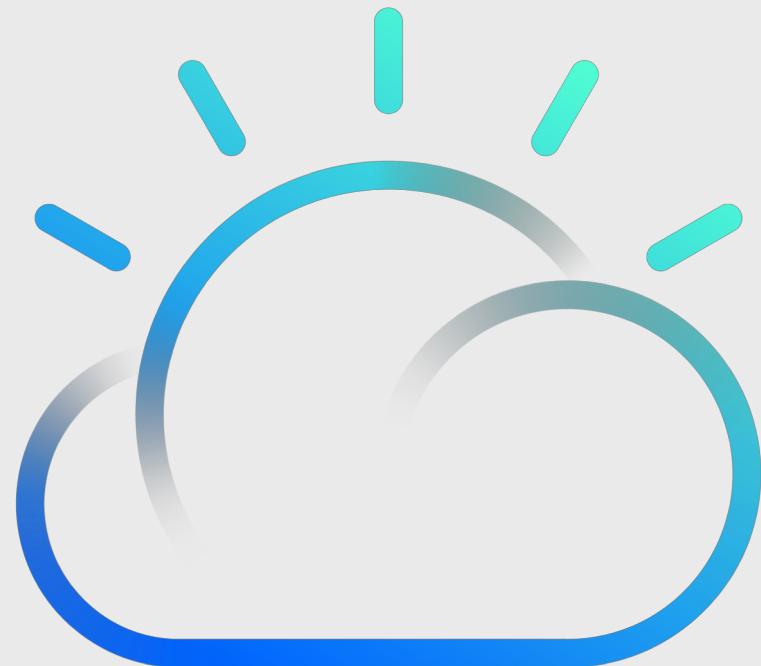


# IBM Cloud Private Architecture



**IBM Cloud**

**IBM**

# IBM Cloud Private Major Components

Topologies  
Nodes  
Services

# IBM Cloud Private Architecture

Components  
Interfaces  
Services

# **IBM Cloud Private Architecture**

Major Components

# Topologies

The ICP Kubernetes cluster consists of both mandatory and optional components. Consider the following typical topologies:

## Simple

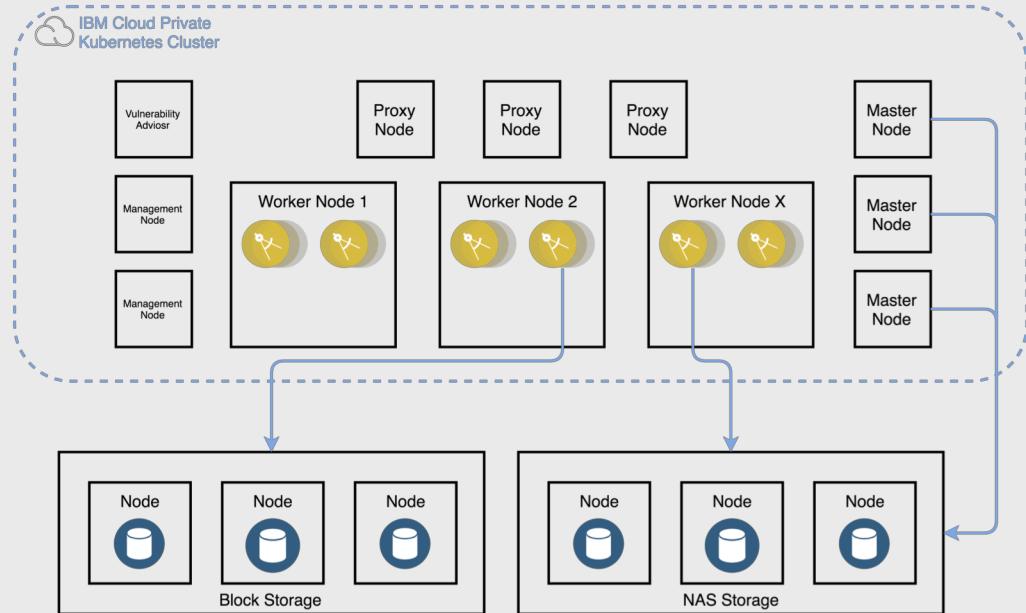
- Single machine install with the master node performing worker node duties
- Works well for learning the platform and testing basic workloads

## Standard

- 1 master, 1 proxy, 1 management, 3+ workers and optionally a Vulnerability Advisor node
- Great for non-production workloads and testing

## High Availability (Enterprise)

- 3, 5 or 7 masters, 10+ worker nodes, 3 proxies, 2+ management nodes, 1 or 3 Vulnerability Advisors
- Ideal for production and enterprise deployments



## Boot Node

A boot or bootstrap node is used for running IBM Cloud Private installation, configuration, node scaling, and cluster updates

Only one boot node is required for any cluster

You can use a single node for both master and boot and sharing this node is common

For convenience purposes and if you plan on performing multiple installations, it is advisable to create a standalone boot node

