Ministero dell'Università e della Ricerca | Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA | PNC Piano nazionale per gli investimenti complementari al PNRR Ministero dell'Università e della Ricerca | DARE DIGITAL LIFELONG PREVENTION

Kubernetes Installation and Administration Course

Upscaling e High availability

Francesco Sinisi (francesco.sinisi@cnaf.infn.it)

INFN

IaaS side Improvements

How to increase the resilience of machines belonging to the cluster

Cluster K8s, but even better

To increase the resilience and/or performance of the cluster, the following measures can be used:

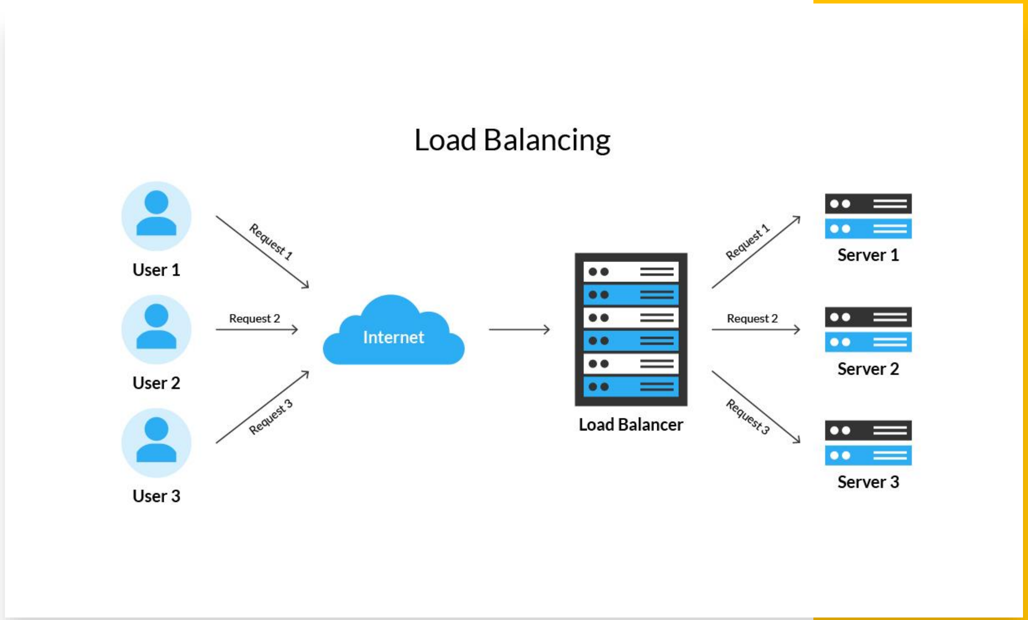
- Update the **operating system** when creating the VM
- Use a **bastion**, open to the outside, to access the cluster VMs
- Distribute workers and especially masters **geographically** (or at least on different racks of the same DataCenter)
- **Add/resize** workers quickly thanks to the cloud paradigm
- Add a **Load Balancer** (Octavia in Openstack)
- Have a **multi-master** cluster (**odd number**) to increase the redundancy of the main components (especially etcd **quorum**) and allow an update **without interrupting** the provision of services
- The nodes hosting the ETCD should have **fast disks** (or save data in RAM with periodic backups) due to the **high I/O**
- Possibility to **separate** master nodes and nodes hosting the ETCD (maybe it is better to have 5 masters?)

