FOSDEM

MySQL NDB 8.0

Sure you can run your database in kubernetes

Successfully run your MySQL NDB Cluster in kubernetes

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Snr Director MySQL Cluster Development

Track: MySQL devroom

Room: D.mysql

Day: Sunday, 7. Feb 2021

▶ Start: 16:30 CET/UTC+1

■ Duration: 25 min

About me

Bernd Ocklin

Product Owner MySQL NDB Cluster at Oracle

with NDB and MySQL since 2005

Sharded Distributed Datasets

Parallel Real-Time Performance. Auto-partitioning, data distribution and replication built-in.

Always-On 99.9999% Availability

Designed for mission critical systems. Masterless, shared-nothing with no single point of failure.

Always Consistent

Transactional consistency across distributed and partitioned dataset.

MySQL™ Cluster

Ease of use

Out of the box straightforward application programming. Standalone or with MySQL as a SQL front-end.

Massively linear scale

Read- and Write Scale-Out TBs on commodity hardware.

Shared Nothing

Written in C++. Can be used standalone or with MySQL as a SQL front-end.

Open Source

Written in C++.

MySQL Cluster Industries

- Telecom
- Gaming & Massive Parallel Online Games
- Financials

Why Cloud Native?

Speed

Fast introduction of new services

Scaling

Fast scaling from hundred of users to millions

Efficient Operations

Automation

Lifecycle

Performance / Capacity

Improved capacity

Better resource utilisation

Fit for kubernetes?

VMs or container?

	VM	Containers / K8
workload isolation	++	o / ++ *) e.g. katacontainers
performance	+	++
IO	o	++
operations	-	++
maturity / community / best practices	++	+
footprint	-	+
cloud native principles	o	++

But running databases in a container and kubernetes?

- Yes, you can run any database in a container. Period.
- Just a matter of workload to serve and requirements.
- Milage varies with database’s suitability.

Suitable databases and cloud native principles

Resilience

Losing parts of the system should not be a big deal.

It should automatically recover and heal it self.

Shared-Nothing

Cloud-native databases can operate without centralized management or any single point of failure.

Scaling, sharding

Distributed data

Scaling out, not up

Sharding.

Consistency

Distributed, cloud-native databases should present a the same view of data independent of instance queried. With the consistency guarantees of a single-machine system.

Standards

Cloud-native databases should *also* support query standards.

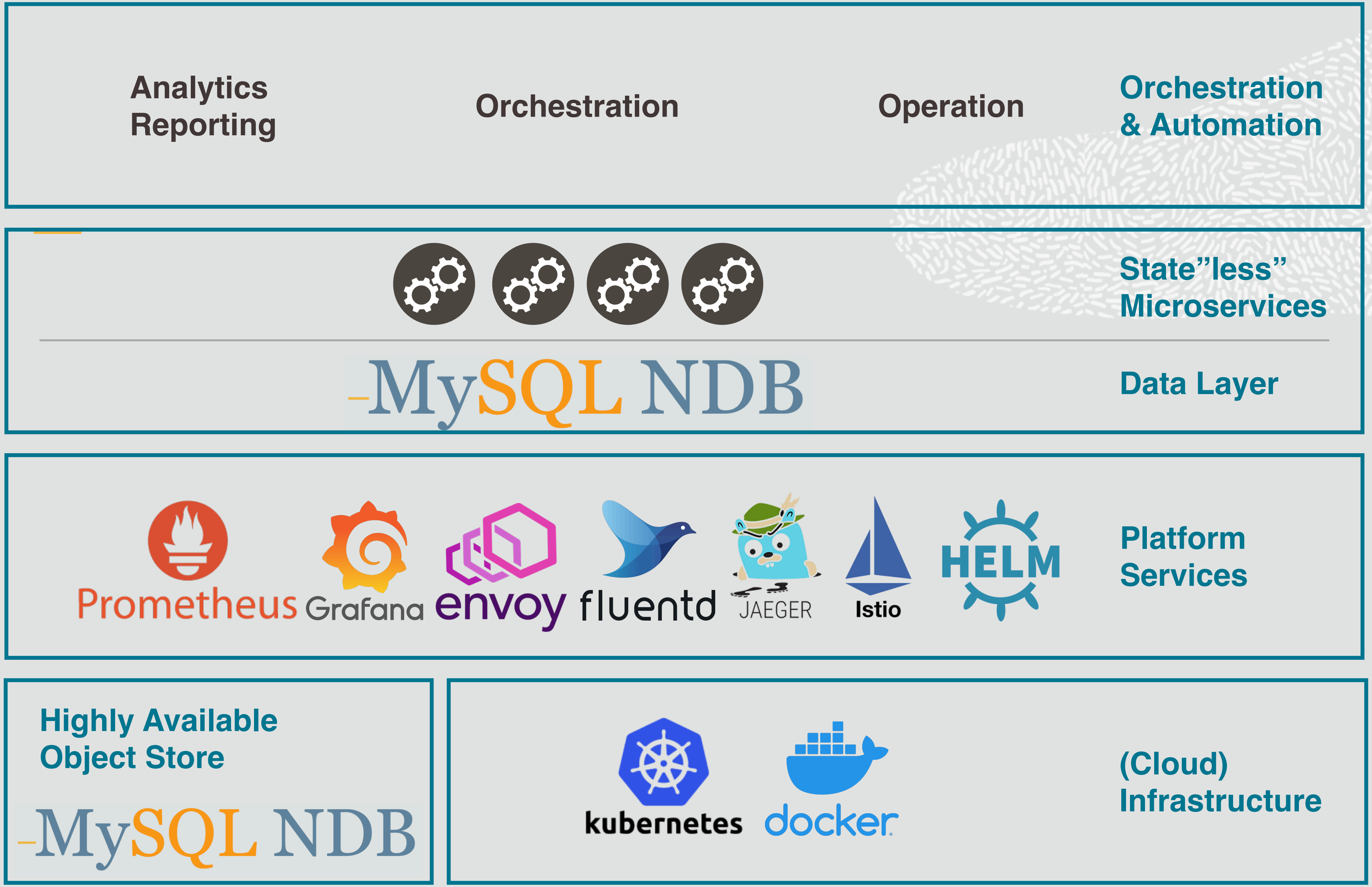
Cloud native databases

	MySQL NDB	classic RDMS	InnoDB Cluster
Resilience	✓		✓
Shared-nothing	✓		✓
Consistent view of data	✓		
Scaling out, sharding	✓		
Standard query language	✓	✓	✓
Self healing	✓		

Stateless?