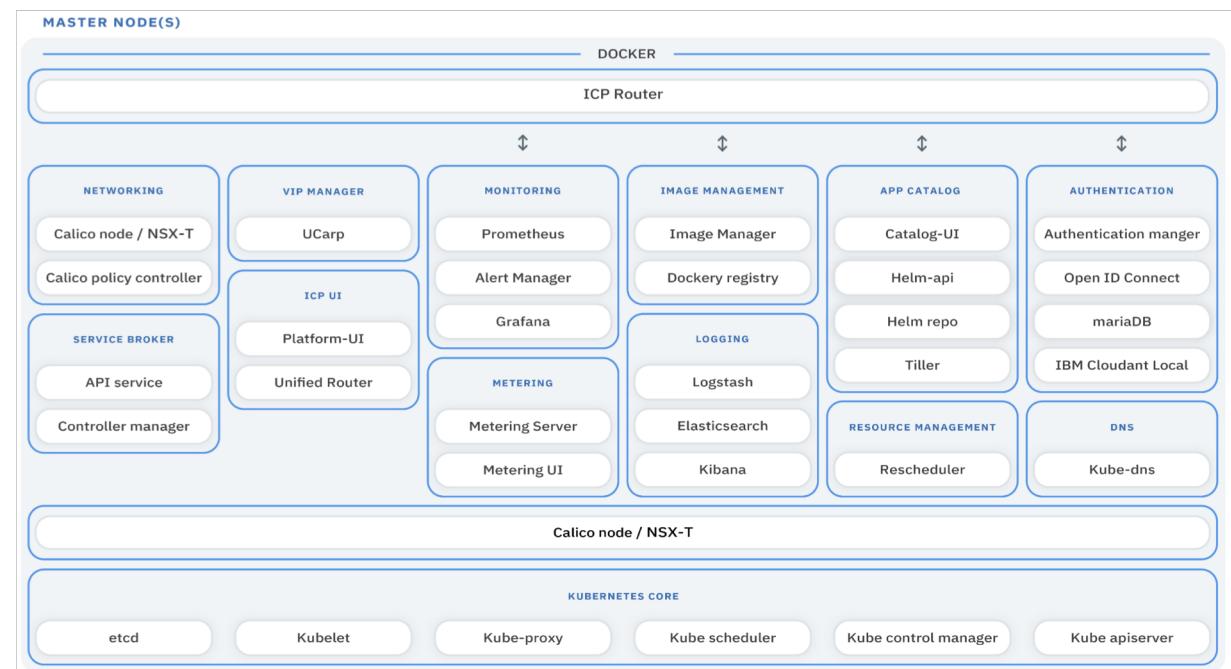
# Master Node

Provides management services and controls the worker nodes in a cluster

Master nodes host processes that are responsible for resource allocation, state maintenance, scheduling, and monitoring

Multiple master nodes are in a high availability (HA) environment to allow for failover if the leading master host fails

It is possible to load balance across multiple master nodes



## etcd Node

An etcd node is an optional node that is used for running the etcd distributed key value store that typically runs on the master nodes

Calico shares etcd with cluster management

Configuring an etcd node in an IBM Cloud Private cluster that has many nodes, such as 100 or more, helps to improve the etcd performance by separating workload from the master node(s)

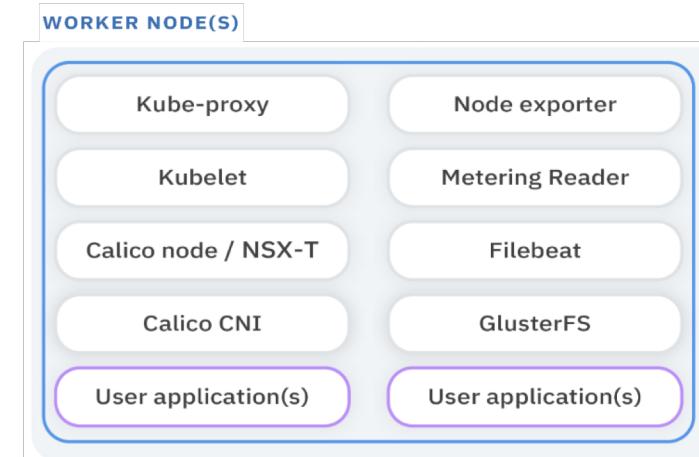
# Worker Node

Provides a containerized environment for running workload and tasks

Worker nodes can be added at any time to accommodate additional workload

Worker nodes can be drained and removed to scale down the capacity of the cluster

A cluster can contain any number of worker nodes, but a minimum of one worker node is required



## Proxy Node

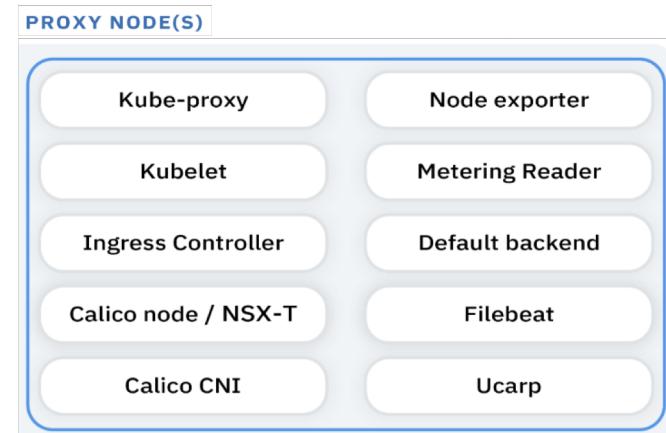
Transmits external request to the services created inside your cluster

Multiple proxy nodes are typically deployed for resiliency and scaling

While you can use a single node as both master and proxy, it is best to use dedicated proxy nodes to reduce the load on the master node

Configure traffic to use the proxy via the Ingress object

For ICP the proxy nodes run NGINX and can be configured / tuned via ConfigMaps



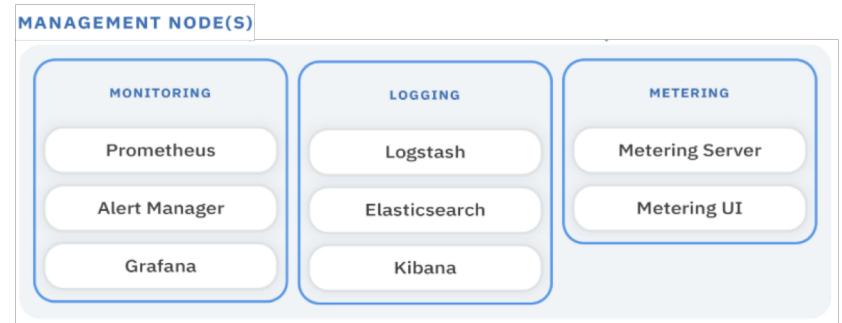
## Management Node

Optional node that only hosts management services such as monitoring, metering, and logging

