
KubeCon
CloudNativeCon
Europe 2023
TiKV

Container is the new VM:
The paradigm change no one explained to you

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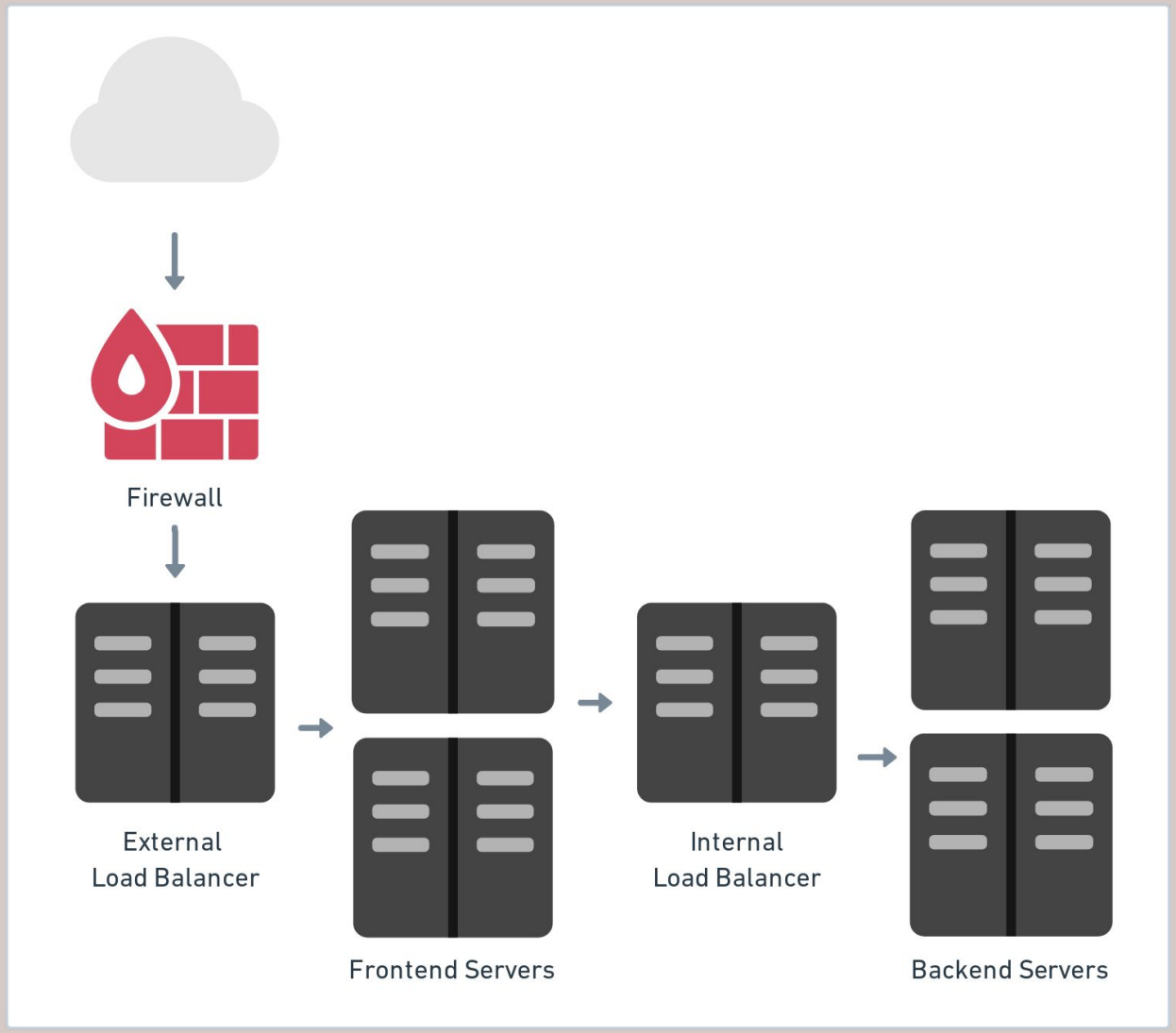
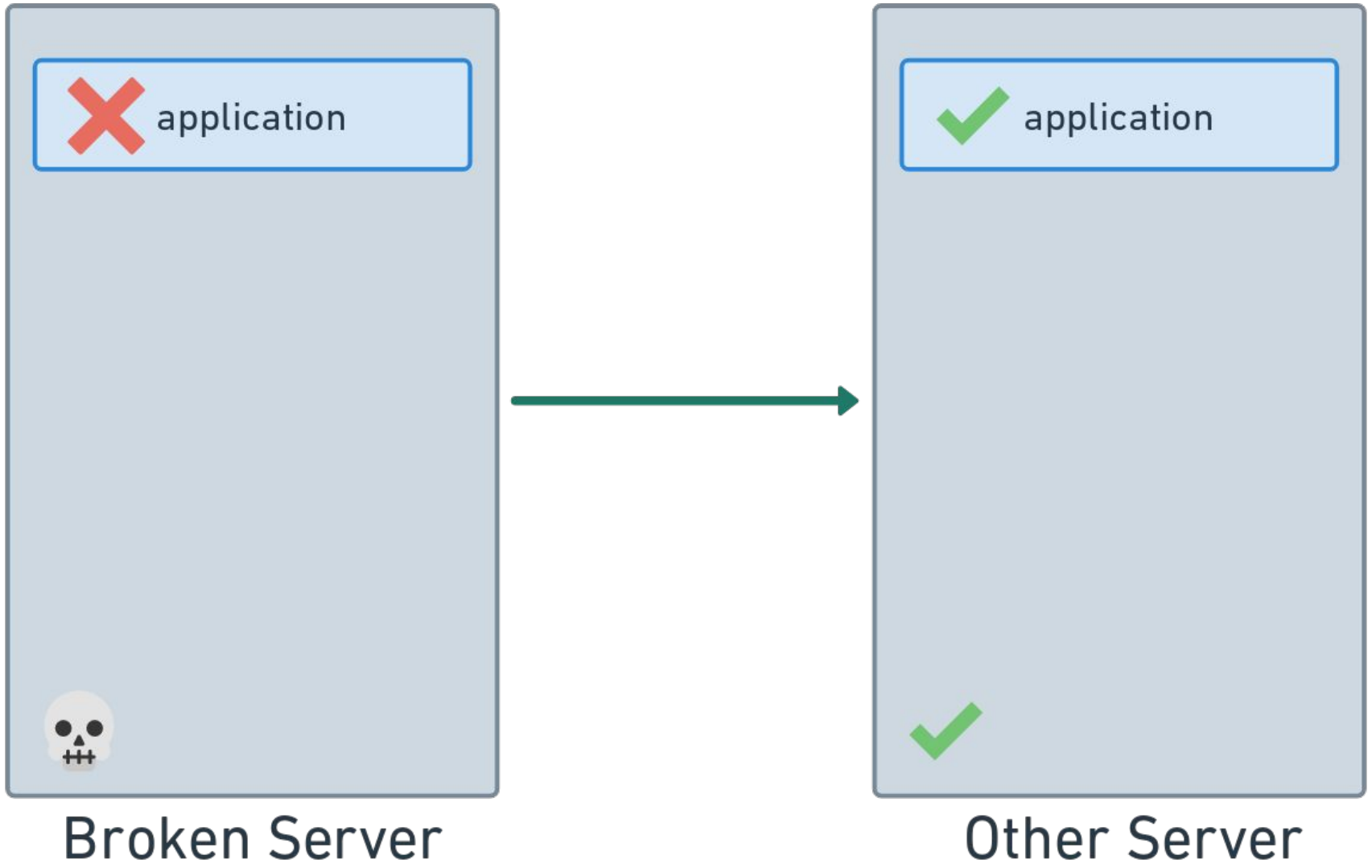
Meet Taylor