- You should architect your system to be **intentional** about when, and how, you store state
- Design components to be **stateless wherever you can**
- **Not stateless but smart about state, state optimized!**

Kubernetes



Analytics Reporting

Orchestration

Operation

Orchestration & Automation

State”less” Microservices

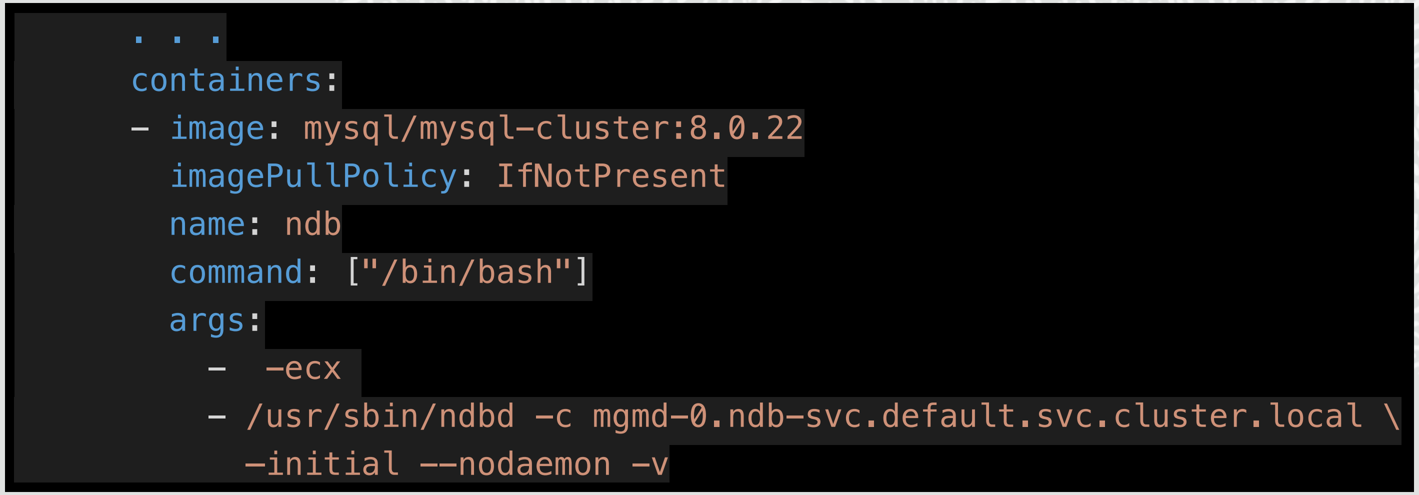
Data Layer

Platform Services

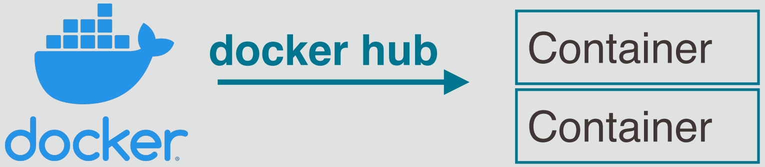
Highly Available Object Store

(Cloud) Infrastructure

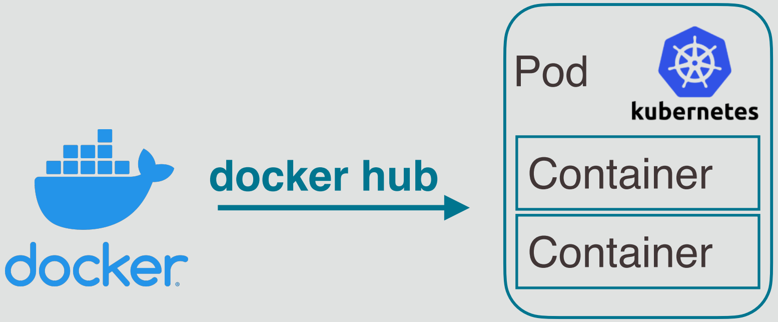
Kubernetes Objects running a database



```
. . .
containers:
- image: mysql/mysql-cluster:8.0.22
  imagePullPolicy: IfNotPresent
  name: ndb
  command: ["/bin/bash"]
  args:
    -  -ecx
    - /usr/sbin/ndbd -c mgmd-0.ndb-svc.default.svc.cluster.local \
      -initial --nodaemon -v
```



