Deploying SQL Server in Kubernetes

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Agenda

- **Deploying SQL Server in Kubernetes**
  - Data Persistency and Storage in Kubernetes
  - Pod Configuration and Running SQL Server in a Pod
  - Disk and Resource Configurations
  - Backups
  - The ~~Future~~ **Present** of SQL Server and Kubernetes

Kubernetes 101

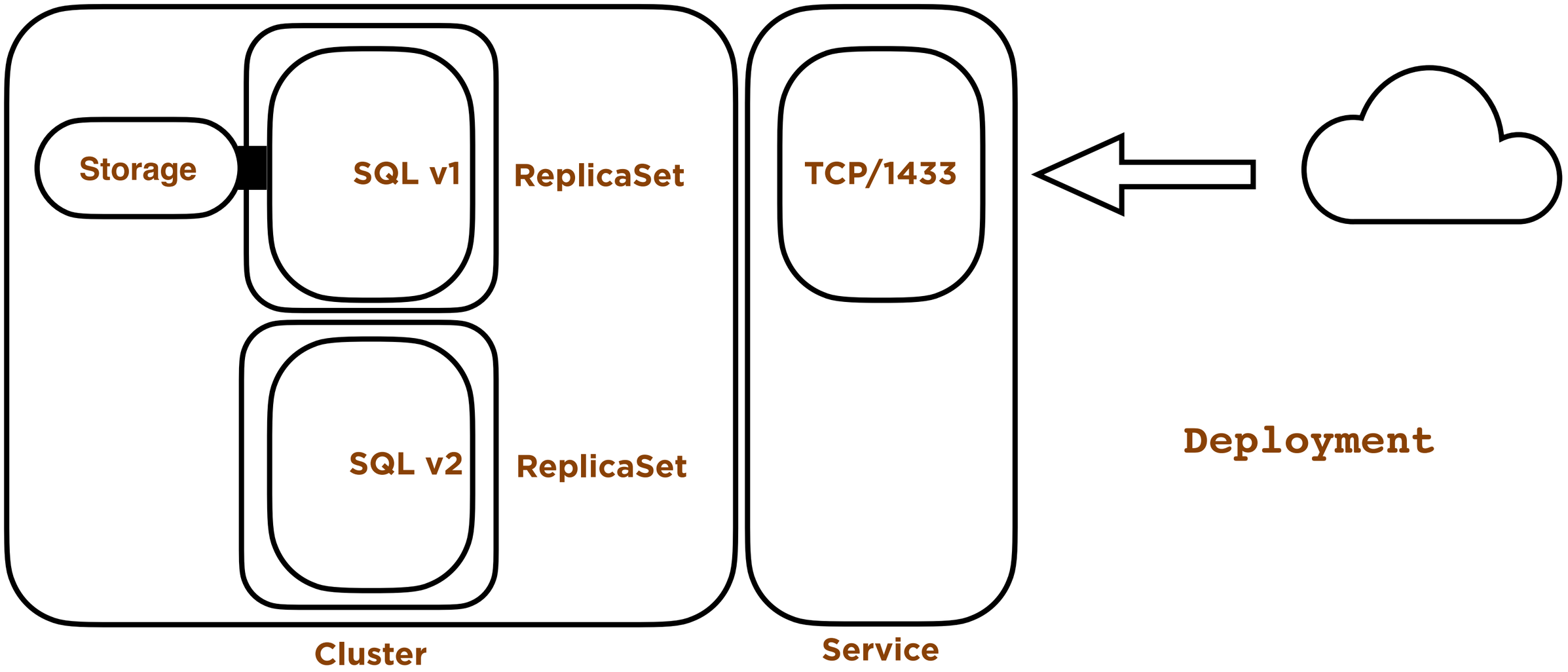
- Container Orchestrator
- Pods are Container Based Applications
- A Cluster is a Collection of Compute Resources
- Infrastructure Abstraction
- Declarative Configuration in Code
- Desired State