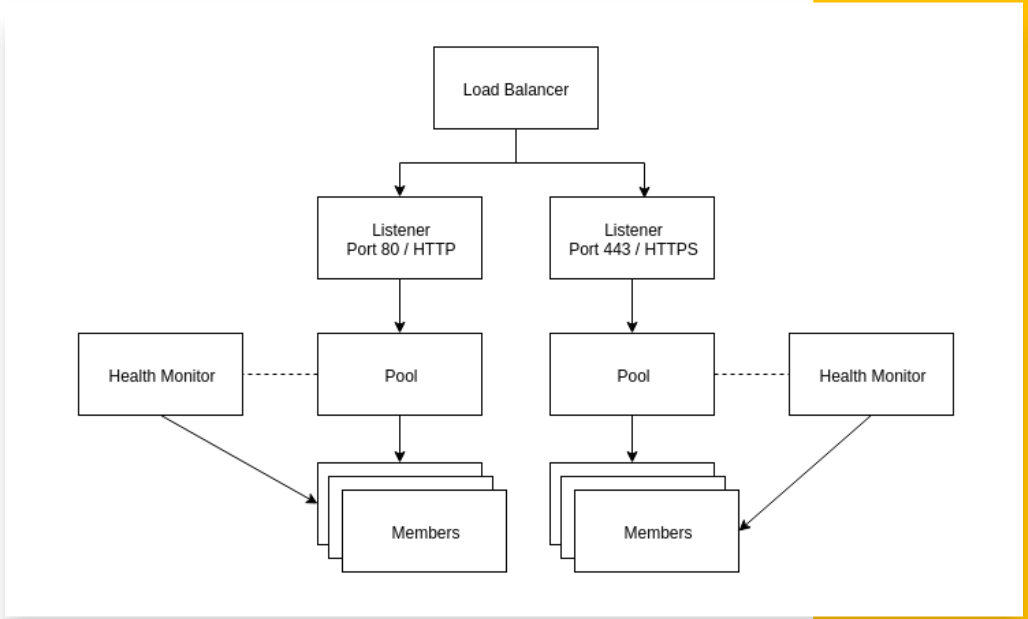
ETCD quorum

An etcd cluster must be comprised of an **odd number** of server nodes for etcd to maintain **quorum**. For a cluster with n servers, quorum is *(n/2)+1*. For any odd-sized cluster, adding one node will always increase the number of nodes necessary for quorum. Although adding a node to an odd-sized cluster appears better since there are more machines, the fault tolerance is worse. Exactly the same number of nodes can fail without losing quorum, but there are now more nodes that can fail.

Octavia Load Balancer

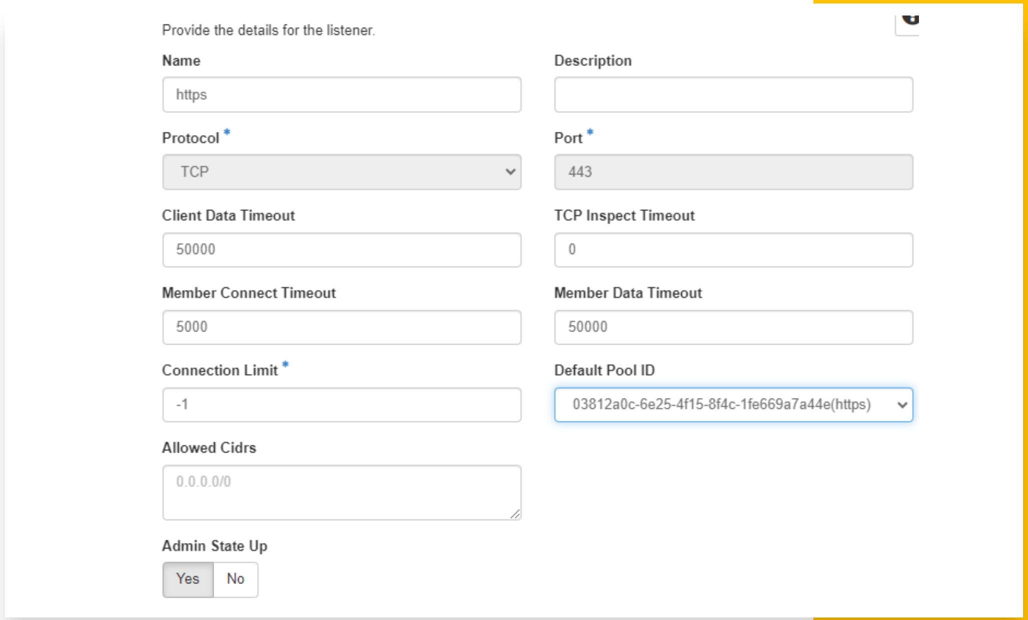
- Automatic creation of 2 VMs (active + backup)
- Health monitor integrated and pool composed of multiple members



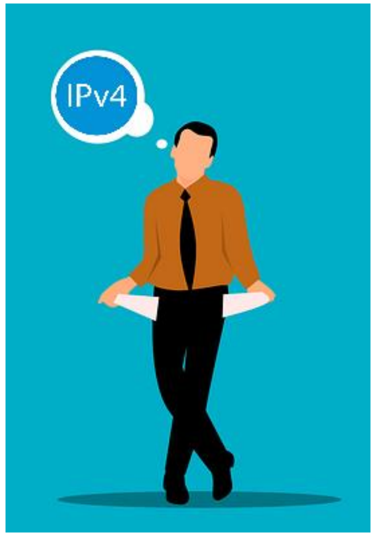


Octavia Load Balancer

- Ability to easily configure connections (protocol, timeout, CIDR, etc.)
- Lower consumption of FloatingIP


Provide the details for the listener.