Kubernetes Objects running a database



docker

docker hub

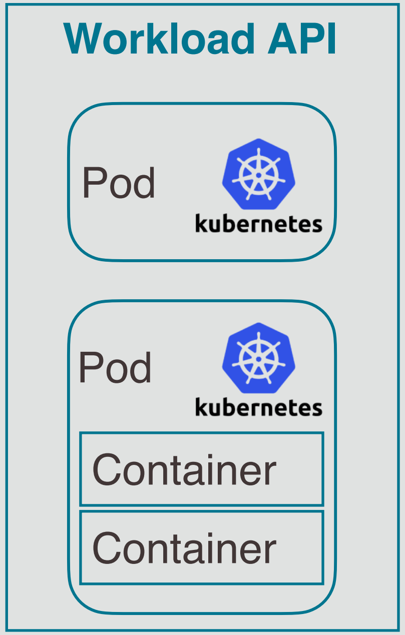
Pod

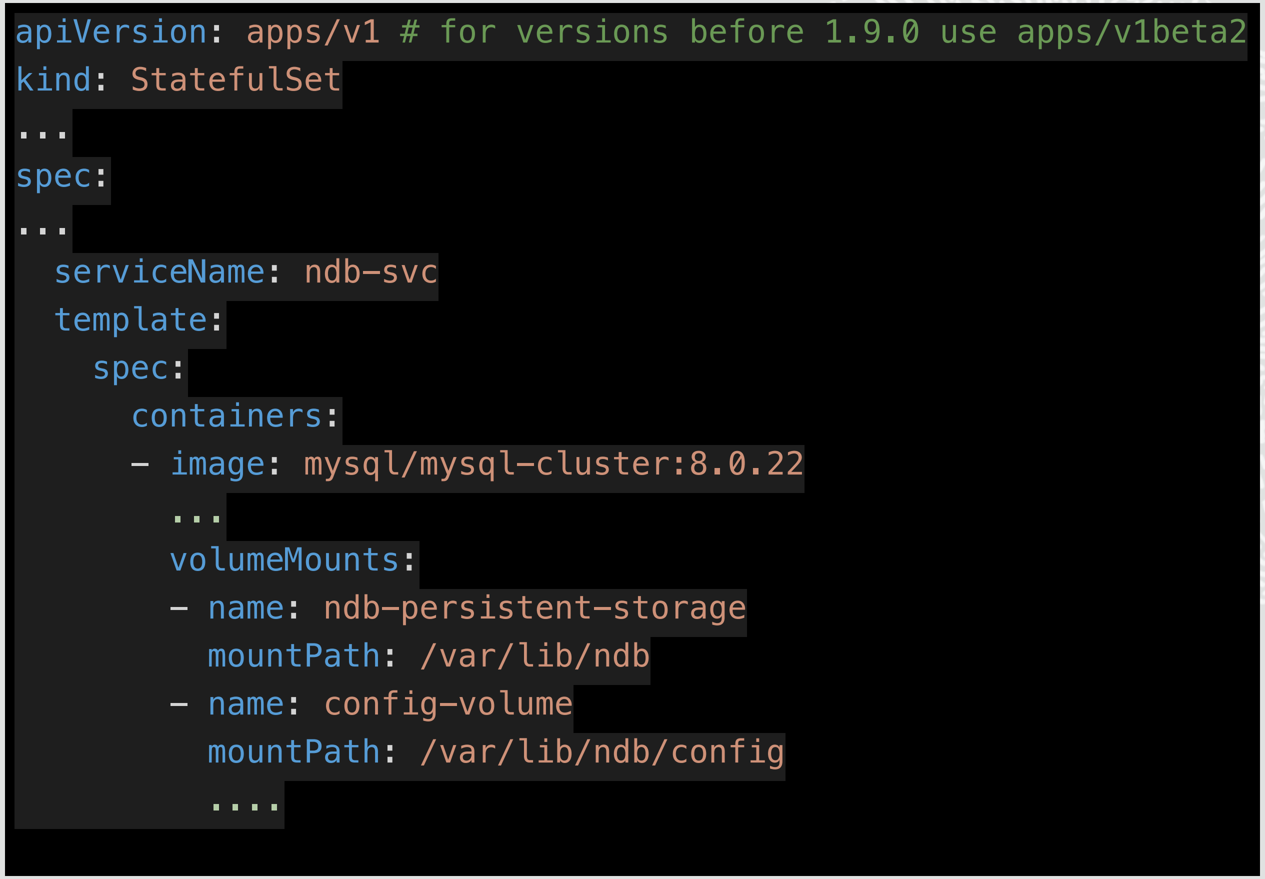
kubernetes

Container

Container

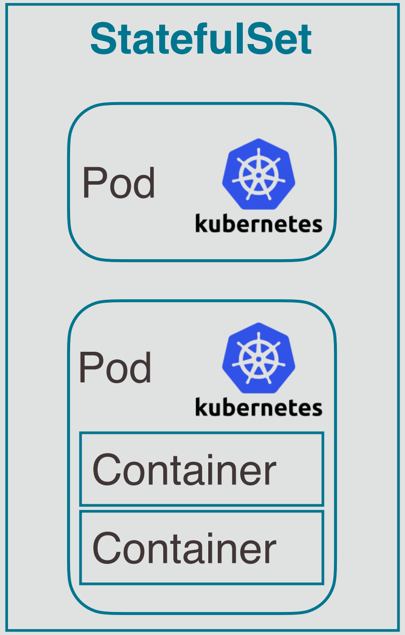
Workload Resources





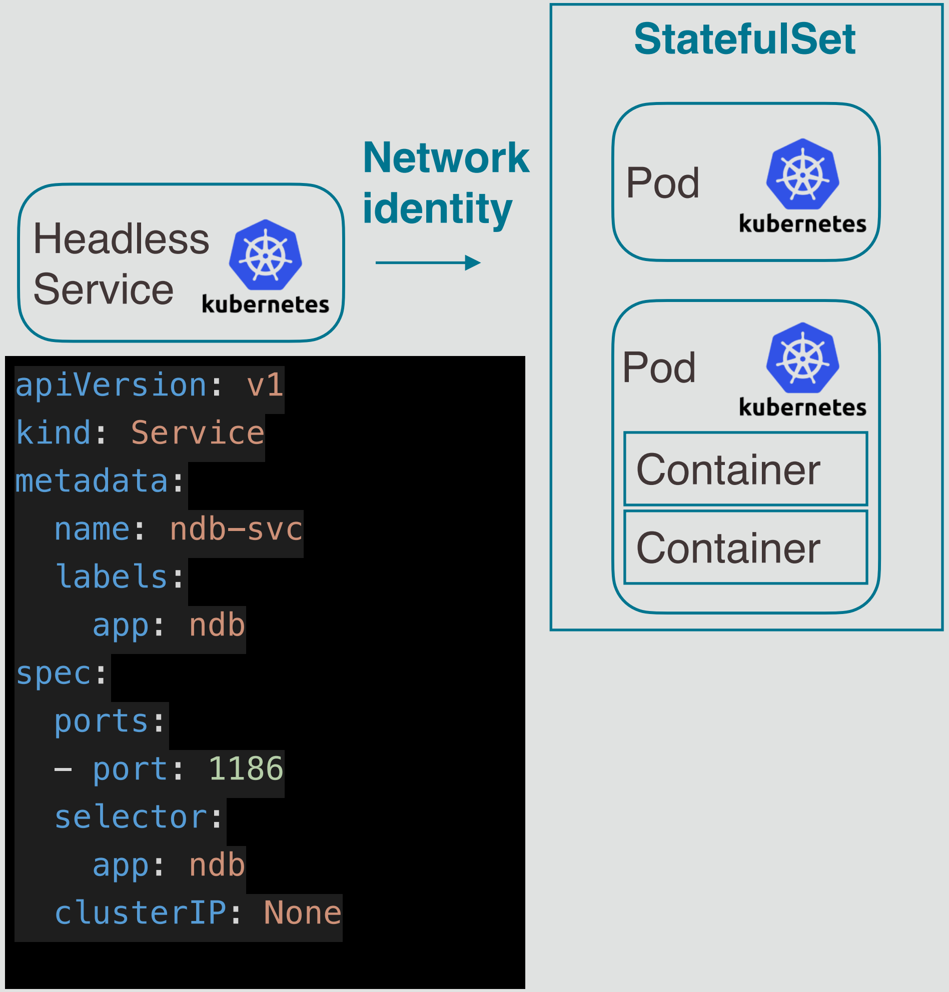
```
apiVersion: apps/v1 # for versions before 1.9.0 use apps/v1beta2
kind: StatefulSet
...
spec:
...
  serviceName: ndb-svc
  template:
    spec:
      containers:
      - image: mysql/mysql-cluster:8.0.22
        ...
        volumeMounts:
        - name: ndb-persistent-storage
          mountPath: /var/lib/ndb
        - name: config-volume
          mountPath: /var/lib/ndb/config
          ....
```

