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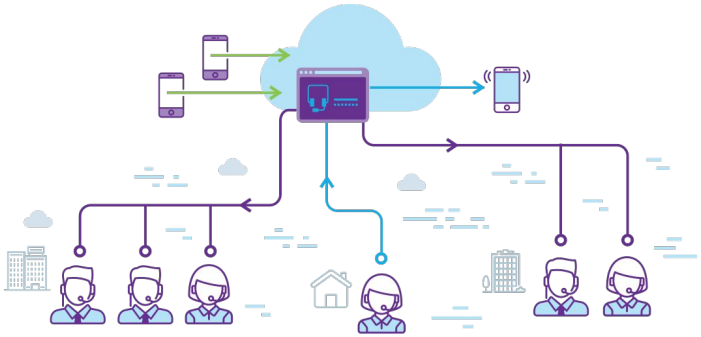
Kubernetes Networking

AGENDA

- Cluster Networking
- Services
- Service Types
- Labels and loose coupling

1 Cluster Networking

Cluster Networking



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Cluster Networking

There are 4 distinct networking problems to address:

1. container-to-container communications:
2. Pod-to-Pod communications:
3. Pod-to-Service communications:
4. External-to-Service communications:

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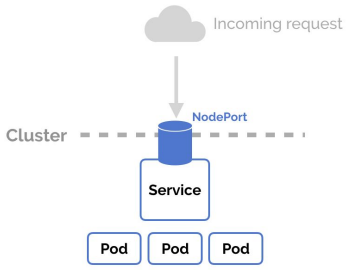
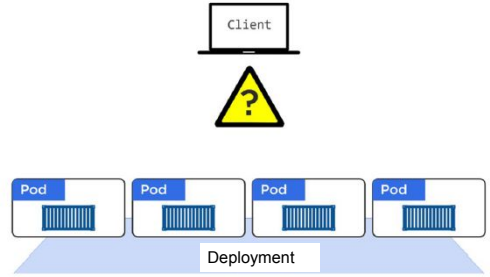
Services



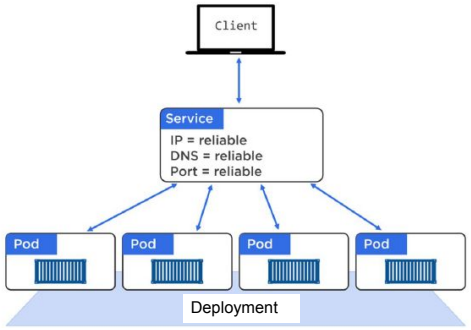
Services

Pods are not reliable



Services

A **Service** offers a single **DNS entry** for a containerized application managed by the Kubernetes cluster

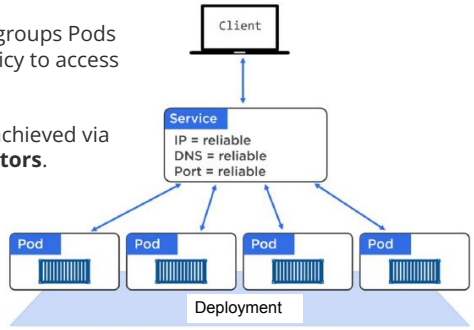


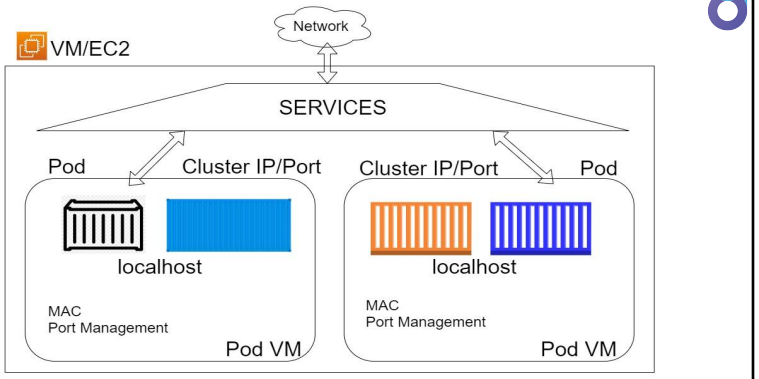
Services

The **Service** is associated with the Pods, and provides them with a stable IP, DNS and port. It also **loadbalances** requests across the Pods.