By configuring dedicated management nodes, you can prevent the master node from becoming overloaded

Additional management nodes can be added post installation

Multiple management nodes do not natively provide for high availability



## Vulnerability Advisor (VA) Node

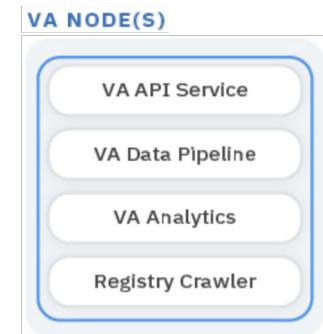
Optional node that is used for running the Vulnerability Advisor services

VA provides security management for Kubernetes environments

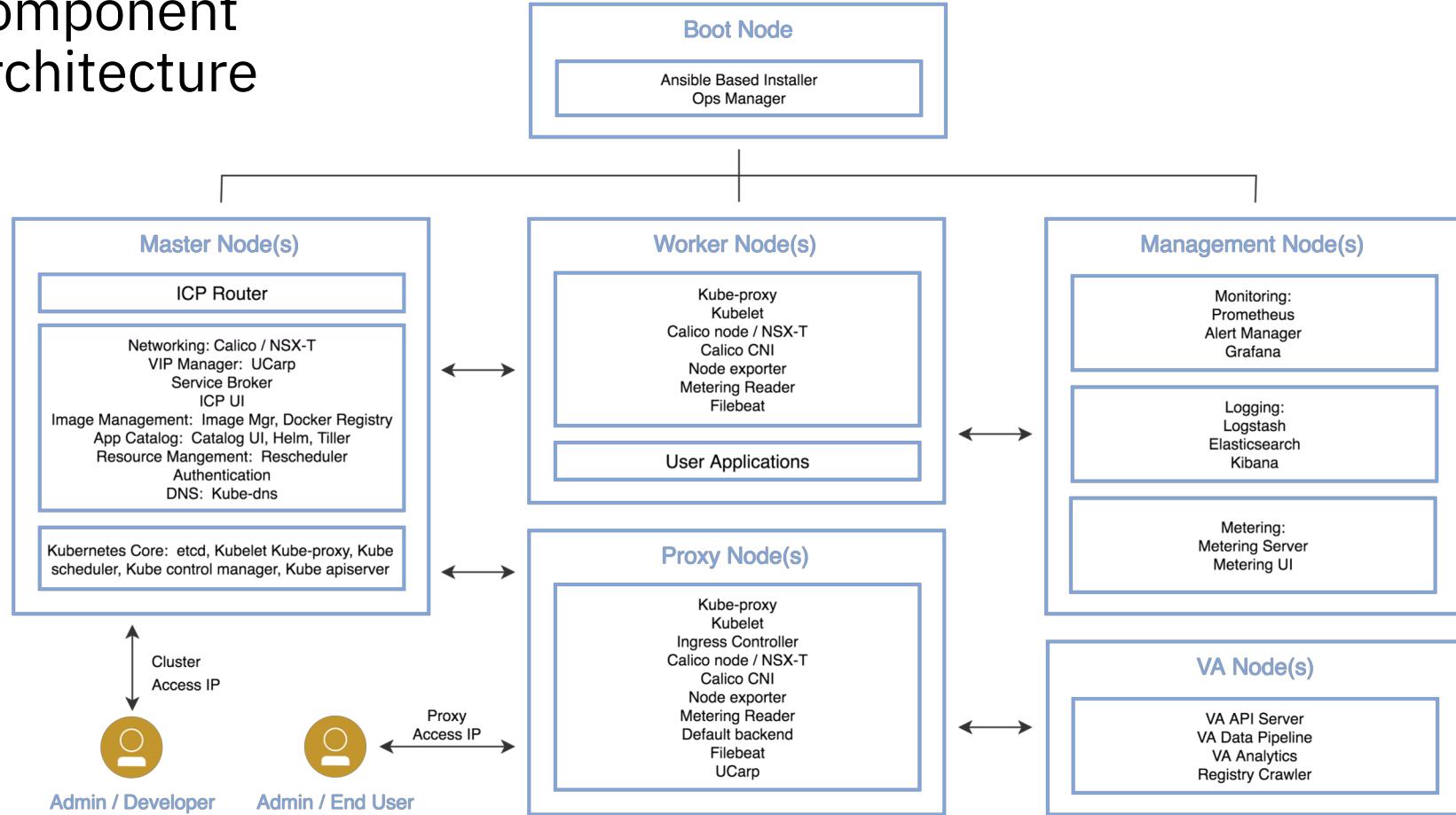
It generates a security status report suggesting fixes and best practices also providing management to restrict non-secure images from running

Can be added post cluster deployment

Can deploy multiple VA nodes to accommodate failover



# Component Architecture



# **IBM Cloud Private Architecture**

Components, Interfaces, Services

## Kubernetes Core Components

These primary components provide the cluster's control plane and global decisions about the cluster and detecting and responding to cluster events

**Etcd:** A strong, consistent, and highly-available key value store which Kubernetes uses for persistent storage of all of its API objects and also shares with Calico

**Kubelet:** The primary “node agent” that runs as a service on each of the cluster nodes

**K8s Proxy:** The Kubernetes network proxy runs on each node implementing a VIP for each of the services running in K8s (except the externalName service)

**K8s Scheduler:** A policy-rich, topology-aware, workload-specific function that significantly impacts availability, performance, and capacity of the cluster taking into consideration resource requirements, hardware / software / policy constraints, affinity specifications, data locality, inter-workload interference, etc.