Running MySQL Cluster in Kubernetes with StatefulSets



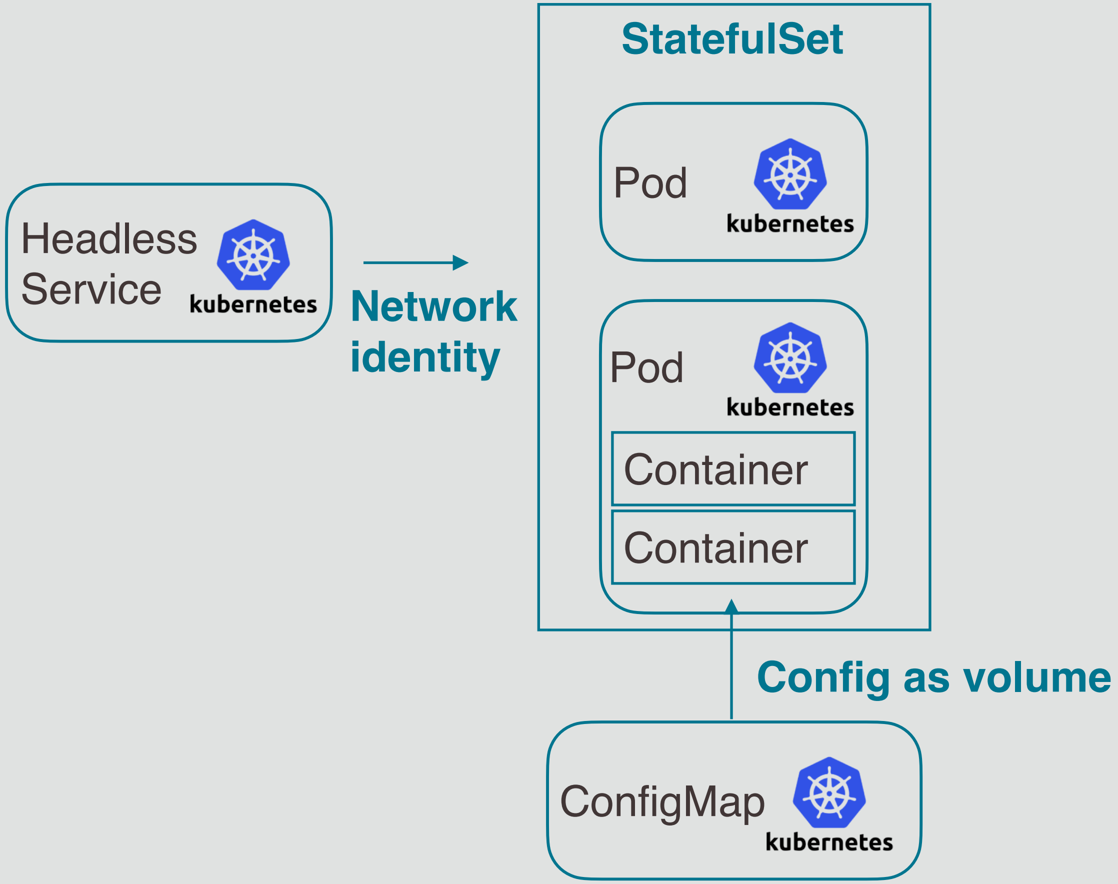
- Stable, unique network identifiers.
- Stable, persistent storage.
- Ordered, graceful deployment and scaling.
- Ordered, automated rolling updates.

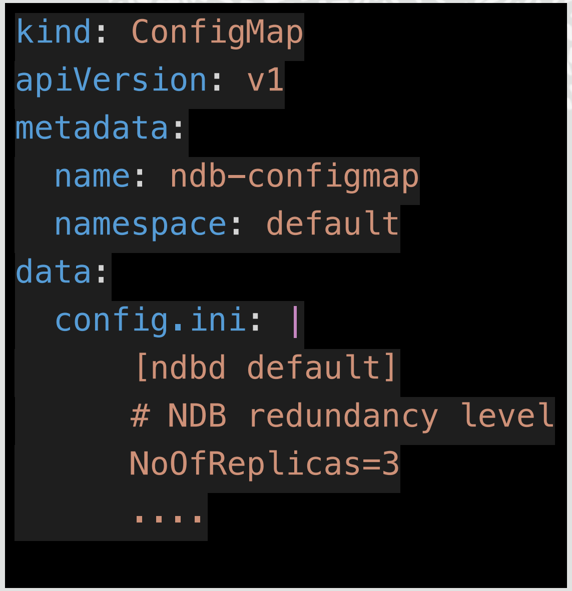
Headless Service providing network identity



```yaml
apiVersion: v1
kind: Service
metadata:
  name: ndb-svc
  labels:
    app: ndb
spec:
  ports:
  - port: 1186
  selector:
    app: ndb
  clusterIP: None
```

