



{K}ODE{K}LOUD

# Course Objectives

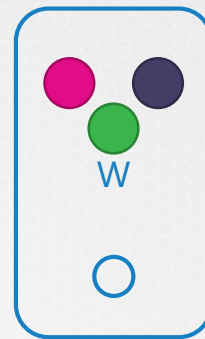
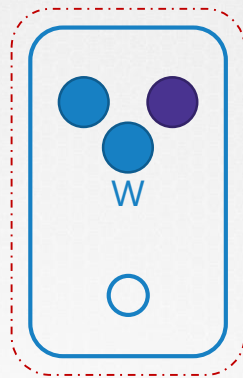
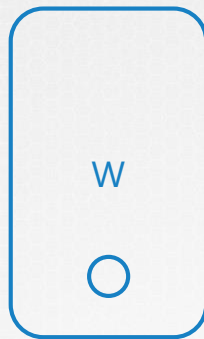
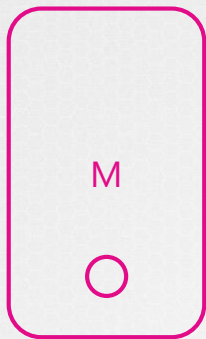
- ✓ Core Concepts
- ✓ Scheduling
- ✓ Logging Monitoring
- ✓ Application Lifecycle Management
- Cluster Maintenance
  - Operating System Upgrades
  - Kubernetes Releases/Versions
- Security
- Storage
- Networking
- Installation, Configuration & Validation
- Troubleshooting

○ Cluster Upgrade Process

○ Backup and Restore Methodologies



# Operating System Upgrade



▶ `kubectl drain node-1`

▶ `kubectl cordon node-2`

▶ `kubectl uncordon node-1`



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# Course Objectives

Core Concepts

Scheduling

Logging Monitoring

Application Lifecycle Management

Cluster Maintenance

○ Operating System Upgrades

○ Cluster Upgrade Process

○ Kubernetes Releases/Versions

○ Backup and Restore Methodologies

Security

Storage

Networking

Installation, Configuration & Validation

Troubleshooting



# Kubernetes Releases

```
▶ kubectl get nodes
```

| NAME   | STATUS | ROLES  | AGE | VERSION |
|--------|--------|--------|-----|---------|
| master | Ready  | master | 1d  | v1.11.3 |
| node-1 | Ready  | <none> | 1d  | v1.11.3 |
| node-2 | Ready  | <none> | 1d  | v1.11.3 |



