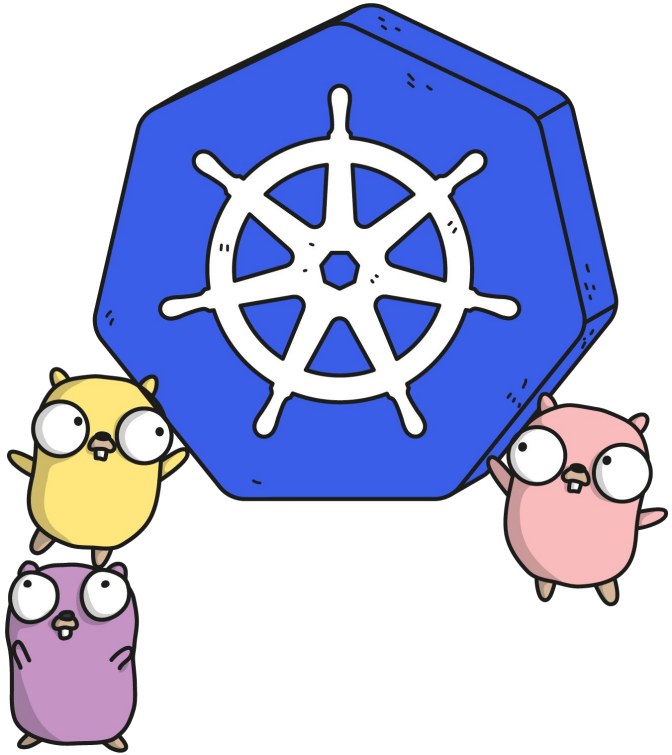
CLOUDRAFT

Kubernetes for Beginners

Anjul Sahu, CEO, Cloudraft



@anjuls /in/anjul

Kubernetes Gopher by Ashley McNamara
Last Updated: 7 July 2023

About Me

- Founder and CEO, **Cloudraft**
- Organizer - Kubernetes & Cloud Native Indore
- Previously worked at Lummo, InfraCloud, and Accenture
- 15 yrs exp. spanning DBA, Tech Arch, Cloud, DevOps, Cloud native platforms
- Alumni of SGSITS IT 2008
- Apart from work, I do writing, mentoring and travel
- Connect with me → linktr.ee/anjulsahu
- Cloud Native Weekly - anjulsahu.substack.com

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Agenda

- What is Kubernetes?
- Evolution of Kubernetes
- Why Kubernetes?
- Kubernetes Architecture
- Running Kubernetes Clusters
- Primitive Kubernetes Objects
- Interacting with cluster - Kubectl, APIs
- Q&A

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What is Kubernetes?

Poll

- How many of you have some idea of Kubernetes?
- How old is the Kubernetes project?

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Kubernetes

- Open source container orchestrator (2014, Google)
- Second largest open source project after Linux
- Run your containerized workload and manage its lifecycle
- Other popular options - Mesos, Nomad, Docker Swarm and some proprietary ones.
- Foundation for building platforms
- Open API, extensible system
- Declarative
- Run on anything - baremetal, VM, Cloud, Edge, IOT, Raspberry Pi etc