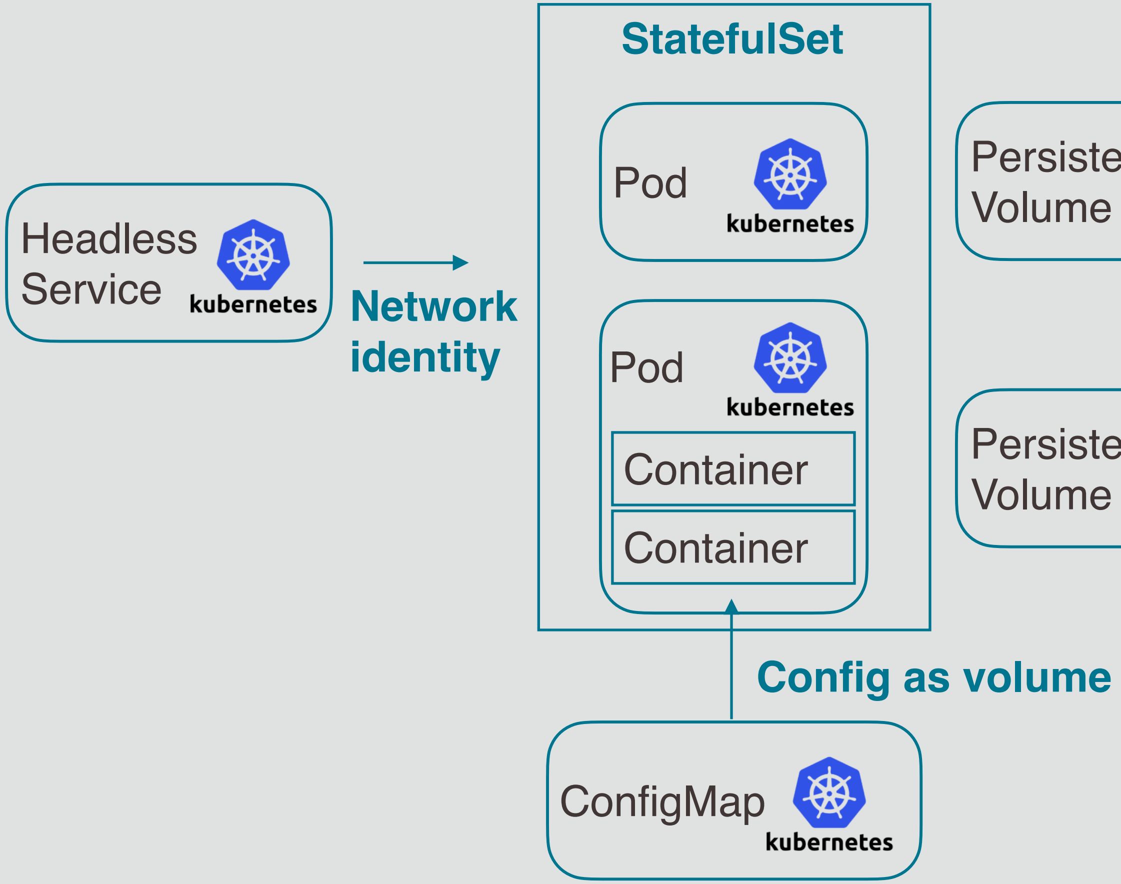
ConfigMaps to “inject” configuration into Pods/Containers





```yaml
kind: ConfigMap
apiVersion: v1
metadata:
  name: ndb-configmap
  namespace: default
data:
  config.ini: |
      [ndbd default]
      # NDB redundancy level
      NoOfReplicas=3
      ....
```

Use Persistent Volumes for storage



StatefulSet

Headless Service kubernetes

Network identity

Pod kubernetes

Pod kubernetes

Container

Container

Config as volume

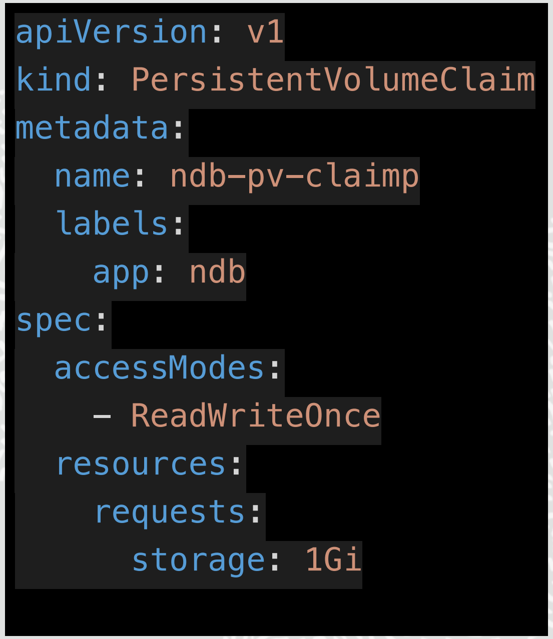
ConfigMap kubernetes

Persistent Volume Claim kubernetes

Persistent Volume Claim kubernetes

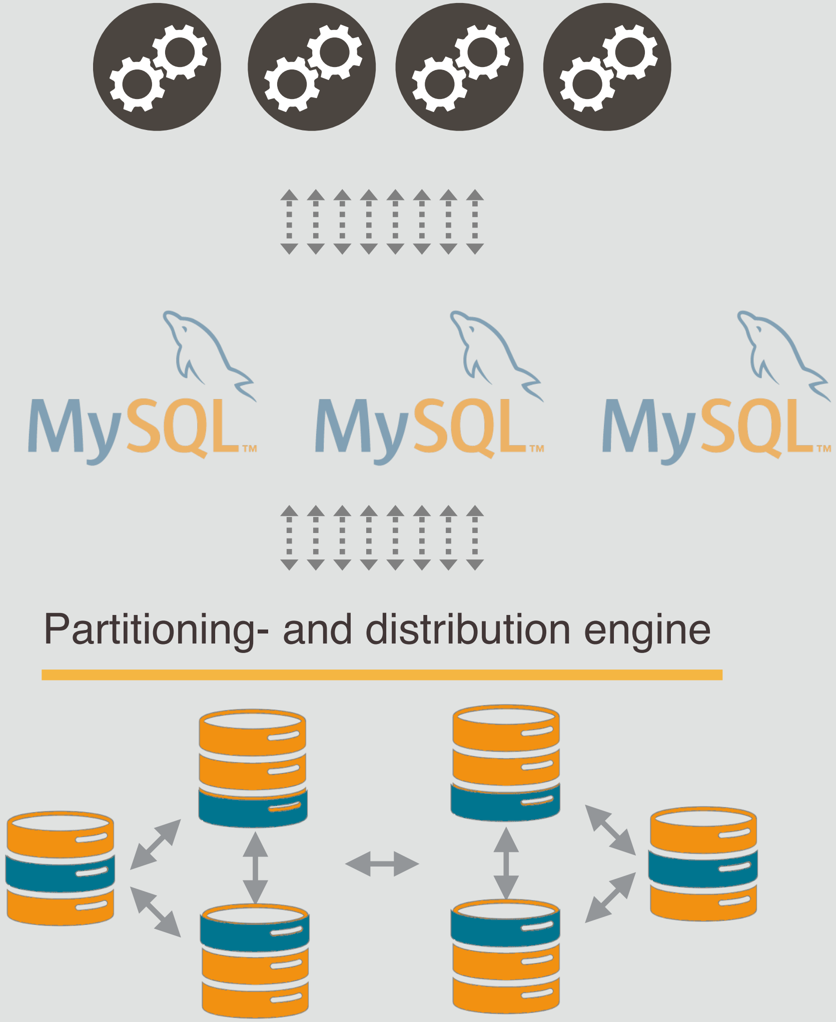
Persistent Volume

Persistent Volume



```yaml
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: ndb-pv-claimp
  labels:
    app: ndb
spec:
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 1Gi
```