v1.11.3

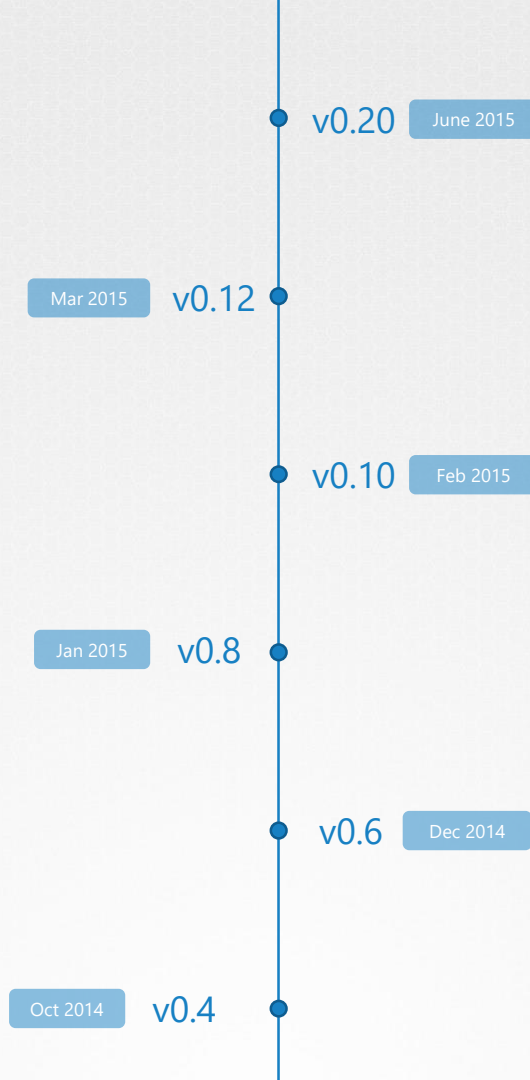


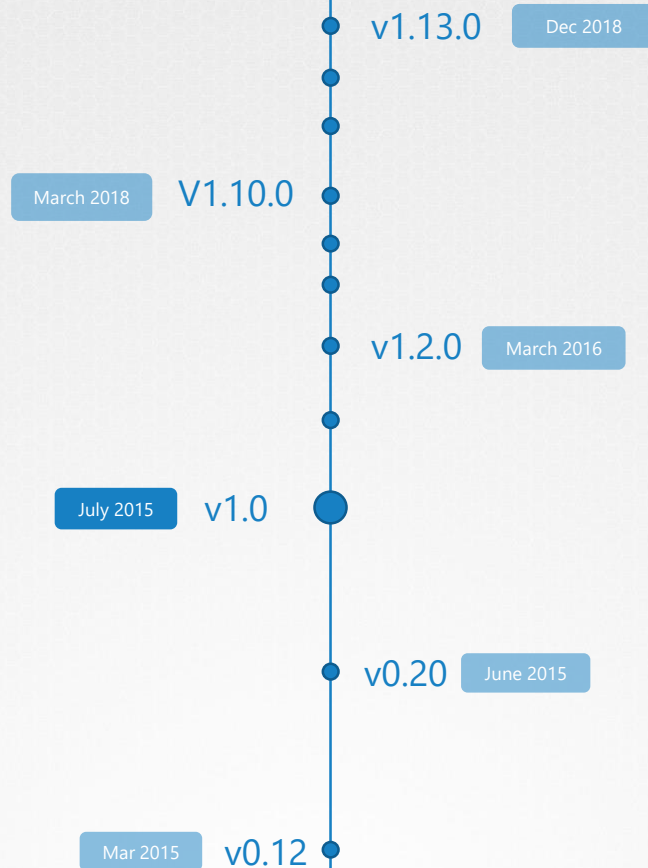
MAJOR

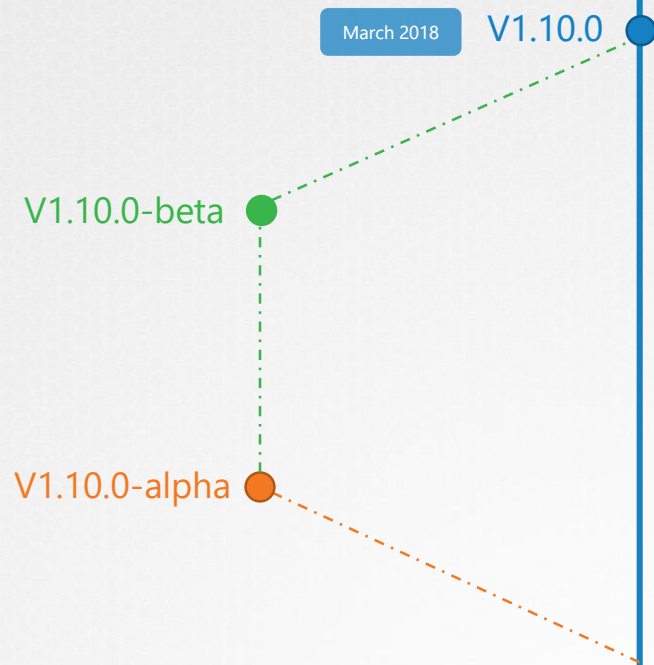
MINOR

PATCH

- Features
- Bug Fixes
- Functionalities







&lt;&gt; Code

🔔 Issues 2,151

🔗 Pull requests 992

📁 Projects 11

📊 Insights

Releases

Tags

8 days ago

v1.13.5-beta.0

🔗 9cb83c5 📄 zip 📄 tar.gz

🔗 v1.13.4

🔗 c27b913

v1.13.4

👤 k8s-release-robot released this 8 days ago · 8 commits to release-1.13 since this release

See [kubernetes-announce@](#) and [CHANGELOG-1.13.md](#) for details.SHA512 for `kubernetes.tar.gz` :

```
591cd3f4f479744a1d47544902817350321c63f8c37ad771d559e293bcd421e89d62663300a6739c667d34e1e24bb080dd73562dc29713381db079ba6e9223
```

Additional binary downloads are linked in the [CHANGELOG-1.13.md](#).

▼ Assets 3

|  |         |
|--|---------|
| 📄 <a href="#">kubernetes.tar.gz</a>    | 1.85 MB |
| 📄 <a href="#">Source code (zip)</a>    |         |
| 📄 <a href="#">Source code (tar.gz)</a> |         |



