



# Inside Kubernetes

An Architectural Deep Dive

Anthony Nocentino, Centino Systems  
Enterprise Architect





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# Anthony Nocentino

## **Centino Systems**

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 @nocentino

**Consultant and Trainer**

**Founder and President of**

**Centino Systems**

Microsoft MVP - 2017 - 2020

Friend of Redgate - 2015-2019

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[www.centinosystems.com/blog](http://www.centinosystems.com/blog)

**Pluralsight Author:**

[www.pluralsight.com](http://www.pluralsight.com)

# Agenda

1. What is Kubernetes
2. Benefits of Using Kubernetes
3. Kubernetes API Objects
4. Exploring Kubernetes Architecture
5. Deploying Applications
6. Deploying SQL Server
7. The Future...

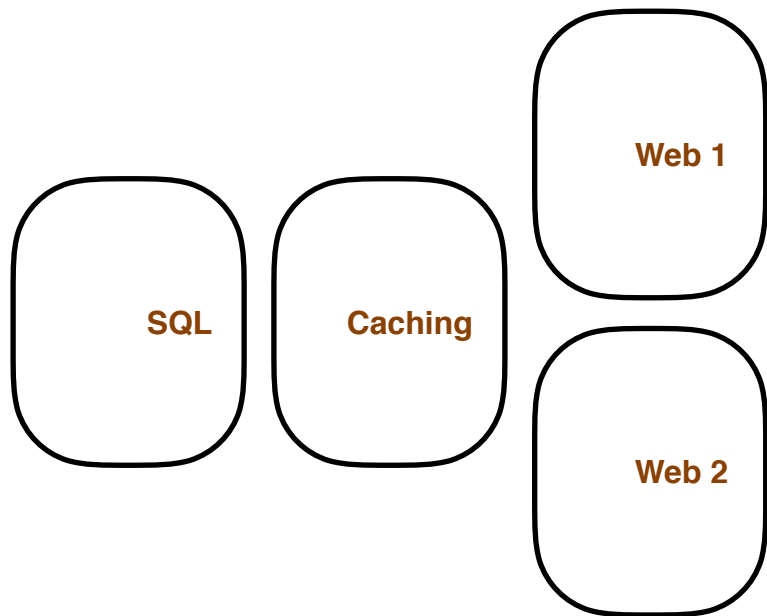
# Container Based Application Deployment

Single-tier applications - anything written by IBM

Multi-tier applications - Service oriented, Client/Server...

Micro-services - smaller, more easily changed units

# Modern Application Deployment



Where do I run the application?  
How do I scale the application?  
How do I consistently deploy?  
How do I access these  
application services?



# Kubernetes 101

Container Orchestrator

Pods are Container Based  
Applications

Infrastructure Abstraction

Desired State

Declarative Configuration in Code



# Kubernetes Benefits

Managing state, starting things and keeping them up

Speed and consistency of deployment

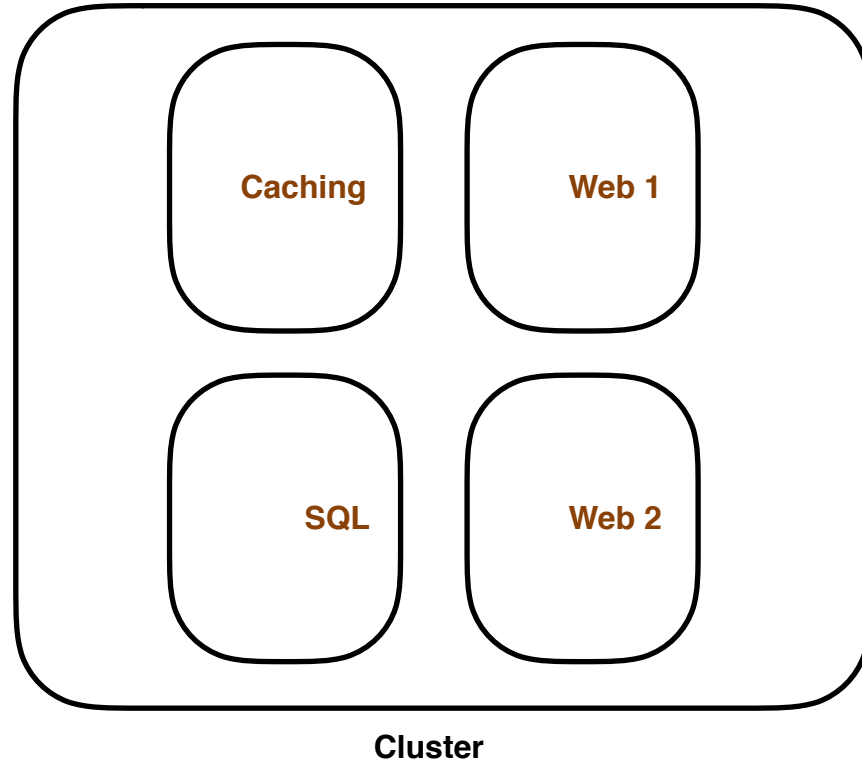
Ability to absorb change quickly

Ability to recovery quickly

Hide complexity in Cluster

Persistent application access endpoints

# Kubernetes Cluster



# Kubernetes API

**API Objects** - Represent resources in your system

**API Server** - Main communication hub

- Pods
- Controllers
- Services
- Storage
- ...and more

# Pods

One or more containers

It's your application or service

The most basic unit of work

Unit of scheduling

Ephemeral - no Pod is ever "redeployed"