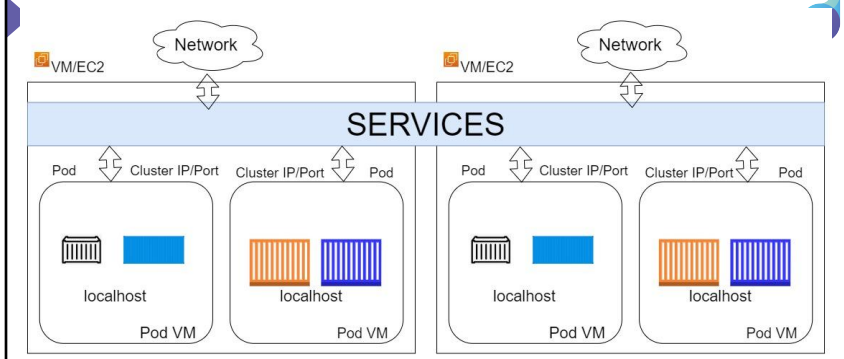
Service logically groups Pods and defines a policy to access them.

This grouping is achieved via **Labels** and **Selectors**.



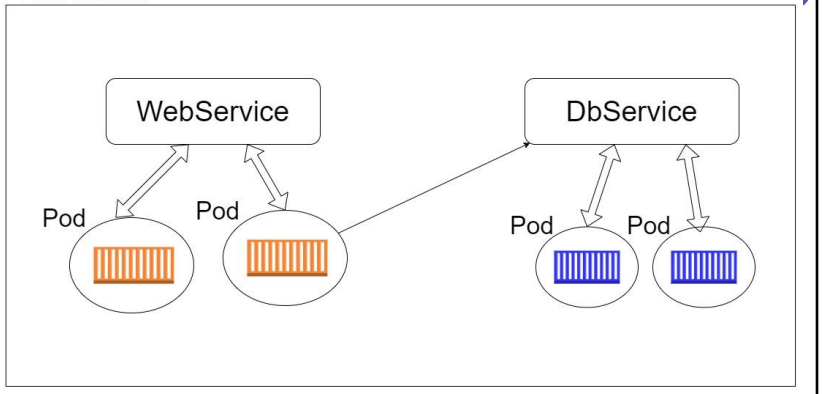


K8s Network



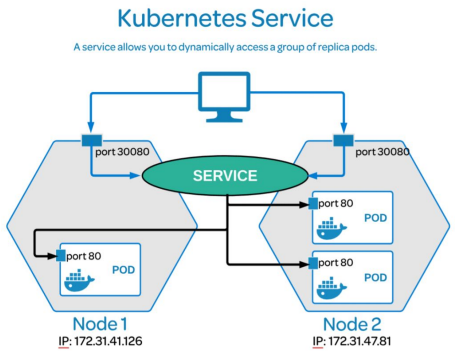
K8s Network

K8s Cluster



Services

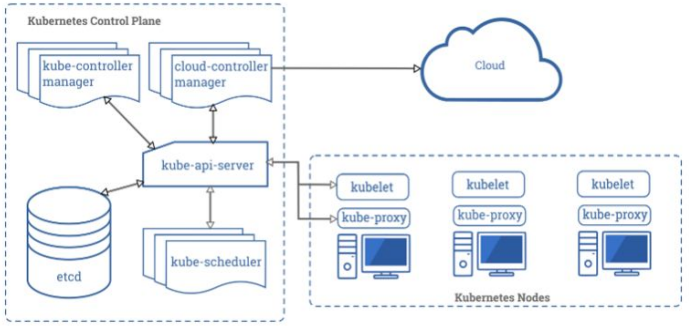
Kubernetes **Services** enable communication between various components **within** and **outside** of the application. Kubernetes Services helps us connect applications together with other applications or users.



kube-proxy

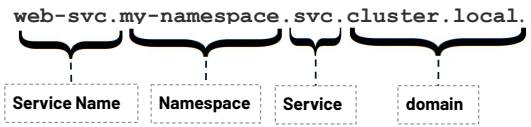
- Each cluster node runs a daemon called **kube-proxy**
- `kube-proxy` is responsible for ***implementing the Service configuration*** on behalf of an administrator or developer
- For each new Service, on each node, `kube-proxy` configures **iptables** rules to capture the traffic for its `ClusterIP` and forwards it to one of the Service's endpoints.
- When the Service is removed, `kube-proxy` removes the corresponding **iptables** rules on all nodes as well.