v1.13.4

kube-apiserver

v1.13.4

Controller-manager

v1.13.4

kube-scheduler

v1.13.4

kubelet

v1.13.4

kube-proxy

v1.13.4

kubectl

v1.13.4

ETCD CLUSTER

v3.2.18

CoreDNS

v1.1.3



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Core Concepts

Scheduling

Logging Monitoring

Application Lifecycle Management

Cluster Maintenance

○ Operating System Upgrades

○ Cluster Upgrade Process

○ Kubernetes Releases/Versions

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# Cluster Upgrade Process



kube-apiserver

X v1.10

Controller-manager

X-1  
v1.9 or v1.10

kube-scheduler

X-1  
v.19 or v1.10

kubectl

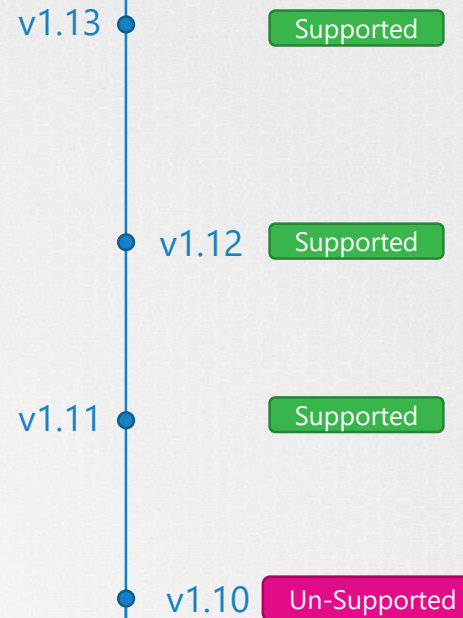
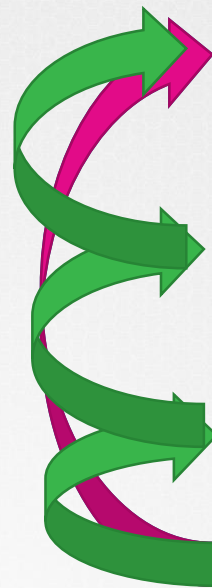
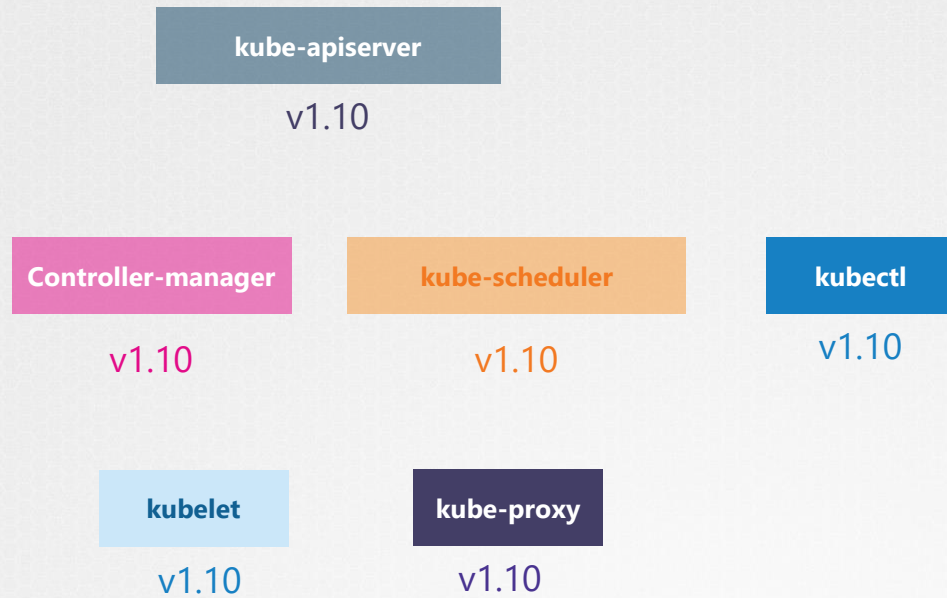
$X+1 > X-1$

kubelet

X-2  
v1.8 or v1.9 or v.110

kube-proxy

X-2  
V1.8 or v1.9 or v1.10





kubeadm

“The hard way”

✓ standard-cluster-1

[Details](#) [Storage](#) [Nodes](#)

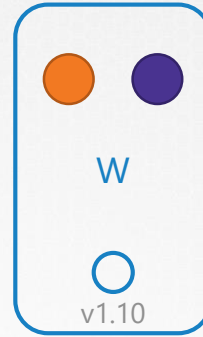
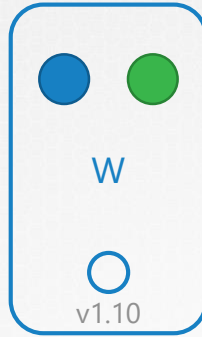
Cluster

|                           |                         |                                   |
|---------------------------|-------------------------|-----------------------------------|
| Master version            | 1.10.12-gke.7           | <a href="#">Upgrade available</a> |
| Endpoint                  | 35.238.15.143           | <a href="#">Show credentials</a>  |
| Client certificate        | Enabled                 |                                   |
| Binary authorisation      | Disabled                |                                   |
| Kubernetes alpha features | Disabled                |                                   |
| Total size                | 3                       |                                   |
| Master zone               | us-central1-a           |                                   |
| Node zones                | us-central1-a           |                                   |
| Network                   | <a href="#">default</a> |                                   |

▶ `kubect1 upgrade plan`

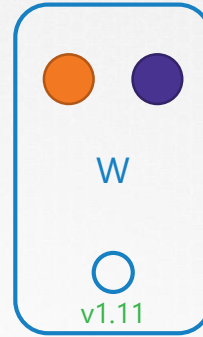
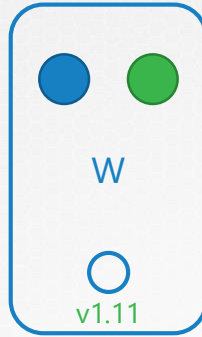
▶ `kubect1 upgrade apply`