# Controllers

Create and manage Pods for you

Define your desired state

Respond to Pod State and Health

ReplicaSet

Deployment

# Services

Adds persistency to our ephemeral world

Networking abstraction for Pod access

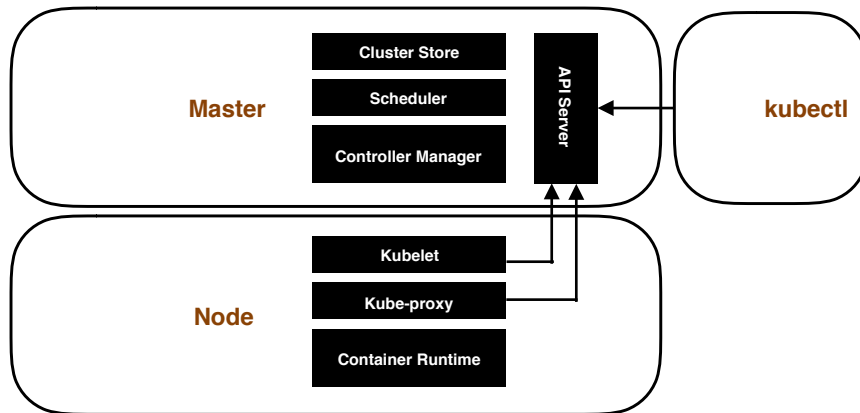
IP and DNS name for the service

Load balancing

Recreated Pods automatically updated

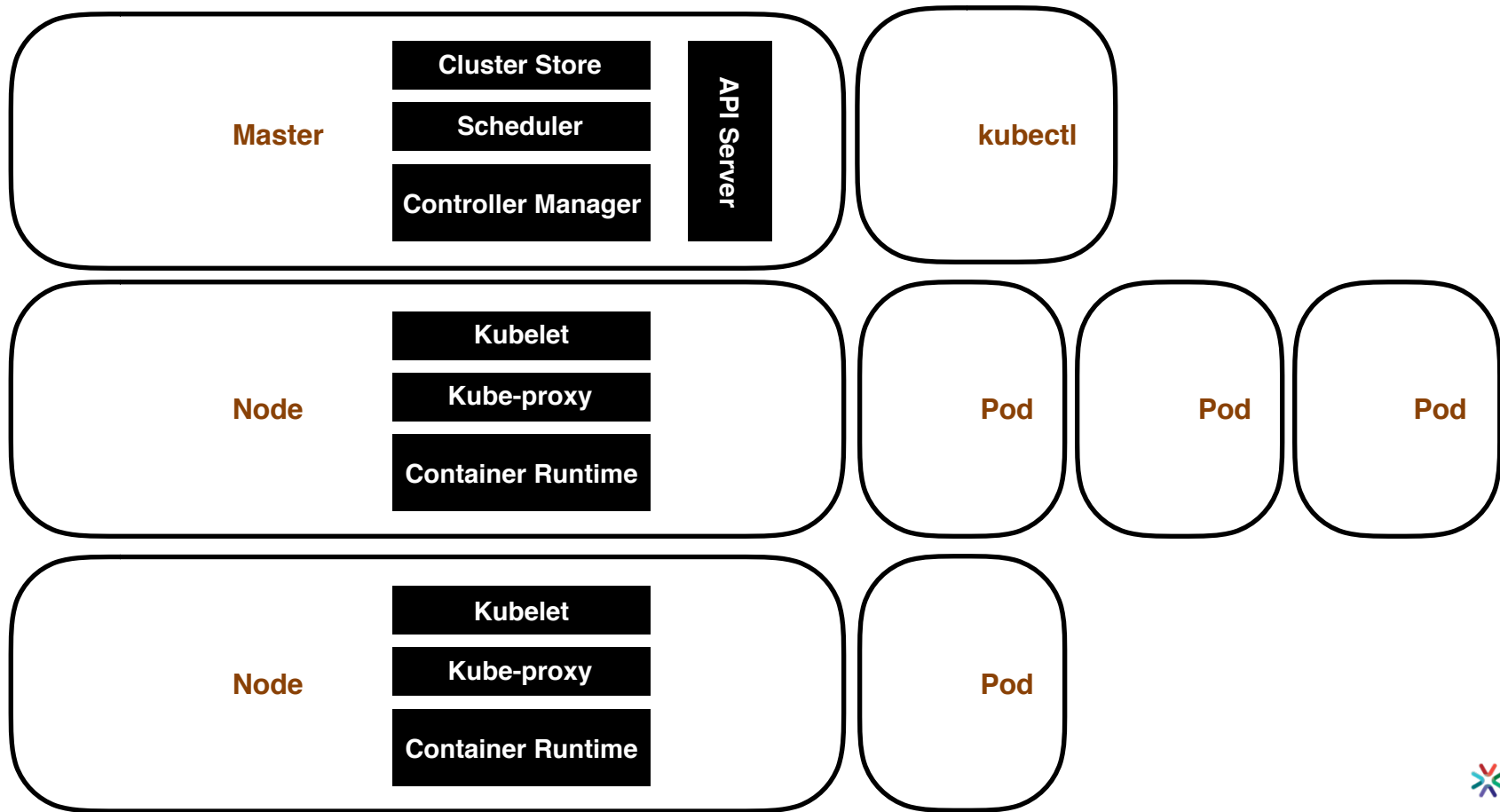
Scaled by adding/removing Pods

