Inside Kubernetes Architecture Fundamentals

Anthony E. Nocentino
aen@centinosystems.com

Centino systems

Anthony E. Nocentino

- **Consultant and Trainer**
- **Founder and President of Centino Systems**
  - Specialize in system architecture and performance
  - Masters Computer Science
  - Microsoft MVP - Data Platform - 2017 - 2020
  - Linux Foundation Certified Engineer
  - Friend of Redgate - 2015-2020
- **email**: aen@centinosystems.com
- **Twitter**: @nocentino
- **Blog**: www.centinosystems.com/blog
- **Pluralsight Author**: www.pluralsight.com

Centino systems

Agenda

- What is Kubernetes
- Benefits of Using Kubernetes
- Kubernetes API Objects
- Exploring Kubernetes Architecture
- Deploying Applications
- Deploying SQL Server

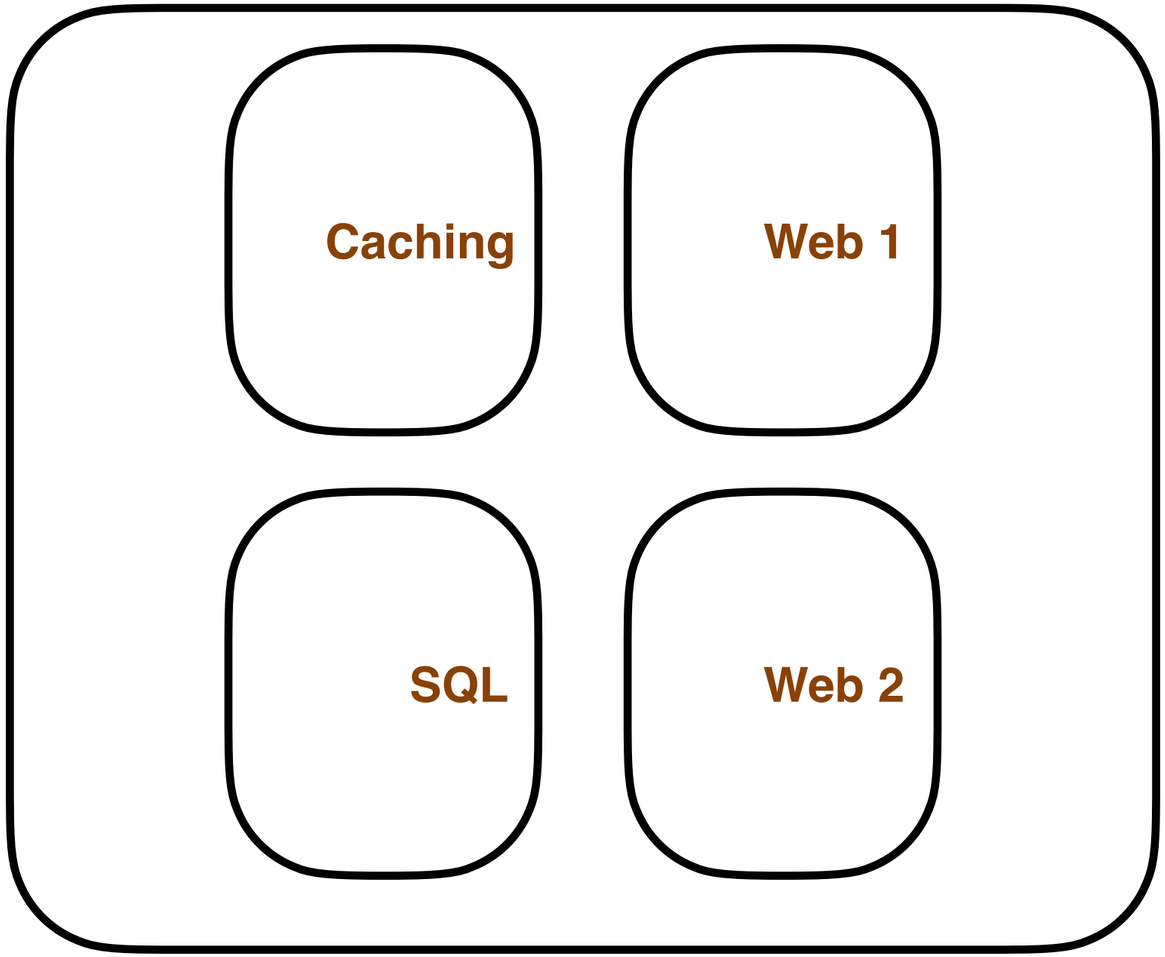
What is Kubernetes?