NDB Architecture

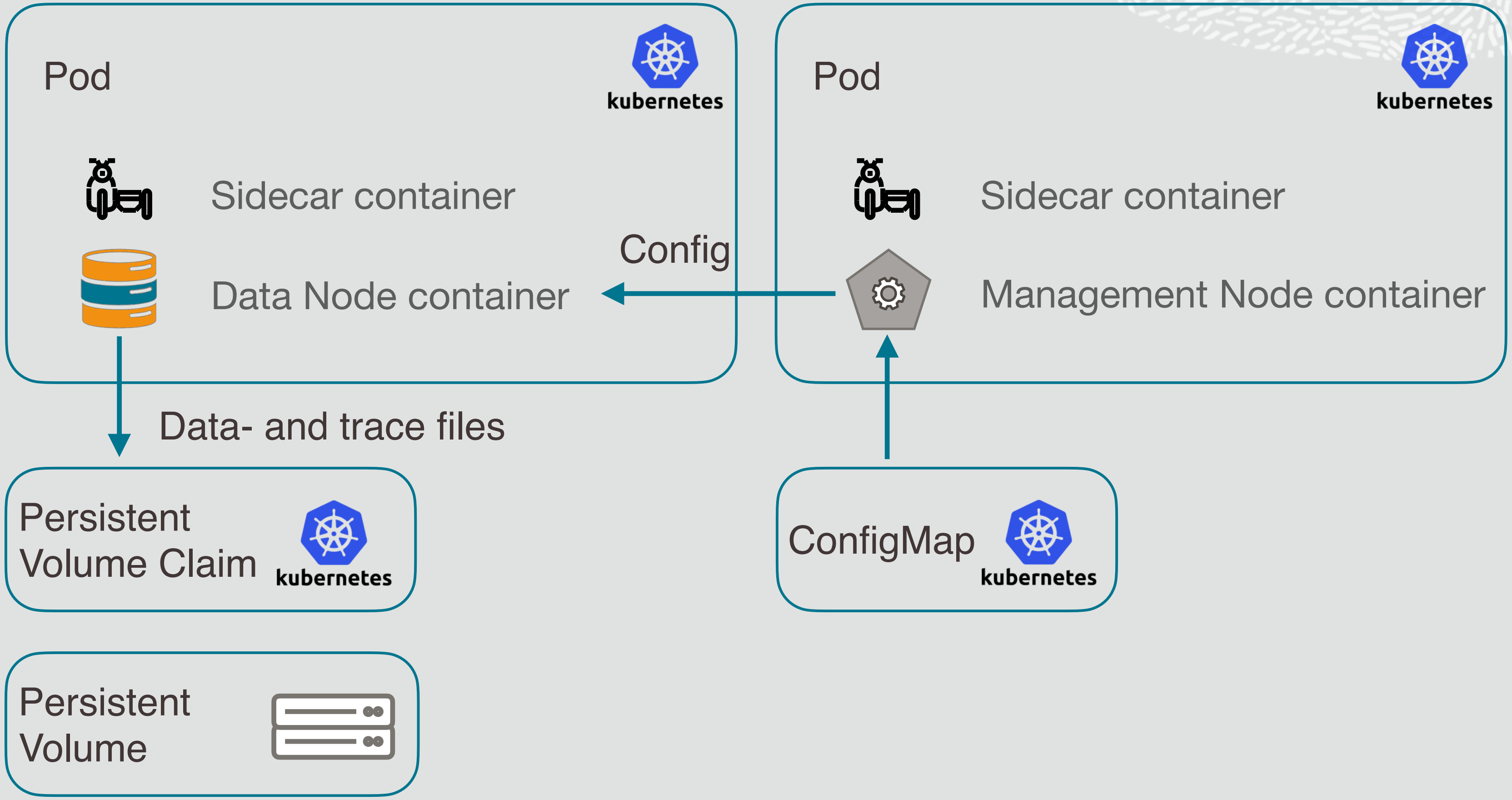


"stateless"
Microservices

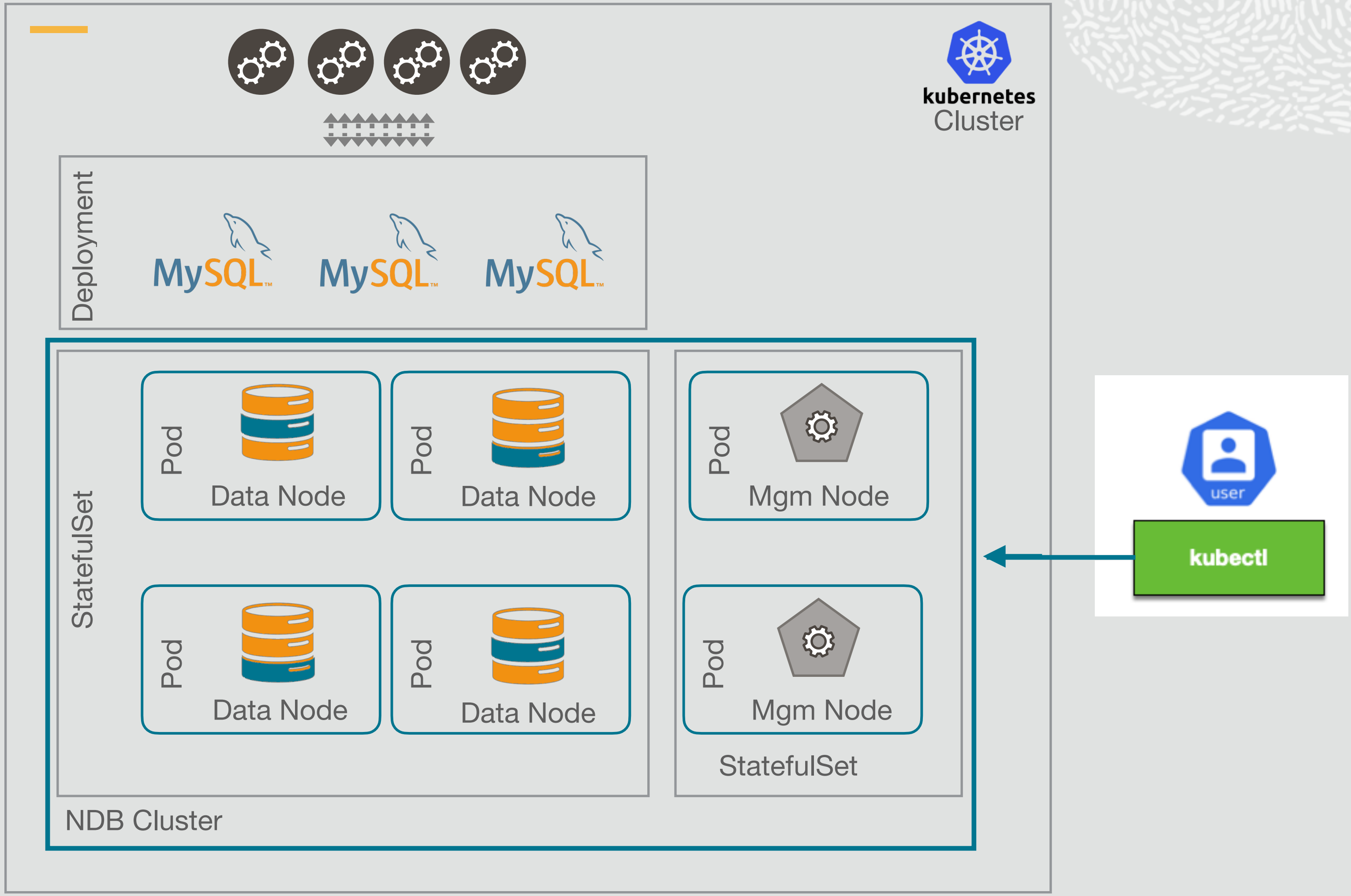
optional
SQL Layer

MySQL NDB Cluster

MySQL NDB Cluster in Kubernetes



MySQL NDB Cluster in Kubernetes



Demo - deploying manually

https://www.github.com/ocklin/ndb-k8-manually

Best practices

DNS “stability”

- Pods
  - reschedule on other Kubernetes nodes
  - change IP addresses
  - consider DNS TTL, time to resolve new host address
  - ⚠ **GRANT** … TO ‘username’@<IP-address>
  - Use AllowUnresolvedHostnames=1
  - Retry

Service Mesh Istio

- Envoy is a proxy
  - connects to cluster will “look like” connects from localhost
  - cluster expects connects from remote host
  - use `TcpBind_INADDR_ANY = 1`

Sidecars

- Always use a most minimal maintenance container
    - idle, low resource
