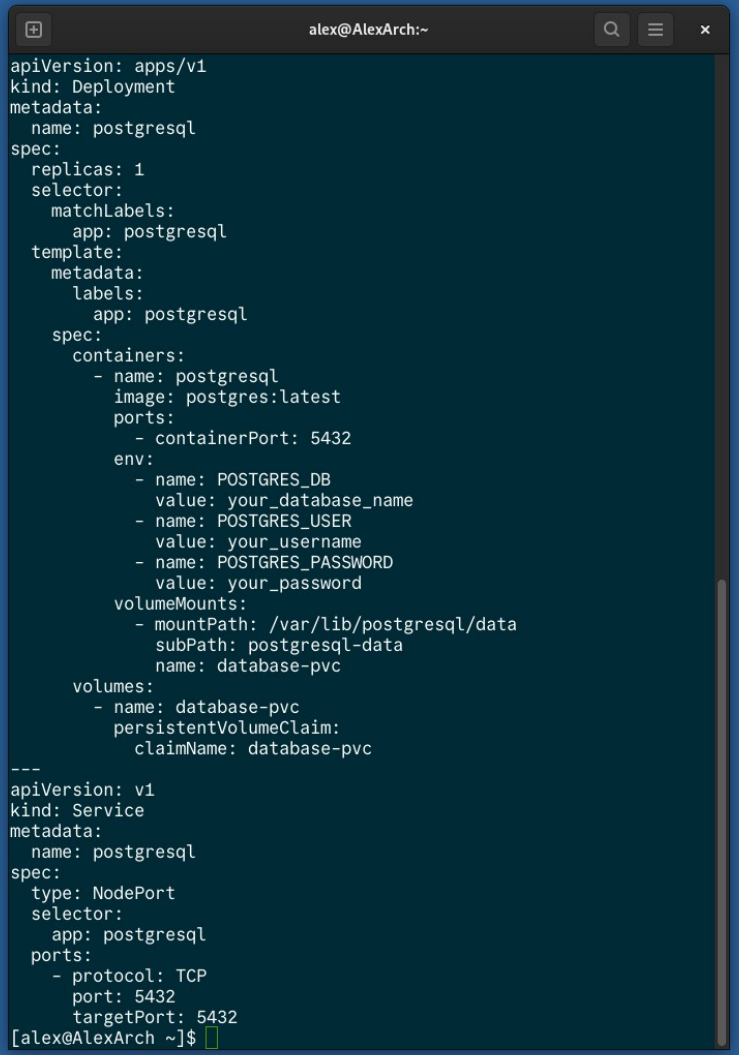
By Alex Bissessur

Who Am I?

