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How to Setup Dynamic NFS Provisioning in a Kubernetes Cluster



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Dynamic NFS storage provisioning in Kubernetes streamlines the creation and management of NFS volumes for your Kubernetes applications. It eliminates the need for manual intervention or pre-provisioned storage. The NFS provisioner dynamically creates persistent volumes (PVs) and associates them with persistent volume claims (PVCs), making the process more efficient. If you have an external NFS share and want to use it in a pod or deployment, the `nfs-subdir-external-provisioner` provides a solution for effortlessly setting up a storage class to automate the management of your persistent volumes.

Prerequisites

- Pre-installed Kubernetes Cluster
- A Regular user which has admin rights on the Kubernetes cluster
- Internet Connectivity

Step 1: Installing the NFS Server

```
sudo apt-get update  
sudo apt-get install nfs-common nfs-kernel-server -y
```

Create a directory to export:

```
sudo mkdir -p /data/nfs
sudo chown nobody:nogroup /data/nfs
sudo chmod 2770 /data/nfs
```

Export directory and restart NFS service:

```
echo -e "/data/nfs\t10.124.0.0/24(rw,sync,no_subtree_check,no_root_squash)" | s
```

```
sudo exportfs -av
```

```
root@master:~# sudo exportfs -av
exporting 10.124.0.0/24:/data/nfs
root@master:~#
```

```
# Restart and show logs
sudo systemctl restart nfs-kernel-server
sudo systemctl status nfs-kernel-server
```

```
root@master:~# sudo systemctl restart nfs-kernel-server
sudo systemctl status nfs-kernel-server
● nfs-server.service - NFS server and services
   Loaded: loaded (/lib/systemd/system/nfs-server.service; enabled; preset: enabled)
   Active: active (exited) since Fri 2023-11-03 16:53:28 UTC; 43ms ago
     Process: 398572 ExecStartPre=/usr/sbin/exportfs -r (code=exited, status=0/SUCCESS)
     Process: 398573 ExecStart=/usr/sbin/rpc.nfsd (code=exited, status=0/SUCCESS)
    Main PID: 398573 (code=exited, status=0/SUCCESS)
      CPU: 7ms
```

Show Export Details:

```
/sbin/showmount -e 10.124.0.9
```

```
root@master:~# /sbin/showmount -e 10.124.0.9
Export list for 10.124.0.9:
/data/nfs 10.124.0.0/24
root@master:~#
```

Step 2: Install NFS client packages on K8s Nodes

Make sure all your Kubernetes nodes have the NFS client packages installed. On Ubuntu-based nodes, install `nfs-common`:

```
sudo apt update
sudo apt install nfs-common -y
```

Step 3: Install and Configure NFS Client Provisioner

Deploy the NFS Subdir External Provisioner in your Kubernetes cluster to automate the creation and management of NFS-backed Persistent Volumes (PVs) and Persistent Volume Claims (PVCs).

Install Helm3 on Debian/Ubuntu using the following commands:

```
curl https://baltocdn.com/helm/signing.asc | sudo apt-key add -
sudo apt-get install apt-transport-https --yes
echo "deb https://baltocdn.com/helm/stable/debian/ all main" | sudo tee /etc/ap
sudo apt-get update
sudo apt-get install helm
```

Add Helm Repository for `nfs-subdir-external-provisioner`:

```
helm repo add nfs-subdir-external-provisioner https://kubernetes-sigs.github.io
```

Install Helm Chart for NFS

```
helm install nfs-subdir-external-provisioner \
nfs-subdir-external-provisioner/nfs-subdir-external-provisioner \
--set nfs.server=10.124.0.9 \
--set nfs.path=/data/nfs \
--set storageClass.onDelete=true
```

```
root@master:~# helm install nfs-subdir-external-provisioner \
nfs-subdir-external-provisioner/nfs-subdir-external-provisioner \
--set nfs.server=10.124.0.9 \
--set nfs.path=/data/nfs \
--set storageClass.onDelete=true
NAME: nfs-subdir-external-provisioner
LAST DEPLOYED: Fri Nov  3 16:59:55 2023
NAMESPACE: default
STATUS: deployed
REVISION: 1
TEST SUITE: None
```

```
# Check pods and storage classes:
kubectl get pod
kubectl get sc
```

```
root@master:~# kubectl get po
NAME                                READY   STATUS    RESTARTS   AGE
nfs-subdir-external-provisioner-658d6d459f-2k4tr  1/1     Running   0           2m31s
root@master:~#
```

```
root@master:~# kubectl get sc
NAME            PROVISIONER                RECLAIMPOLICY   VOLUMEBINDINGMODE   ALLOWVOLUMEEXPANSION   AGE
nfs-client      cluster.local/nfs-subdir-external-provisioner  Delete          Immediate            true                    15m
```

NFS dynamic storage class was installed and “nfs-client” storage was created.