Meet Taylor

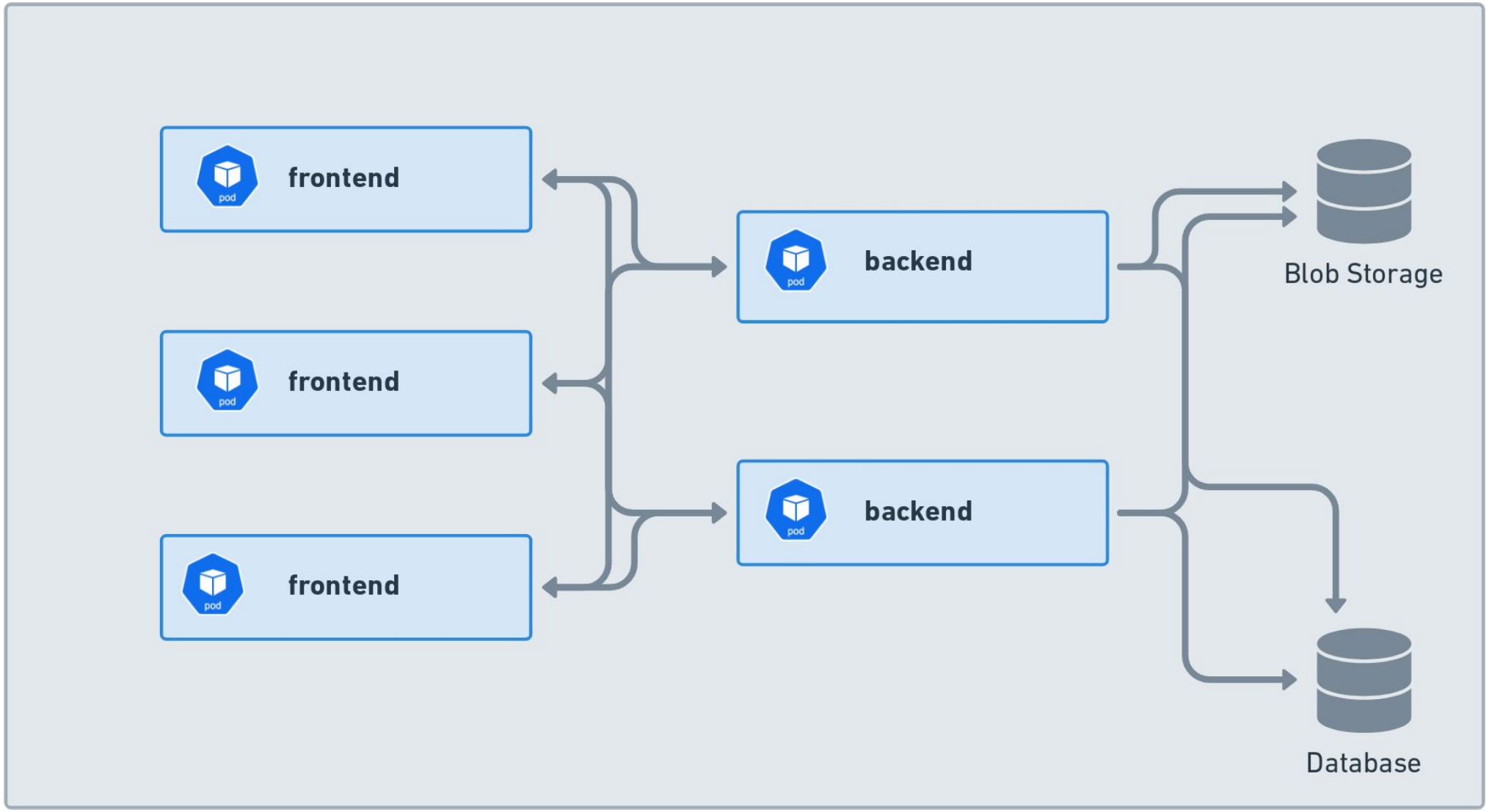

Firewall
External
Load Balancer
Frontend Servers
Internal
Load Balancer
Backend Servers