Control Plane Components



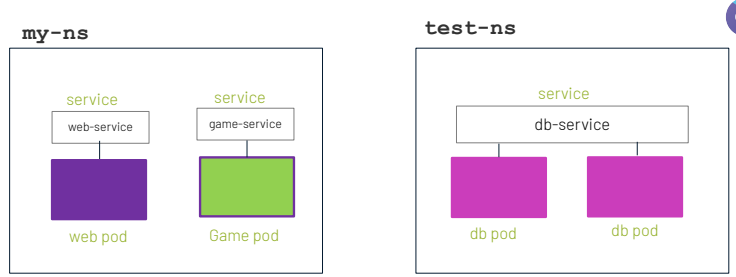
Service Discovery

- Kubernetes has an add-on for **DNS**, which creates a DNS record for each Service and its format is



- Services within the same Namespace find other Services just by their names.
- If we add a Service **`redis-master`** in **`my-ns`** Namespace, all Pods in the same **`my-ns`** Namespace lookup the Service just by its name, **`redis-master`**.

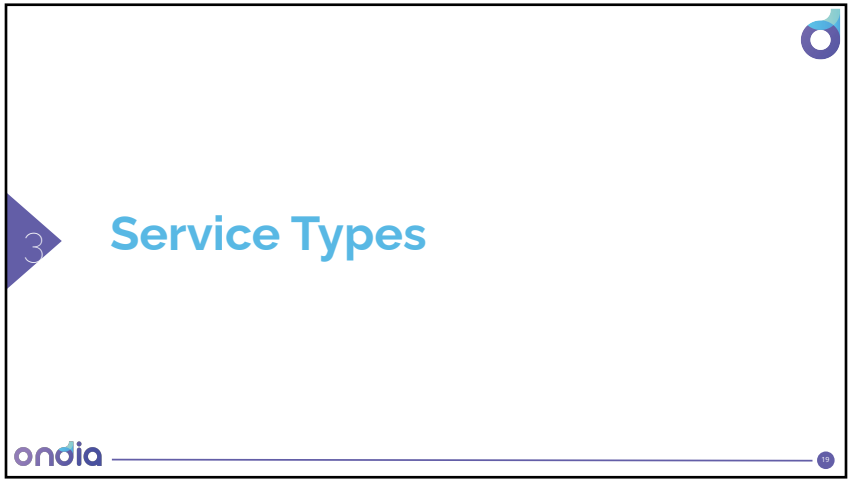
FQDN: fully qualified domain name



To connect to the "Game pod" and "db pod":

From " web pod" -> " Game pod" —> hostname: game-service.my-ns:port
game-service:port

From " web pod" -> "db pod —–> hostname: db-service.test-ns.svc.cluster.local:port