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Kubernetes Stats, Jun 2023

74,680+

Contributors

71%

Fortune 100 companies

7,812+

Contributing companies

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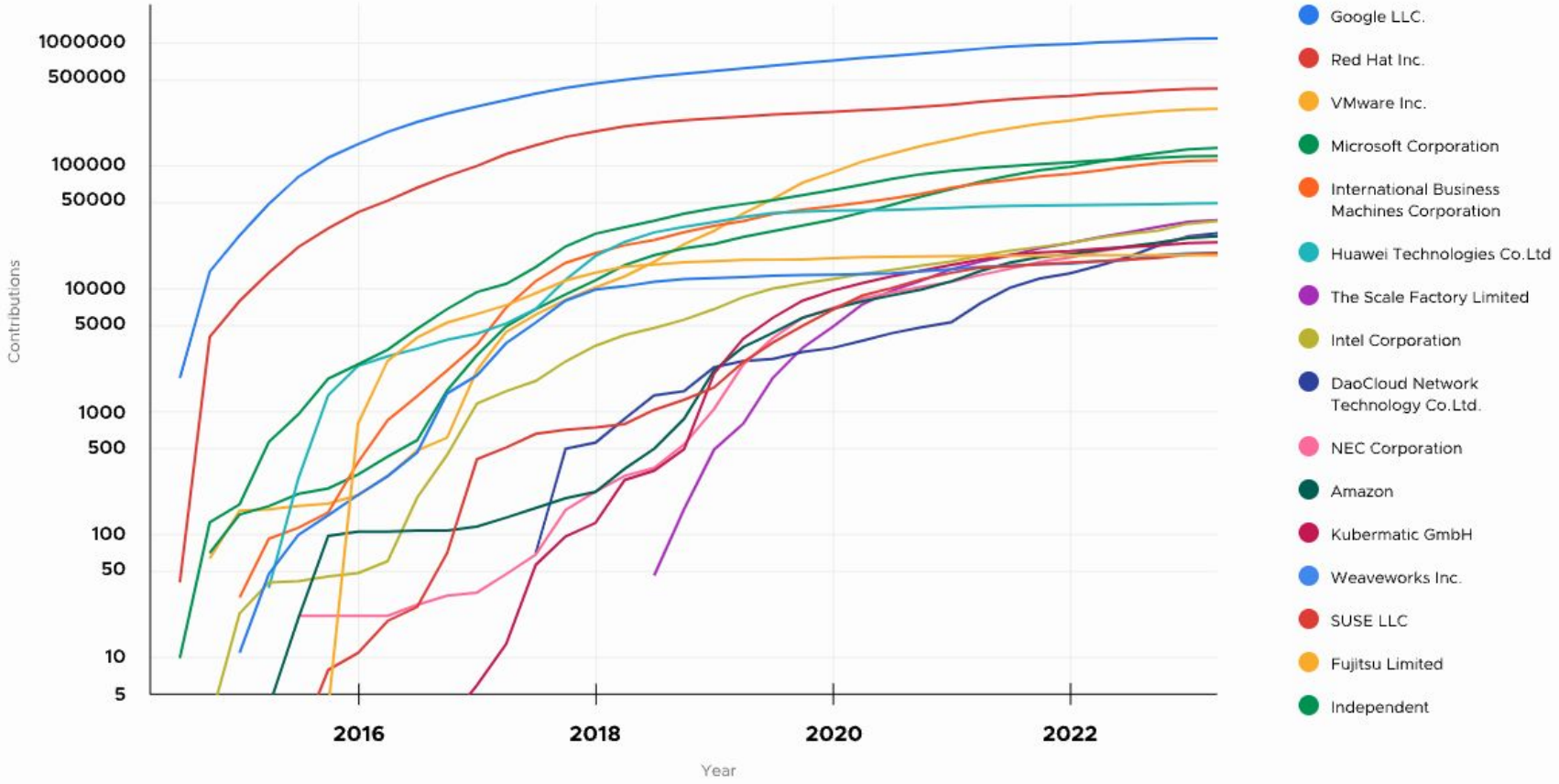
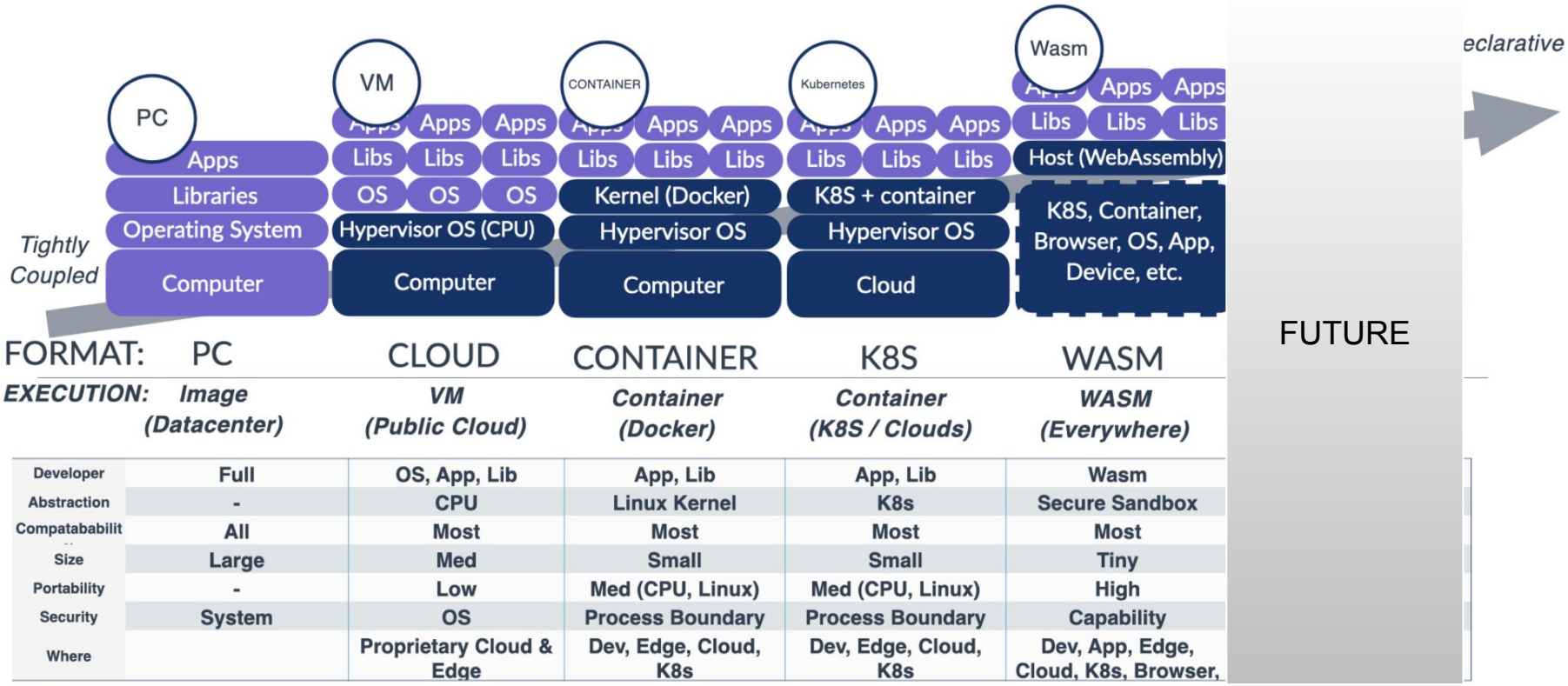
Cumulative growth of Kubernetes contributions by company Q2 2014 – Q2 2023