- Container Orchestrator
- Infrastructure Abstraction
- Desired State

Kubernetes Benefits

- Workload placement
- Managing state, starting things up and keeping things up
- Networking and Services
- Load balancing services
- Persistent storage
- Declarative model

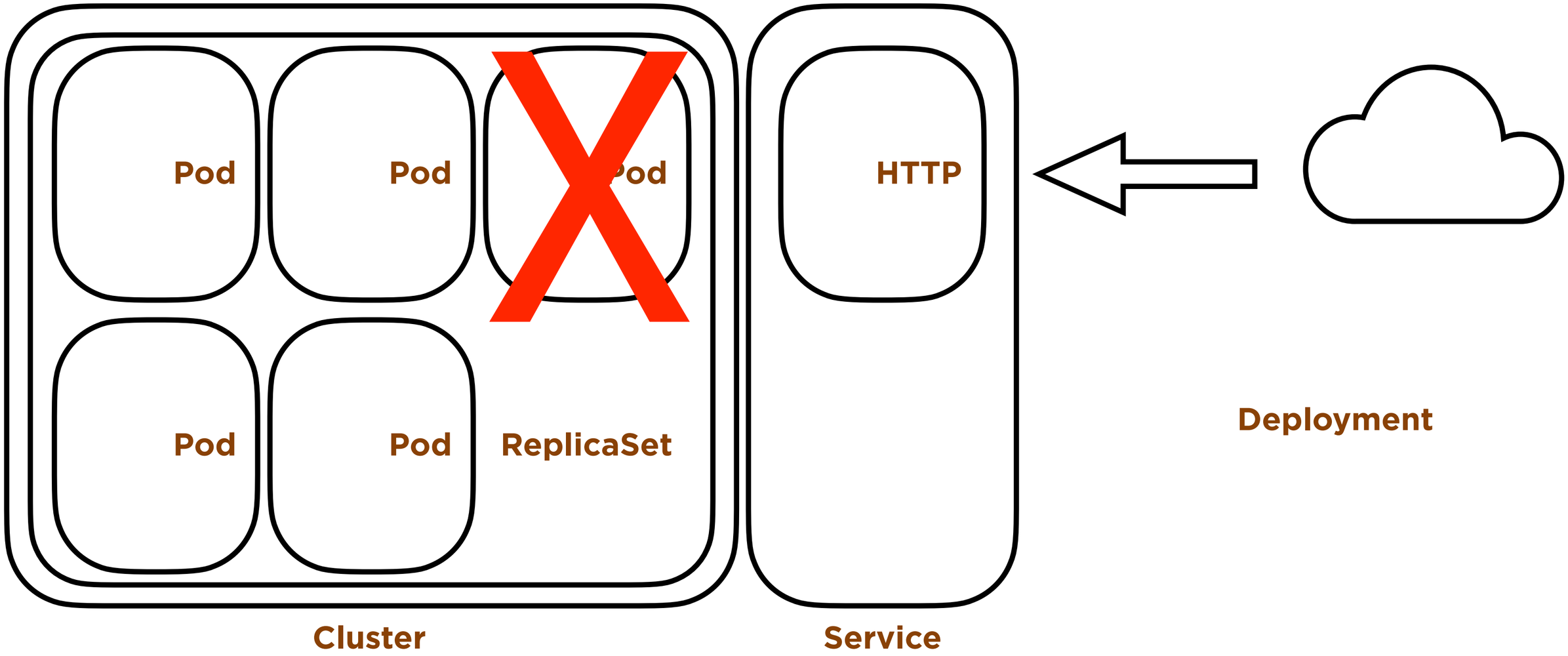
Kubernetes Cluster



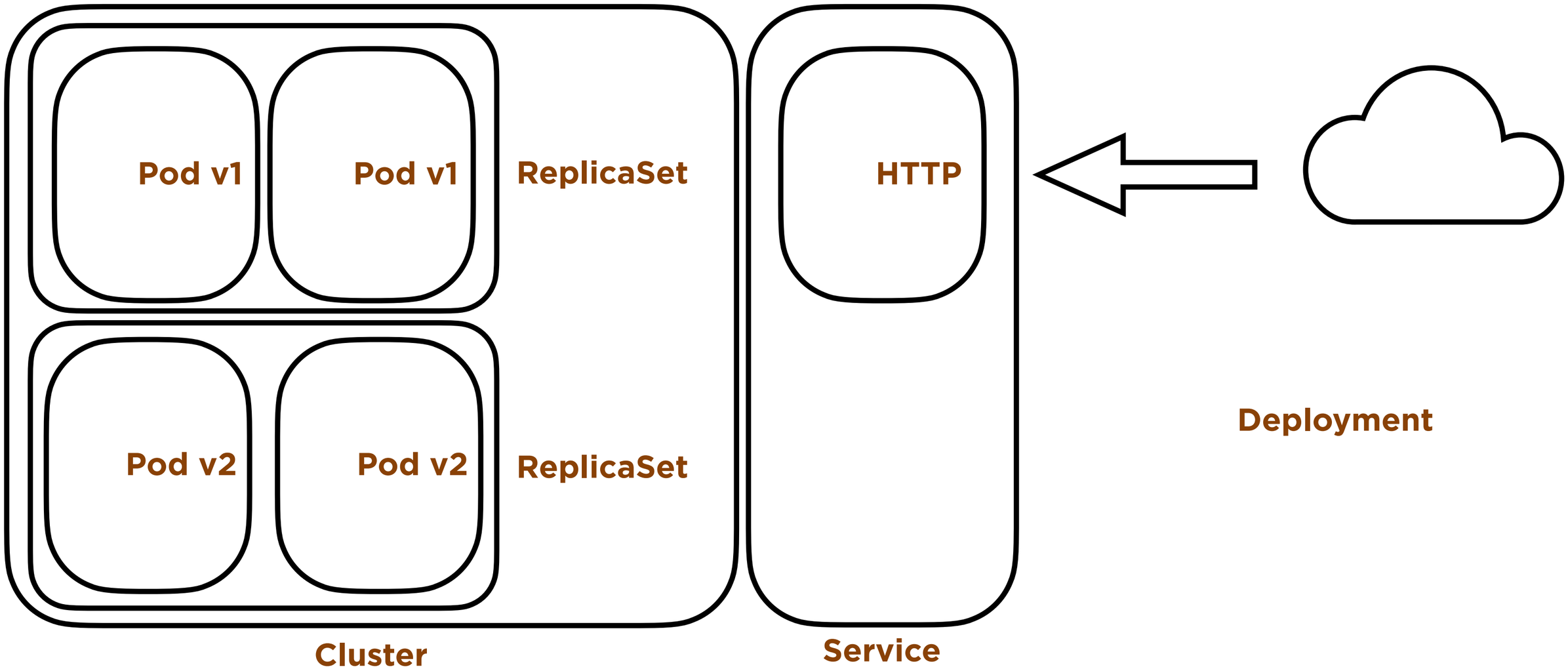
Kubernetes API

- **API Objects** - Represent resources in your system
  - **Pods** - your container based applications
  - **Controllers** - maintain desired state
  - **Services** - persistent access to your apps
  - **Storage** - persistent storage for your data
  - …and more

Services and ReplicaSets



Controller Operations - `Deployment`



Deploying Applications

- Imperative
- Declarative
- YAML and JSON

Demo!