# Exploring Kubernetes Architecture

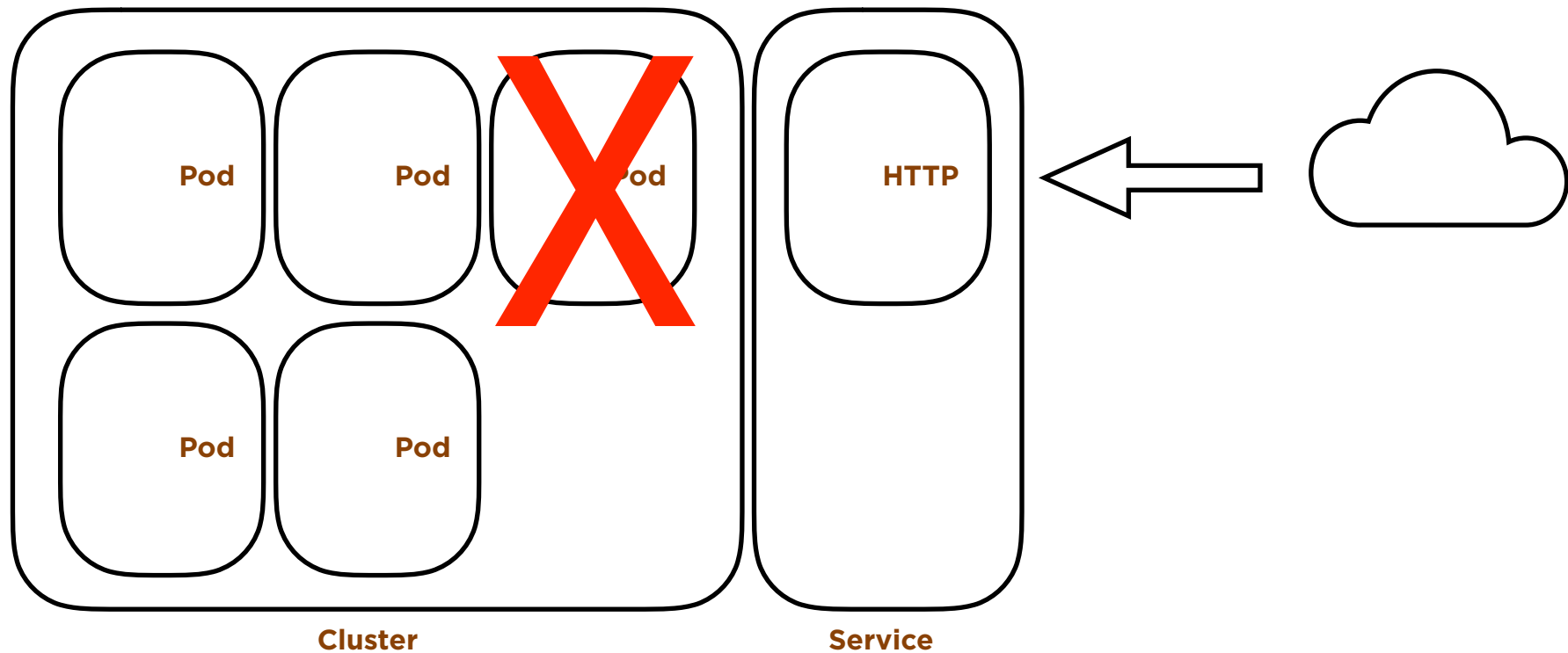




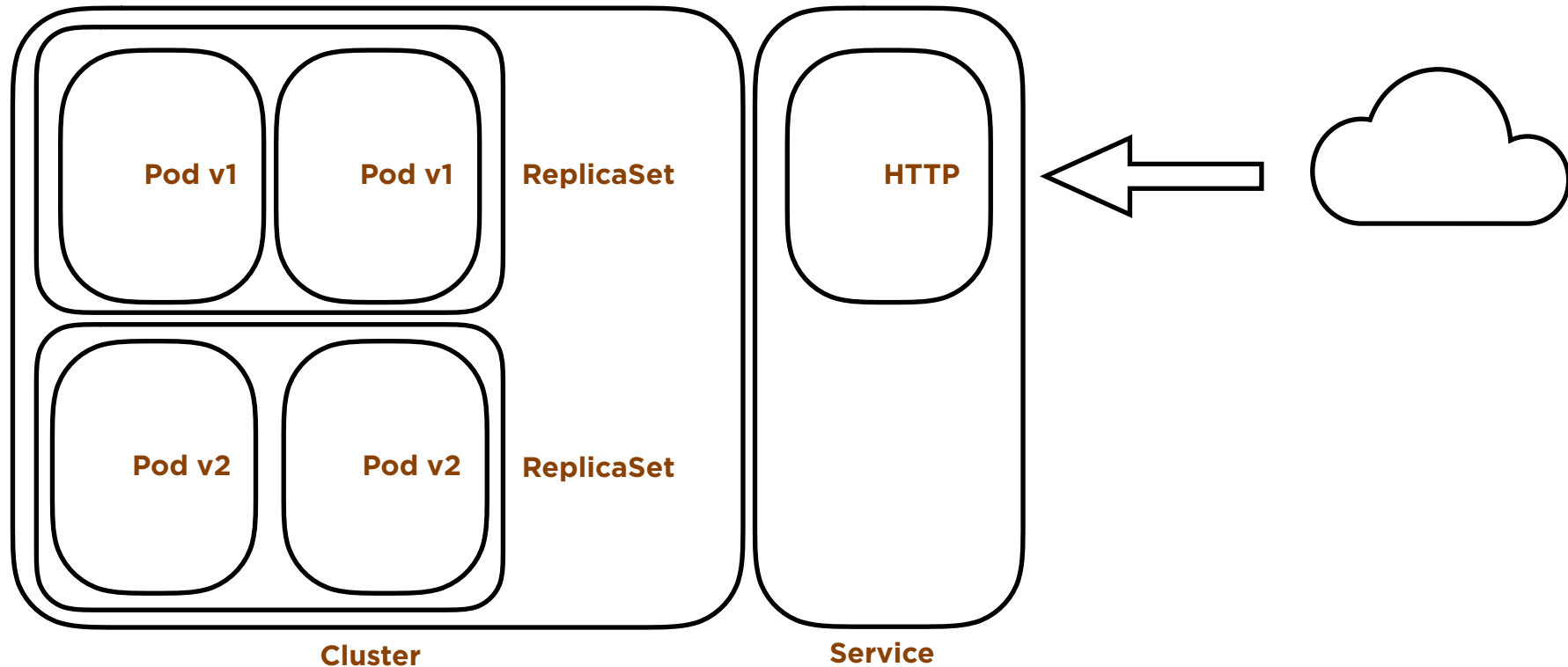
# Controller Operation of Pods



# Services



# Controller Operations - Deployment



# Deploying Applications

Imperative

Declarative

YAML and JSON

# Declarative Deployment - Manifests

## Deployment

```
apiVersion: apps/v1
kind: Deployment
```

```
metadata:
```