Lightweight containers



Cattle instead of pets

It can get complex fast



Automate more tasks

$$O(1) = O(n)$$

Self healing and load balancing

Additional abstraction

No free meal

Creating Deployments

Frontend

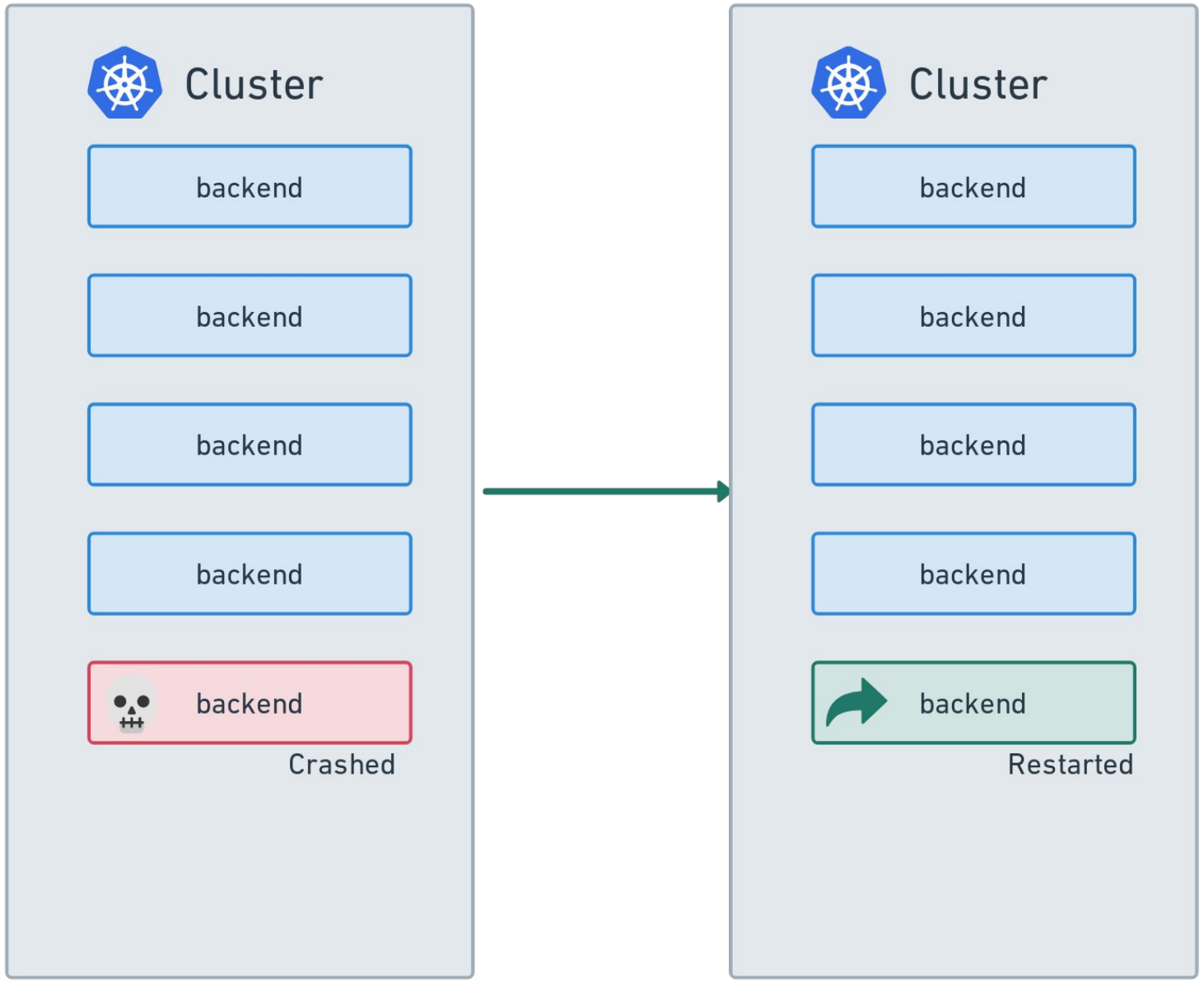
Backend

Taylor's Backend Deployment

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
 name: backend-deployment
spec:
 replicas: 5
 selector:
   matchLabels:
     app-name: backend
 template:
   metadata:
     labels:
       app-name: backend
   spec:
     containers:
     - name: backend
       image: backend:1.2.3
```

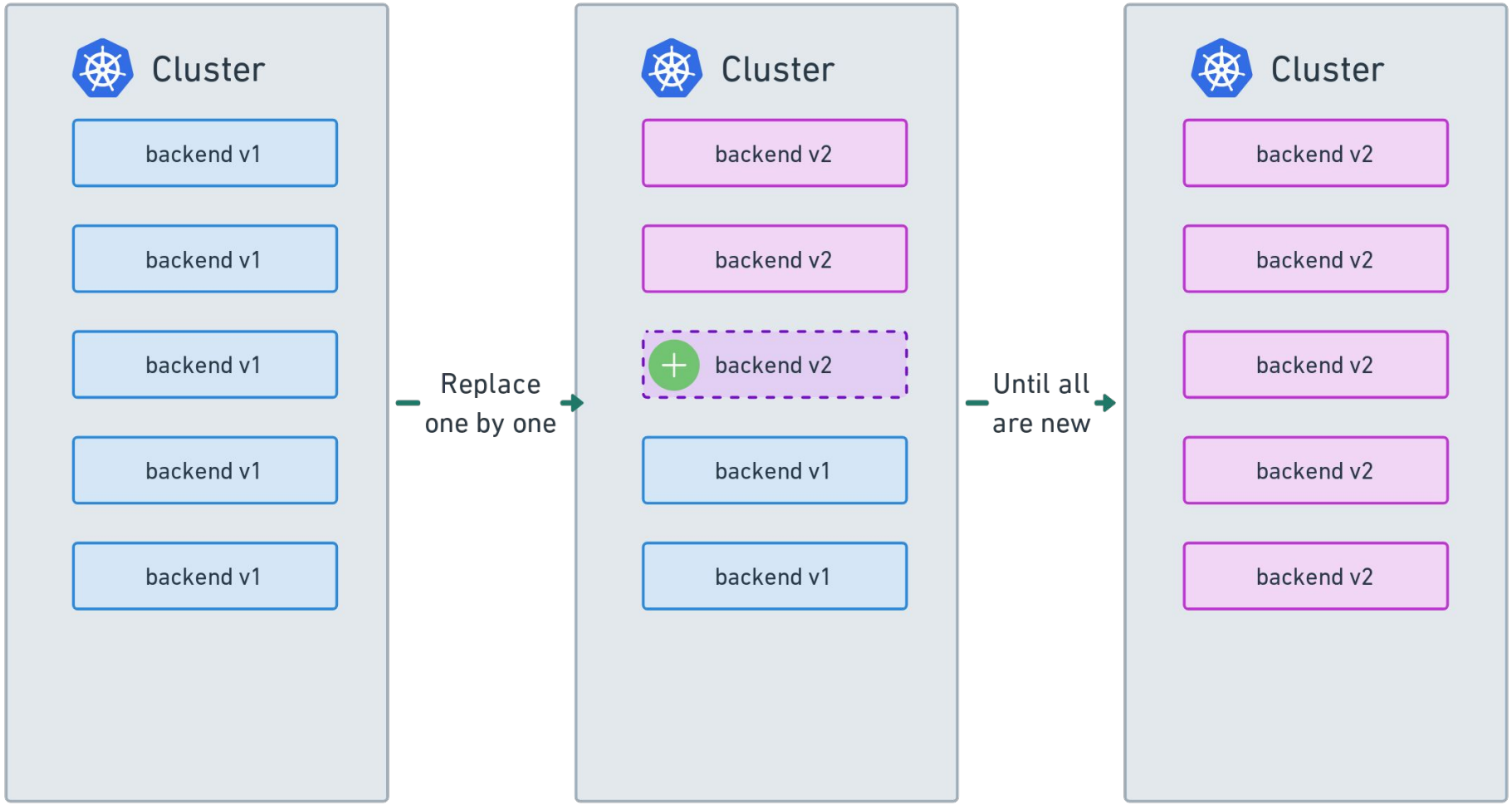
Desired state shapes reality


```
replicas: 5
```

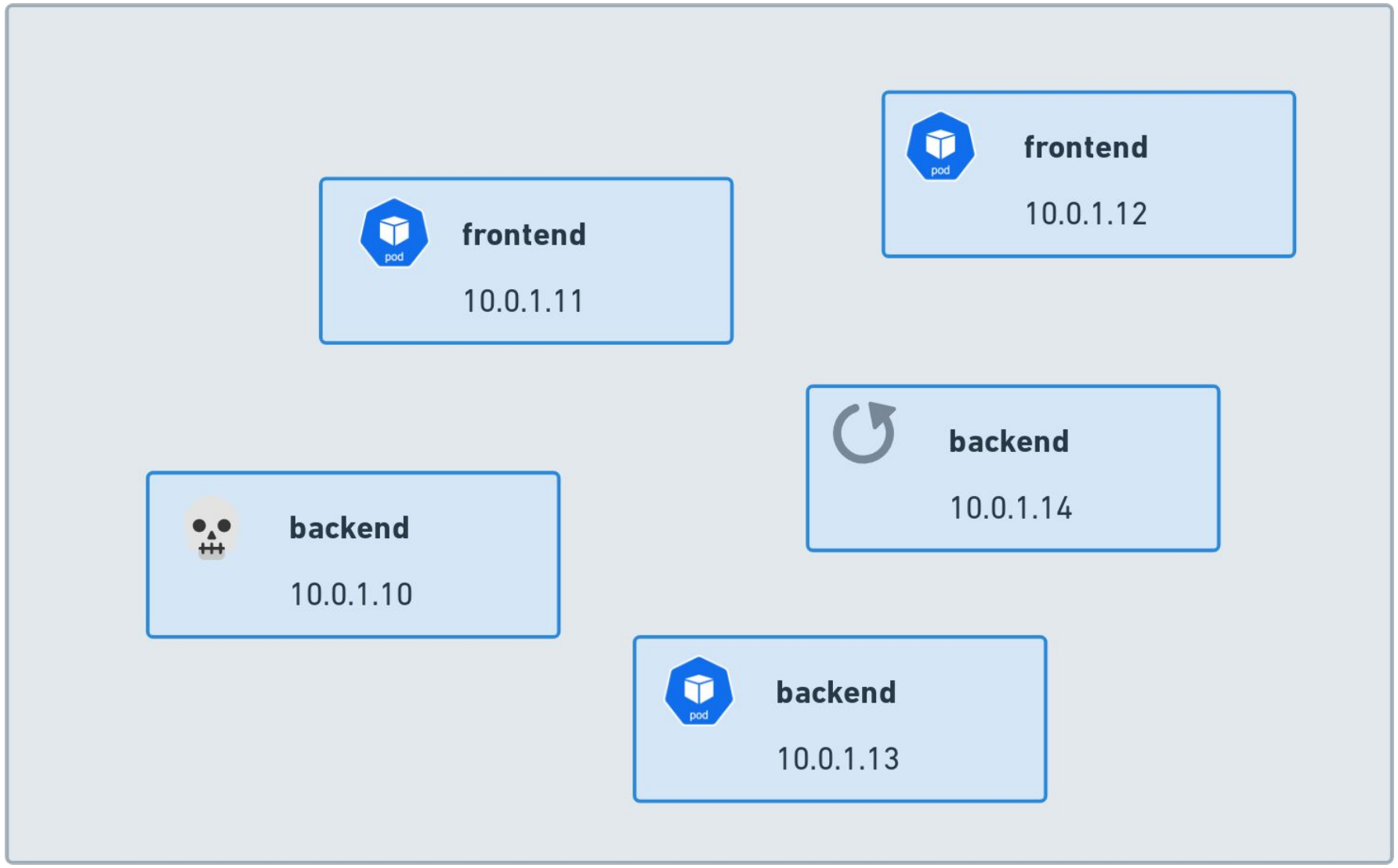


Desired state shapes reality


```
containers:
- name: backend
  image: backend:2.0
```



Container IPs are constantly changing

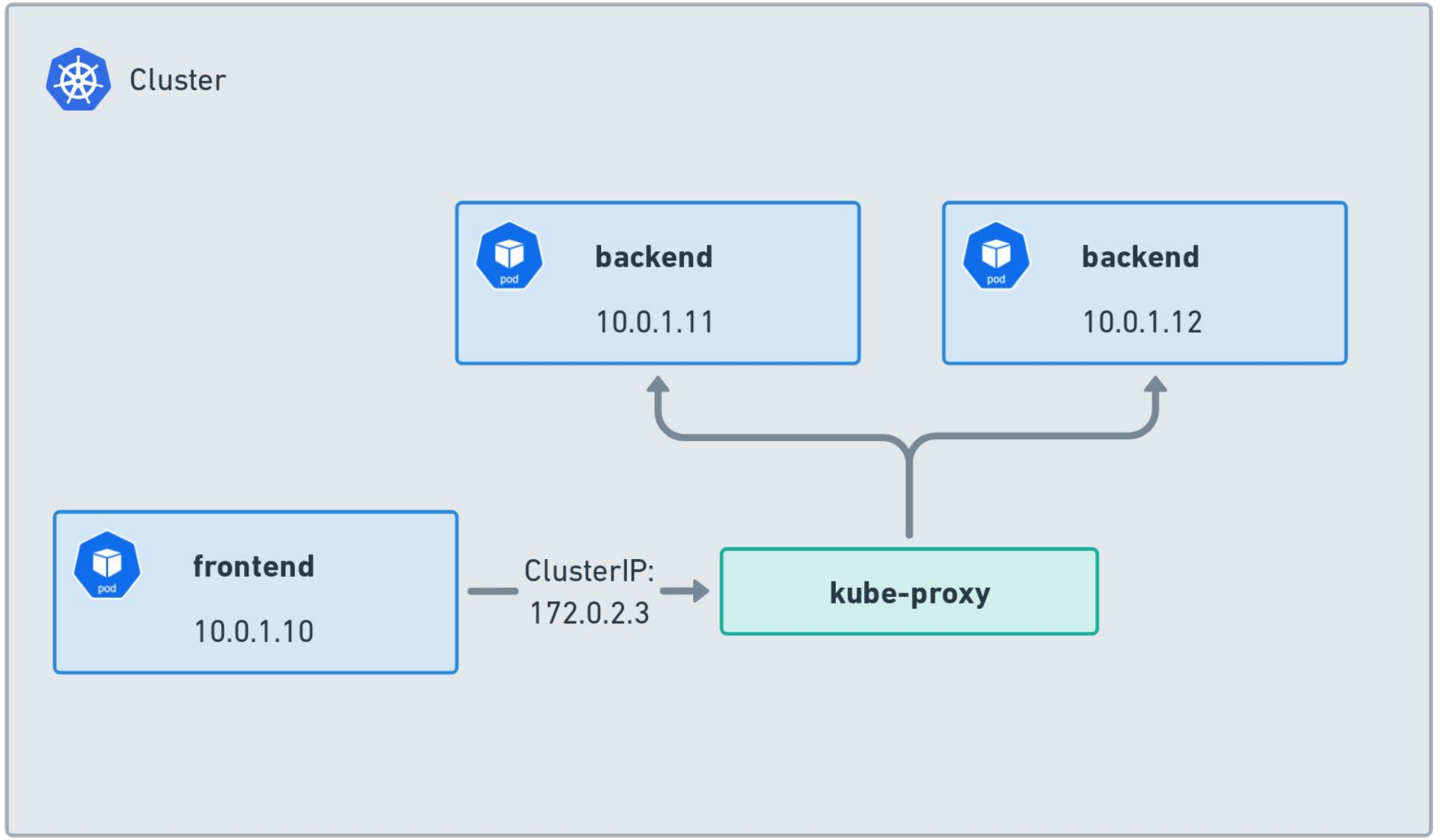


Taylor's services