3
Service Types
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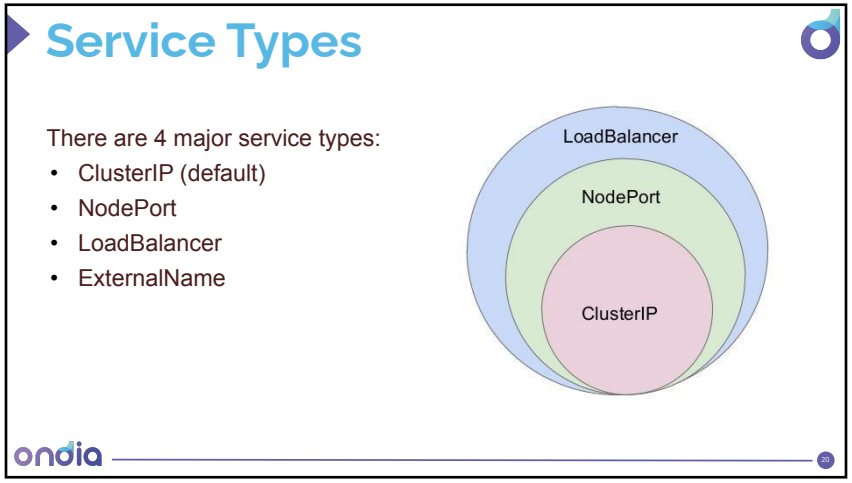
Service Types
There are 4 major service types:
• ClusterIP (default)
• NodePort
• LoadBalancer
• ExternalName
LoadBalancer
NodePort
ClusterIP
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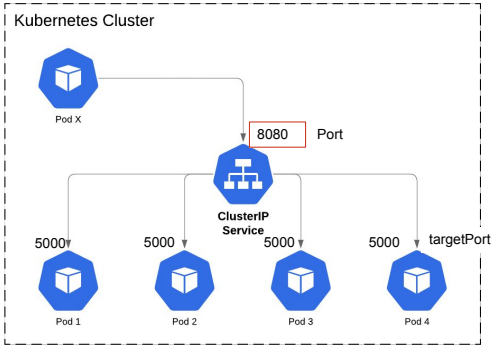
Service Types

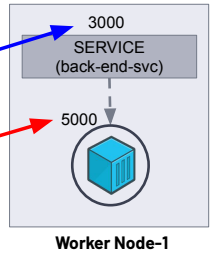


ClusterIP:
Expose traffic internally

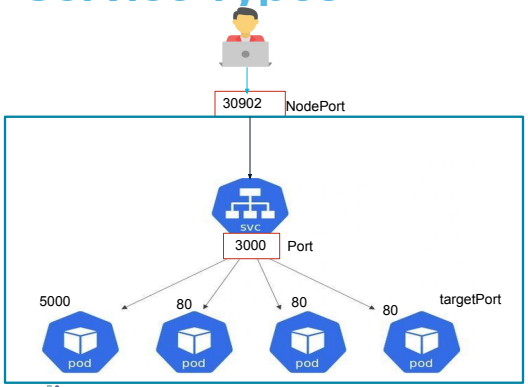
Example Usecase:

Good for service of database & back-end apps.


```
apiVersion: v1
kind: Service
metadata:
 name: back-end-svc
 labels:
   app: back-end
spec:
 type: ClusterIP (default)
 selector:
   app: back-end
 ports:
 - port: 3000
   protocol: TCP
   targetPort: 5000
```



Service Types

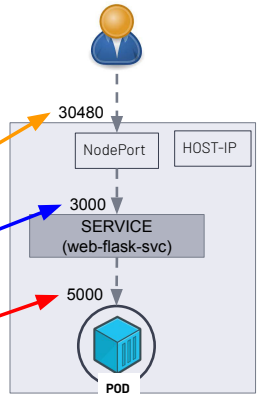


NodePort:
Exposes traffic to the outside.

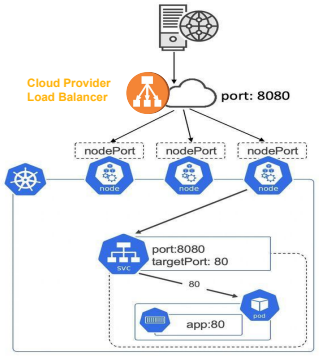
Example Use Case:

when we want to make our Services which has our app or website accessible from the external world.


```
apiVersion: v1
kind: Service
metadata:
 name: web-flask-svc
 labels:
   app: web-flask
spec:
 type: NodePort
 selector:
   app: web-flask
 ports:
 - nodePort: 30480
   port: 3000
   protocol: TCP
   targetPort: 5000
```



Service Types

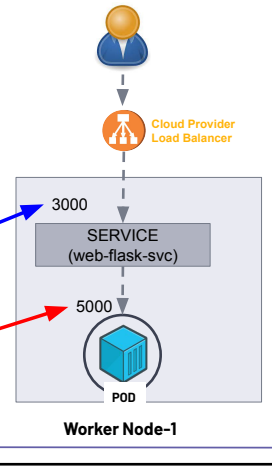


LoadBalancer:
Exposes traffic outside with load balancing feature.

