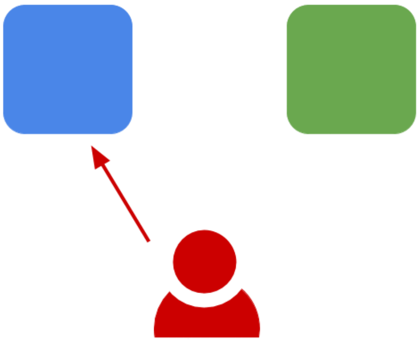
```
spec:
  type: ExternalName
  externalName: my.database.com
```

When looking up the host **my-service-ext.default.svc.cluster.local**, the cluster DNS Service returns a **CNAME** record with the value **my.database.com**.

Accessing my-service works in the same way as other Services but with the crucial difference that redirection happens at the DNS level rather than via proxying or forwarding. Should you later decide to move your database into your cluster, you can start its Pods, add appropriate selectors or endpoints, and change the Service's type.

Blue Green Deployment

Use this deployment strategy to test the new version of the application by a set of people in our organization in Production environment before its made available to public on internet.



Step1:

1. Existing Deployment (Blue)
2. Existing Service (Blue)

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: deployment-blue
spec:
  replicas: 10
  selector:
    matchLabels:
      app: app-blue
  template:
    metadata:
      name: nginx-pod
      labels:
        app: app-blue
    spec:
      containers:
      - name: mynginx-con
        image: nginx:1.18.0
        ports:
        - containerPort: 80

---

apiVersion: v1
kind: Service
metadata:
  name: my-service-blue
spec:
  type: NodePort
  selector:
    app: app-blue
  ports:
    - protocol: TCP
      nodePort: 32000
      port: 8080
      targetPort: 80
```

Open in Browser: http://<minikubeIP>:32000

Step2:

3. New Deployment (Green)

Clone the old deployment YAML and change Deployment Name, Label and Image

4. New Service (Green)

Clone the old service and change Name, Selector Label and and Port

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: deployment-green
spec:
  replicas: 10
  selector:
    matchLabels:
      app: app-green
  template:
    metadata:
      name: nginx-pod
      labels:
        app: app-green
    spec:
      containers:
      - name: httpd-con
        image: httpd
        ports:
        - containerPort: 80


---


apiVersion: v1
kind: Service
metadata:
  name: my-service-green
spec:
  type: NodePort
  selector:
    app: app-green
  ports:
    - protocol: TCP
      nodePort: 32002
      port: 8080
      targetPort: 80
```

Step3: Test of New Deployment using New Service (**http://<MinikubeIP>:32001)**

Step4: Move Traffic from Blue(Existing) to Green(New) Deployment

3. Change **Selector** of existing blue service to New Deployment Label (app: app-green)

```
apiVersion: v1
kind: Service
metadata:
  name: my-service-blue
spec:
  type: NodePort
  selector:
    app: app-green          #Change from  app-blue to app-green
  ports:
    - protocol: TCP
      port: 8080
      targetPort: 80
```

4. Open in Browser: http://<minikubeIP>:32000 and note that the o/p is from New Deployment

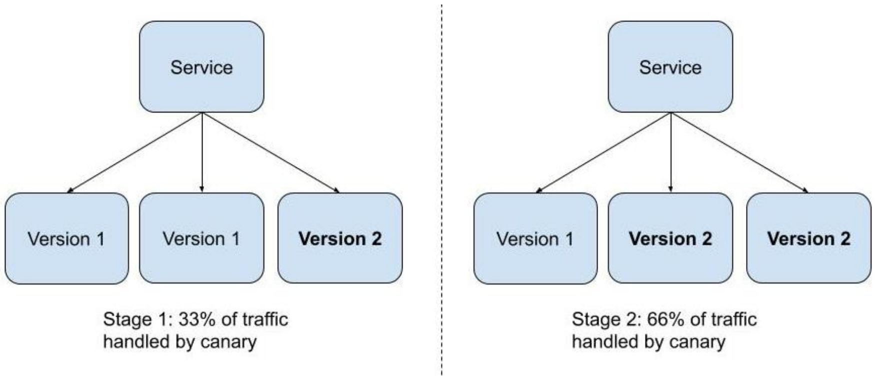
5. Delete Blue Deployment (old version) and Green Service

Canary Deployment

Gradually move load from existing deployment to New Deployment.

a) Create New Deployment with Same Label as Existing Deployment.

b) Gradually increase replicas of New and decrease replicas of Existing.


Service
Version 1
Version 1
Version 2
Stage 1: 33% of traffic handled by canary
Service
Version 1
Version 2
Version 2
Stage 2: 66% of traffic handled by canary

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: nginx-deployment
spec:
  replicas: 10
  selector:
    matchLabels:
      app: nginx-app
  template:
    metadata:
      name: nginx-pod
      labels:
        app: nginx-app
    spec:
      containers:
      - name: mynginx-con
        image: nginx:1.16.0
        ports:
        - containerPort: 80

---

apiVersion: v1
kind: Service
metadata:
  name: my-service-lb
spec:
  type: NodePort
  selector:
    app: nginx-app
  ports:
    - protocol: TCP
      nodePort: 32000
      port: 8080
      targetPort: 80

---

apiVersion: apps/v1
kind: Deployment
metadata:
  name: nginx-deployment-canary
spec:
  replicas: 2
  selector:
    matchLabels:
      app: nginx-app
  template:
    metadata:
      name: nginx-pod
      labels:
        app: nginx-app
    spec:
      containers:
      - name: mynginx-con
        image: httpd
        ports:
        - containerPort: 80
```

With time reduce the replicas of Main Deployment and increase the replica of Canary Deployment.

Do this as long as the users are not complaining about the new deployment and old deployment replica changes to "0" and all traffic is shifted to Canary Deployment which now should become Main deployment.