```yaml
apiVersion: v1
kind: Service
metadata:
 name: frontend-service
spec:
 selector:
   app-name: frontend
 ports:
 - protocol: TCP
     port: 80
```

```yaml
apiVersion: v1
kind: Service
metadata:
 name: backend-service
spec:
 selector:
   app-name: backend
 ports:
 - protocol: TCP
     port: 9376
```

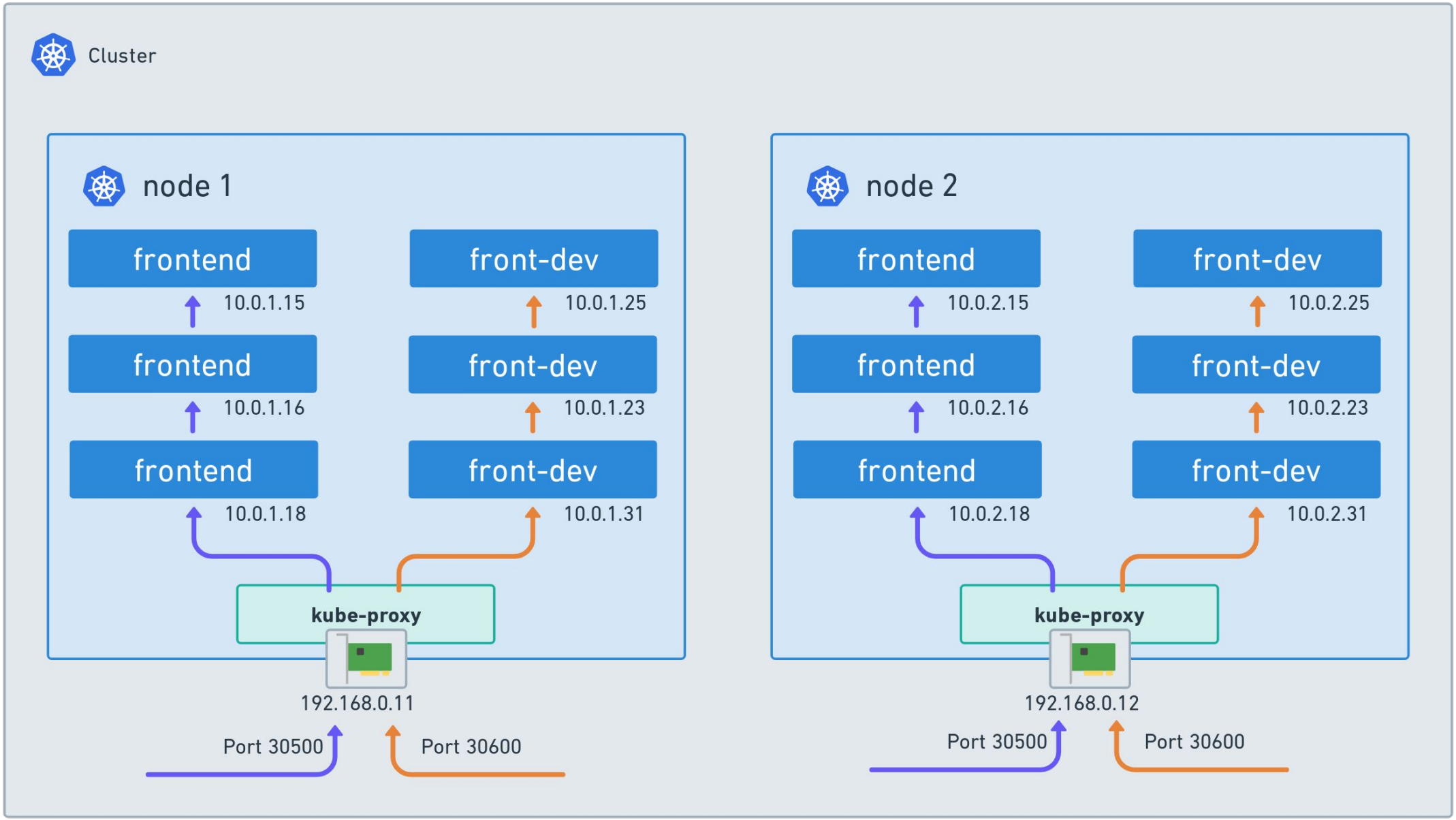
ClusterIP Services



Taylor's backend service

```yaml
apiVersion: v1
kind: Service
metadata:
 name: backend-service
spec:
 type: ClusterIP
 selector:
   app-name: backend
 ports:
 - protocol: TCP
     port: 80
```

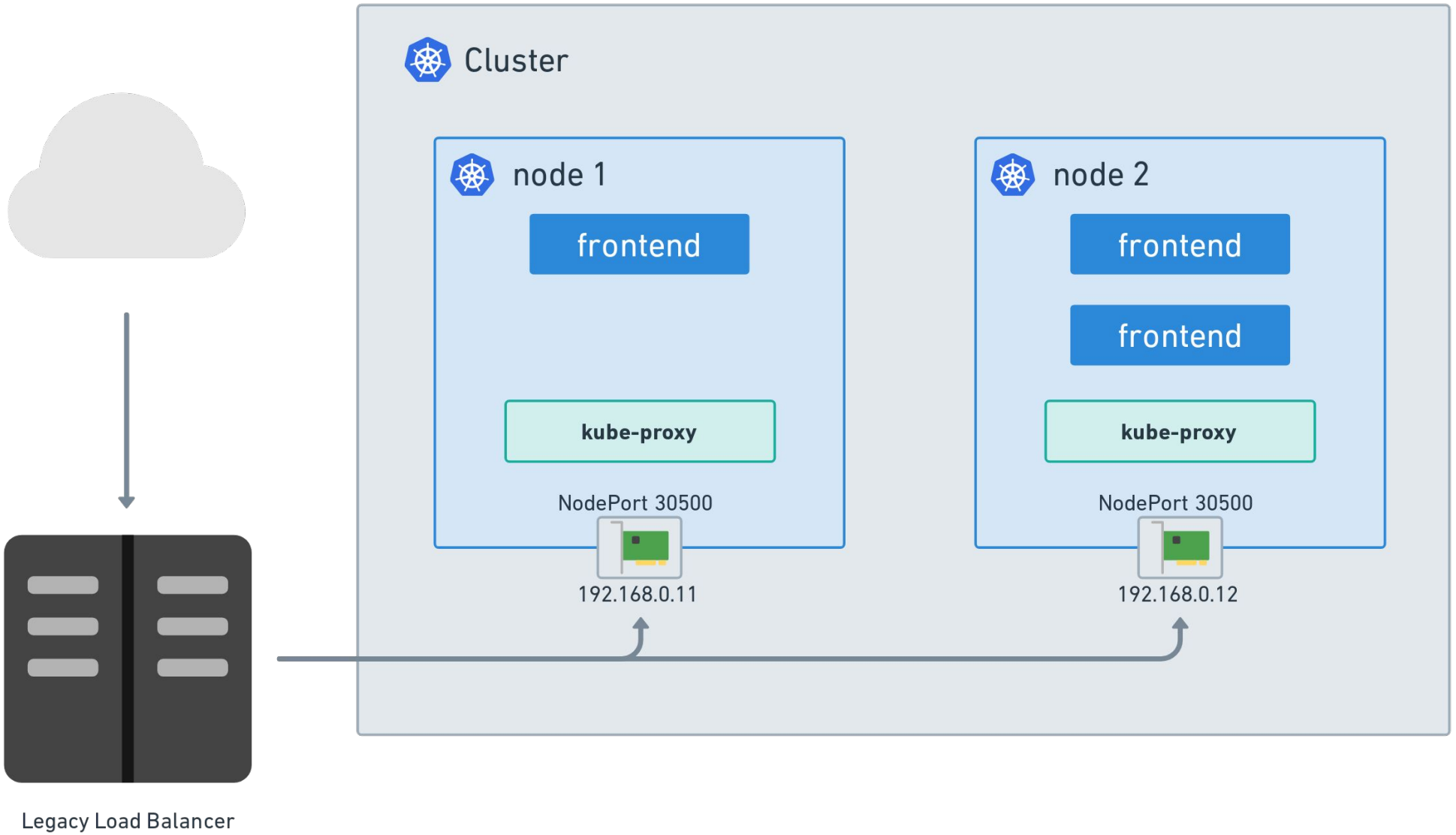
NodePort Services



Taylor's frontend service