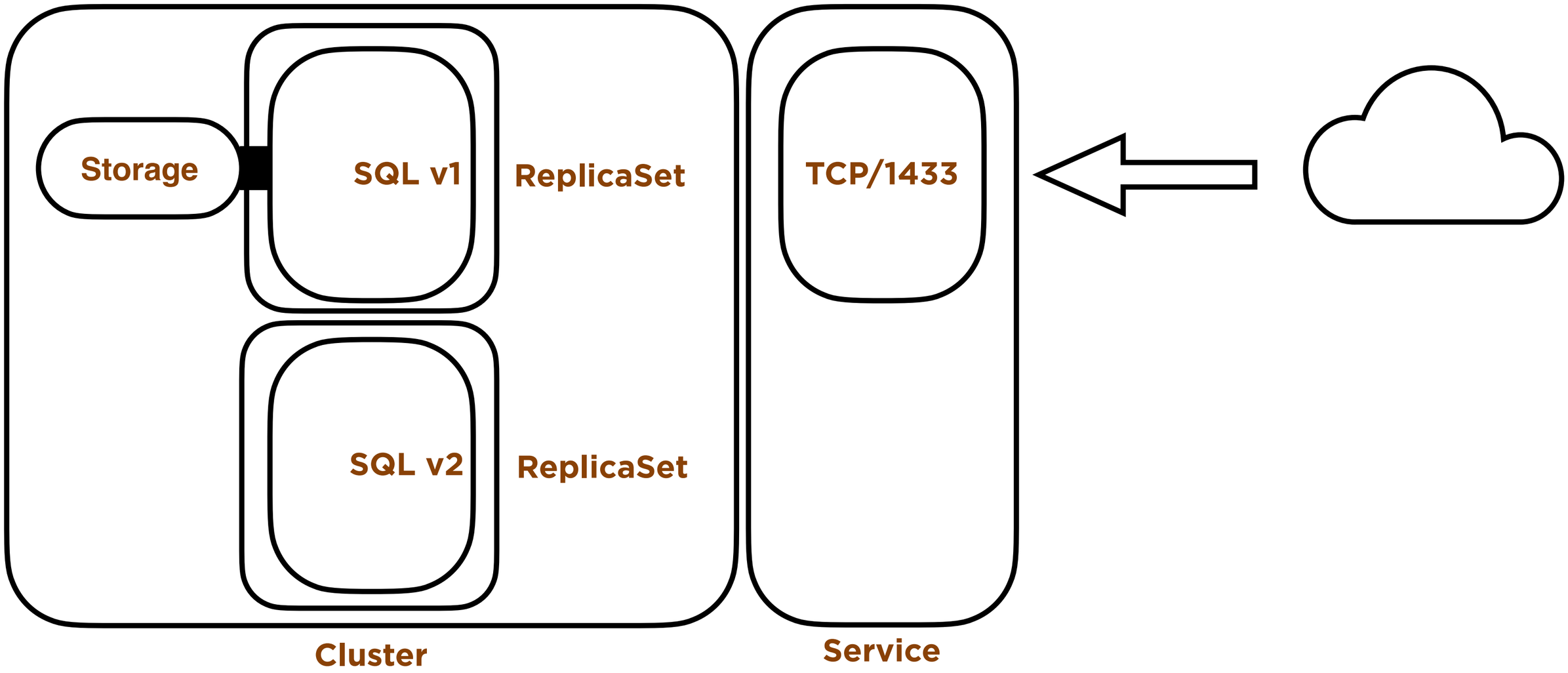
- Imperatively deploying a web application
- Accessing Services within a Cluster