Example Use Case:

when we want to load balance our Services which has our app or website accessible from the external world.


```
apiVersion: v1
kind: Service
metadata:
 name: web-flask-svc
 labels:
   app: web-flask
spec:
 type: LoadBalancer
 selector:
   app: web-flask
 ports:
 - port: 3000
   protocol: TCP
   targetPort: 5000
```

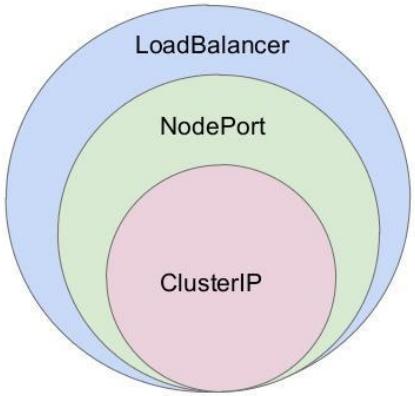


Service Types

LoadBalancer:

- The **LoadBalancer** *ServiceType* will only work if the underlying infrastructure supports the automatic creation of Load Balancers and have the respective support in Kubernetes, as is the case with the Google Cloud Platform, Azure or AWS.
- If no such feature is configured, the ***LoadBalancer IP*** address field is **not populated**, it remains in **Pending** state, but the ***Service will still work as a typical NodePort type Service***.

Service Types



Service Types

ExternalName:

Maps the Service to the contents of the ExternalName field (e.g. example.com), by returning a CNAME record with its value.

Example Use Cases:

to make externally configured services like;

remote.server.url.com

available to applications inside the cluster.

Service Types

```
apiVersion: v1
kind: Service
metadata:
  labels: io.kompose.service: mysql-server
  name: mysql-server
spec:
  type: ExternalName
  externalName: mydb.cbanmzptkrzf.us-east-1.rds.amazonaws.com
```

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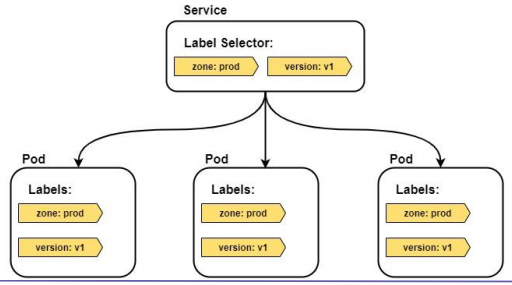
Labels and loose coupling

Labels and loose coupling

- Labels and Selectors use a **key/value** pair format.
- Pods and Services are loosely coupled via labels and label selectors.
- For a Service to match a set of Pods, and therefore provide stable networking and load-balance, it only needs to match some of the Pods labels.
- However, for a Pod to match a Service, the Pod must match all of the values in the Service's label selector.

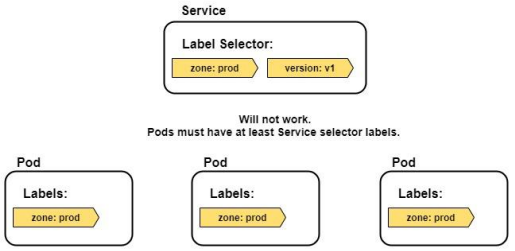
Labels and loose coupling

The figure below shows an example where 3 Pods are labeled as **`zone=prod`** and **`version=v1`**, and the Service has a label selector that matches. This Service provides stable networking to all three Pods. It also provides simple load-balancing.

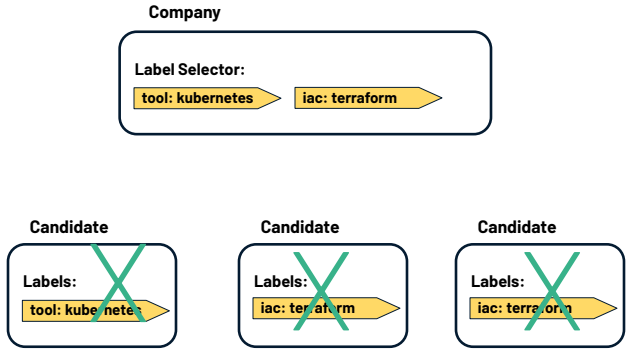


Labels and loose coupling

The figure below shows an example where the Service does not match any of the Pods. This is because the Service is selecting on two labels, but the Pods only have one of them. The logic behind this is a Boolean AND operation.