    - but allows parallel access to volumes and stored data
    - easier debugging if things go wrong

Kubernetes is complex

- Many layers and teams responsible
- Lots of people or resources to blame if something goes wrong
- Observability is key!

PodDisruptionBudgets and Eviction API

- Eviction API considers pod disruption budgets
  - e.g. used when draining kubernetes nodes
- makes sure that you do not accidentally shutdown all your nodes of the database
- `kubectl delete` ignores PodDisruptionBudgets!

PodAffinity and AntiAffinity

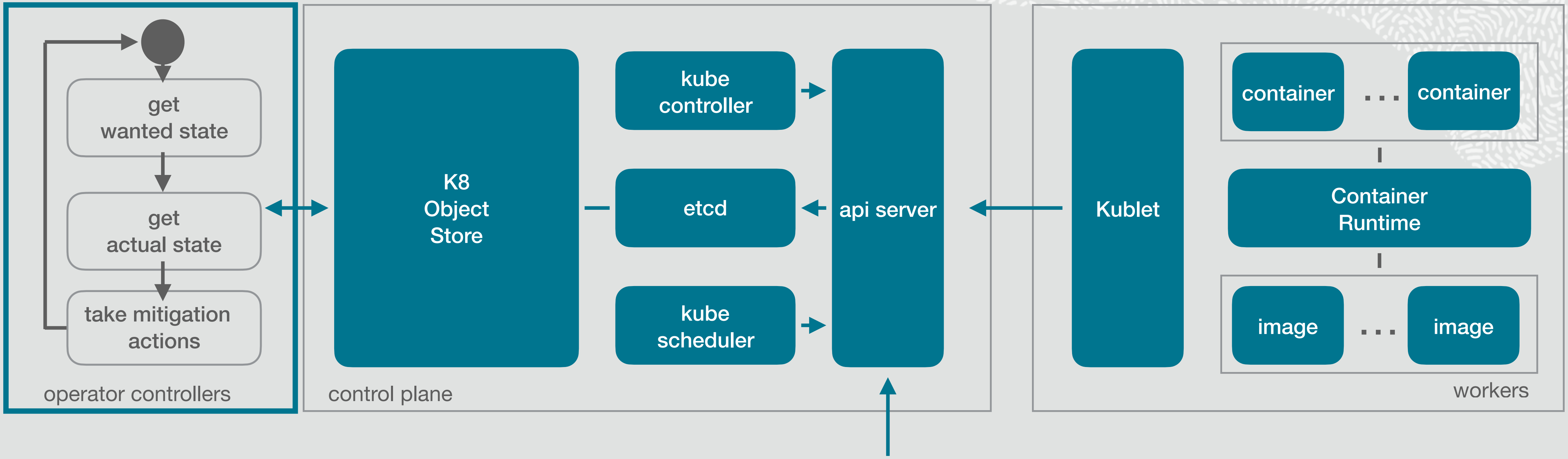
- All nodes have labels, make heavy use of labels!
- PodAffinity allows to prefer k8 nodes with labels to e.g.
  - keep database nodes apart across racks or ADs
  - avoid collocation of instances sharing same data
  - prefer faster storage (e.g. SSD)