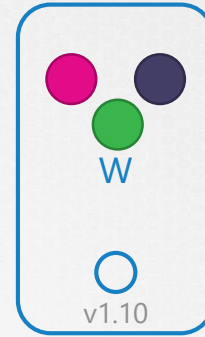
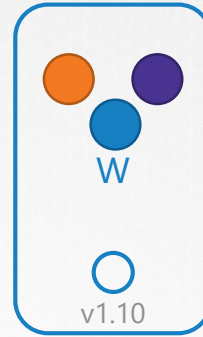
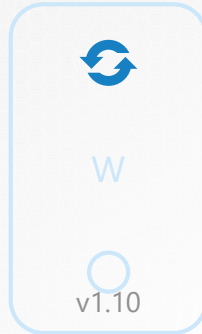




# Strategy - 1

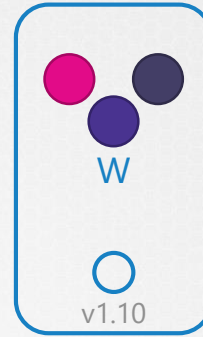
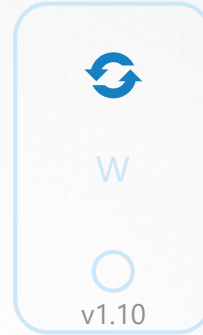
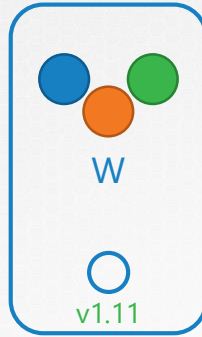


# Strategy - 2

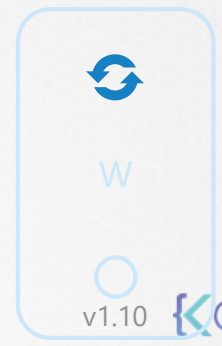
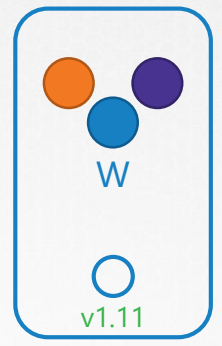
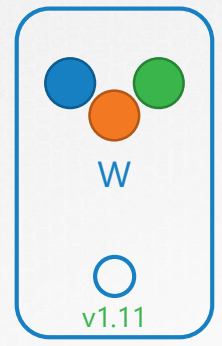
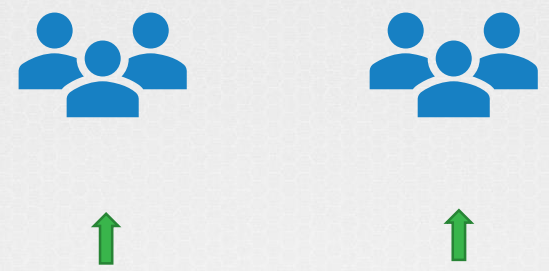




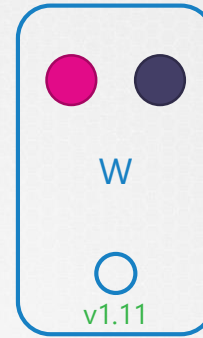
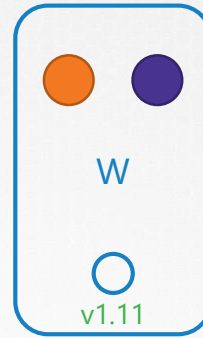
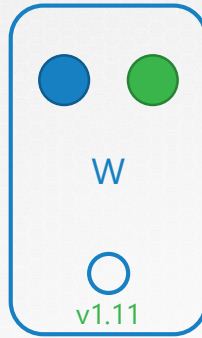
# Strategy - 2



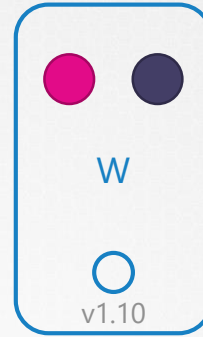
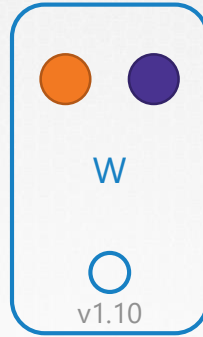
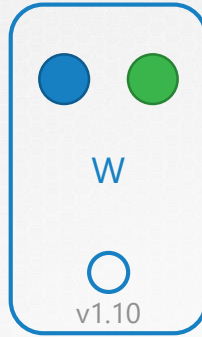
# Strategy - 2



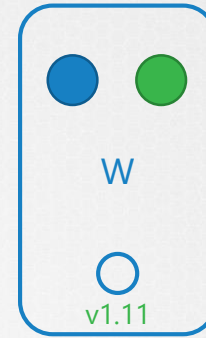
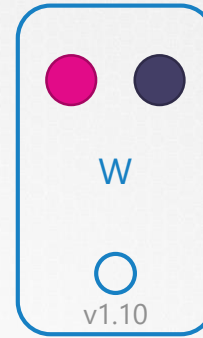
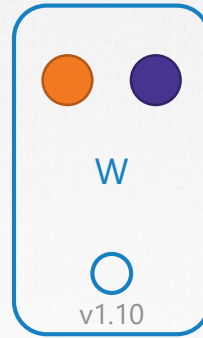
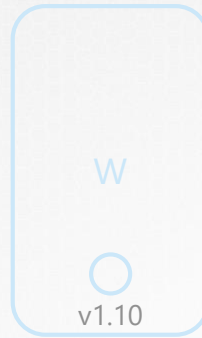
# Strategy - 2