Running SQL Server in Kubernetes

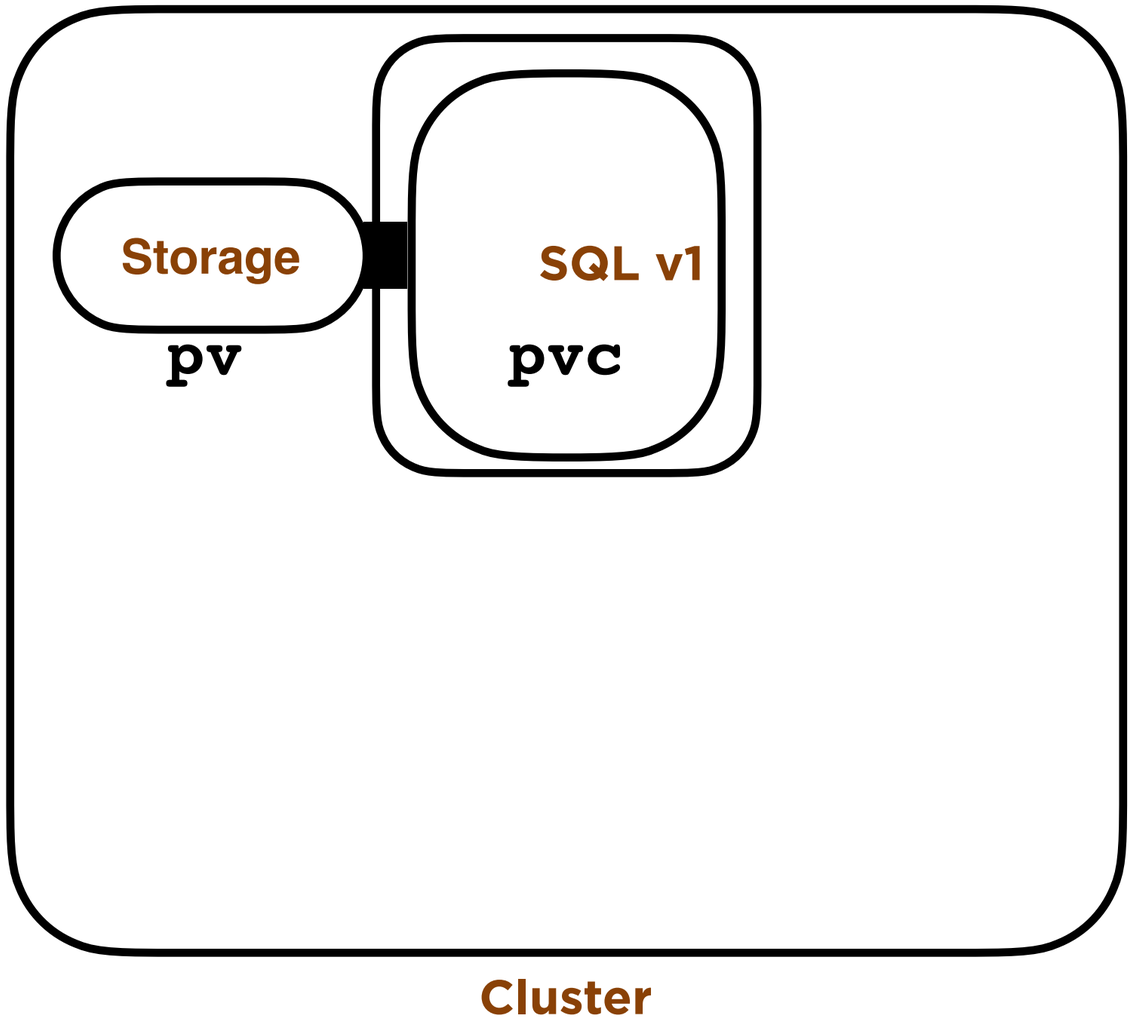
- A Pod goes back its initial state each time it’s deployed