Evolution of Kubernetes

Credits: Cosmonic



FORMAT:	PC	CLOUD	CONTAINER	K8S	WASM
EXECUTION:	***Image (Datacenter)***	***VM (Public Cloud)***	***Container (Docker)***	***Container (K8S / Clouds)***	***WASM (Everywhere)***
Developer	Full	OS, App, Lib	App, Lib	App, Lib	Wasm
Abstraction	-	CPU	Linux Kernel	K8s	Secure Sandbox
Compatabilit	All	Most	Most	Most	Most
Size	Large	Med	Small	Small	Tiny
Portability	-	Low	Med (CPU, Linux)	Med (CPU, Linux)	High
Security	System	OS	Process Boundary	Process Boundary	Capability
Where		Proprietary Cloud & Edge	Dev, Edge, Cloud, K8s	Dev, Edge, Cloud, K8s	Dev, App, Edge, Cloud, K8s, Browser,

cosmonic

Legend: Developer Provided / Device / Computer

Borg

Large-scale cluster management at Google with Borg

Abhishek Verma† Luis Pedrosa‡ Madhukar Korupolu
David Oppenheimer Eric Tune John Wilkes

Google Inc.

Abstract

Google's Borg system is a cluster manager that runs hundreds of thousands of jobs, from many thousands of different applications, across a number of clusters each with up to tens of thousands of machines.

It achieves high utilization by combining admission control, efficient task-packing, over-commitment, and machine sharing with process-level performance isolation. It supports high-availability applications with runtime features that minimize fault-recovery time, and scheduling policies that reduce the probability of correlated failures. Borg simplifies life for its users by offering a declarative job specification language, name service integration, real-time job monitoring, and tools to analyze and simulate system behavior.