```
  name: hello-world
```

```
spec:
```

```
  replicas: 3
```

```
  selector:
```

```
    matchLabels:
```

```
      app: hello-world
```

```
template:
```

```
  metadata:
```

```
    labels:
```

```
      app: hello-world
```

```
  spec:
```

```
    containers:
```

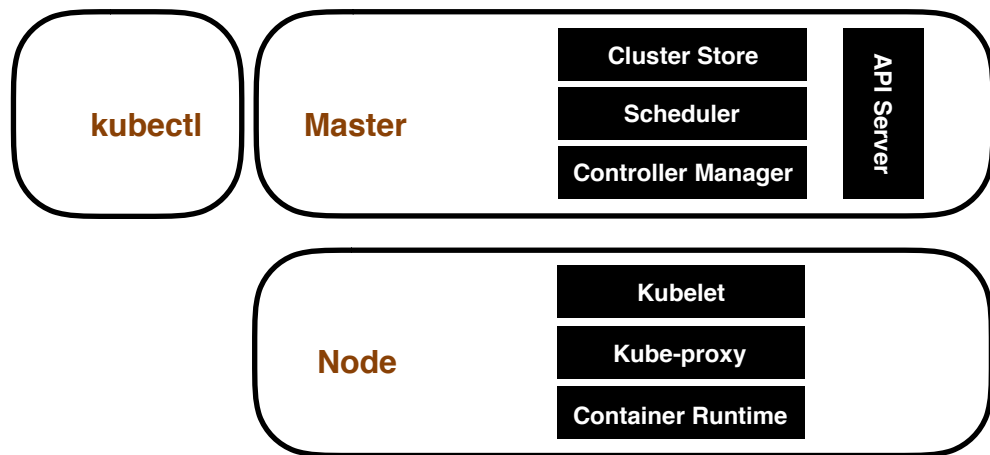
```
    - image: gcr.io/google-samples/hello-app:1.0
```

```
      name: hello-app
```