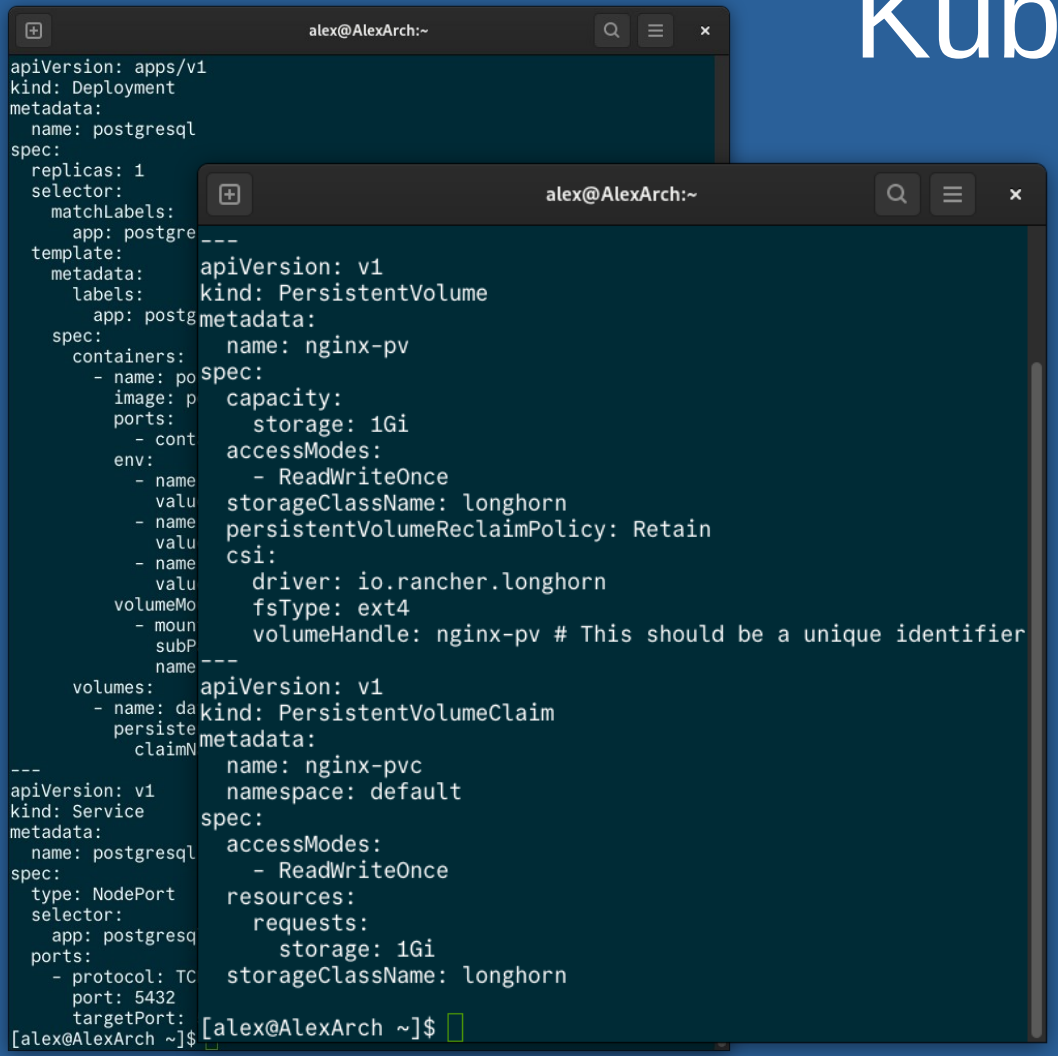
- Kubernetes and Cloud Native enthusiast
- Organiser of Cloud Native Mauritius
- Software Development intern at Swan
- I like Python, Rust, and Linux
- I have a small rack where I play with Kubernetes

- Aspirations?
  Play with Kubernetes for $$

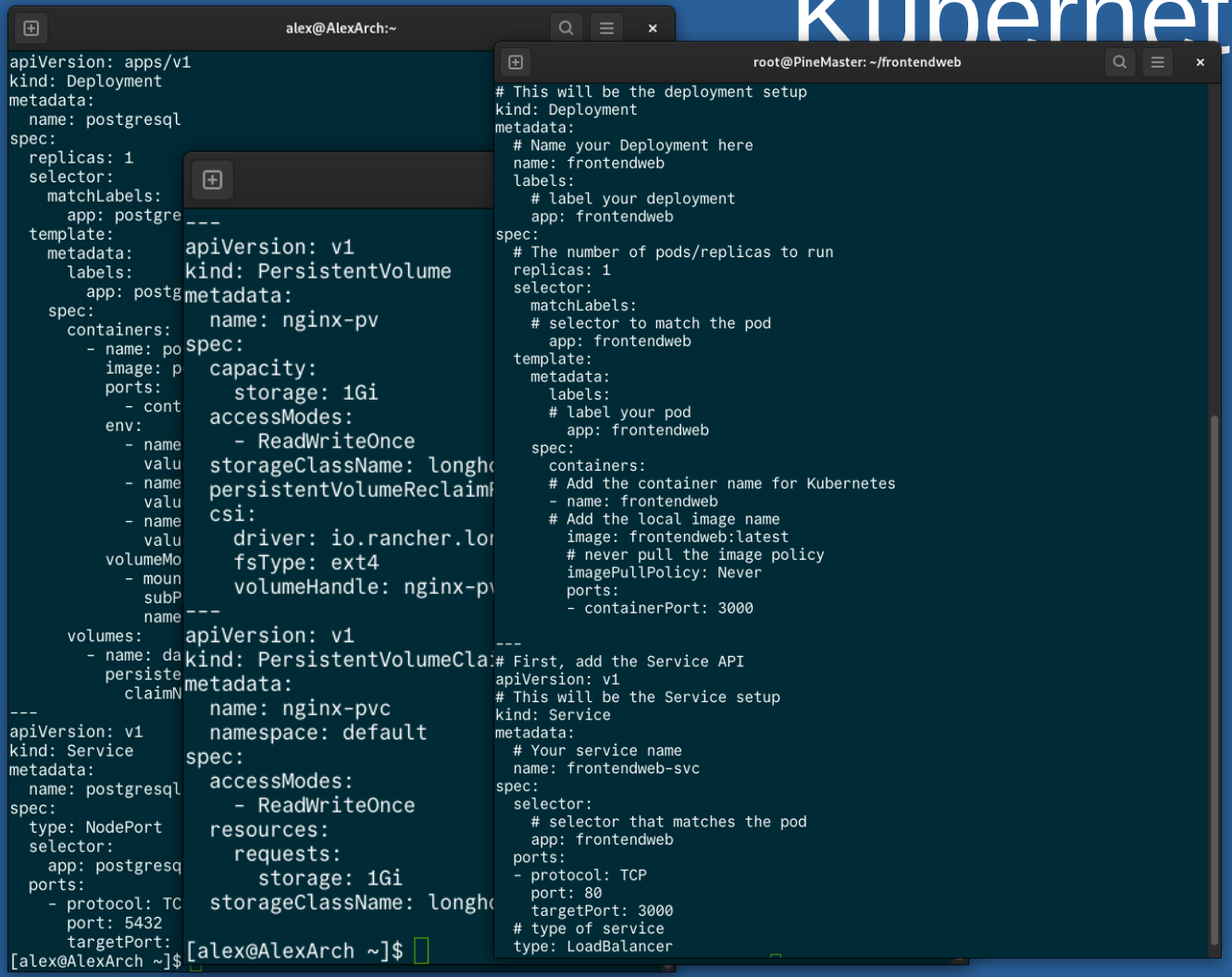
Kubernetes is easy?