We present a summary of the Borg system architecture and features, important design decisions, a quantitative analysis of some of its policy decisions, and a qualitative examination of lessons learned from a decade of operational

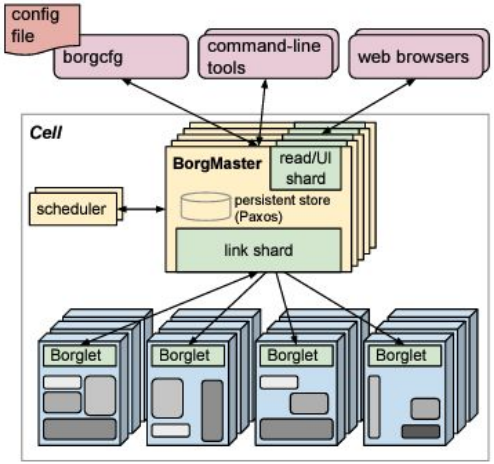


Figure 1: The high-level architecture of Borg. *Only a tiny fraction of the thousands of worker nodes are shown.*

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Why Kubernetes (K8S)?

Why most of the companies are using K8S?

- Microservice based architecture requires containers & orchestration
- Used to manage cross-cutting concerns effectively
- Increased efficiency in Operations
- Standardization (local, cloud, multi-cloud or edge) and portability
- Autoscaling, HA, load balancing, advanced deployment strategies and scheduling
- Extensible platform
- Strong ecosystem and open source

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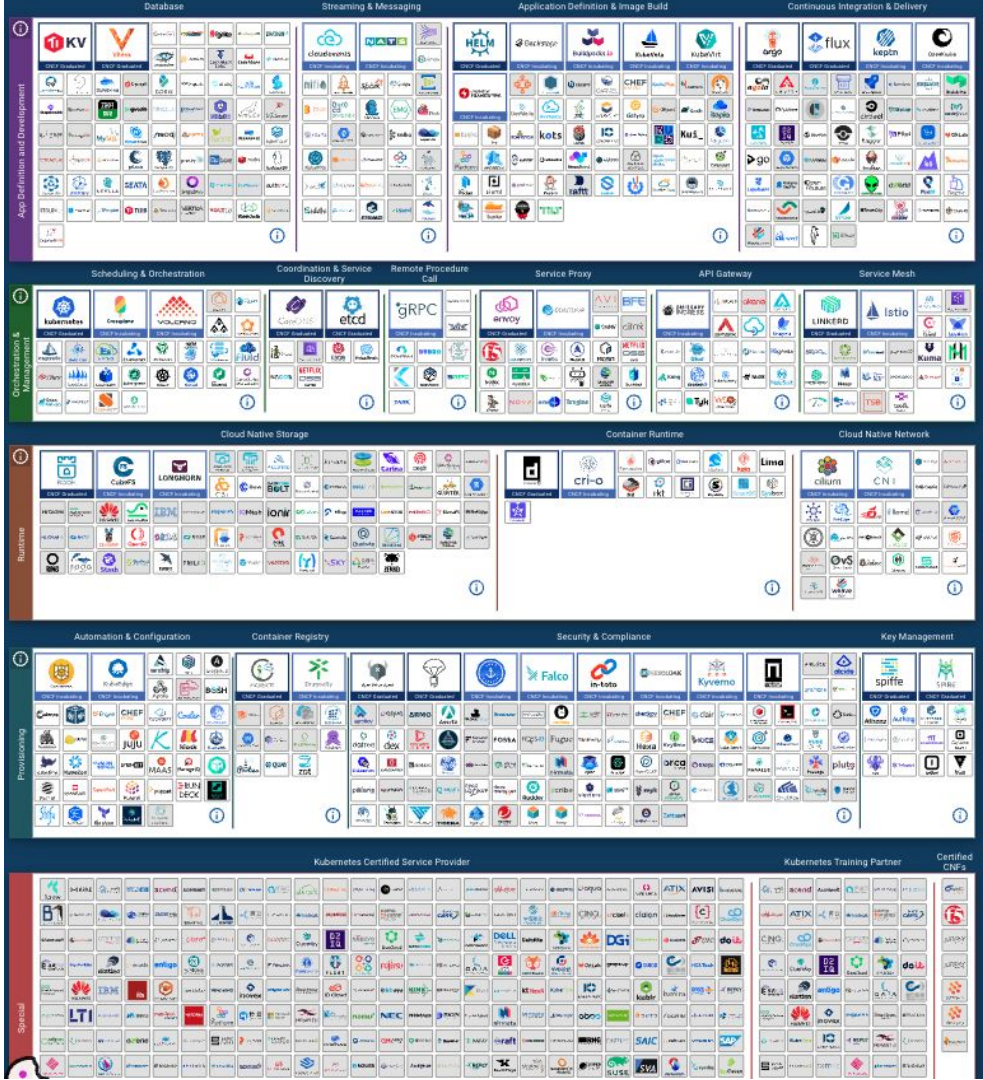
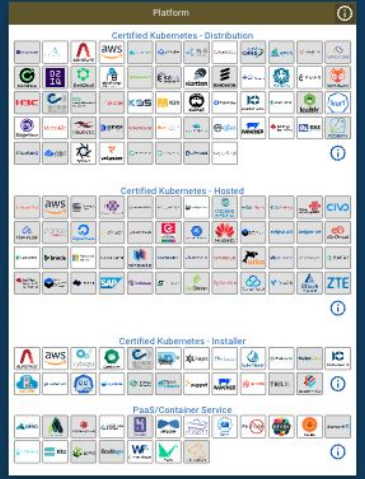
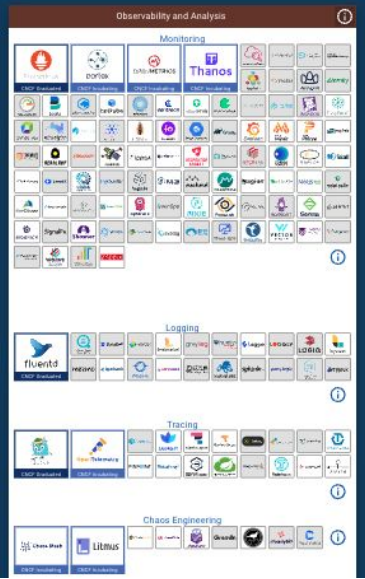
CNCF