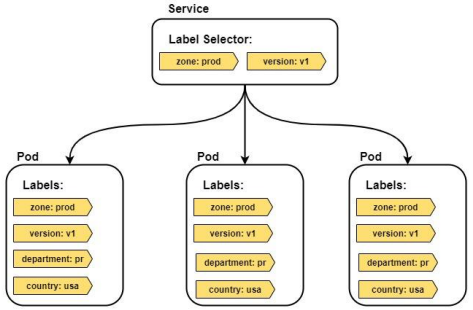


Labels and loose coupling

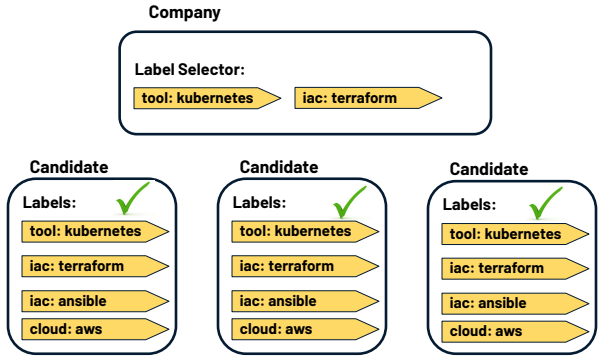


Labels and loose coupling

This figure shows an example that does work. It doesn't matter that the Pods have additional labels that the Service is not selecting on.



Labels and loose coupling



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THANKS!

Any questions?

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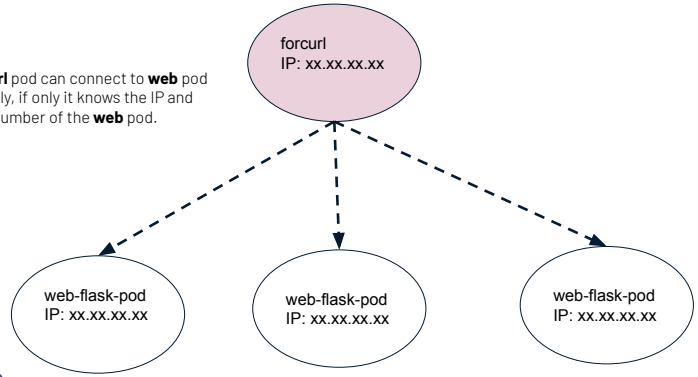
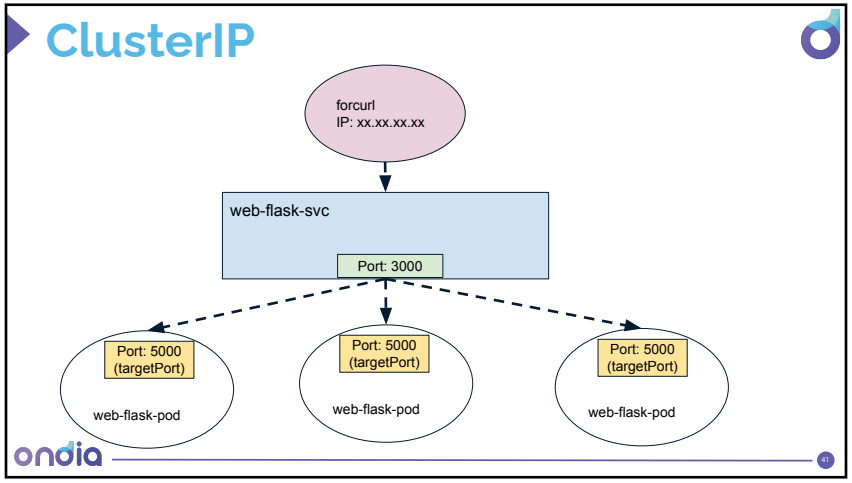
Kubernetes hands-on-03

Pod to Pod Connection

forcurl pod can connect to **web** pod directly, if only it knows the IP and port number of the **web** pod.