## Kubernetes Core Components (continued)

**K8s Control Manager:** A controller is a control loop that watches the shared state of the cluster through the API Server and makes changes attempting to move the current state towards the desired state with the Control Manager being a daemon that embeds the core control loops shipped with K8s

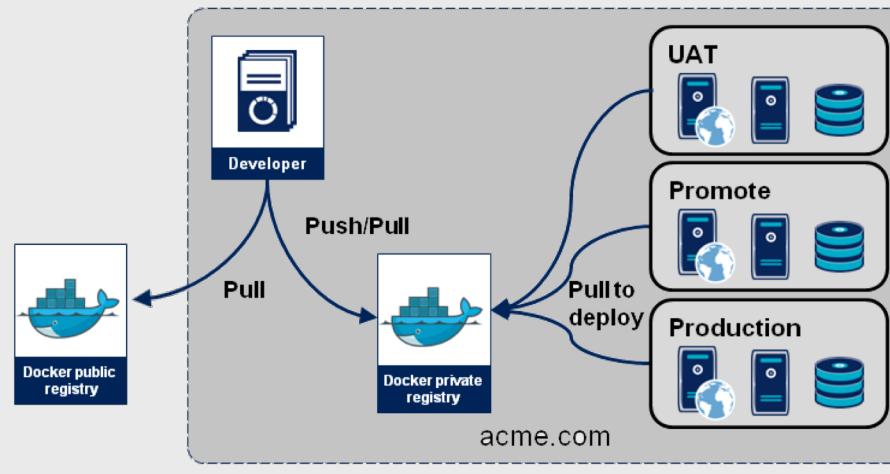
**K8s API Server:** Validates and configures data for the API objects which include pods, services, replication controllers, and others via REST operations providing the frontend to the cluster's shared state through which all other components interact

# Image Management

Runs as a layer over the Docker registry V2 API

Provider of management functions and authorization for image repositories that the Docker registry stores

Similar to the Docker Hub but with restrictions

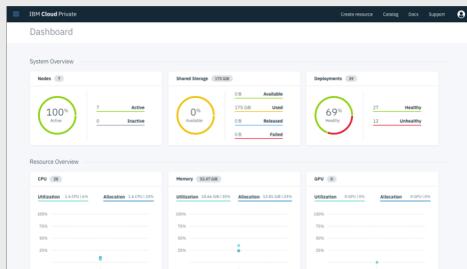


A screenshot of the IBM Cloud Private interface titled 'IBM Cloud Private' with the URL '172.16.3.20'. The page shows a table titled 'Images' with 20 items per page, displaying 1-20 of 20 items. The columns are 'NAME', 'OWNER', 'SCOPE', and 'ACTION'. The table lists various service names such as 'services/icam-boot-cds', 'services/icam-boot-mariadb', 'services/icam-boot-ui', 'services/icam-broker', 'services/icam-busybox', 'services/icam-iaas', 'services/icam-mongo', 'services/icam-orchestration', 'services/icam-portal-ui', 'services/icam-provider-helm', 'services/icam-provider-terraform', 'services/icam-proxy', 'services/icam-redis', and 'services/icam-service-composer-api'. Each row has an 'ACTION' column with three dots (...).

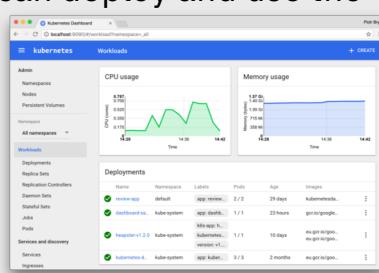
# User Interfaces

Several convenient ways to access the private cloud

**Cluster Management Console:** Manage, monitor, and troubleshoot your applications and cluster from a single, centralized, and secure management console



**K8s Web UI:** You can deploy and use the traditional K8s UI

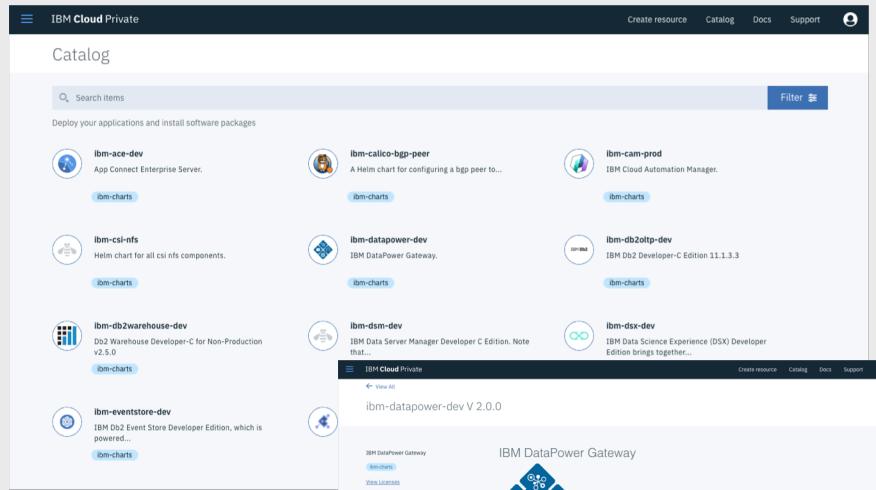


**CLIs:** Manage any / all aspects of your clusters, Kubernetes, charts, deployments etc. using your favorite command line tools such as the ICP CLI, K8s CLI, Helm and Calico interfaces / APIs