```yaml
apiVersion: v1
kind: Service
metadata:
 name: frontend-service
spec:
 type: NodePort
 selector:
   app-name: frontend
 ports:
 - protocol: TCP
     port: 80
   nodePort: 30500
```

Legacy Load Balancer



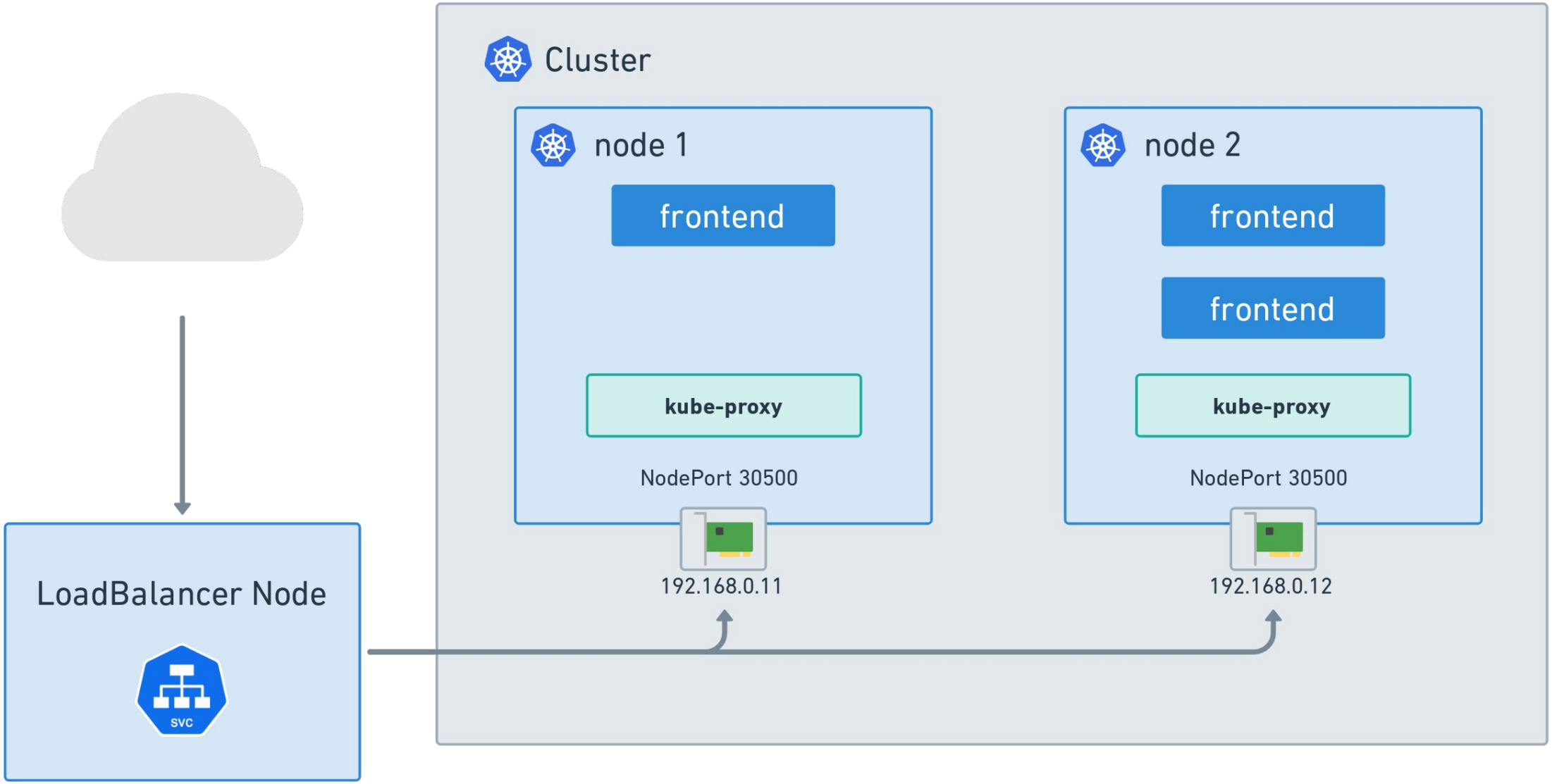
LoadBalancer definition

```yaml
apiVersion: v1
kind: Service
metadata:
 name: frontend-service
spec:
 type: LoadBalancer
 selector:
   app-name: frontend
 ports:
 - protocol: TCP
     port: 80
```

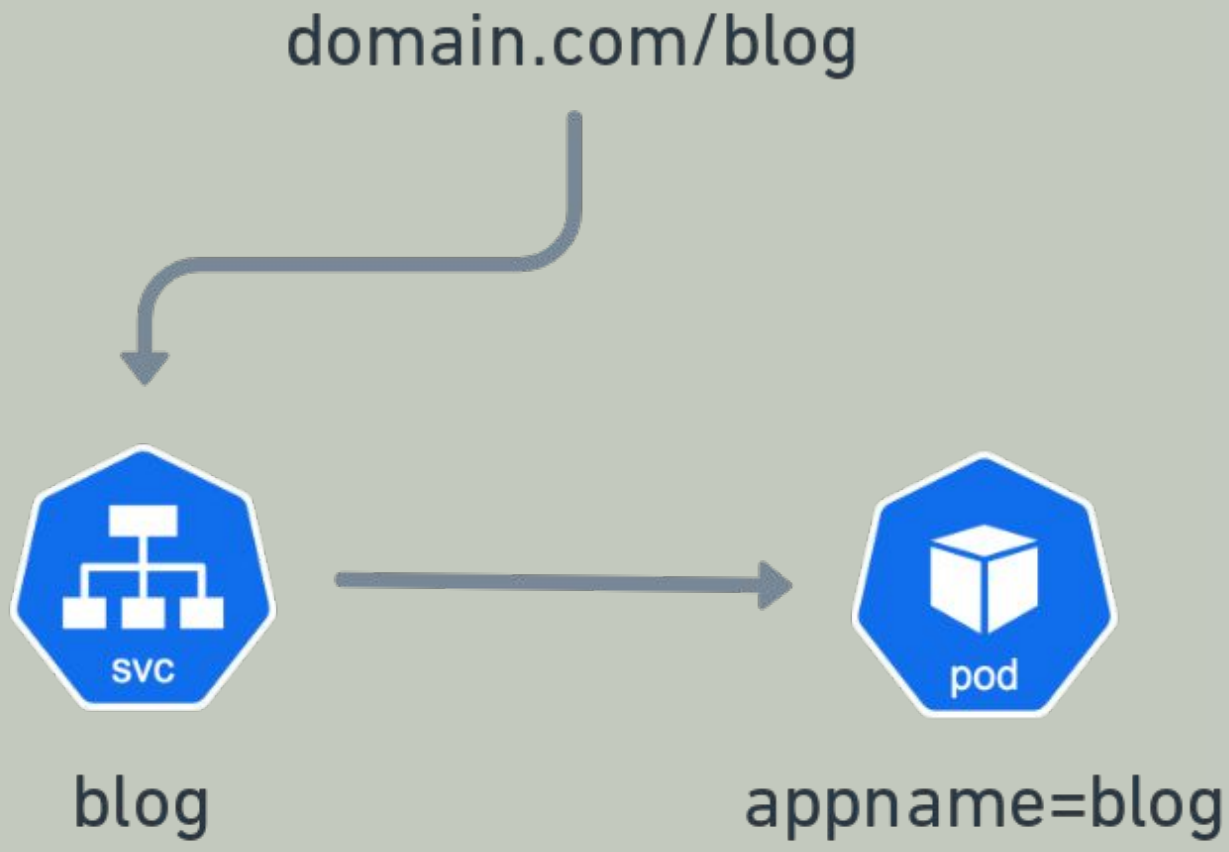
LoadBalancer definition