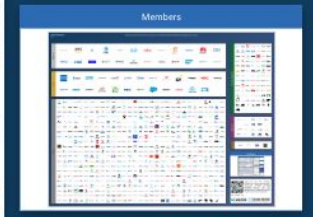
LANDSCAPE

landscape.cncf.io







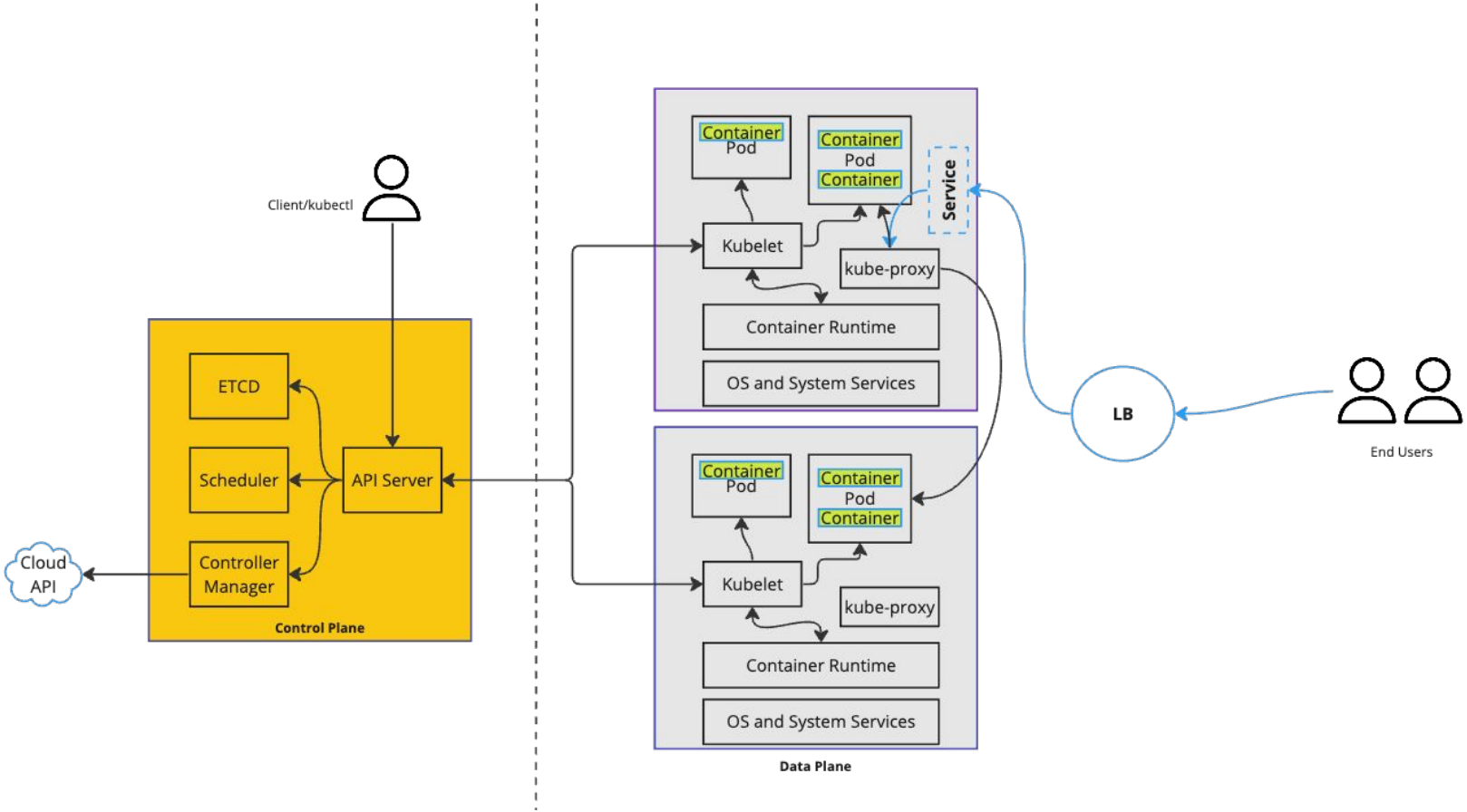


CLOUD NATIVE LANDSCAPE

CLOUD NATIVE COMPUTING FOUNDATION

This landscape is intended as a map through the previously uncharted terrain of cloud native technologies. There are many routes to deploying a cloud native application, with CNCF Projects

Kubernetes Architecture



Simplified Kubernetes Architecture

Credits: OpsRamp

How to Start with Kubernetes

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First Step: Create Cluster

- Prerequisite - container runtime such as Docker Desktop and kubectl
- Lightweight options - k3s, k0s
- Kind (easiest way to get a cluster running) [`kind create cluster`]
- Minikube (a VM with Kubernetes installed) [`minikube start`]
- kubeadm (servers, baremetal) and there are numerous projects
- Kubernetes the hard way (do everything yourself), complex but recommended if you are an operator and do it on baremetal/VMs
- Hardest way is coming soon

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Primitive Objects

Primitive Kubernetes Objects

- Pod - most basic unit, packages one or more containers
- ConfigMap - key-value data or files
- Secret - base64 encoded key value or file data [not encrypted]
- Persistent Volume and Persistent Volume Claim – disk / storage / file mount
- Service – exposes group of pods over network
- Ingress – allows external access, load balancing, TLS etc
- Labels and Annotations – key value to tag and manage resources, also used to link and in automations
- Role, ClusterRole, RoleBinding, ClusterRoleBinding

Workloads

- ReplicaSet
- Deployment
- StatefulSet
- DaemonSet
- Job and CronJob

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Pod

- Most basic unit
- We can run multiple containers
- Various multi container patterns like init, sidecar, ambassador etc
- Containers in a Pod shares common network, file system and IPC

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Deployment

- Manages ReplicaSets that in turn manages Pods
- Declarative specification, Replicas
- changes the actual state to the desired state at a controlled rate
- Any change in Deployment creates new ReplicaSet
- Rollout Strategies - Replace and RollingUpdate

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Pod and Deployment

apiVersion: v1
kind: Pod
metadata:
  name: hello
  labels:
    deployment: hello
spec:
  containers:
  - name: the-container
    image: monopole/hello:1
...