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

## Pod Template

# Demo!



Imperatively Deploying a web application  
Accessing Services within a Cluster

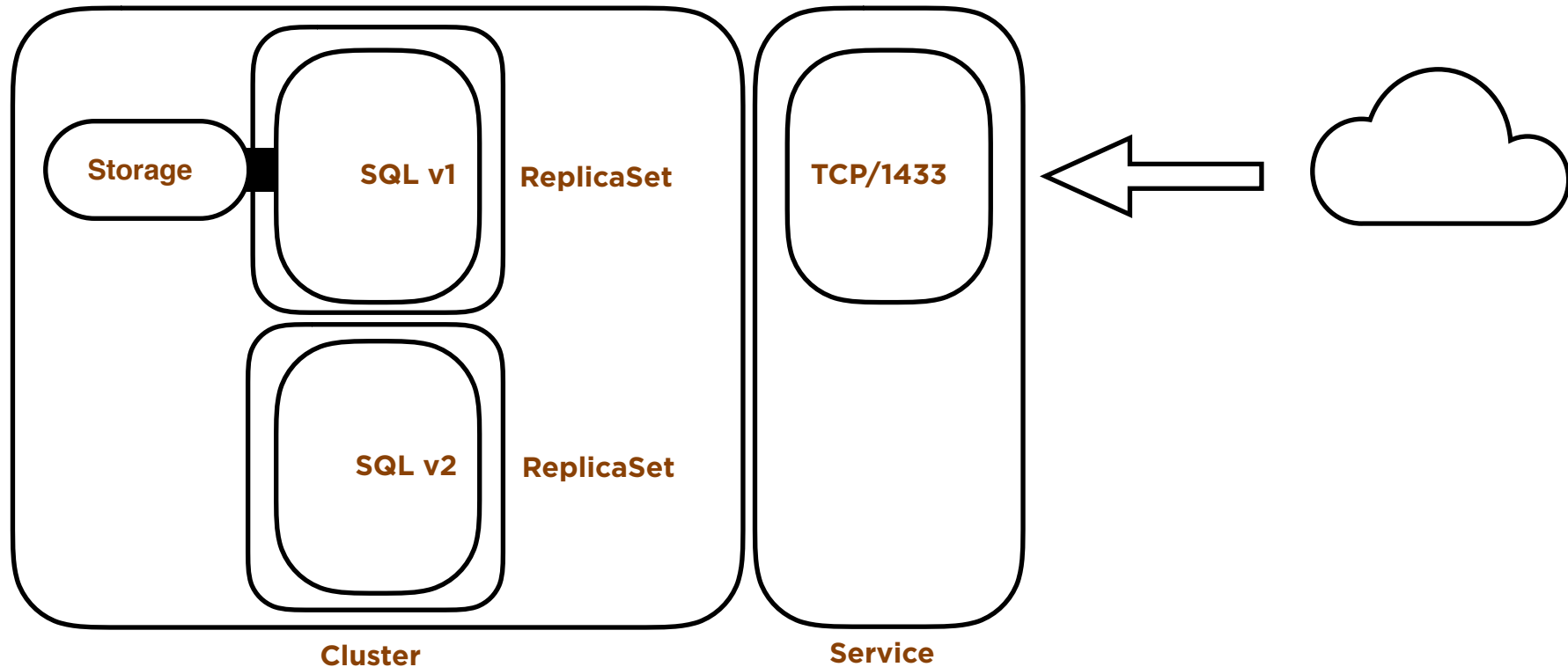
# Running SQL Server in Kubernetes

A Pod goes back to the initial state of the container image each time it's deployed