# Strategy - 3

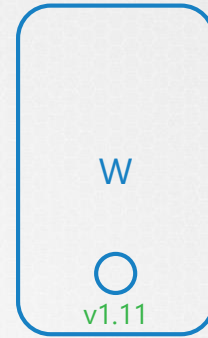
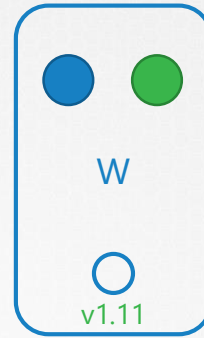
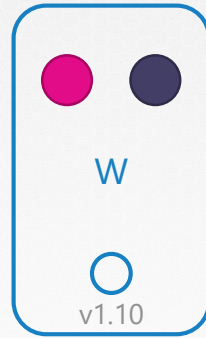
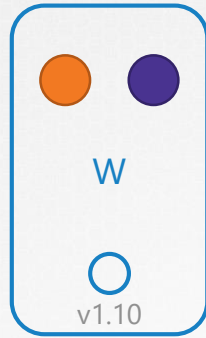


# Strategy - 3





# Strategy - 3



# kubeadm - upgrade



```
► kubeadm upgrade plan
```

```
[preflight] Running pre-flight checks.
[upgrade] Making sure the cluster is healthy:
[upgrade/config] Making sure the configuration is correct:
[upgrade] Fetching available versions to upgrade to
[upgrade/versions] Cluster version: v1.11.8
[upgrade/versions] kubeadm version: v1.11.3
[upgrade/versions] Latest stable version: v1.13.4
[upgrade/versions] Latest version in the v1.11 series: v1.11.8
```

Components that must be **upgraded manually** after you have upgraded the control plane with 'kubeadm upgrade apply':

| COMPONENT | CURRENT     | AVAILABLE |
|-----------|-------------|-----------|
| Kubelet   | 3 x v1.11.3 | v1.13.4   |

Upgrade to the latest stable version:

| COMPONENT          | CURRENT | AVAILABLE |
|--------------------|---------|-----------|
| API Server         | v1.11.8 | v1.13.4   |
| Controller Manager | v1.11.8 | v1.13.4   |
| Scheduler          | v1.11.8 | v1.13.4   |
| Kube Proxy         | v1.11.8 | v1.13.4   |
| CoreDNS            | 1.1.3   | 1.1.3     |
| EtcD               | 3.2.18  | N/A       |

You can now apply the upgrade by executing the following command:

# kubeadm - up



```
kubeadm upgrade plan
```

```
[preflight] Running pre-flight checks.  
[upgrade] Making sure the cluster is healthy:  
[upgrade/config] Making sure the configuration is correct:  
[upgrade] Fetching available versions to upgrade to  
[upgrade/versions] Cluster version: v1.11.8  
[upgrade/versions] kubeadm version: v1.11.3  
[upgrade/versions] Latest stable version: v1.13.4  
[upgrade/versions] Latest version in the v1.11 series: v1.11.8
```

Components that must be upgraded manually after you have upgraded the control plane with 'kubeadm upgrade apply':

| COMPONENT | CURRENT     | AVAILABLE |
|-----------|-------------|-----------|
| Kubelet   | 3 x v1.11.3 | v1.13.4   |

Upgrade to the latest stable version:

| COMPONENT          | CURRENT | AVAILABLE |
|--------------------|---------|-----------|
| API Server         | v1.11.8 | v1.13.4   |
| Controller Manager | v1.11.8 | v1.13.4   |
| Scheduler          | v1.11.8 | v1.13.4   |
| Kube Proxy         | v1.11.8 | v1.13.4   |
| CoreDNS            | 1.1.3   | 1.1.3     |
| Etcd               | 3.2.18  | N/A       |

You can now apply the upgrade by executing the following command:

```
kubeadm upgrade apply v1.13.4
```

Note: Before you can perform this upgrade, you have to update kubeadm to v1.13.4.



# kubeadm - upgrade



```
▶ apt-get upgrade -y kubeadm=1.12.0-00
```

```
▶ kubeadm upgrade apply v1.12.0
```

...

[upgrade/successful] SUCCESS! Your cluster was upgraded to "v1.12.0". Enjoy!