```
apiVersion: v1
kind: Service
metadata:
 name: my-service
spec:
 type: LoadBalancer
 selector:
   app-name: externally-reachable
 ports:
 - protocol: TCP
     port: 80
 clusterIP: 10.0.171.239
status:
 loadBalancer:
 ingress:
 - ip: 192.0.2.127
```

Cloud provided Load Balancer



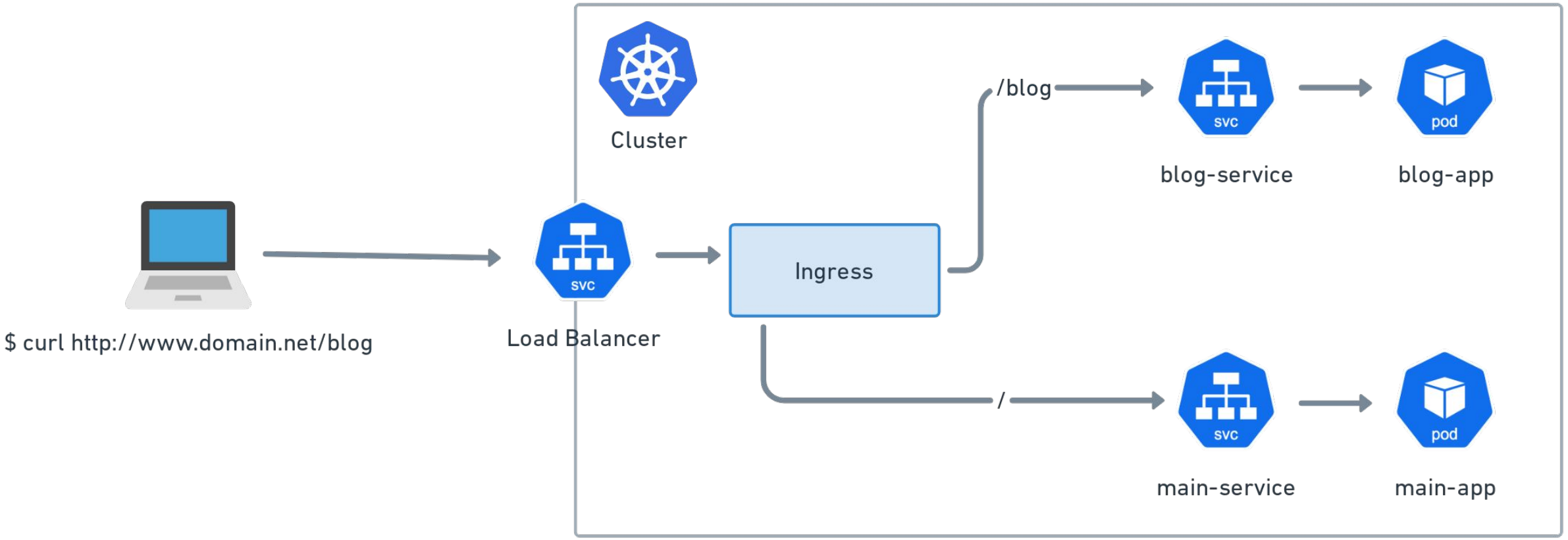
Taylor's app got more complex!



Ingress definition