**State** - where do we store data?

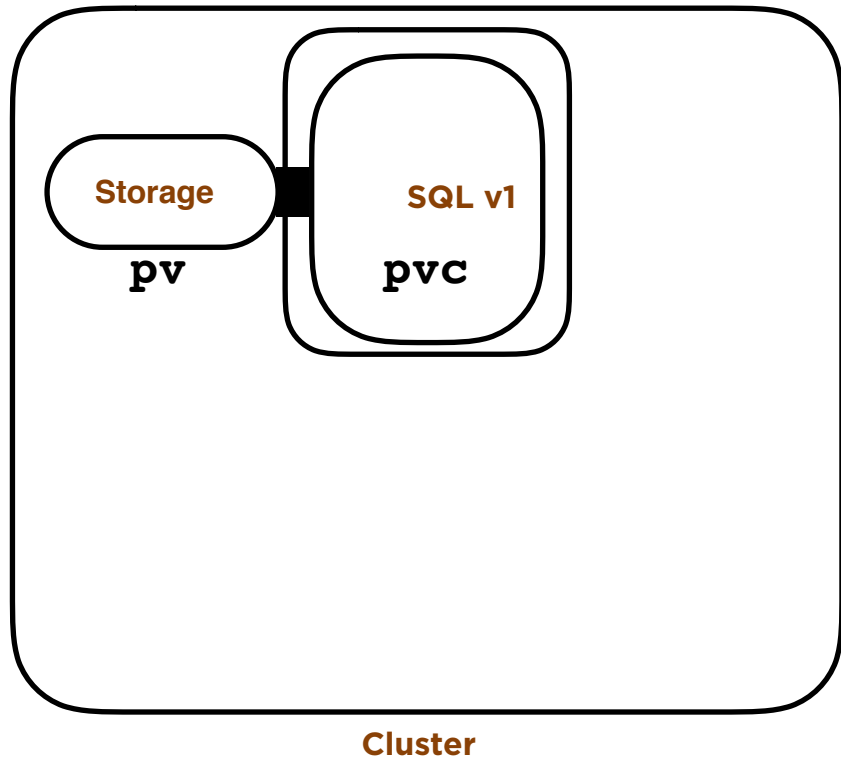
**Configuration** - how do we configure SQL Server?

# Decoupling Data and Computation





# Storage in Kubernetes

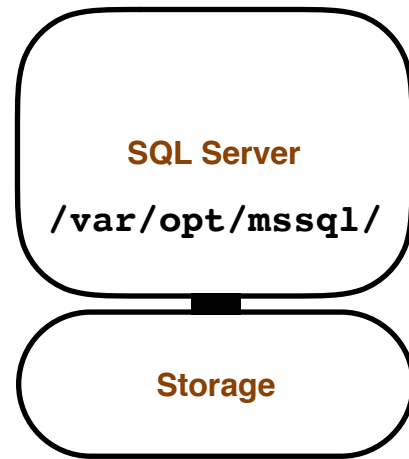


- **Persistent Volumes (pv)**
  - Administrator defined storage
  - iSCSI, NFS, FC, AzureDisk...many more
- **Persistent Volume Claims (pvc)**
  - The Pod “claims” the **pvc**
  - The **pvc** is mapped to the **pv** by k8s
  - Decouples the Pod and the storage

# Data Persistency in SQL Server in K8S

Define Persistent Volumes/Persistent Volume Claims

- Instance directory (error log, default trace, etc..)
  - **`/var/opt/mssql/`**
- User Database default directory
  - **`/var/opt/mssql/data`**



<http://www.centinosystems.com/blog/sql/data-persistency-and-advanced-sql-server-disk-topologies-in-kubernetes/>

# Configuring SQL Server in a Pod

Pods go back to the initial state of the container image on creation

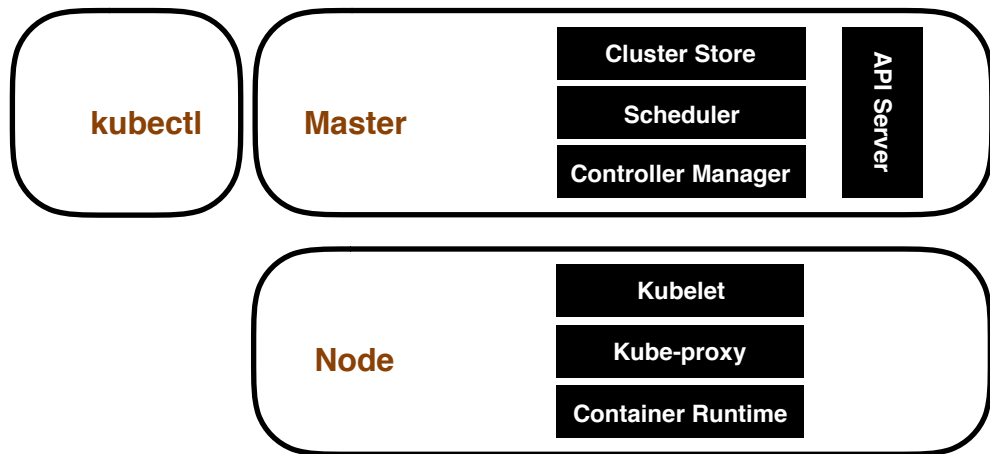
In our Pod configuration we define **Environment Variables**