ClusterIP
forcurl
IP: xx.xx.xx.xx
web-flask-svc
Port: 3000
Port: 5000
(targetPort)
web-flask-pod
Port: 5000
(targetPort)
web-flask-pod
Port: 5000
(targetPort)
web-flask-pod
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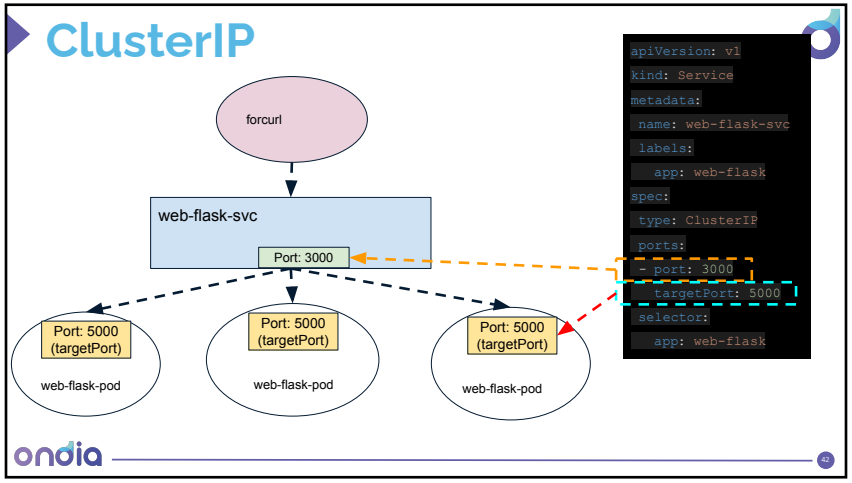
ClusterIP
forcurl
web-flask-svc
Port: 3000
Port: 5000
(targetPort)
web-flask-pod
Port: 5000
(targetPort)
web-flask-pod
Port: 5000
(targetPort)
web-flask-pod
apiVersion: v1
kind: Service
metadata:
name: web-flask-svc
labels:
app: web-flask
spec:
type: ClusterIP
ports:
- port: 3000
targetPort: 5000
selector:
app: web-flask
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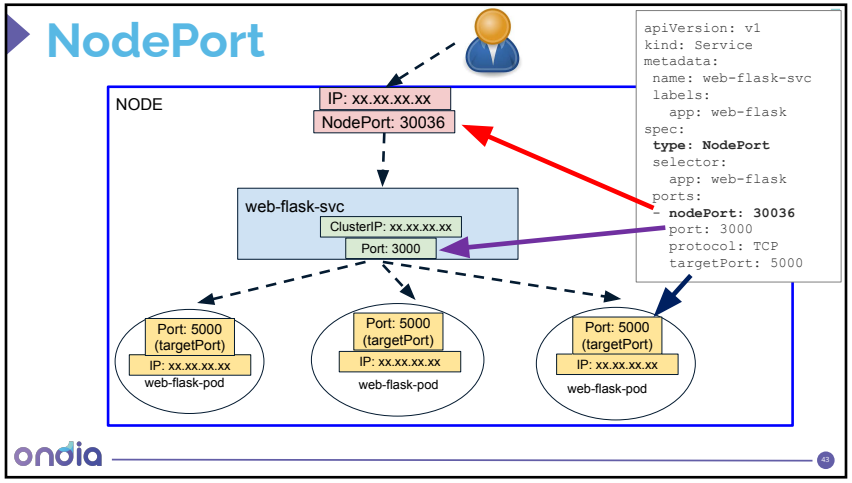
NodePort
NODE
IP: xx.xx.xx.xx
NodePort: 30036
web-flask-svc
ClusterIP: xx.xx.xx.xx
Port: 3000
Port: 5000 (targetPort)
IP: xx.xx.xx.xx
web-flask-pod
Port: 5000 (targetPort)
IP: xx.xx.xx.xx
web-flask-pod
Port: 5000 (targetPort)
IP: xx.xx.xx.xx
web-flask-pod