```yaml
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
 name: basic-ingress
spec:
 rules:
 - http:
     paths:
     - backend:
         service:
           name: blog
           port:
             number: 9080
       path: /blog
       pathType: Prefix
     - backend:
         service:
           name: frontend
           port:
             number: 80
       path: /
       pathType: Prefix
```

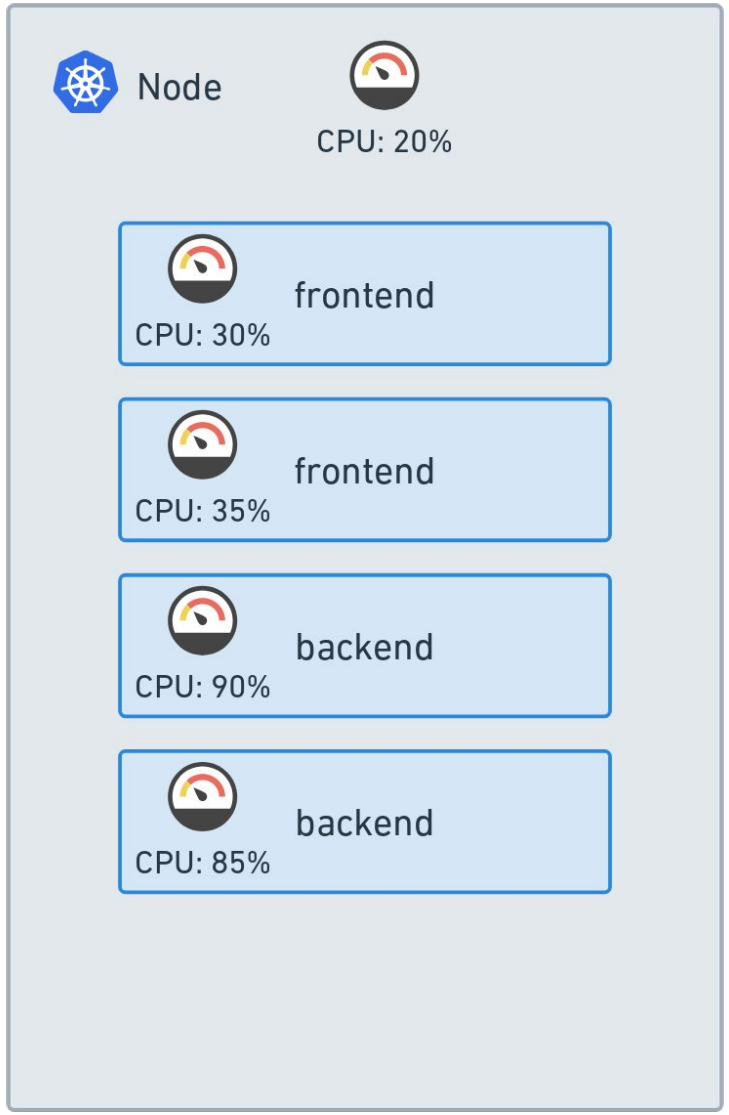
Ingress


Cluster
/blog
svc
pod
blog-service
blog-app
svc
Ingress
$ curl http://www.domain.net/blog
Load Balancer
/
svc
pod
main-service
main-app

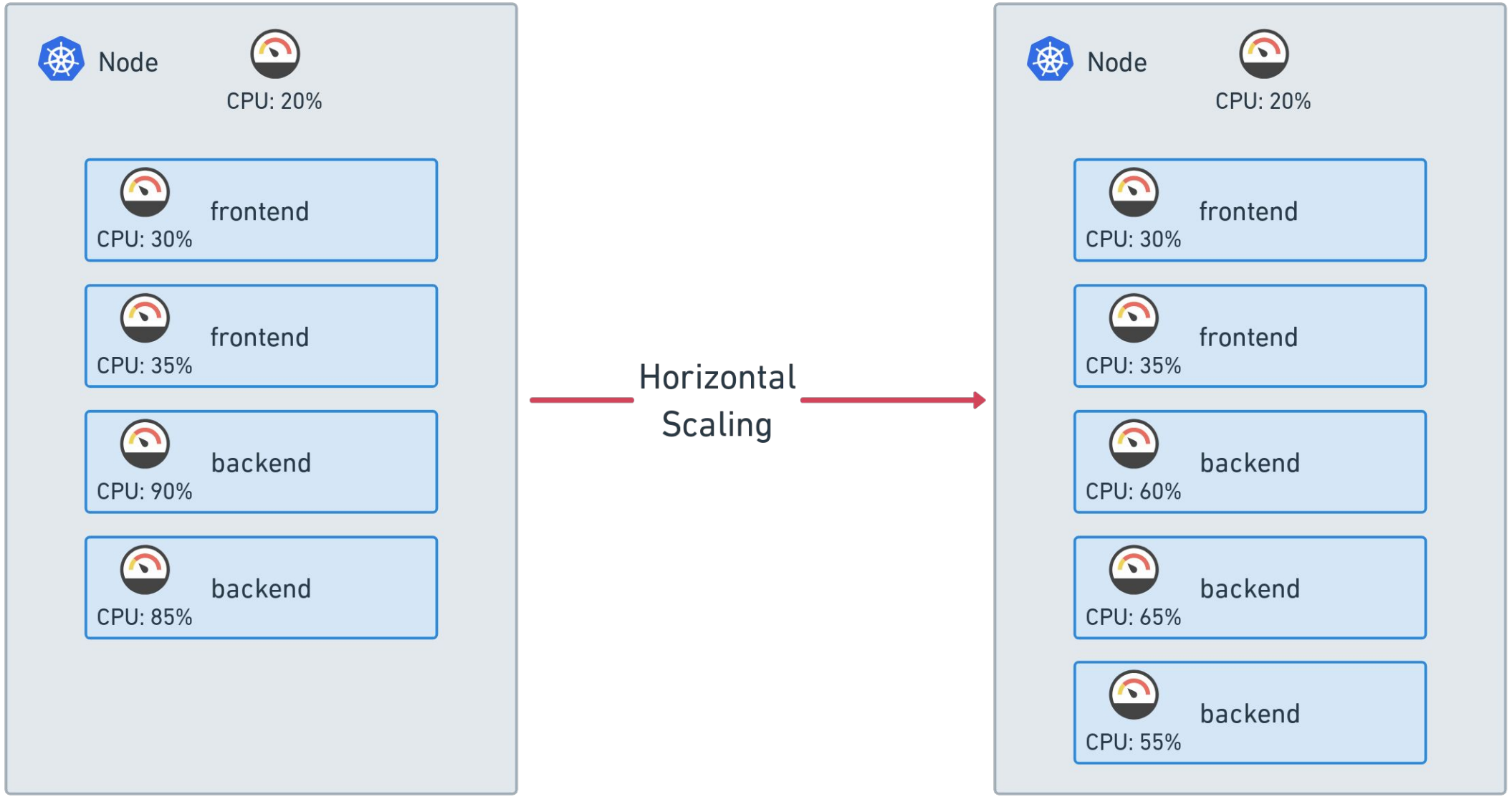
Autoscaling

Autoscaling in the VM world

Horizontal Scaling



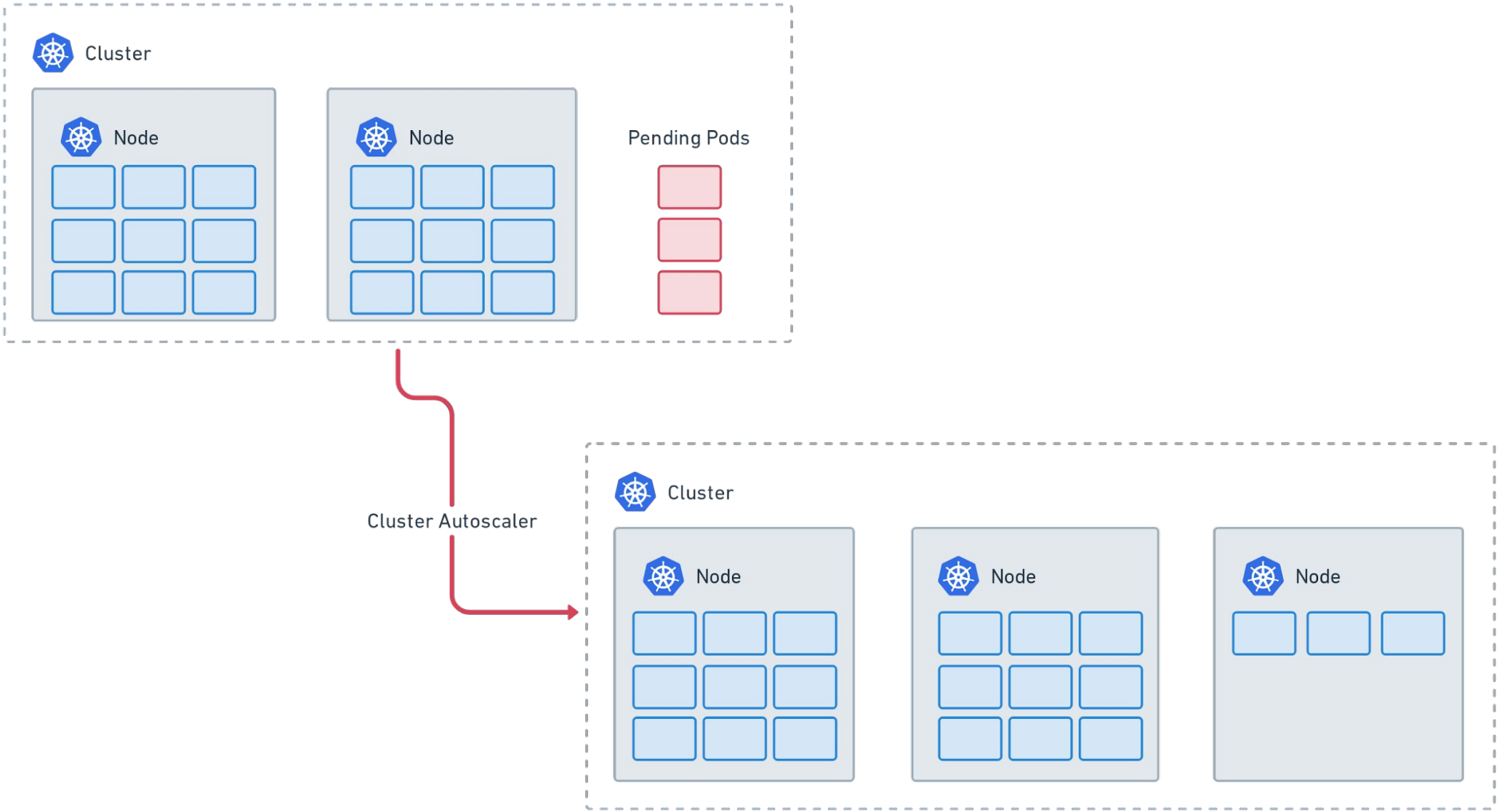
Horizontal Scaling



HorizontalPodAutoscaler definition

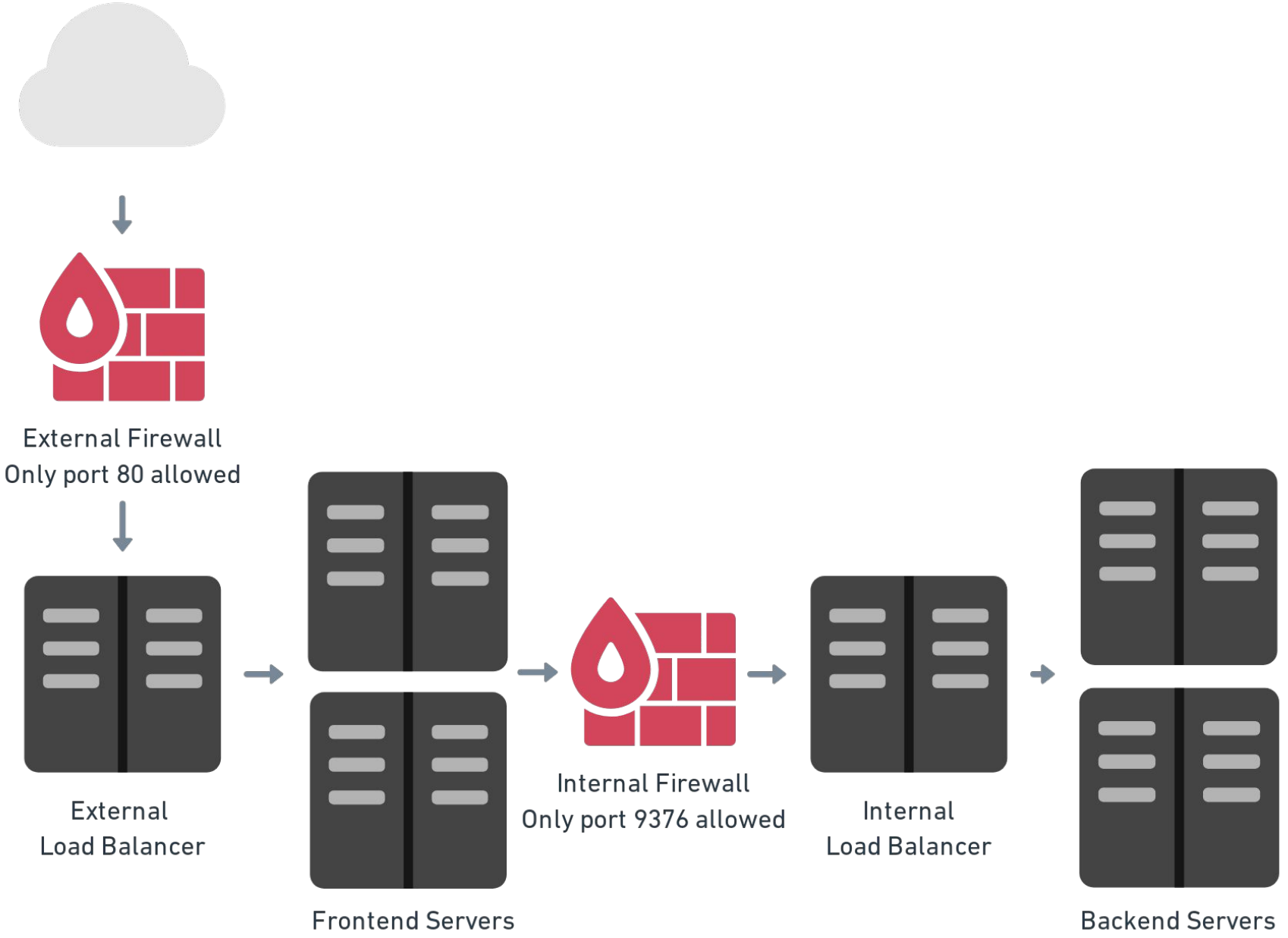