A central black silhouette of a person with a thought bubble above their head, with three arrows pointing from it to the three sections described in the text.

```
[root@ip-172-31-56-194 kubernetes]# export PATH=/home/ec2-user/kubernetes/platforms/linux/amd64:$PATH
[root@ip-172-31-56-194 kubernetes]# kubectl get nodes
NAME           LABELS
ip-172-20-0-138.ec2.internal   kubernetes.io/hostname=ip-172-20-0-138.ec2.internal   Ready   3m
ip-172-20-0-25.ec2.internal   kubernetes.io/hostname=ip-172-20-0-25.ec2.internal   Ready   20m
[root@ip-172-31-56-194 kubernetes]# kubectl run ttnd-nginx --image=nginx
replicationcontroller "ttnd-nginx" created
[root@ip-172-31-56-194 kubernetes]# kubectl get pods
NAME          READY   STATUS    RESTARTS   AGE
ttnd-nginx-wp2y9   0/1   Pending   0          8s
[root@ip-172-31-56-194 kubernetes]# kubectl get pods --namespace=kube-system
NAME          READY   STATUS    RESTARTS   AGE
elasticsearch-logging-v1-mcd2q   1/1   Running   0          23m
elasticsearch-logging-v1-mmqm   1/1   Running   0          23m
fluentd-elasticsearch-ip-172-20-0-138.ec2.internal   1/1   Running   0          3m
fluentd-elasticsearch-ip-172-20-0-25.ec2.internal   1/1   Running   0          28m
heptester-v1-eco91   1/1   Running   0          23m
kibana-logging-v1-slamn   1/1   Running   0          23m
kube-dns-v9-7pe5g   4/4   Running   0          23m
kube-ui-v2-057a   1/1   Running   0          23m
monitord-75455d446d-kdbd-grafana-v2-mg2vo   2/2   Running   0          23m
[root@ip-172-31-56-194 kubernetes]#
[root@ip-172-31-56-194 kubernetes]# kubectl get pods
NAME          READY   STATUS    RESTARTS   AGE
ttnd-nginx-wp2y9   0/1   Running   0          36s
```

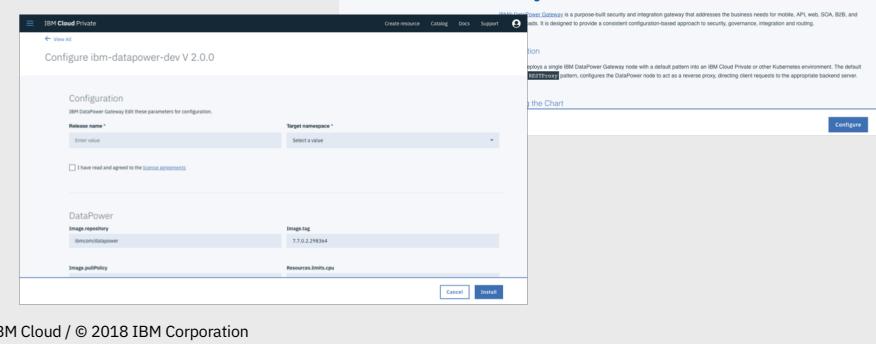
# Catalog



The screenshot shows the IBM Cloud Private Catalog interface. At the top, there's a search bar labeled "Search items" and a "Filter" button. Below the search bar, a message says "Deploy your applications and install software packages". A grid of application icons and names is displayed:

- ibm-ace-dev
- ibm-calico-bgp-peer
- ibm-cam-prod
- ibm-csi-efs
- ibm-datapower-dev
- ibm-db2oltp-dev
- ibm-db2warehouse-dev
- ibm-dsm-dev
- ibm-dsx-dev
- ibm-eventstore-dev
- ibm-datapower-dev V 2.0.0

Each item has a brief description and a "View All" link below it.

This screenshot shows the configuration interface for the "ibm-datapower-dev V 2.0.0" chart. It includes fields for "Release name" (with a dropdown for "Select a value"), "Target namespace" (with a dropdown for "Select a value"), and "Image repository" (set to "ibmdatapower" with tag "3.7.0.2.298394"). There are also sections for "DataPower" and "Image pull policy". At the bottom are "Cancel" and "Install" buttons.

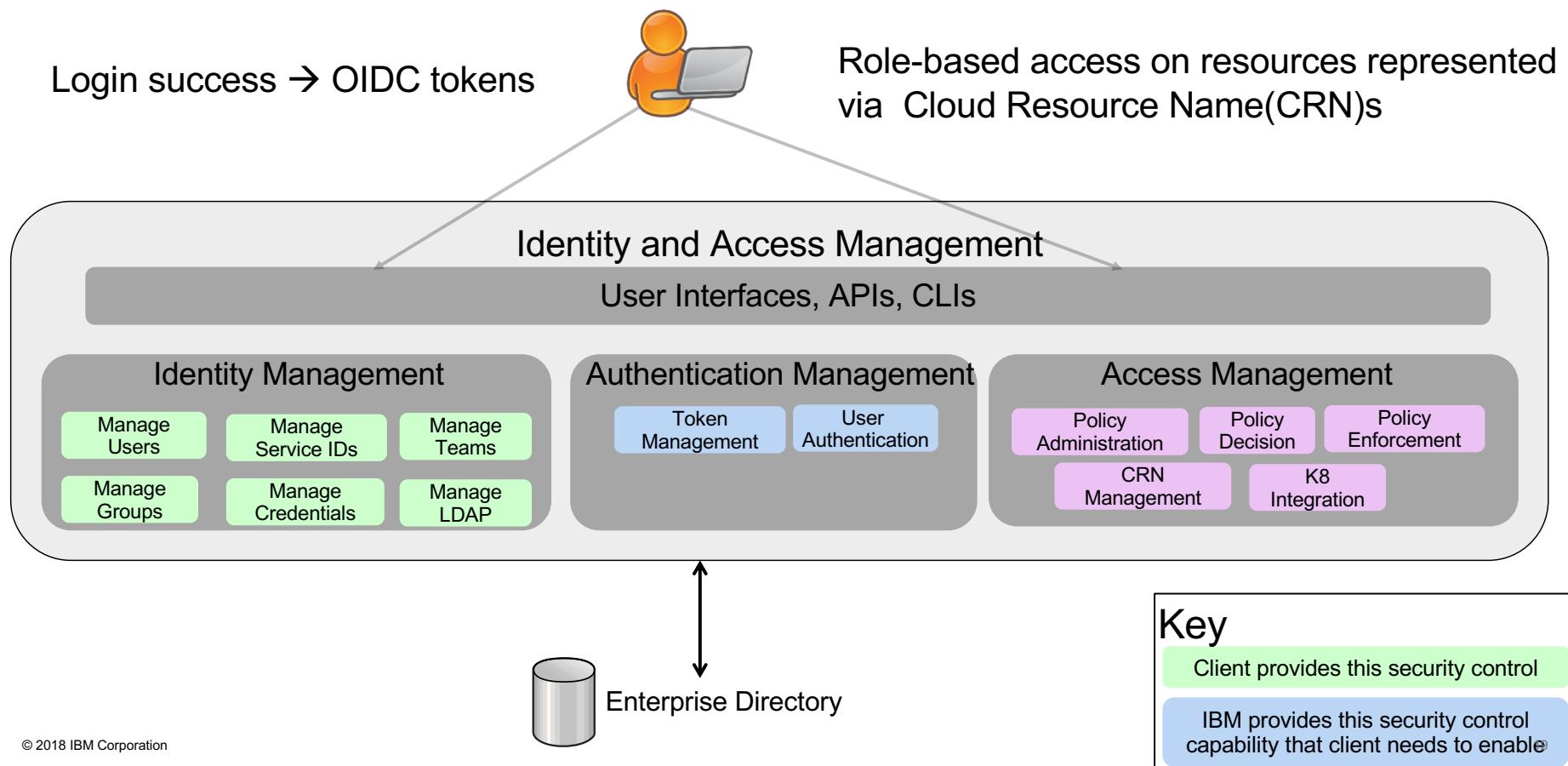
The catalog provides a centralized location from which you can browse, and install applications and software packages in your cluster