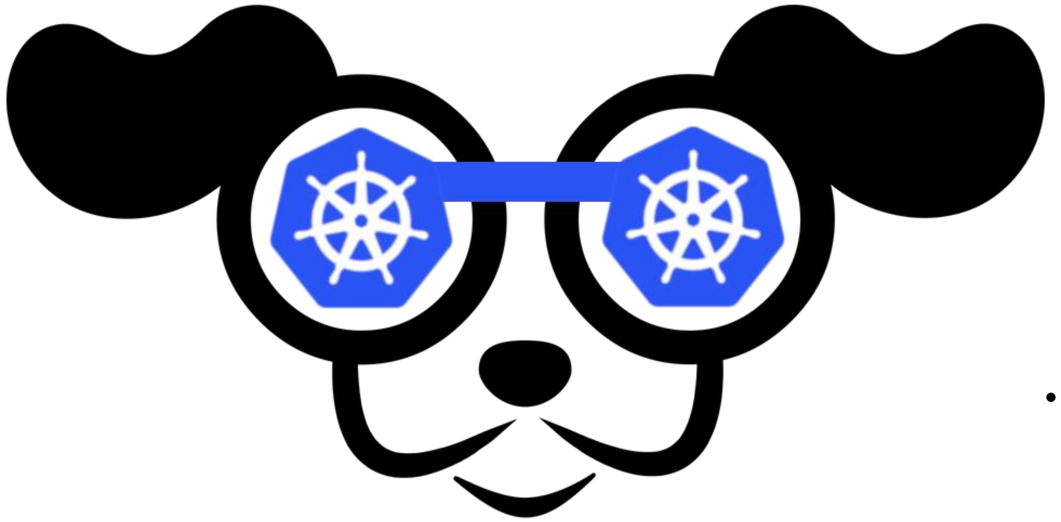
Name: https	Description:
Protocol *: TCP	Port *: 443
Client Data Timeout: 50000	TCP Inspect Timeout: 0
Member Connect Timeout: 5000	Member Data Timeout: 50000
Connection Limit *: -1	Default Pool ID: 03812a0c-6e25-4f15-8f4c-1fe669a7a44e(https)
Allowed Cidrs: 0.0.0.0/0	
Admin State Up: [✓ Yes] No	