```yaml
apiVersion: autoscaling/v2
kind: HorizontalPodAutoscaler
metadata:
 name: backend-hpa
spec:
 scaleTargetRef:
   apiVersion: apps/v1
   kind: Deployment
   name: backend-deployment
 minReplicas: 3
 maxReplicas: 10
 metrics:
 - type: Resource
   resource:
     name: cpu
     target:
       type: Utilization
       averageUtilization: 70
```

Cluster autoscaling

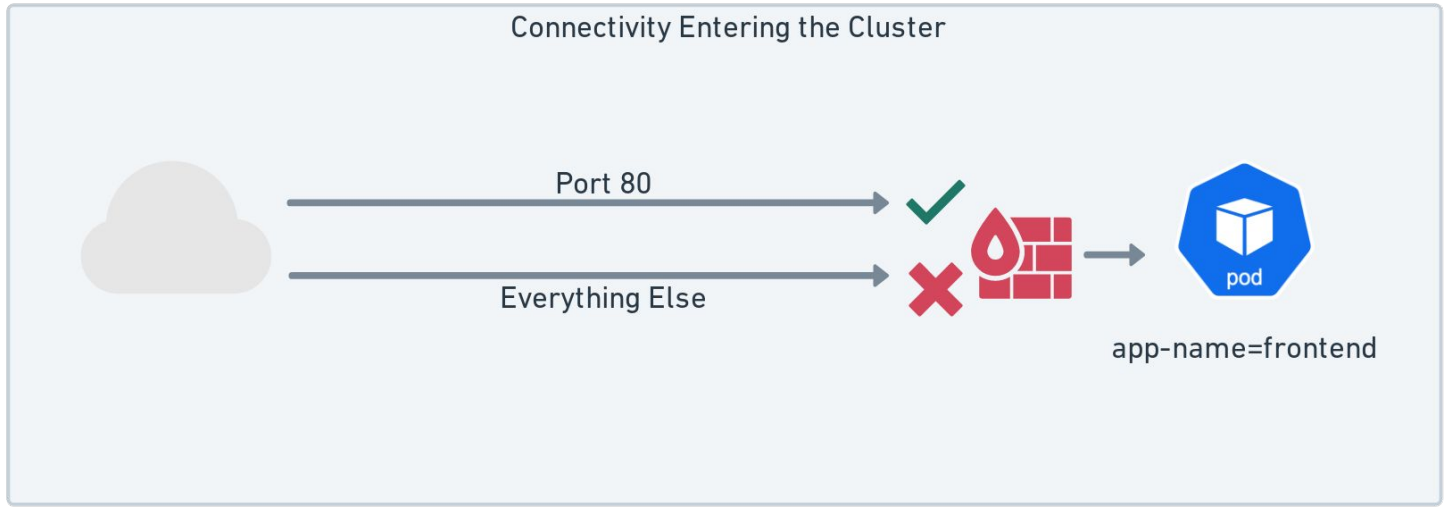


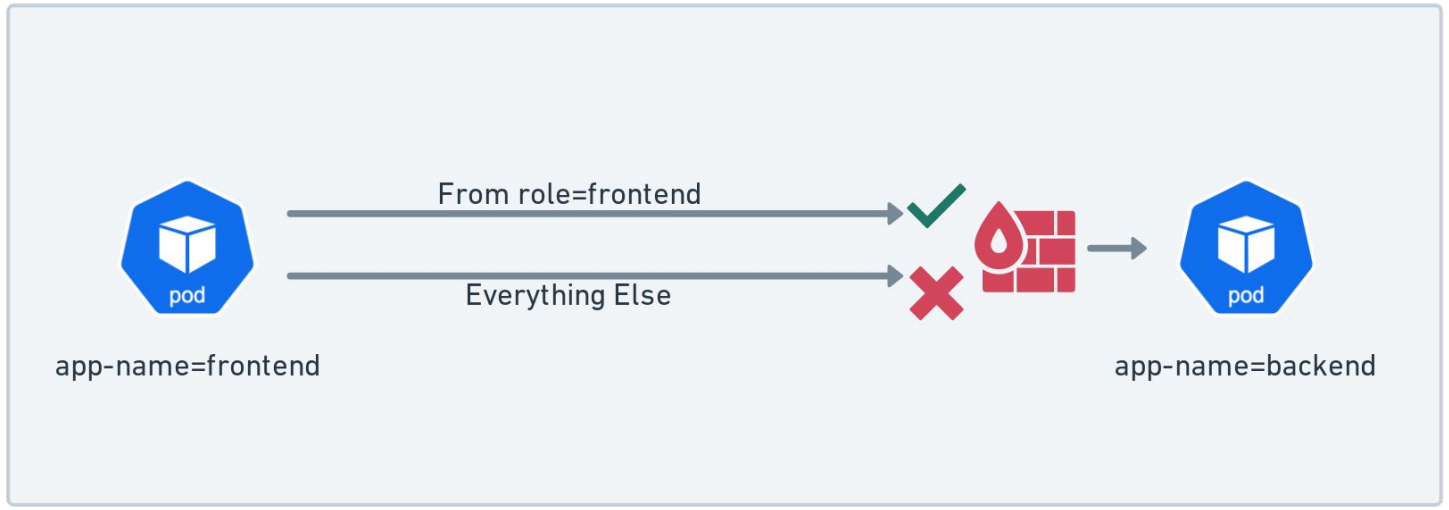
Firewalls

Old Style Firewall



Network Policies





Network Policies


```yaml
kind: NetworkPolicy
apiVersion: networking.k8s.io/v1
metadata:
 name: allow-frontend-to-backend
spec:
 podSelector:
   matchLabels:
     app-name: backend
 policyTypes:
 - Ingress
 ingress:
   - from:
     - podSelector:
         matchLabels:
           app-name: frontend
     ports:
       - protocol: TCP
         port: 9376
```

Security

Taylor's app runs as root!

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Dockerfile

```
FROM debian:jessie
WORKDIR /app
COPY --from=build /home/lab/target .
ENTRYPOINT ["java", "-Xmx8m", "-Xms8m", "-jar", "/app/words.jar"]
EXPOSE 8080
```

Deploy as non-root

```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
 name: backend-deployment
spec:
 replicas: 5
 selector:
   matchLabels:
     app-name: backend
 template:
   metadata:
     labels:
       app-name: backend
   spec:
     securityContext:
       runAsUser: 65534
       runAsGroup: 65534
     containers:
     - name: backend
       image: backend:1.2.3
```

Image Security

Image Security

Dockerfile

```
FROM taylor.azurecr.io/java-base:v1
WORKDIR /app
COPY --from=build /home/lab/target .
ENTRYPOINT ["java", "-Xmx8m", "-Xms8m", "-jar", "/app/words.jar"]
EXPOSE 8080
```

Minimizing access


```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
 name: backend-deployment
spec:
 replicas: 5
 selector:
   matchLabels:
     app-name: backend
 template:
   metadata:
     labels:
       app-name: backend
   spec:
     securityContext:
       seccompProfile:
         type: RuntimeDefault
     containers:
     - name: backend
       image: backend:1.2.3
       securityContext:
         allowPrivilegeEscalation: false
```

Cluster admin = root in the VM

Final words

References

- Kubernetes Service reference.
  - And the rest of the Kubernetes docs, they are really good!
- The dockerfile in the “wordsmith” example from Docker documentation is a case of a common example that runs a root.
- Inspektor Gadget:
  - https://www.inspektor-gadget.io/
- Cilium
  - https://www.cilium.io
- Dockerhub vulnerabilities analysis (link1, link2)
- Kubercon 2022 Detroit - user namespaces talk (video, slides)
- Taylor images were created with MidJourney and Gimp.
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