MySQL NDB Operator

Kubernetes Operators

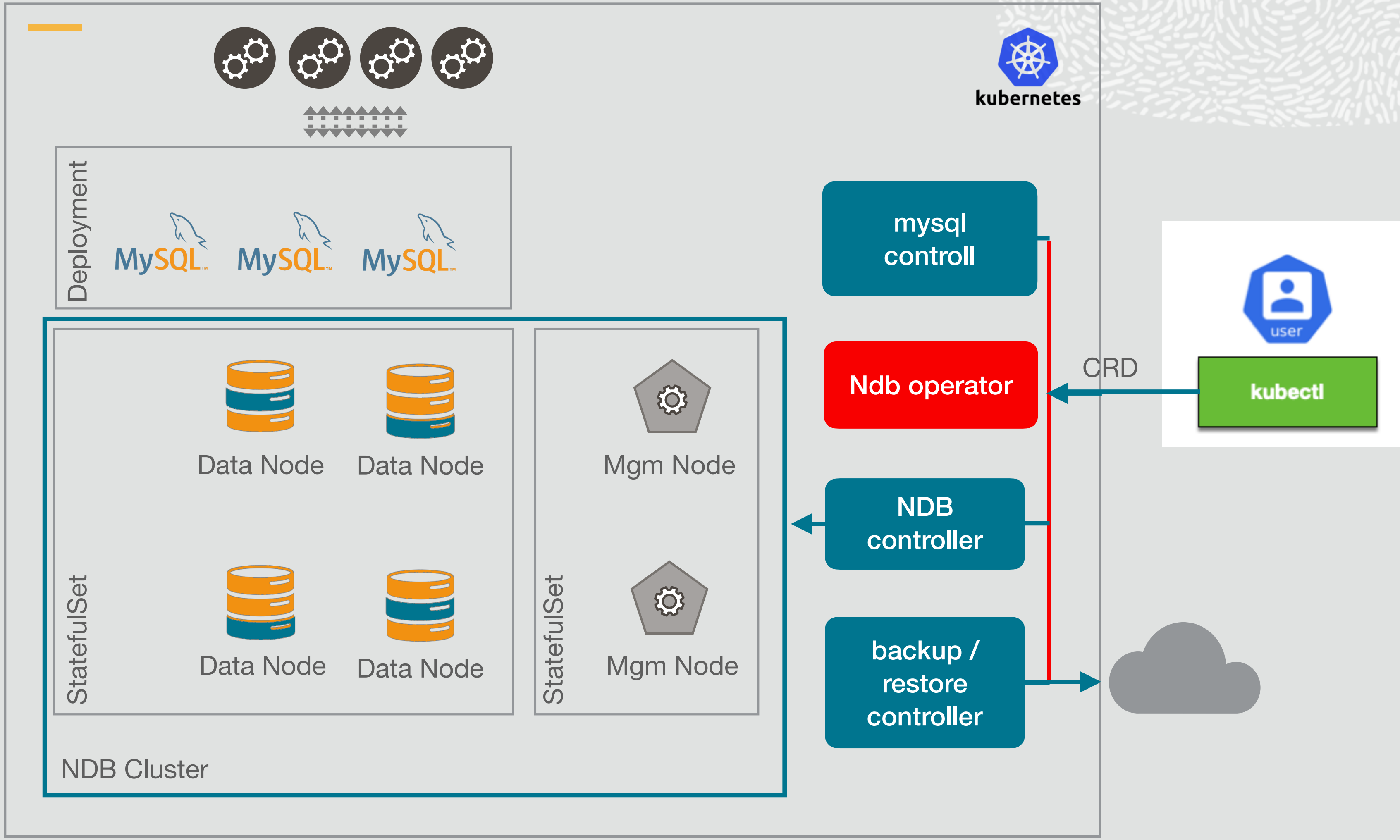
- Declarative approach
- Manages services “like a human”
- Based on
  Custom Resource Definitions

Operator reconciliation driving towards desired state



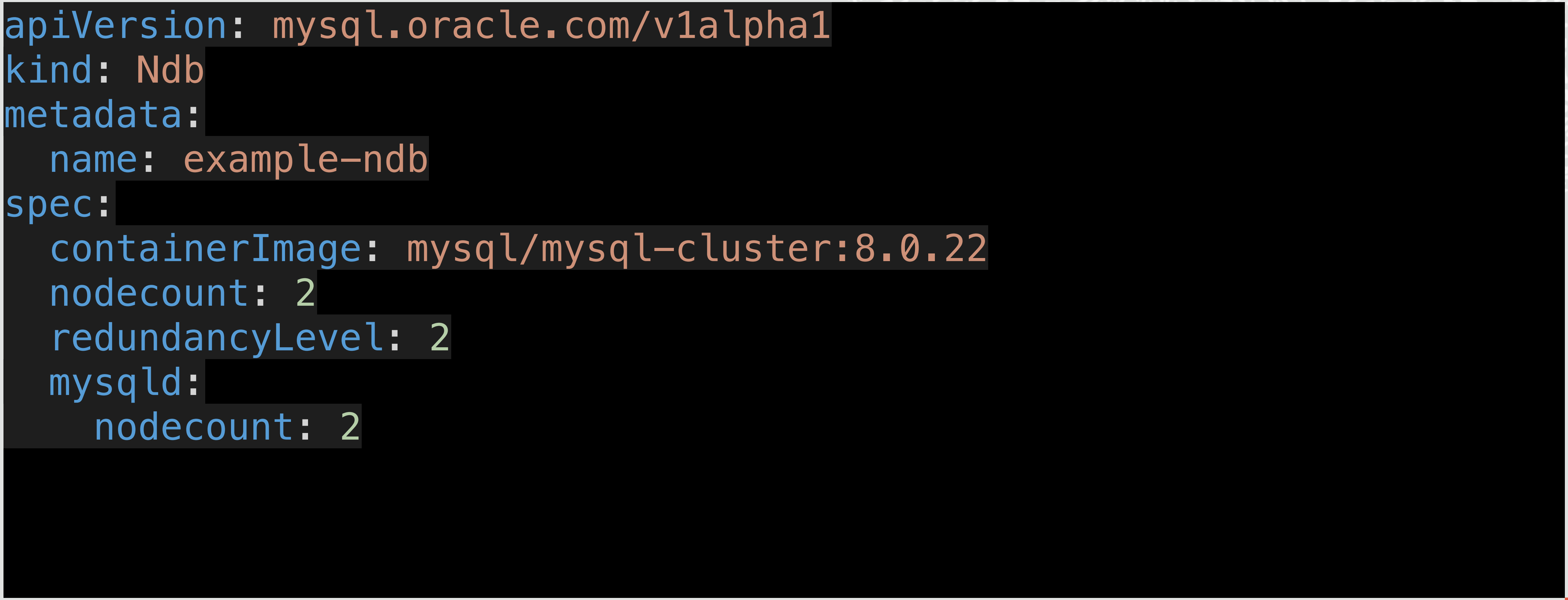
```
$ kubectl apply -f operator-crd.yaml
```

MySQL NDB Cluster in Kubernetes



Operator Demo

Ndb Custom Resource Definition



```yaml
apiVersion: mysql.oracle.com/v1alpha1
kind: Ndb
metadata:
  name: example-ndb
spec:
  containerImage: mysql/mysql-cluster:8.0.22
  nodecount: 2
  redundancyLevel: 2
  mysqld:
    nodecount: 2
```

Thank You

Bernd Ocklin

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