K8s side Improvements

Increase resilience and management of a service thanks to K8s components

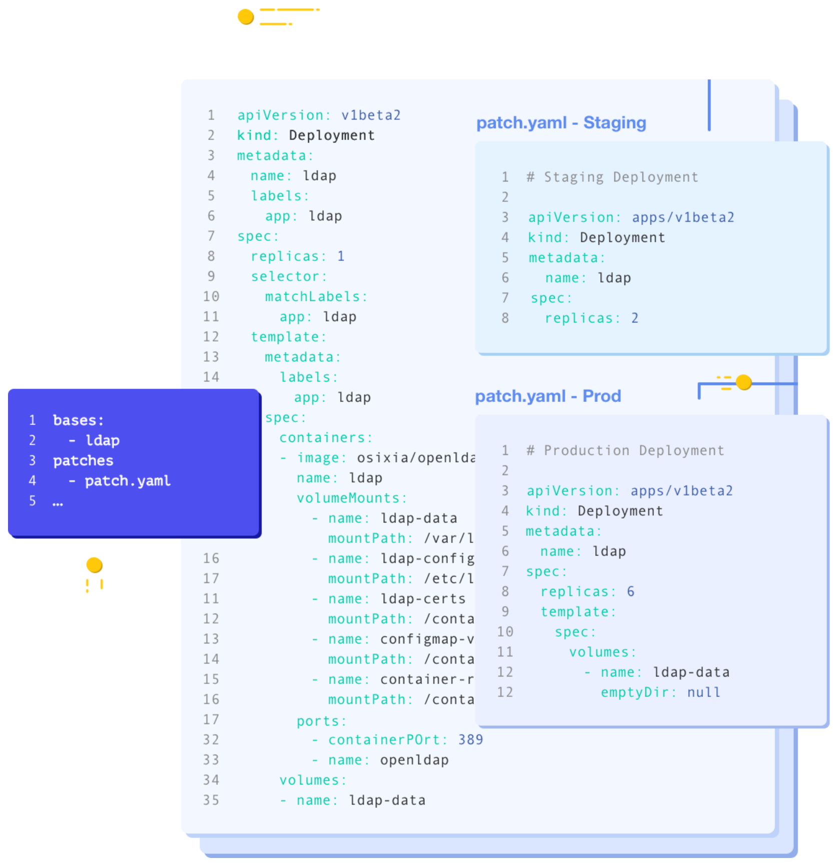
API server, but even better with…



- Bash auto-completion for K8S
  - Install and enable bash-completion
    ```
    $ dnf install bash-completion
    ```
  - Insert the following lines into the `.bashrc` file
    ```
    source /usr/share/bash-completion/bash_completion
    source <(kubectl completion bash)
    alias k=kubectl
    complete -F __start_kubectl k
    ```
- K9s is a terminal based UI to interact with your Kubernetes clusters. The aim of this project is to make it easier to navigate, observe and manage your deployed applications in the wild. K9s continually watches Kubernetes for changes and offers subsequent commands to interact with your observed resources.

Kustomize

- Kustomize is an open-source configuration management tool designed for Kubernetes. It empowers developers and operators to customize, patch, and manage Kubernetes manifests in a declarative manner.



```
bases:
  - ldap
patches
  - patch.yaml
…
```

```
apiVersion: v1beta2
kind: Deployment
metadata:
  name: ldap
  labels:
    app: ldap
spec:
  replicas: 1
  selector:
    matchLabels:
      app: ldap
  template:
    metadata:
      labels:
        app: ldap
    spec:
      containers:
      - image: osixia/openlda
        name: ldap
        volumeMounts:
          - name: ldap-data
            mountPath: /var/l
          - name: ldap-config
            mountPath: /etc/l
          - name: ldap-certs
            mountPath: /conta
          - name: configmap-v
            mountPath: /conta
          - name: container-r
            mountPath: /conta
        ports:
          - containerPOrt: 389
          - name: openldap
      volumes:
      - name: ldap-data
```

patch.yaml - Staging

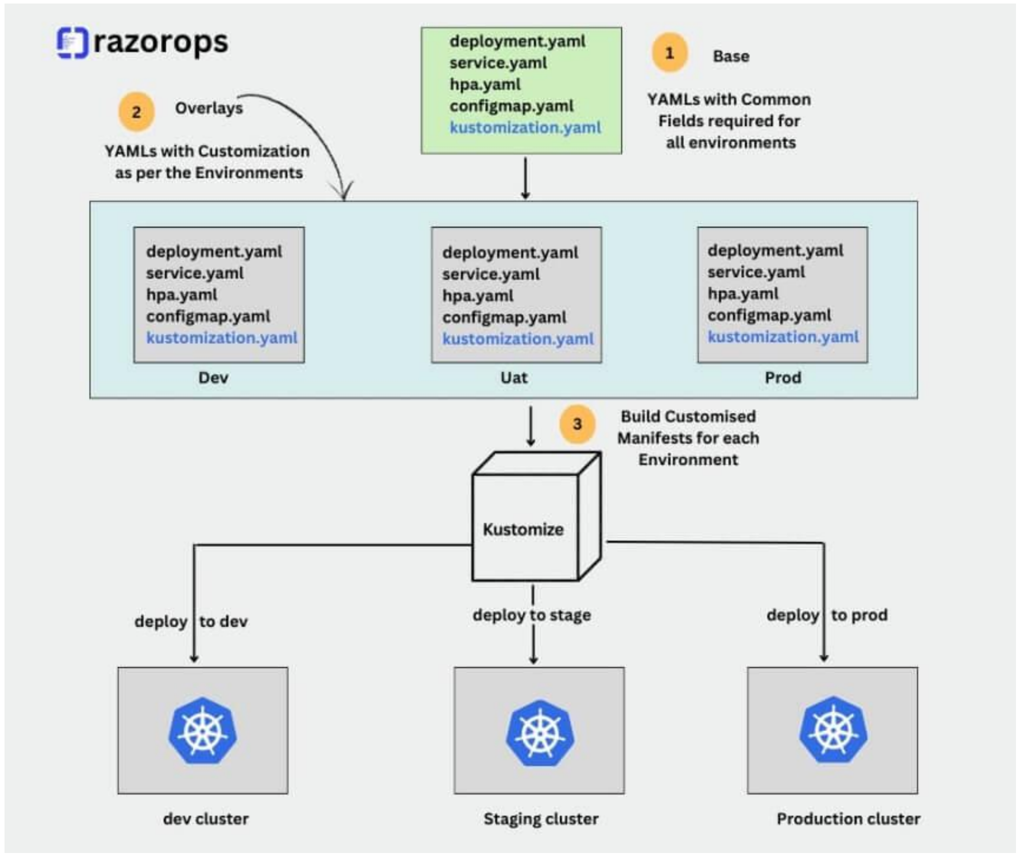
```
# Staging Deployment

apiVersion: apps/v1beta2
kind: Deployment
metadata:
  name: ldap
spec:
  replicas: 2
```