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: the-deployment
  annotation:
    pager: 999-999-000
spec:
  replicas: 3
  selector:
    matchLabels:
      deployment: hello
  template:
    metadata:
      labels:
        deployment: hello
    spec:
      containers:
      - name: the-container
        image: monopole/hello:1
        command: ["/hello",
                  "--port=8080",
                  "--enableRiskyFeature=$(ENABLE_RISKY)"]
        ports:
        - containerPort: 8080
        env:
        - name: ALT_GREETING
          valueFrom:
            configMapKeyRef:
              name: the-map
              key: altGreeting
        - name: ENABLE_RISKY
          valueFrom:
            configMapKeyRef:
              name: the-map
              key: enableRisky
```


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Labels and Annotations

- Plays important role in organization
- Used for various automations as well
- Binds Service with Pods
- Used in advanced deployment strategies

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: the-deployment
  annotation:
     pager: 999-999-000
spec:
  replicas: 3
  selector:
    matchLabels:
      deployment: hello
  template:
    metadata:
      labels:
        deployment: hello
    spec:
      containers:
      - name: the-container
        image: monopole/hello:1
        command: ["/hello",
                  "--port=8080",
                  "--enableRiskyFeature=$(ENABLE_RISKY)"]
        ports:
        - containerPort: 8080
        env:
        - name: ALT_GREETING
          valueFrom:
            configMapKeyRef:
              name: the-map
              key: altGreeting
        - name: ENABLE_RISKY
          valueFrom:
            configMapKeyRef:
              name: the-map
              key: enableRisky
```


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ConfigMap

```
apiVersion: v1
kind: ConfigMap
metadata:
  name: the-map
data:
  altGreeting: "Good Morning!"
  enableRisky: "false"
```


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Secret

```
apiVersion: v1
kind: Secret
metadata:
  name: the-map-secret
data:
  password: cGFzc3dvcmQK
```

```
❯ echo password | base64
cGFzc3dvcmQK

❯ echo cGFzc3dvcmQK | base64 -d
Password
```

No encryption

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Service

```
kind: Service
apiVersion: v1
metadata:
  name: the-service
spec:
  selector:
    deployment: hello
  type: LoadBalancer | Cluster IP | NodePort
  ports:
  - protocol: TCP
    port: 8666
    targetPort: 8080
```


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Ingress

```
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: hello
  labels:
    name: hello
spec:
  rules:
  - host: hello.foo.com
    http:
      paths:
      - pathType: Prefix
        path: "/"
        backend:
          service:
            name: the-service
            port:
              number: 8666
```

- Ingress is just a specification
- You also need an ingress controller like nginx-ingress controller or traefik etc
- Typically we don't directly expose Service
- Helpful in advanced routing scenarios such as Canary, Blue Green etc

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Other workloads

- **StatefulSet** - used to run stateful workload such as Databases, Queues, Cache like Redis
- **DaemonSet** - runs on every node, typically used to run agents, log collector etc
- **Job** - One time pod execution
- **CronJob** - Scheduled or recurring Jobs

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Interacting with Cluster

Talk to Kubernetes

- You basically talk to API Server for everything
- Use CLI like kubectl or k9s
- You can write your own programs (use Kubernetes-clients)
- Need kubeconfig file, list of clusters and authentication details
- kubectl <verb> <object-type> [<name>] -n namespace
- Examples:

  kubectl apply -f pod.yaml
  kubectl get pods
  kubectl delete pod my-pod -n dev
  kubectl logs my-pod -n dev
  kubectl scale deploy hello -- replicas = 3

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UI

- K8S Lens - https://k8slens.dev/
- K9S (TUI)
- Headlamp
- Vscode IDE integration

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This is just a start

- Kubernetes has a lot of moving parts once you start diving in.
- Start using it to understand more about it.

How to go from here

- Kubernetes documentation is awesome. Best place to start.
- Do it on your machine, yourself.
- Participate in Kubernetes Communities (Slack, Github, kubernetes.dev)
- Participate in future sessions and share your knowledge with the community

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Solved all your problems. You're welcome.

Q & A

Connect with me:
linktr.ee/anjulsahu