Running SQL Server in Kubernetes

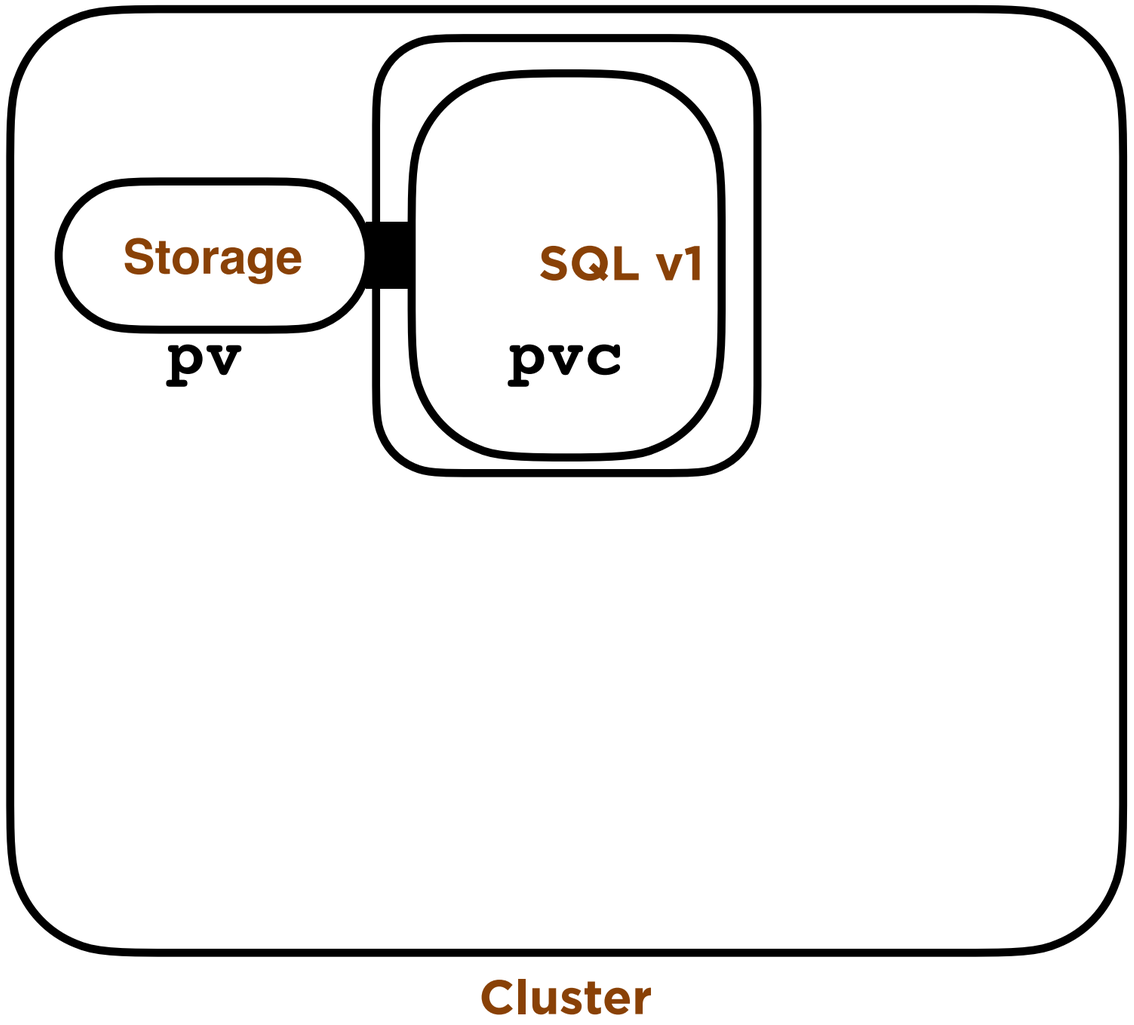
- A Pod goes back to its initial state each time it's deployed

- **State** - where do we store data?
- **Configuration** - how do we configure SQL Server?

Decoupling Data and Computation



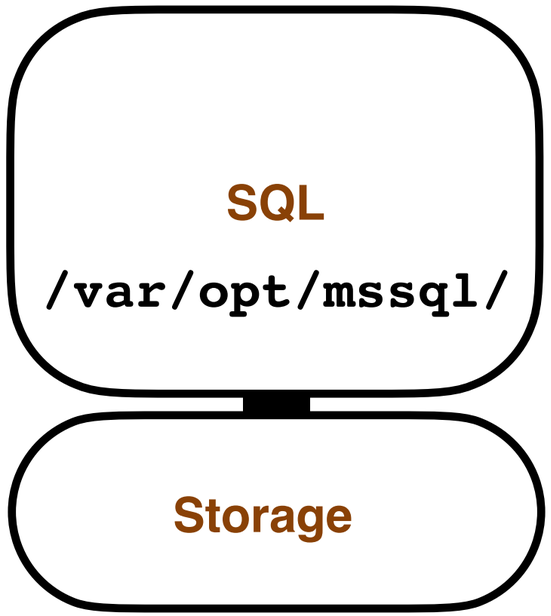
Storage in Kubernetes



- **`Persistent Volume (pv)`**
  - Administrator defined storage
  - iSCSI, NFS, FC, AzureDisk…many more
- **`Persistent Volume Claim (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`**



Configuring SQL Server in a Pod

- In our Pod configuration we define **Environment Variables**
  - Used at initial startup to configure the SQL Instance
    - **`ACCEPT_EULA`**
    - **`SA_PASSWORD`**
      - Stored in the cluster as a **`Secret`** (hashed, not encrypted)
  - Pods go back its initial state of the container image on creation

https://docs.microsoft.com/en-us/sql/linux/sql-server-linux-configure-environment-variables