Kubernetes is easy?



Kubernetes is easy?



k asy?

alex@AlexArch:~

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: postgresql
spec:
  replicas: 1
  selector:
    matchLabels:
      app: postgre
  template:
    metadata:
      labels:
        app: postg
    spec:
      containers:
        - name: po
          image: p
          ports:
            - cont
          env:
            - name
              valu
            - name
              valu
            - name
              valu
          volumeMo
            - moun
              subP
              name
      volumes:
        - name: da
          persiste
            claimN
---
apiVersion: v1
kind: Service
metadata:
  name: postgresql
spec:
  type: NodePort
  selector:
    app: postgresq
  ports:
    - protocol: TC
      port: 5432
      targetPort:
[alex@AlexArch ~]$
```

```
---
apiVersion: v1
kind: PersistentVolume
metadata:
  name: nginx-pv
spec:
  capacity:
    storage: 1Gi
  accessModes:
    - ReadWriteOnce
  storageClassName: longho
  persistentVolumeReclaimP
  csi:
    driver: io.rancher.lon
    fsType: ext4
    volumeHandle: nginx-pv
---
apiVersion: v1
kind: PersistentVolumeCla
metadata:
  name: nginx-pvc
  namespace: default
spec:
  accessModes:
    - ReadWriteOnce
  resources:
    requests:
      storage: 1Gi
  storageClassName: longho

[alex@AlexArch ~]$
```

root@PineMas

```
# This will be the deployment setup
kind: Deployment
metadata:
  # Name your Deployment here
  name: frontendweb
  labels:
    # label your deployment
    app: frontendweb
spec:
  # The number of pods/replicas to run
  replicas: 1
  selector:
    matchLabels:
    # selector to match the pod
      app: frontendweb
  template:
    metadata:
      labels:
      # label your pod
        app: frontendweb
    spec:
      containers:
      # Add the container name for Kube
      - name: frontendweb
      # Add the local image name
        image: frontendweb:latest
        # never pull the image policy
        imagePullPolicy: Never
        ports:
        - containerPort: 3000

---
# First, add the Service API
apiVersion: v1
# This will be the Service setup
kind: Service
metadata:
  # Your service name
  name: frontendweb-svc
spec:
  selector:
    # selector that matches the pod
    app: frontendweb
  ports:
  - protocol: TCP
    port: 80
    targetPort: 3000
  # type of service
  type: LoadBalancer
```

root@PineMaster: ~/ghost/new