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

Decoupling Data and Computation



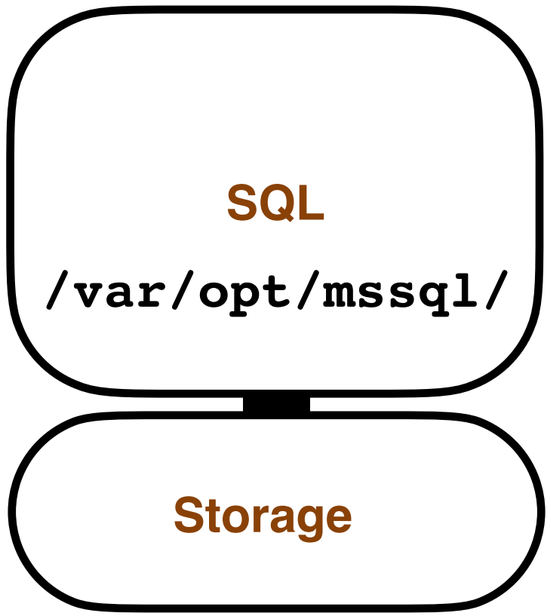
Storage in Kubernetes



- **`Persistent 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`**



Defining Persistent Volumes and Persistent Volume Claims

```yaml
apiVersion: v1
kind: PersistentVolume
metadata:
  name: pv-nfs-data
  labels:
    disk: data
spec:
  capacity:
    storage: 10Gi
  accessModes:
    - ReadWriteOnce
  persistentVolumeReclaimPolicy: Retain
  nfs:
    server: 172.16.94.5
    path: "/export/volumes/sql/data"
```

```yaml
apiVersion: v1
kind: PersistentVolumeClaim
metadata:
  name: pvc-nfs-data
spec:
  selector:
    matchLabels:
      disk: data
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 10Gi
```

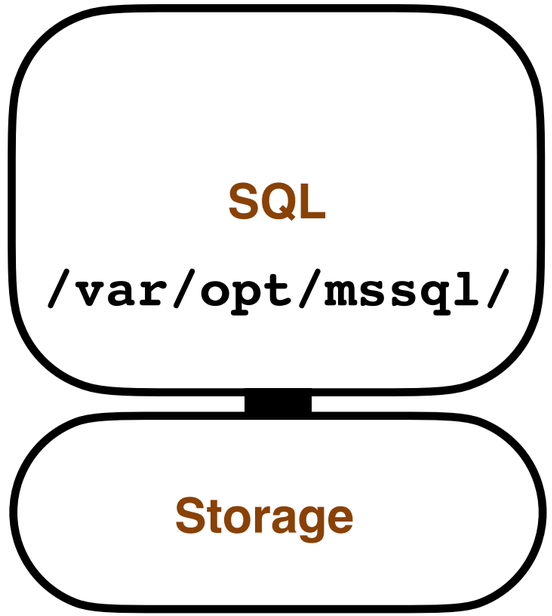
Configuring SQL Server in a Pod

- In our Pod configuration we define **Environment Variables**
  - Used at initial startup to configure the SQL Instance
    - **`ACCEPT_EULA`**
    - **`MSSQL_SA_PASSWORD`**
      - Stored in the cluster as a **`Secret`**
  - Pods go back their initial state of the container image on creation
  - But some settings are persisted in master, right…yep!

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

Running SQL Server in a Pod (con't)

- In our Pod configuration define our storage configuration (**`pvc`**)
- Initial Pod deployment
  - If there's no system databases in the default data directory…
    - **`/var/opt/mssql/data`**
  - They're copied into the default data directory from the SFPs
- On subsequent Pod deployments the storage is attached into the 'new' Pod
  - Databases are already there
  - Master is read…contains our instance's configuration and state
  - Defined and accessible user databases are brought online



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
```

```yaml
spec:
  hostname:
    sql01
  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
```