patch.yaml - Prod

```
# Production Deployment

apiVersion: apps/v1beta2
kind: Deployment
metadata:
  name: ldap
spec:
  replicas: 6
  template:
    spec:
      volumes:
        - name: ldap-data
          emptyDir: null
```



Pod controller

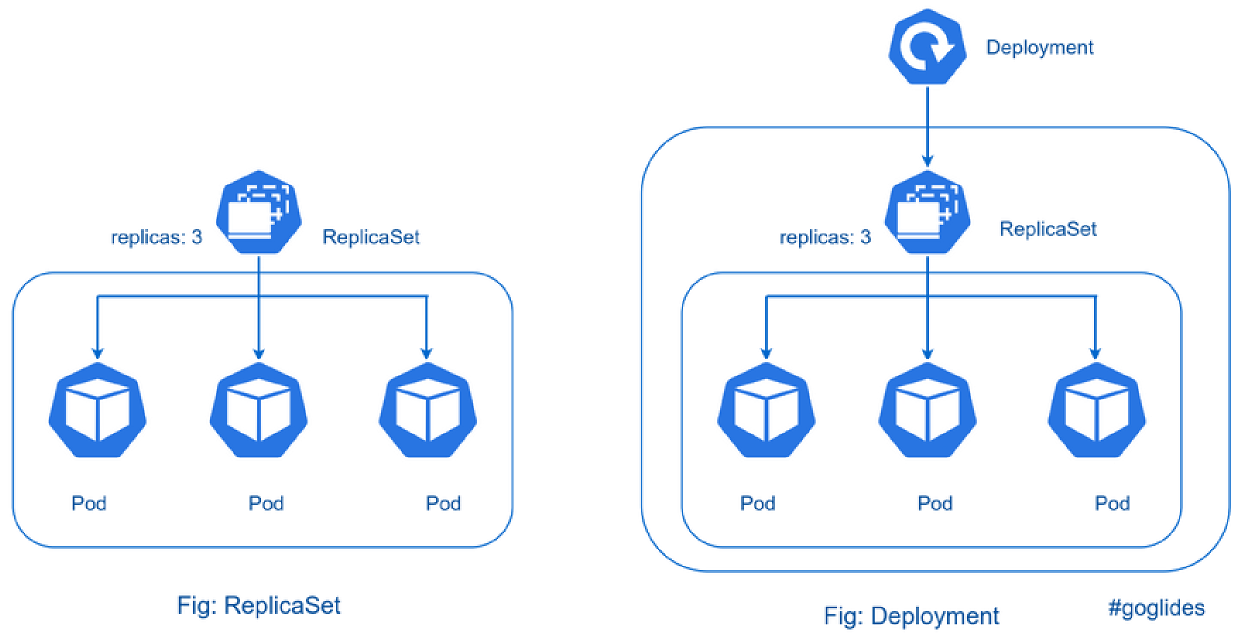


Fig: ReplicaSet

Fig: Deployment

The nature of Pods is ephemeral, so controllers have been created to monitor their **number** and **health status**.

- **ReplicaSet** (**RS**): the purpose is to multiply the number of copies of a certain application (Pod). This serves to increase the reliability of the application in the event of a replica failure and/or to manage requests that would not be digestible by a single instance.
- **Deployment**: ensures that there are a certain number of replicas (using the RS) and allows rollout strategies. Thanks to the rollout it is possible to gradually replace the Pods belonging to the old version of the Deployment, with the new ones. Furthermore, it is always possible to perform a rollback to the previous version.

Horizontal Pod Autoscaler

- Horizontal Pod Autoscaler (HPA) automatically scales the number of Pods in a replication controller, deployment, replicaSet or statefulSet based on observed CPU or Memory (RAM) utilization.
- To create an HPA

```
$ kubectl autoscale <kind> <name> --cpu-
percent=<value> --min=<value> --max=<values>
```

```
$ kubectl autoscale deployment php-apache --
cpu-percent=50 --min=1 --max=10
```