- Used at startup to configure the SQL Instance
  - **ACCEPT\_EULA**
  - **MSSQL\_SA\_PASSWORD**

<https://docs.microsoft.com/en-us/sql/linux/sql-server-linux-configure-environment-variables?view=sql-server-2017>

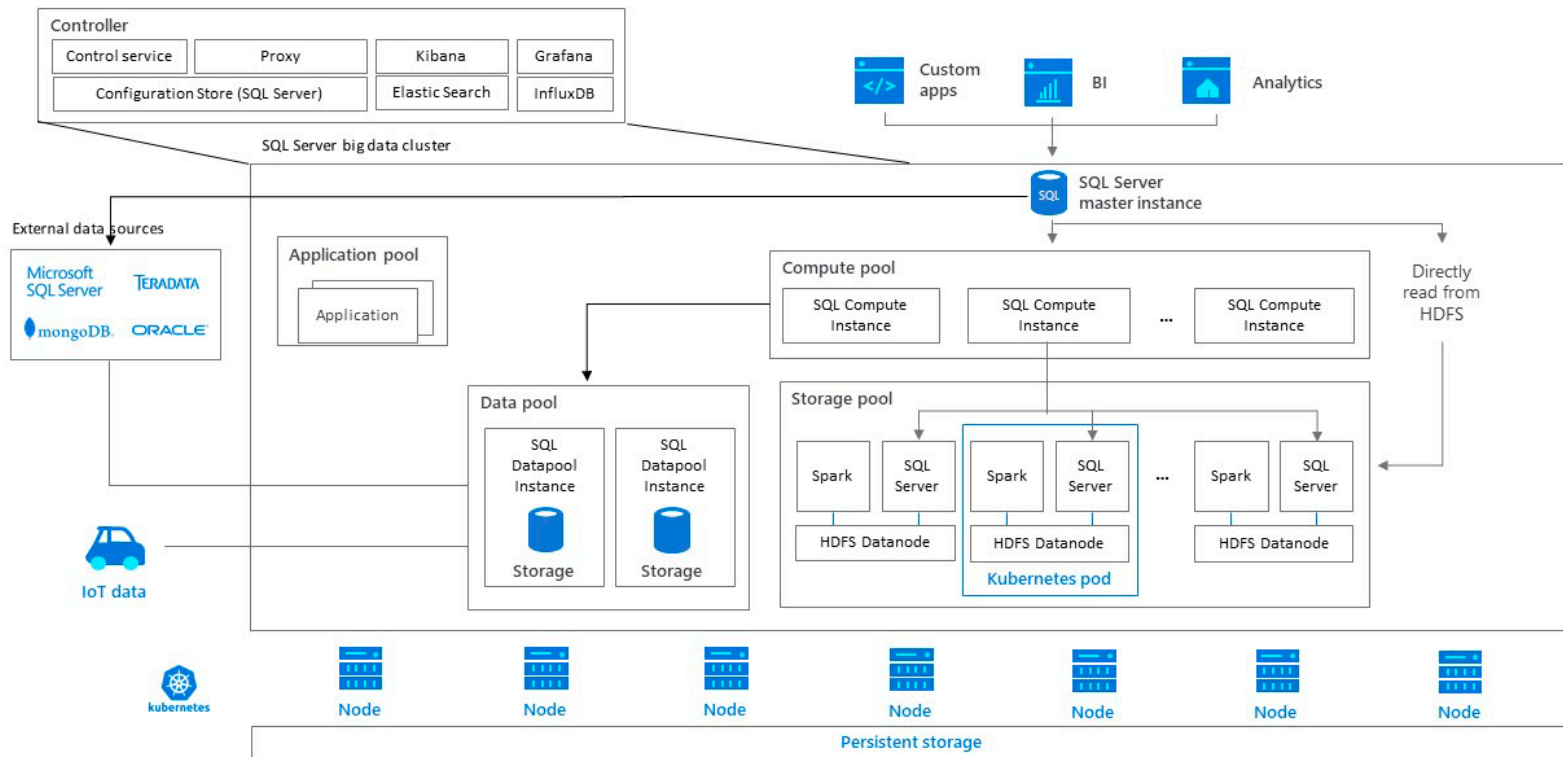
<https://docs.microsoft.com/en-us/sql/linux/sql-server-linux-configure-environment-variables?view=sql-server-2019>