Step 4: Dynamic PVC Volume Create Testing:

Now we can test creating dynamic PVC volume.

nfs-pvc.yaml

```
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: nfs-pvc
spec:
  accessModes:
    - ReadWriteOnce
  storageClassName: nfs-client
  resources:
    requests:
      storage: 5Gi
```

Create an NGINX pod that mounts the NFS export in its web directory:

deployment.yaml

```
apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    app: nginx
  name: nfs-nginx
spec:
  replicas: 1
  selector:
    matchLabels:
      app: nginx
  template:
    metadata:
      labels:
        app: nginx
    spec:
      volumes:
        - name: nfs-nginx
          persistentVolumeClaim:
            claimName: nfs-pvc
      containers:
        - image: nginx
          name: nginx
          volumeMounts:
            - name: nfs-nginx
              mountPath: /usr/share/nginx/html
```

```
kubectl apply -f nfs-pvc.yaml
kubectl apply -f deployment.yaml
```

Apply this file to create an NGINX pod with the NFS volume mounted at
/usr/share/nginx/html

```
root@master:~# kubectl get sc
NAME                                PROVISIONER                                RECLAIMPOLICY  VOLUMEBINDINGMODE  ALLOWVOLUME
ON  AGE
nfs-client                          cluster.local/nfs-subdir-external-provisioner  Delete         Immediate          true
15m
root@master:~# kubectl get pv
NAME                                CAPACITY  ACCESS MODES  RECLAIM POLICY  STATUS  CLAIM
ORAGECLASS  REASON  AGE
pvc-8a531138-1a09-4e7e-a963-fbec5ecd0a41  5Gi      RWO           Delete          Bound   default/nfs-p
s-client  10m
root@master:~# kubectl get pvc
NAME                                STATUS  VOLUME                                CAPACITY  ACCESS MODES  STORAGECLASS  AGE
nfs-pvc  Bound   pvc-8a531138-1a09-4e7e-a963-fbec5ecd0a41  5Gi      RWO           nfs-client    10m
root@master:~#
```

Now, let's enter the pod and create an 'index.html' file under '/usr/share/nginx/html.'

```
kubectl get po
kubectl exec -it nfs-nginx-66bcd8b957-7vl2g sh
#now we are into pod
# cd /usr/share/nginx/html
# ls -l
# echo "hello world" >index.html
# ls -l
# exit
```

```
root@master:~# kubectl get po
NAME                                READY  STATUS    RESTARTS  AGE
nfs-nginx-66bcd8b957-7vl2g         1/1    Running   0          83s
nfs-subdir-external-provisioner-658d6d459f-2k4tr  1/1    Running   0          6m53s
root@master:~# kubectl exec -it nfs-nginx-66bcd8b957-7vl2g sh
kubectl exec [POD] [COMMAND] is DEPRECATED and will be removed in a future version. Use kubectl exec [POD] --
[COMMAND] instead.
# cd /usr/share/nginx/html
# ls -l
total 0
# echo "hello world" >index.html
# ls -l
total 4
-rw-r--r-- 1 root root 12 Nov  3 17:07 index.html
# exit
```

```
cd /data
cd nfs
ls -l
cd default-nfs-pvc-pvc-8a531138-1a09-4e7e-a963-fbec5ecd0a41/
```

```
root@master:~# cd /data/
root@master:/data# cd nfs
root@master:/data/nfs# ls -l
total 4
drwxrwxrwx 2 root nogroup 4096 Nov  3 17:07 default-nfs-pvc-pvc-8a531138-1a09-4e7e-a963-fbec5ecd0a41/
root@master:/data/nfs# cd default-nfs-pvc-pvc-8a531138-1a09-4e7e-a963-fbec5ecd0a41/
root@master:/data/nfs/default-nfs-pvc-pvc-8a531138-1a09-4e7e-a963-fbec5ecd0a41# ls
index.html
root@master:/data/nfs/default-nfs-pvc-pvc-8a531138-1a09-4e7e-a963-fbec5ecd0a41#
```

During our testing, we observed that we could access the file (index.html) we created from the '/data/nfs' folder on the server, confirming that the NFS server share is also accessible within the pod.