```yaml
volumeMounts:
- name: mssqldb
  mountPath: /var/opt/mssql
volumes:
- name: mssqldb
  persistentVolumeClaim:
    claimName: pvc-sql-data
```

Advanced Disk Topologies for SQL Server

- Define your **`Persistent Volumes`** and **`Persistent Volume Claims`**
- Use environment variables to specify default directories on Pod at startup
  - **`MSSQL_DATA_DIR (/data)`**
  - **`MSSQL_LOG_DIR (/log)`**
- New user databases will be created in these locations
- On Pod creation
  - All **`PV`**/**`PVCs`** will be mounted in the container at the defined locations
  - Master will online the databases

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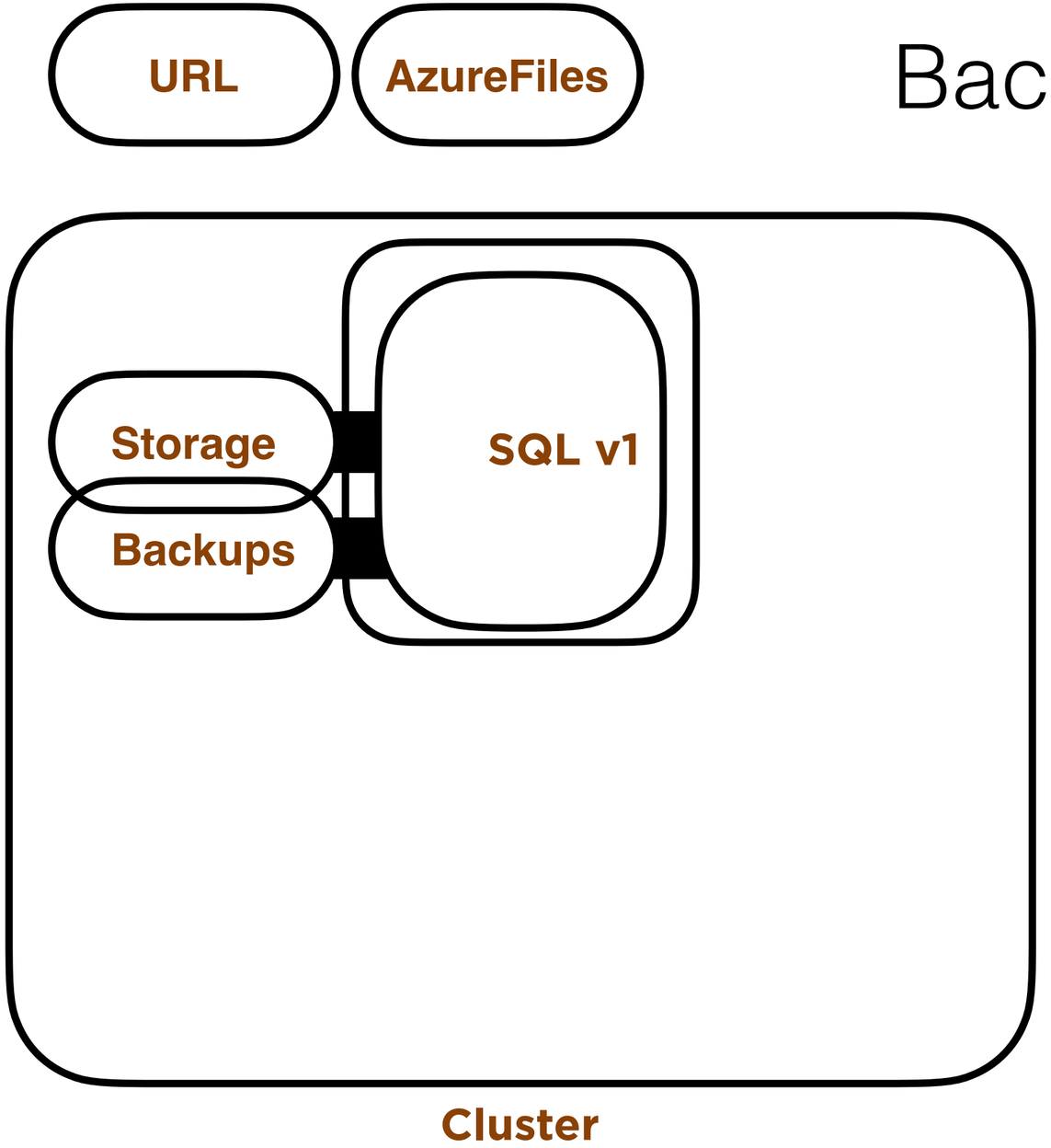
Resource Management

- Pod level resource management
  - CPU and Memory
    - **`requests`** - guarantee
    - **`limits`** - upper limit
  - No limits by default