**Helm:** A tool for managing Kubernetes packages of pre-configured Kubernetes resources called “charts”

**Helm Repository:** A Helm chart repository is a location where packaged charts can be stored and shared

**Tiller:** Runs inside of the cluster, and manages releases (installations) of your charts

# Identity and Access Management (IAM)



# DNS

Every Service defined in the cluster gets a CNAME record in the cluster DNS

Only Services can be resolved by the DNS service

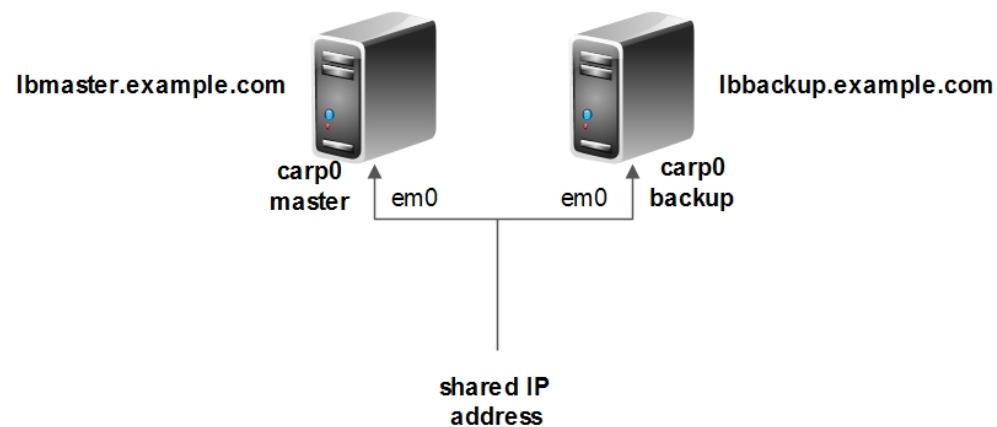
Name resolution is based upon namespace and the service name can also be resolved from outside of the name space by appending .<namespace>

```
web-terminal@webbterm-ibm-webterminal-6bf989c956-nrtfv:~$ kubectl get svc
NAME           TYPE      CLUSTER-IP   EXTERNAL-IP  PORT(S)        AGE
csi-attacher-nfsplugin  ClusterIP  10.0.0.104  <none>       12345/TCP    1d
details         ClusterIP  10.0.0.144  <none>       9080/TCP     5d
dx9-digitalexperience ClusterIP  10.0.0.218  <none>       30015/TCP    14d
kubernetes      ClusterIP  10.0.0.1    <none>       443/TCP      54d
my-nginx-service ClusterIP  10.0.0.248  <none>       80/TCP       32d
my-other-service ClusterIP  10.0.0.252  <none>       80/TCP       32d
nginx-np-service  NodePort    10.0.0.225  <none>       80:31357/TCP 32d
productpage     ClusterIP  10.0.0.45   <none>       9080/TCP    5d
ratings          ClusterIP  10.0.0.126  <none>       9080/TCP    5d
reviews         ClusterIP  10.0.0.157  <none>       9080/TCP    5d
webbterm-ibm-webterminal NodePort    10.0.0.204  <none>       3000:31864/TCP 6d
web-terminal@webbterm-ibm-webterminal-6bf989c956-nrtfv:~$ ping reviews
PING reviews.default.svc.cluster.local (10.0.0.157) 56(84) bytes of data.
```

# VIP and UCarp / etcd

## kube-dns / Cluster DNS

UCarp / etcd allows multiple hosts to share common virtual IP (or floating IP) addresses in order to provide automatic failover