[upgrade/kubelet] Now that your control plane is upgraded, please proceed with upgrading your kubelets if you haven't already done so.

```
▶ kubectl get nodes
```

| NAME   | STATUS | ROLES  | AGE | VERSION |
|--------|--------|--------|-----|---------|
| master | Ready  | master | 1d  | v1.11.3 |
| node-1 | Ready  | <none> | 1d  | v1.11.3 |
| node-2 | Ready  | <none> | 1d  | v1.11.3 |

```
▶ apt-get upgrade -y kubelet=1.12.0-00
```

```
▶ systemctl restart kubelet
```

# kubeadm - upgrade



```
▶ kubectl get nodes
```

| NAME   | STATUS | ROLES  | AGE | VERSION |
|--------|--------|--------|-----|---------|
| master | Ready  | master | 1d  | v1.11.3 |
| node-1 | Ready  | <none> | 1d  | v1.11.3 |
| node-2 | Ready  | <none> | 1d  | v1.11.3 |

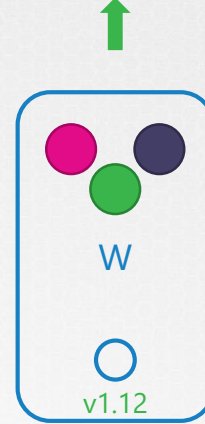
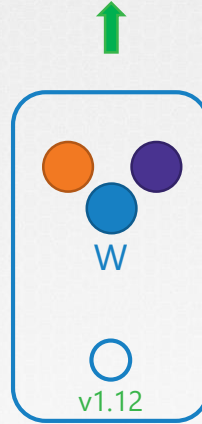
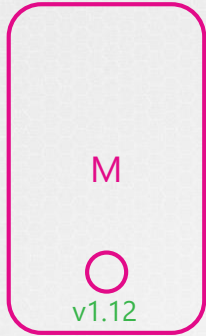
```
▶ apt-get upgrade -y kubelet=1.12.0-00
```

```
▶ systemctl restart kubelet
```

```
▶ kubectl get nodes
```

| NAME   | STATUS | ROLES  | AGE | VERSION |
|--------|--------|--------|-----|---------|
| master | Ready  | master | 1d  | v1.12.0 |
| node-1 | Ready  | <none> | 1d  | v1.11.3 |
| node-2 | Ready  | <none> | 1d  | v1.11.3 |

# kubeadm - upgrade



```
▶ kubectl drain node-1
```

```
▶ kubectl uncordon node-1
```

```
▶ kubectl drain node-2
```

```
▶ kubectl uncordon node-2
```

```
▶ kubectl drain node-3
```

```
▶ kubectl uncordon node-3
```



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# Backup and Restore

# | Backup Candidates



Resource Configuration



ETCD Cluster



Persistent Volumes



# Imperative



Resource Configuration

```
▶ kubectl create namespace new-namespace
```

```
▶ kubectl create secret
```

```
▶ kubectl create configmap
```



# Declarative



GitHub

Resource Configuration

pod-definition.yml

```
apiVersion: v1
kind: Pod

metadata:
  name: myapp-pod
  labels:
    app: myapp
    type: front-end

spec:
  containers:
  - name: nginx-container
    image: nginx
```

```
▶ kubectl apply -f pod-definition.yml
```

# | Backup – Resource Configs

kube-apiserver



Resource Configuration

```
▶ kubectl get all --all-namespaces -o yaml > all-deploy-services.yaml
```



Formerly called ARK by HeptIO

{CODE}{CLOUD}

# | Backup - ETCD



ETCD Cluster

# Backup - ETCD



ETCD Cluster



etcd.service

```
ExecStart=/usr/local/bin/etcd \\  
  --name ${ETCD_NAME} \\  
  --cert-file=/etc/etcd/kubernetes.pem \\  
  --key-file=/etc/etcd/kubernetes-key.pem \\  
  --peer-cert-file=/etc/etcd/kubernetes.pem \\  
  --peer-key-file=/etc/etcd/kubernetes-key.pem \\  
  --trusted-ca-file=/etc/etcd/ca.pem \\  
  --peer-trusted-ca-file=/etc/etcd/ca.pem \\  
  --peer-client-cert-auth \\  
  --client-cert-auth \\  
  --initial-advertise-peer-urls https://${INTERNAL_IP}:2380 \\  
  --listen-peer-urls https://${INTERNAL_IP}:2380 \\  
  --listen-client-urls https://${INTERNAL_IP}:2379,https://0.0.0.0:2379 \\  
  --advertise-client-urls https://${INTERNAL_IP}:2379 \\  
  --initial-cluster-token etcd-cluster-0 \\  
  --initial-cluster controller-0=https://${CONTROLLER0_IP}:2380 \\  
  --initial-cluster-state new \\  
  --data-dir=/var/lib/etcd
```

# Backup - ETCD



ETCD Cluster



```
ETCDCTL_API=3 etcdctl \  
    snapshot save snapshot.db
```

```
ls  
snapshot.db
```

```
ETCDCTL_API=3 etcdctl \  
    snapshot status snapshot.db
```

|   |          |          |            |            |
|---|----------|----------|------------|------------|
| + | -----+   | -----+   | -----+     | -----+     |
|   | HASH     | REVISION | TOTAL KEYS | TOTAL SIZE |
| + | -----+   | -----+   | -----+     | -----+     |
|   | e63b3fc5 | 473353   | 875        | 4.1 MB     |
| + | -----+   | -----+   | -----+     | -----+     |