```
containers:
– name: mssql
  image: '.../mssql/server:2019-CU5-ubuntu-18.04'
 resources
    requests:
      cpu: 1
      memory: 1Gi
```

- Server Instance settings still apply
- Kind of like multi-instance clusters
- Workload is stopped and started when moved between Nodes



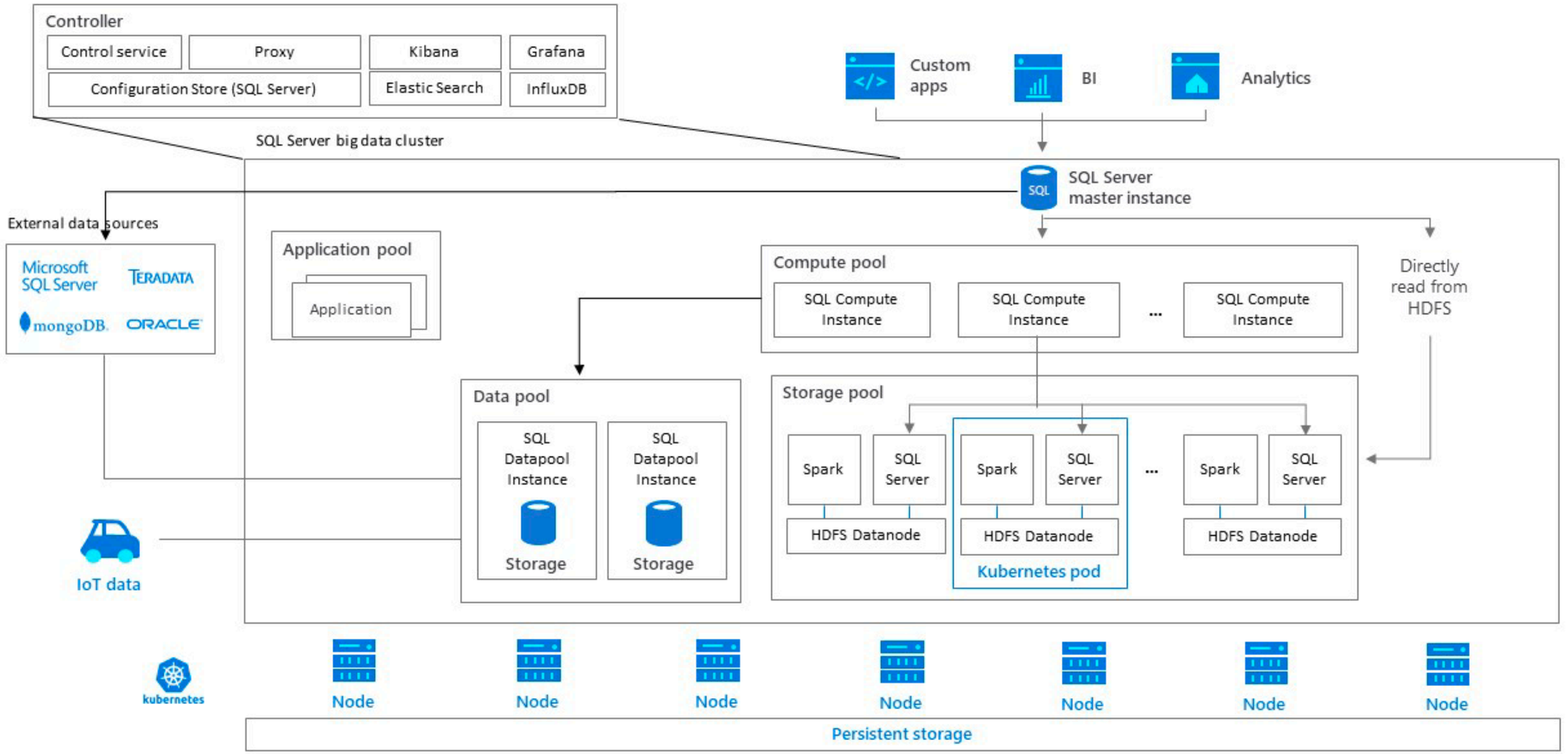
Backups!

- Persistent Volume (Shared or Dedicated)
  - AzureDisk
  - AzureFile
  - NFS/iSCSI/FC
- To URL
- Drive the backup jobs with normal techniques
  - Ola Hallengren's
  - Maintenance Plans
  - dbatools

Demo!

- Deploying SQL Server in a **`Deployment`** with Persistent Storage
  - Disk Topology
  - Setting Resource Limits