Nfs Server

Kubernetes Cluster

Persistent Volume

Persistent Volume Claim

Storageclass



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```
join 146.190.135.86:6443 --token f1h95l.u4nkex9cw8d0g63w --discovery-token-ca-cert-hash sha256:8d1666af50c85f060b9fadc73f13c932e0e2a9eeef08f51f91a
# Run the following commands on the worker node to join the cluster...
# 1. Install kubelet
# 2. Install kubeadm
# 3. Install kubectl
# 4. Configure kubelet
# 5. Start kubelet
# 6. Join the cluster

# Look at this config file with 'kubectl -n kube-system get cm kubelet-config'
# Copy kubelet configuration to file "/var/lib/kubelet/config.yaml"
# Copy kubelet environment file with flags to file "/var/lib/kubelet/kubeadm-config.yaml"
# Start the kubelet
# Wait for the kubelet to perform the TLS Bootstrap...

# Verify the cluster:
# A request was sent to apiserver and a response was received.
# The node is now a member of the new secure connection details.

# Run 'kubectl get nodes' on the control-plane to see this node join the cluster.
```



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- Resources:** A table showing the usage of various Amazon EC2 resources in the US East (N. Virginia) Region. The resources and their counts are: Instances (running) - 0, Auto Scaling Groups - 0, Dedicated Hosts - 0, Elastic IPs - 0, Instances - 0, Key pairs - 0, Load balancers - 0, Placement groups - 0, Security groups - 1, Snapshots - 0, and Volumes - 0.
- Launch instance:** A section with a 'Launch instance' button and a 'Migrate a server' link.
- Service health:** A section with an 'AWS Health Dashboard' link.
- Account attributes:** A section showing the 'Default VPC' (vpc-0b889f3413dee8f3e) and 'Settings' for data protection and security, zones, EC2 Serial Console, default credit specification, and console experiments.
- Explore AWS:** A section with promotional text about saving up to 90% on EC2 with Spot Instances and getting up to 40% better price performance.



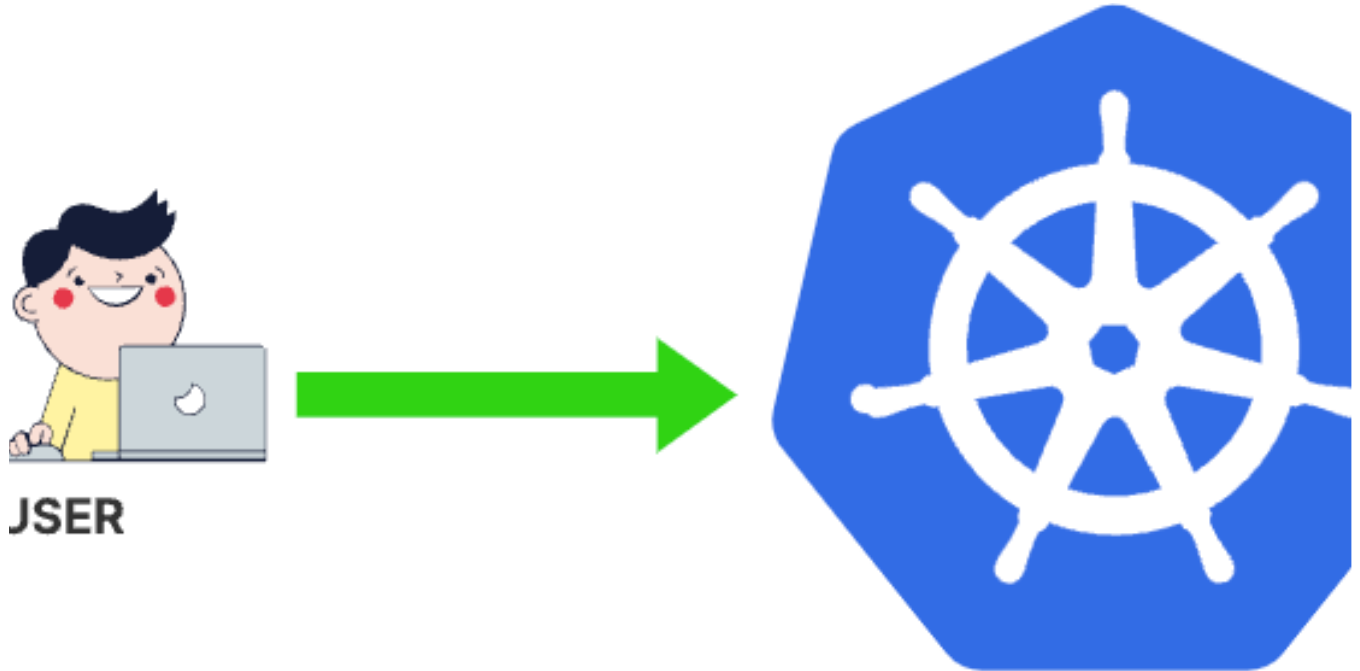
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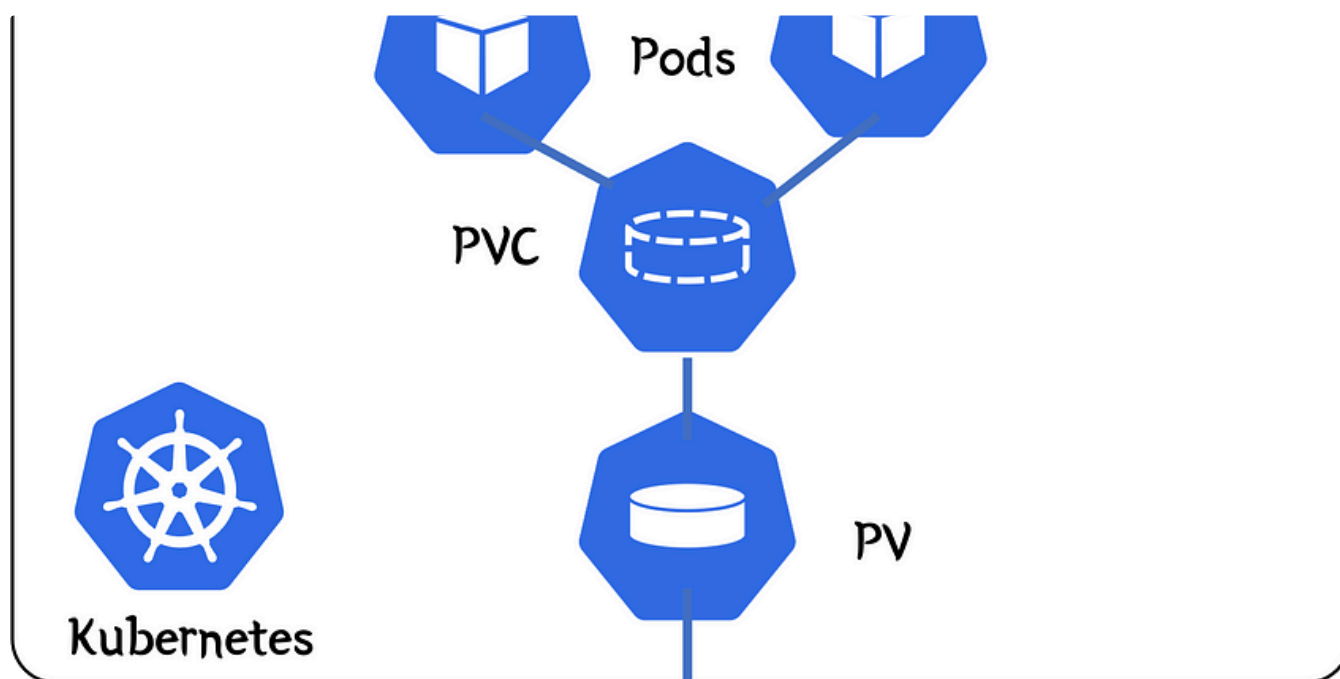
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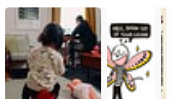
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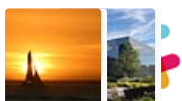


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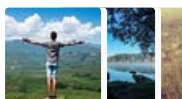
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