# Restore - ETCD



ETCD Cluster

```
ETCDCTL_API=3 etcdctl \  
    snapshot save snapshot.db
```

```
ls  
  
snapshot.db
```

```
service kube-apiserver stop  
Service kube-apiserver stopped
```

```
ETCDCTL_API=3 etcdctl \  
    snapshot restore snapshot.db \  
    --data-dir /var/lib/etcd-from-backup \  
    --initial-cluster master-1=https://192.168.5.11:2380,master-2=https://192.168.5.12:2380 \  
    --initial-cluster-token etcd-cluster-1 \  
    --initial-advertise-peer-urls https://${INTERNAL_IP}:2380
```

```
I | mvcc: restore compact to 475629  
I | etcdserver/membership: added member 5e89ccdf3 [https://192.168.5.12:2380] to cluster 894c7131f5165a78  
I | etcdserver/membership: added member c8246cee7c [https://192.168.5.11:2380] to cluster 894c7131f5165a78
```



# Restore - ETCD



ETCD Cluster

```
ETCDCTL_API=3 etcdctl \
  snapshot restore snapshot.db \
  --data-dir /var/lib/etcd-from-backup \
  --initial-cluster master-
1=https://192.168.5.11:2380,master-
2=https://192.168.5.12:2380 \
  --initial-cluster-token etcd-cluster-1 \
  --initial-advertise-peer-urls
https://${INTERNAL_IP}:2380

I | mvcc: restore compact to 475629
I | etcdserver/membership: added member 5e89ccdf3
[https://192.168.5.12:2380] to cluster 894c7131f5165a78
I | etcdserver/membership: added member c8246cee7c
[https://192.168.5.11:2380] to cluster 894c7131f5165a78
```

```
systemctl daemon-reload
```

```
service etcd restart
```

Service etcd **restarted**

```
ETCDCTL_API=3 etcdctl \
  snapshot save snapshot.db
```

```
ls
snapshot.db
```

```
service kube-apiserver stop
Service kube-apiserver stopped
```

## etcd.service

```
ExecStart=/usr/local/bin/etcd \
  --name ${ETCD_NAME} \
  --cert-file=/etc/etcd/kubernetes.pem \
  --key-file=/etc/etcd/kubernetes-key.pem \
  --peer-cert-file=/etc/etcd/kubernetes.pem \
  --peer-key-file=/etc/etcd/kubernetes-key.pem \
  --trusted-ca-file=/etc/etcd/ca.pem \
  --peer-trusted-ca-file=/etc/etcd/ca.pem \
  --peer-client-cert-auth \
  --client-cert-auth \
  --initial-advertise-peer-urls https://${INTERNAL_IP}:2380 \
  --listen-peer-urls https://${INTERNAL_IP}:2380 \
  --listen-client-urls https://${INTERNAL_IP}:2379 \
  --advertise-client-urls https://${INTERNAL_IP}:2379 \
  --initial-cluster-token etcd-cluster-1 \
  --initial-cluster controller-0=https://${CONTROLLER_IP}:2380 \
  --initial-cluster-state new \
  --data-dir=/var/lib/etcd-from-backup
```

# Restore - ETCD



ETCD Cluster

```
ETCDCTL_API=3 etcdctl \  
    snapshot save snapshot.db
```

```
ls  
snapshot.db
```

```
service kube-apiserver stop  
Service kube-apiserver stopped
```

```
ETCDCTL_API=3 etcdctl \  
    snapshot restore snapshot.db \  
    --data-dir /var/lib/etcd-from-backup \  
    --initial-cluster master-1=https://192.168.5.11:2380,master-2=https://192.168.5.12:2380 \  
    --initial-cluster-token etcd-cluster-1 \  
    --initial-advertise-peer-urls https://${INTERNAL_IP}:2380
```

```
I | mvcc: restore compact to 475629  
I | etcdserver/membership: added member 5e89ccdf3 [https://192.168.5.12:2380] to cluster 894c7131f5165a78  
I | etcdserver/membership: added member c8246cee7c [https://192.168.5.11:2380] to cluster 894c7131f5165a78
```


```
systemctl daemon-reload
```

```
service etcd restart
```

```
Service etcd restarted
```

```
service kube-apiserver start
```

```
Service kube-apiserver started
```