  - High Availability
  - Backing up SQL Server in Kubernetes

Big Data Clusters



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

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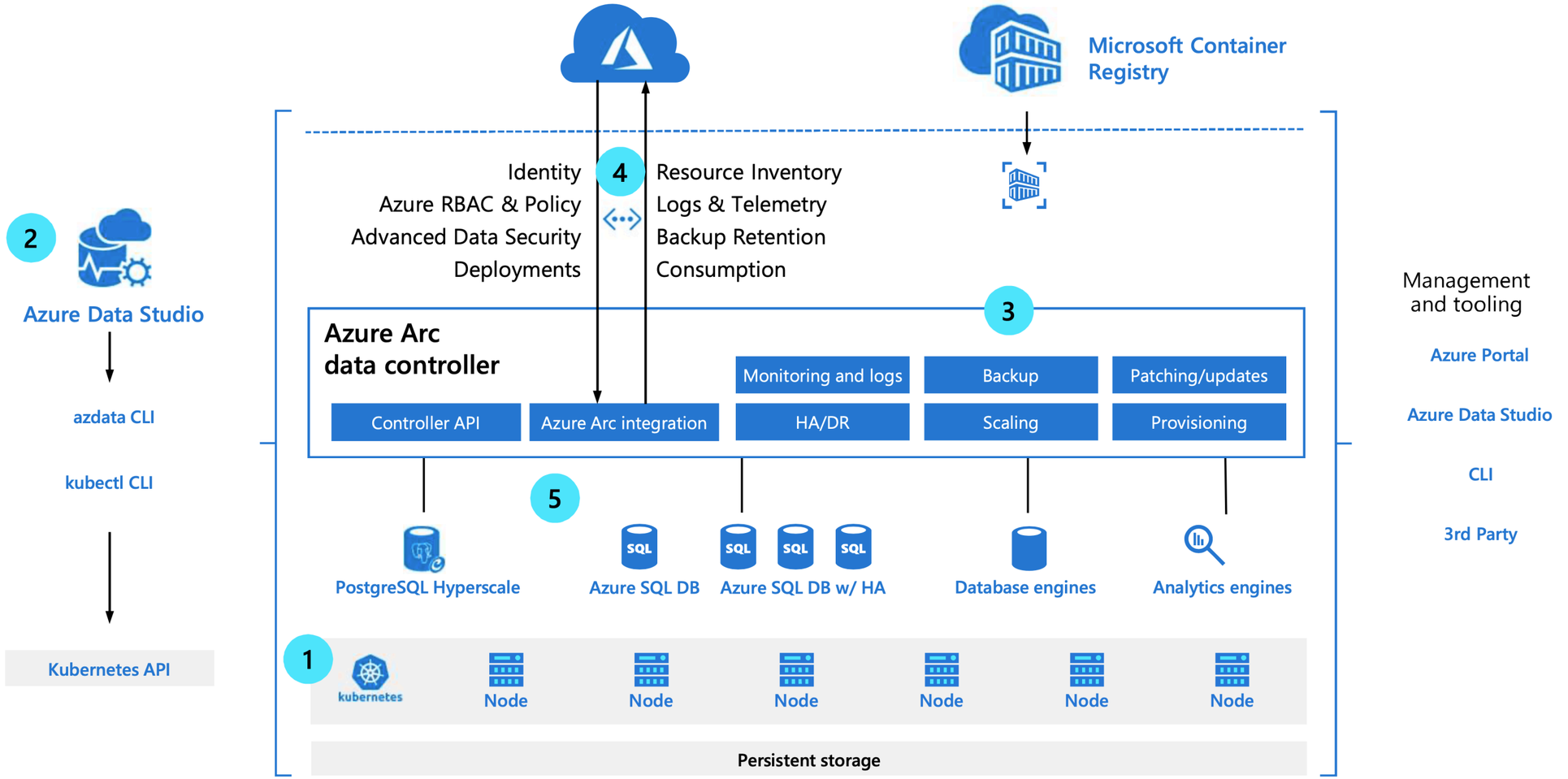
Azure Arc Enabled Data Services

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



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Review

- **Deploying SQL Server in Kubernetes**
  - Data Persistency and Storage in Kubernetes
  - Pod Configuration and Running SQL Server in a Pod
  - Disk and Resource Configurations
  - Backups
  - The Future of SQL Server and Kubernetes

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