Define SQL Server in a Pod in YAML

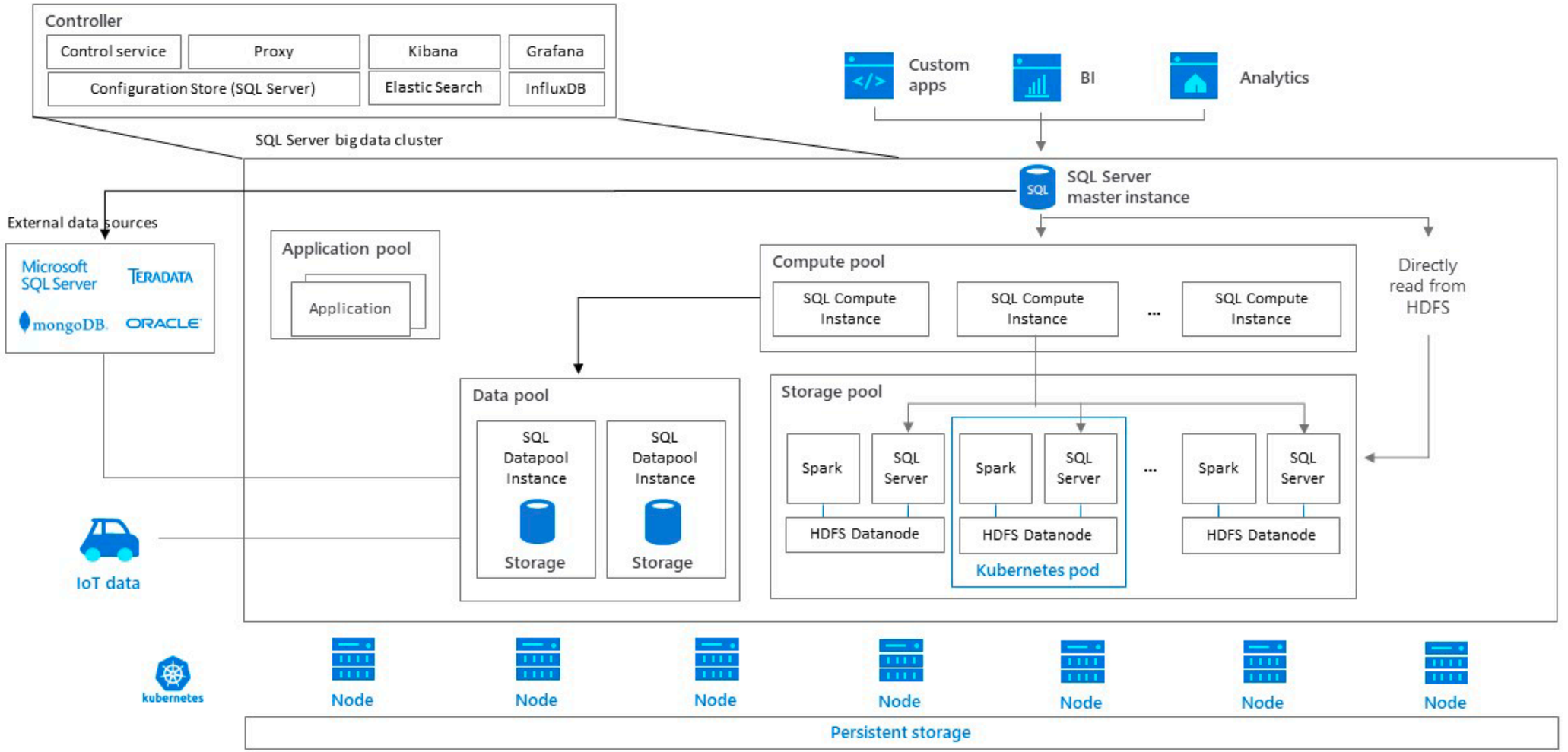
```yaml
apiVersion: apps/v1
kind: Deployment
metadata:
  name: mssql-deployment
spec:
  replicas: 1
  strategy:
    type: Recreate
  selector:
    matchLabels:
        app: mssql
  spec:
    securityContext:
      fsGroup: 10001
    containers:
    - name: mssql
      image: '.../mssql/server:2019-CU5-ubuntu-18.04'
      ports:
      - containerPort: 1433
      env:
      - name: ACCEPT_EULA
        value: "Y"
      - name: SA_PASSWORD
        valueFrom:
          secretKeyRef:
            name: mssql
            key: SA_PASSWORD
      volumeMounts:
      - name: mssqldb
        mountPath: /var/opt/mssql
    volumes:
    - name: mssqldb
      persistentVolumeClaim:
        claimName: pvc-sql-data
```

Centino systems

Demo

- Deploying SQL Server in a **`Deployment`** with Persistent Storage
  - Recovery Scenario
  - Upgrading SQL Server