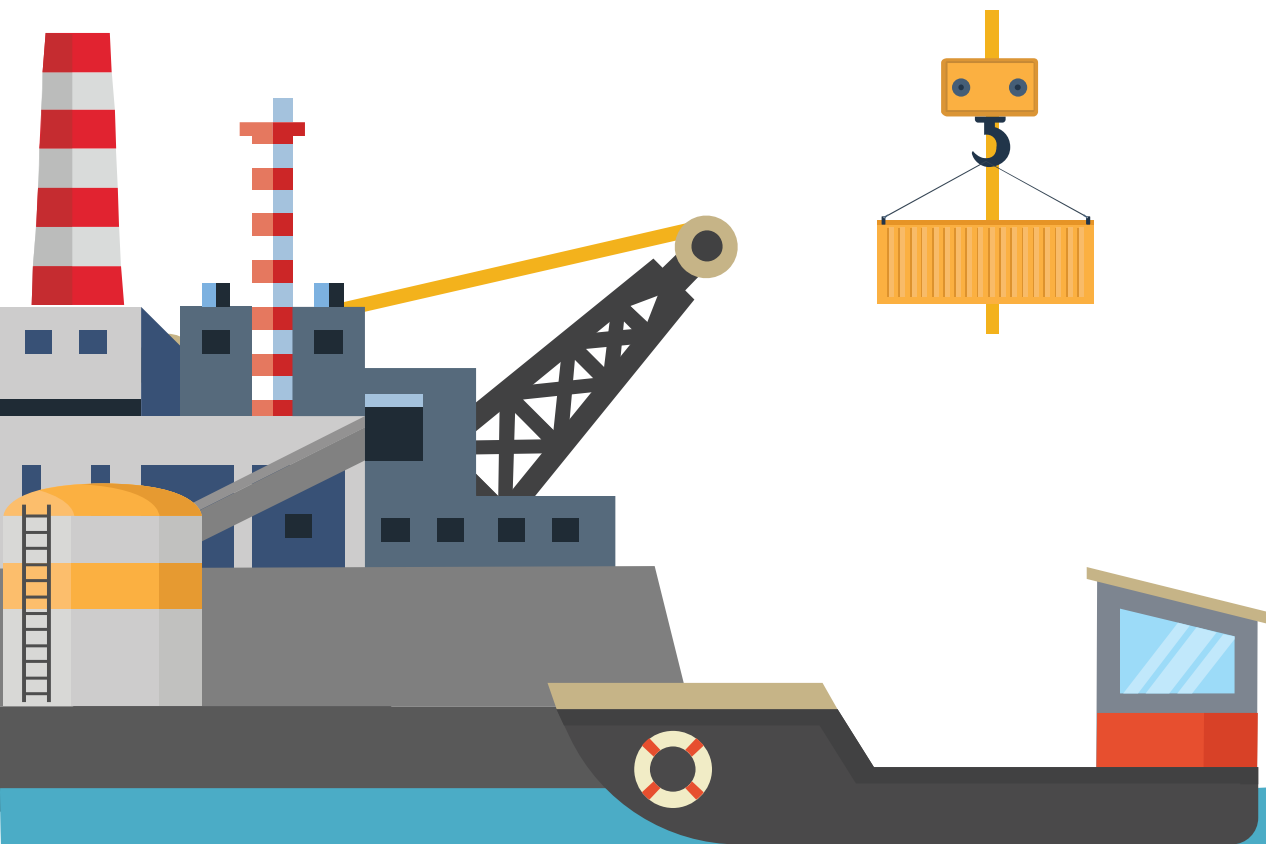


```
▶ ETCCTL_API=3 etcdctl \  
    snapshot save snapshot.db \  
    --endpoints=https://127.0.0.1:2379 \  
    --cacert=/etc/etcd/ca.crt \  
    --cert=/etc/etcd/etcd-server.crt \  
    --key=/etc/etcd/etcd-server.key
```



{K}ODE{K}LOUD

# KUBERNETES ARCHITECTURE







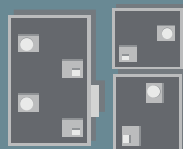
## Master

Manage, Plan, Schedule, Monitor  
Nodes

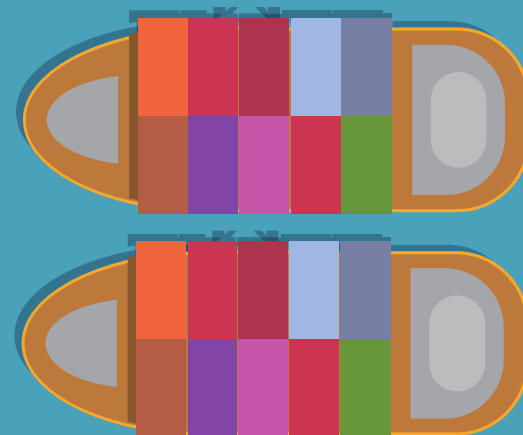
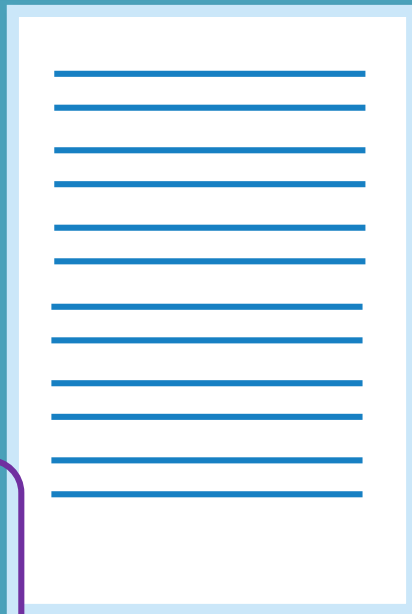


## Worker Nodes

Host Application as Containers



**ETCD  
CLUSTER**



# Kubernetes Architecture



## Master

Manage, Plan, Schedule, Monitor  
Nodes



## Worker Nodes

Host Application as Containers



Kube  
Controller  
Manager

kube-scheduler

kubelet

Container Runtime Engine

Run containers



Kube-proxy

kubelet

Container Runtime Engine

Run containers



Kube-proxy