apiVersion: v1
kind: Service
metadata:
name: web-flask-svc
labels:
app: web-flask
spec:
type: NodePort
selector:
app: web-flask
ports:
- nodePort: 30036
port: 3000
protocol: TCP
targetPort: 5000
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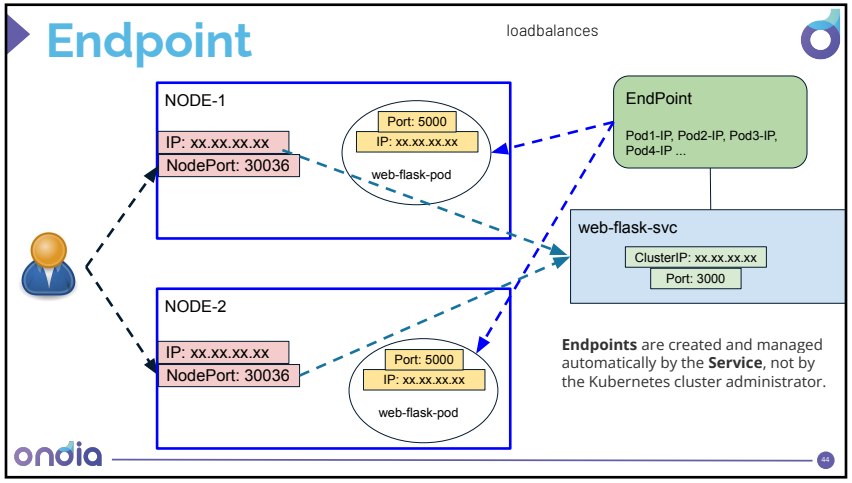
Endpoint
loadbalances
NODE-1
IP: xx.xx.xx.xx
NodePort: 30036
Port: 5000
IP: xx.xx.xx.xx
web-flask-pod
NODE-2
IP: xx.xx.xx.xx
NodePort: 30036
Port: 5000
IP: xx.xx.xx.xx
web-flask-pod
EndPoint
Pod1-IP, Pod2-IP, Pod3-IP, Pod4-IP ...
web-flask-svc
ClusterIP: xx.xx.xx.xx
Port: 3000
Endpoints are created and managed automatically by the Service, not by the Kubernetes cluster administrator.
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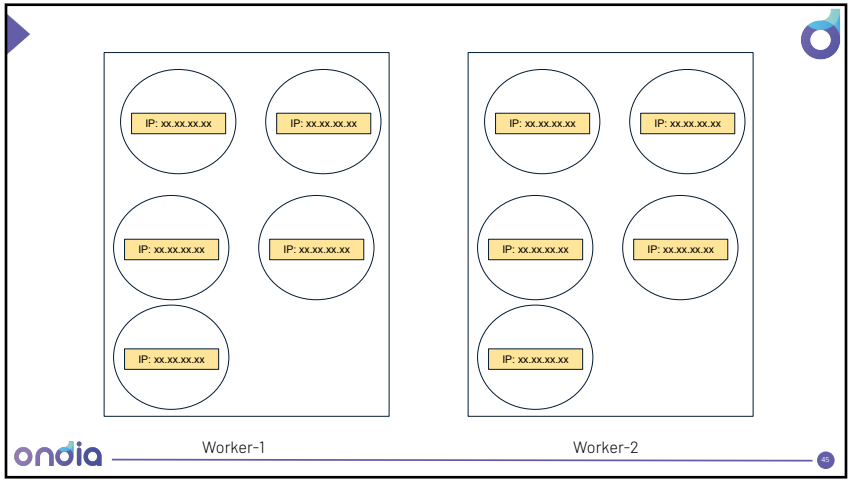
IP: xx.xx.xx.xx
IP: xx.xx.xx.xx
IP: xx.xx.xx.xx
IP: xx.xx.xx.xx
IP: xx.xx.xx.xx
IP: xx.xx.xx.xx
IP: xx.xx.xx.xx
IP: xx.xx.xx.xx
IP: xx.xx.xx.xx
Worker-1
Worker-2