Big Data Clusters



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

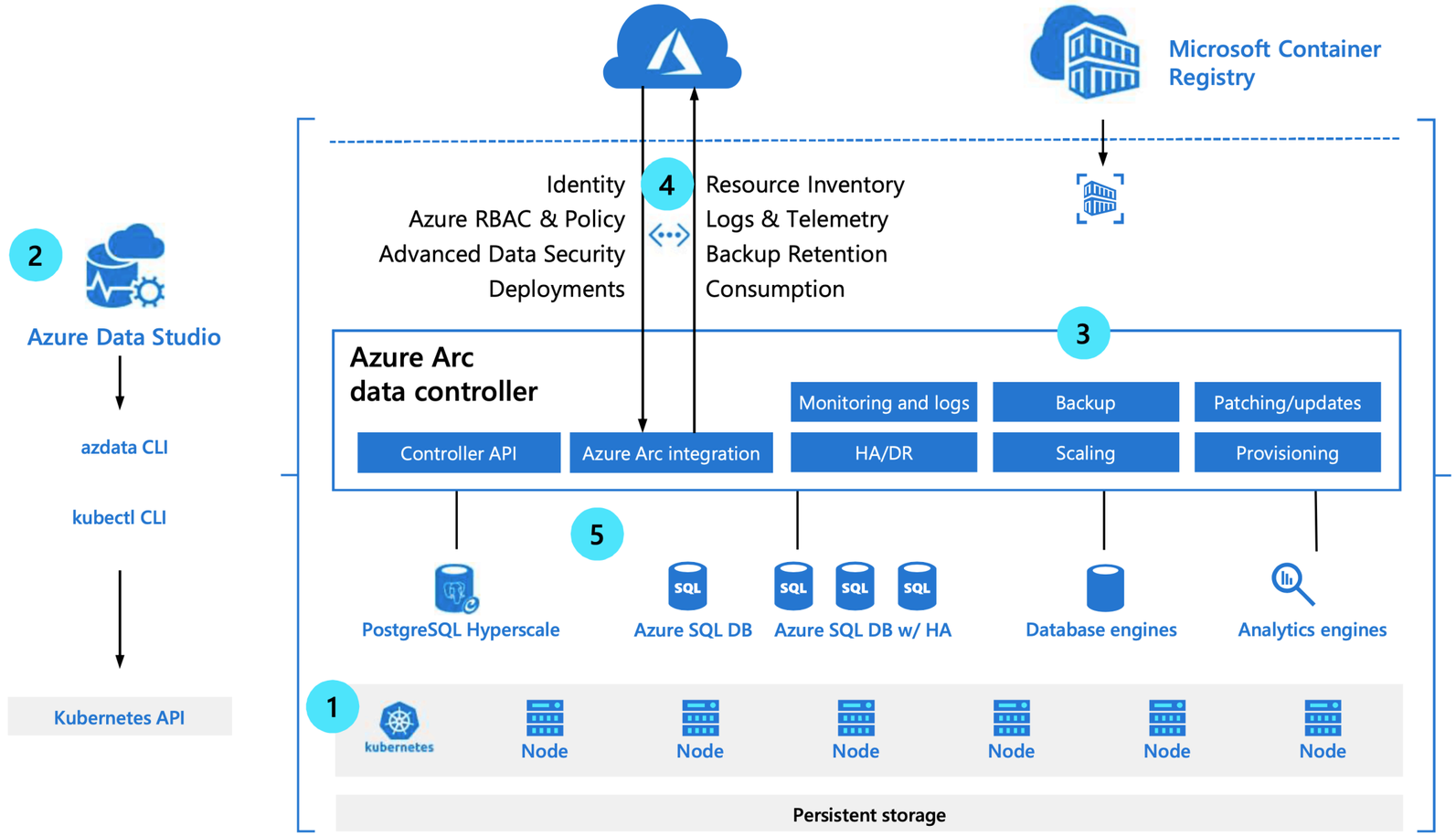
Centino systems

Azure Arc - Data Services

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



Review

- What is Kubernetes
- Benefits of Using Kubernetes
- Kubernetes API Objects
- Exploring Kubernetes Architecture
- Deploying Applications
- Deploying SQL Server

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

Need more data or help?

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

Links to resources
Demos
Presentation
Pluralsight

aen@centinosystems.com
@nocentino
www.centinosystems.com

Solving tough business challenges with technical innovation

Centino systems

Thank You!