# Demo!



Deploying SQL Server in a **Deployment** with Persistent Storage

# Big Data Clusters



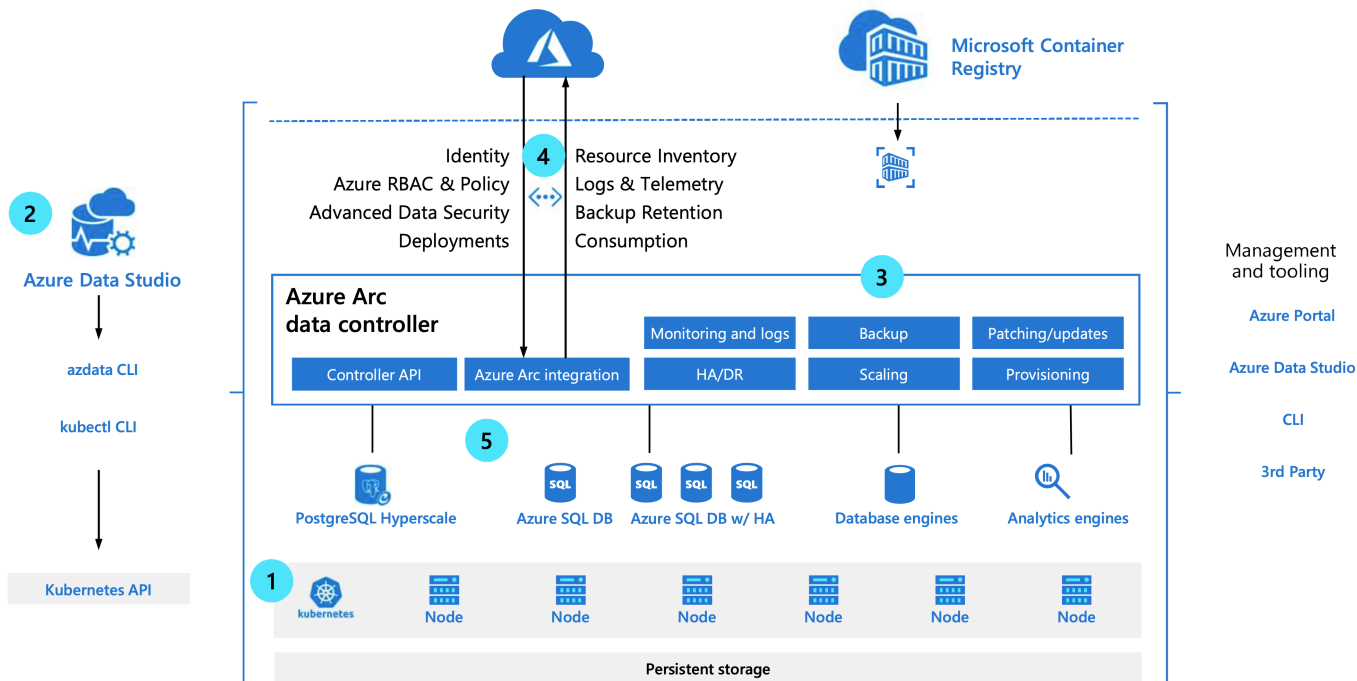
From: <https://docs.microsoft.com/en-us/sql/big-data-cluster/big-data-cluster-overview?view=sqlallproducts-allversions>

# Azure Arc - Data Services Anywhere!

How it works: architecture of Azure data services on customer infrastructure

A few steps to get Azure data services in your environment:

- 1 Have Kubernetes on your infrastructure
- 2 Prepare environment with APIs and CLIs
- 3 Install Azure Arc data controller
- 4 Connect to Azure
- 5 Deploy and run Azure data services for your workloads



From: <https://azure.microsoft.com/en-us/services/azure-arc/hybrid-data-services/>

# Review

What is Kubernetes

Benefits of Using Kubernetes

Kubernetes API Objects

Exploring Kubernetes Architecture

Deploying Applications

Deploying SQL Server

# Kubernetes at PASS Summit!

**Hamish Watson - @TheHybridDBA**

**How to Deploy SQL Server Containers on Kubernetes in Azure**

**Nov 7 @ 10:15AM**

**Bob Ward - @bobwardms**

**Inside SQL Server on Kubernetes**

**Nov 8 @ 8:00AM**





# More Resources

## Docker for Windows/Mac

## Managed Service Providers

- Azure Kubernetes Service (**AKS**)
  - <https://docs.microsoft.com/en-us/azure/aks/kubernetes-walkthrough>
- Elastic Container Service for Kubernetes (**EKS**)
  - <https://aws.amazon.com/getting-started/projects/deploy-kubernetes-app-amazon-eks/>
- Google Kubernetes Engine (**GKE**)
  - <https://cloud.google.com/kubernetes-engine/docs/how-to/>

## Pluralsight - Kubernetes Installation and Configuration Fundamental and more!

- <https://app.pluralsight.com/profile/author/anthony-nocentino>

## Deploying SQL Server in Kubernetes from PASS HADR Virtual Chapter

- <https://youtu.be/5u3Dk4zKa9A> (Configuration, Resource Management, Backups)

# Need more data or help?

**<http://www.centinosystems.com/blog/talks/>**  
**<http://www.github.com/nocentino/presentations/>**

Links to resources

Demos

Presentation

Pluralsight

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# Thank You

## Anthony Nocentino



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