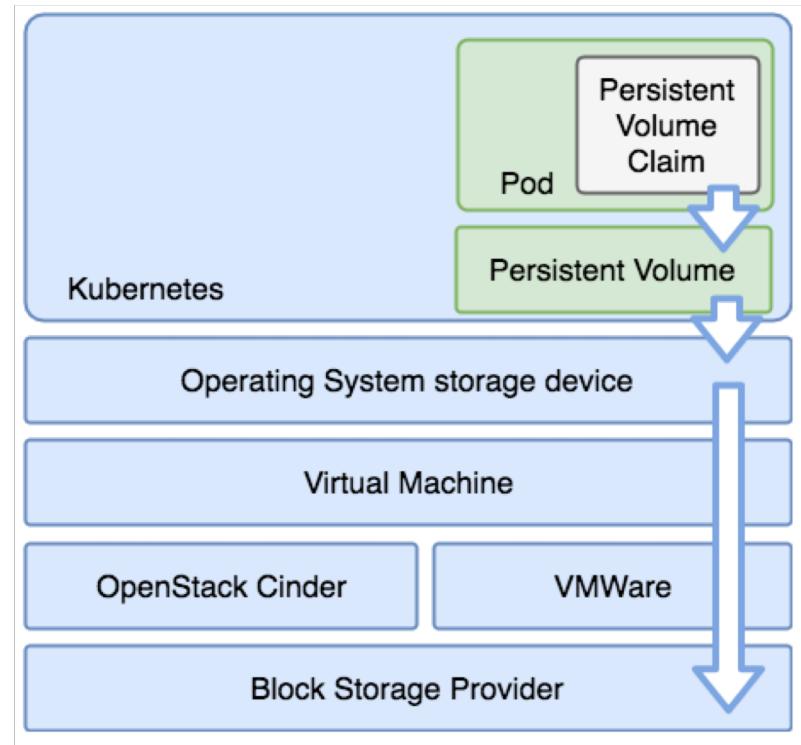


# Persistent Storage

**Persistent Volume** is a storage resource within the cluster. PVs have a lifecycle independent of any individual pod that uses it. This API object encapsulates the details of the storage implementation or cloud-provider-specific storage system.

A **Persistent Volume Claim** is a storage request, or claim, made by the developer. Claims request specific sizes of storage, as well as other aspects such as access modes.

A **StorageClass** describes an offering of storage and allow for the dynamically provisioning of PVs and PVCs based upon these controlled definitions.



# IBM Cloud Private Storage Providers

Kubernetes and IBM Cloud Private offer many options for managing persistent storage within the cluster. ICP features the following:



**GlusterFS** enterprise grade of storage to K8s pods offering ease of configuration, scaling, encryption support, replication, striping and dynamic provisioning.



**vSphere Cloud Provider (vSphereVolume Plugin)** gives access to enterprise grade storage (vSAN, VMFS, Vvol) that is native to and already supported by the VMware infrastructure.



**IBM Spectrum Scale** for solutions not hosted in VMware provides direct access to IBM block storage via dynamic provisioning.



**NFS** provides a versatile and easy to use method of getting persistent storage to pods that is already available in most customer environments.



**HostPath** is ideal for testing persistence in non-production environments.



**Ceph (Rook)** is an industry proven option that can provide several storage options along with persistent volumes for Kubernetes

# Logging

## ELK / Elastic Stack

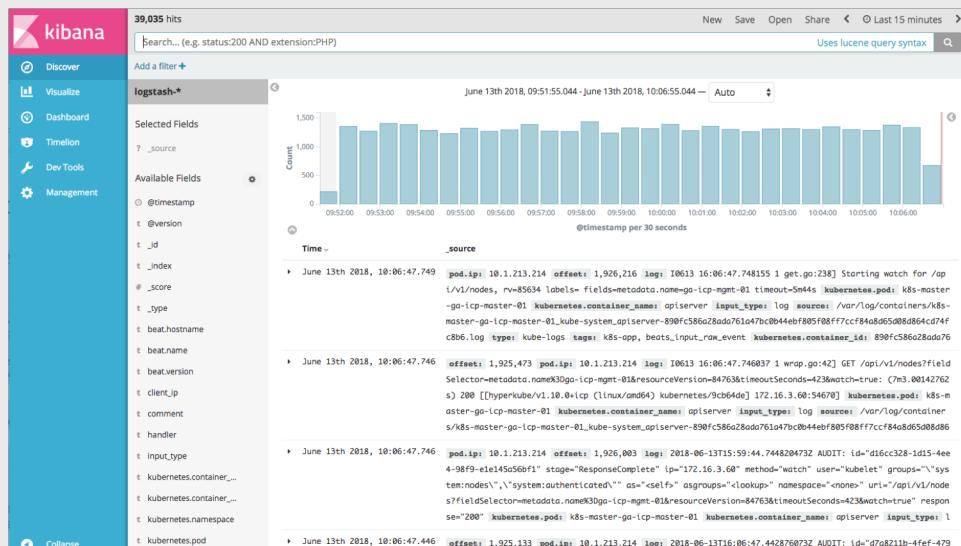
**Filebeat:** A log data shipper for local files. Filebeat monitors the log directories or specific log files, tails the files, and forwards them either to [Elasticsearch](#) and/or [Logstash](#) for indexing

**Elasticsearch:** An open source full-text search engine based on Lucene. It provides HTTP web interface and schema-free JSON documents

**Logstash:** A open source tool for collecting, parsing, and storing logs for future use.

**Heapster:** The Kubernetes network proxy runs on each node

**Kibana:** An open source data visualization plugin for Elasticsearch. Users can create bar, line and scatter plots, or pie charts and maps on top of large volumes of data



# Monitoring

## Prometheus and Grafana

**Prometheus:** An open-source systems monitoring and alerting toolkit originally built at [SoundCloud](#). Since its inception in 2012, many companies and organizations have adopted Prometheus, and the project has a very active developer and user [community](#). It is now a standalone open source project and maintained independently of any company.

**Grafana:** An open-source, general purpose dashboard and graph composer, which runs as a web application.



# Network Overlay



PROJECT  
**CALICO**

A new approach to virtual networking and network security for containers, VMs, and bare metal services, that provides a rich set of security enforcement capabilities running on top of a highly scalable and efficient virtual network

- The calico/node Docker container runs on the Kubernetes master and each Kubernetes node in the cluster
- The calico-cni plugin integrates directly with the Kubernetes kubelet process on each node to discover which pods have been created, and adds them to Calico networking
- The calico/kube-policy-controller container runs as a pod on top of Kubernetes and implements the NetworkPolicy API
- Calico makes use of Layer 3

Calico network policy enforcement ensures that the only packets that flow to and / or from a workload are the ones the developer expects

# Ingress Resources

Ingress, Ingress Controller, Proxy

**Ingress:** Typically, services and pods have IPs only routable by the cluster network. All traffic that ends up at an edge router is either dropped or forwarded elsewhere.

- An Ingress is a collection of rules that allow inbound connections to reach the cluster services
- It can be configured to give services externally-reachable URLs, load balance traffic, terminate SSL, offer name based virtual hosting etc.
- Users request ingress by POSTing the Ingress resource to the API server

**Ingress Controller:** Responsible for fulfilling the Ingress, usually with a load balancer, though it may also configure your edge router or additional frontends to help handle the traffic in an HA manner

# IBM Transformation Advisor

Transformation Advisor is a tool that **consumes information about your WebSphere Environment and Applications.** These inputs are combined with rules and insights gained from years of working with WebSphere and WebSphere applications to provide recommendations for your cloud journey.

## CHALLENGES

- Leverage existing application logic
- Need to accelerate application development and maintenance
- Monolithic applications that are complex and brittle

## BENEFITS

- Included and deployed on IBM Cloud Private
- Introspects existing WebSphere Deployments
- THE source of truth
- Provides recommendations for Application Modernization

Welcome to Transformation Advisor.

We know that migrating your legacy applications to the cloud can be overwhelming and difficult. Transformation Advisor will help you take your first step towards getting your legacy WebSphere applications onto IBM Cloud Private.



Tired of this top section? [Hide it](#)

Let's get started.

Choose a workspace. [?](#)

Add a new workspace



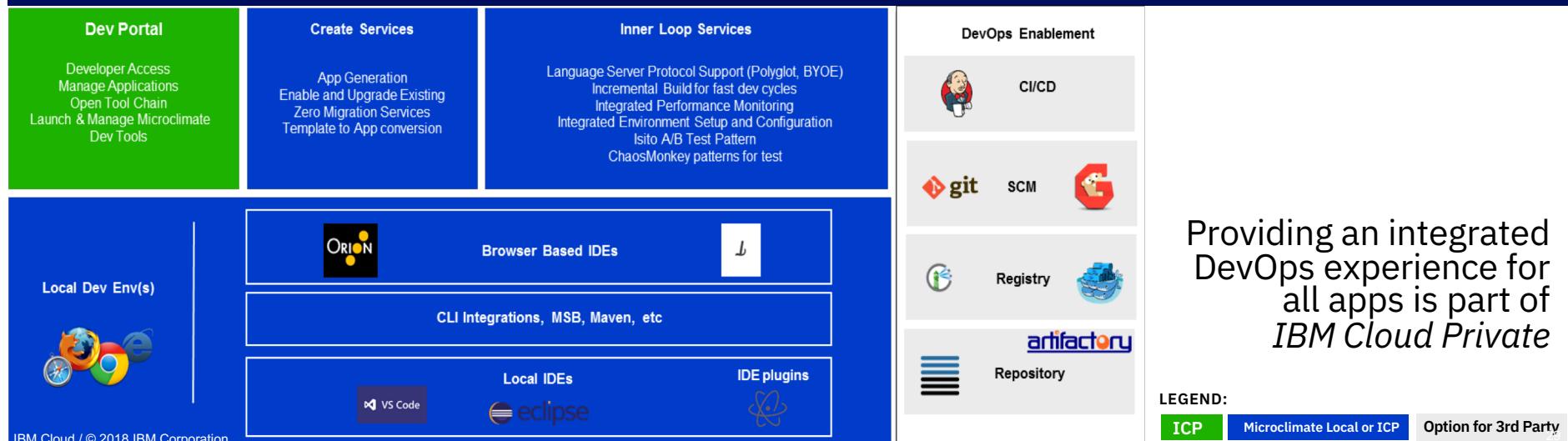
You have no workspaces, try creating one!

*Enabling app modernization for our existing estates is part of IBM Cloud Private*

# IBM Microclimate

Microclimate is an **end to end development environment that lets you rapidly create, edit, and deploy applications.**

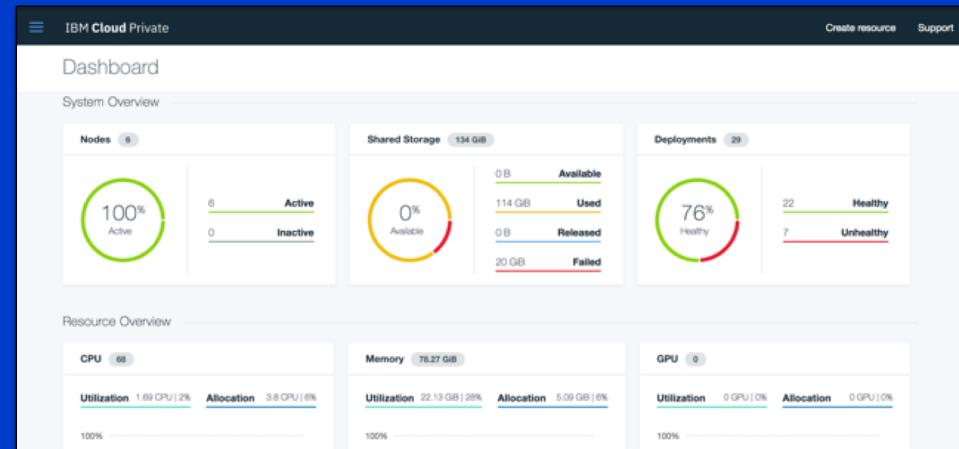
Applications are run in **containers** from day one and can be delivered into production on **Kubernetes** through an automated DevOps pipeline using **Jenkins**. Microclimate can be installed locally or on **IBM Cloud Private**.



# Try IBM Cloud Private today!

Guided and Proof of  
Technology demos

Free Community Edition!



<http://ibm.biz/ICP-DTE>