```
apiVersion: apps/v1
kind: Deployment
metadata:
  name: ghost-deployment
spec:
  replicas: 1  # You can adjust the number of replicas as needed
  selector:
    matchLabels:
      app: ghost
  template:
    metadata:
      labels:
        app: ghost
    spec:
      containers:
        - name: ghost
          image: ghost:5.71.0
          ports:
            - containerPort: 2368
          volumeMounts:
            - name: ghost-data
              mountPath: /bitnami/ghost
          env:
            - name: ALLOW_EMPTY_PASSWORD
              value: "yes"
            - name: GHOST_DATABASE_HOST
              value: mysql
            - name: GHOST_DATABASE_PORT_NUMBER
              value: "3306"
            - name: GHOST_DATABASE_USER
              value: bn_ghost
            - name: GHOST_DATABASE_NAME
              value: bitnami_ghost
      volumes:
        - name: ghost-data
          persistentVolumeClaim:
            claimName: ghost-data  # Replace with your PVC name
---
apiVersion: v1
kind: Service
metadata:
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spec:
  selector:
    app: ghost
  ports:
    - protocol: TCP
      port: 80
      targetPort: 2368
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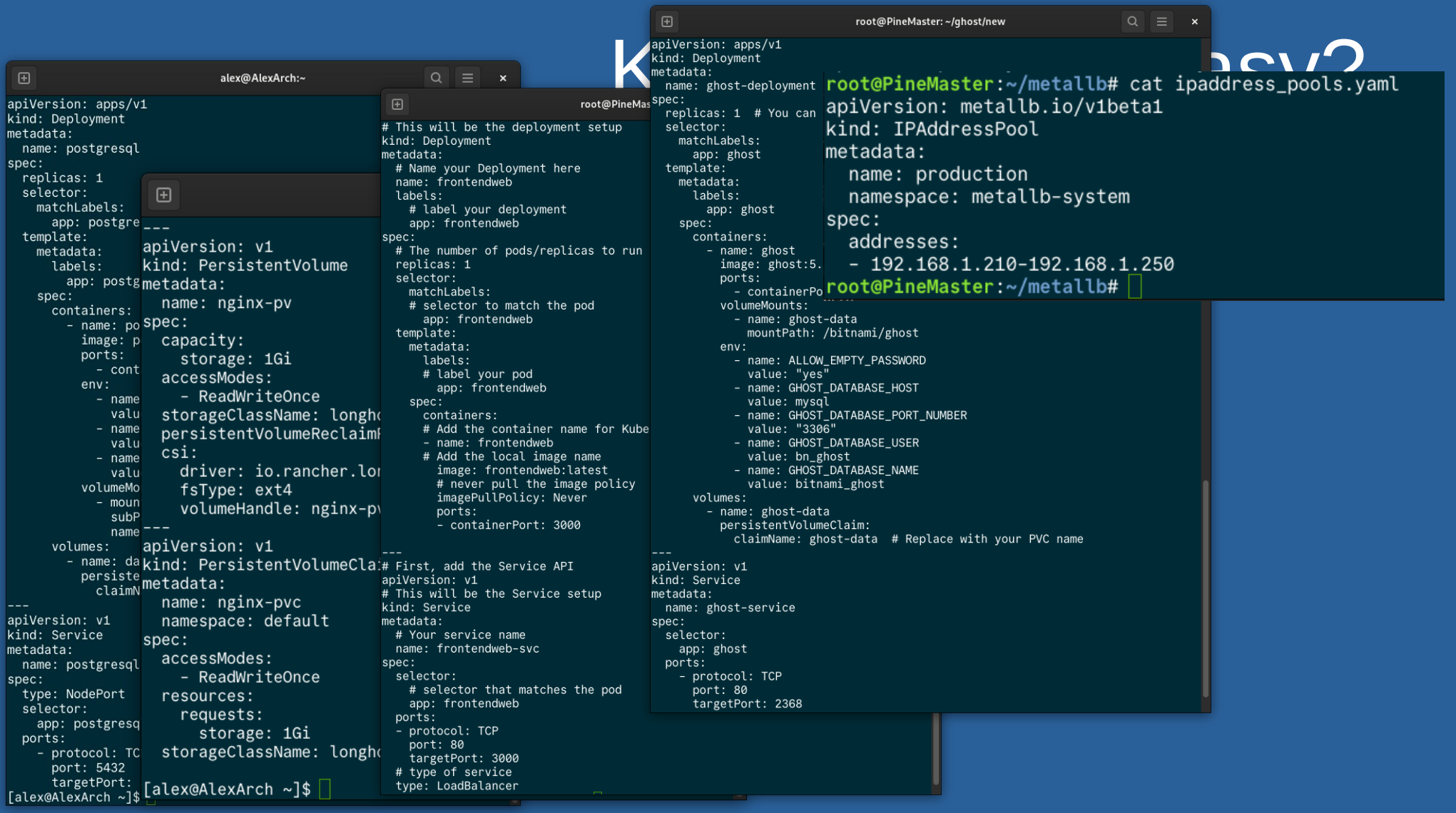
alex@AlexArch:~
root@PineMaster: ~/ghost/new
root@PineMaster:~/metallb# cat ipaddress_pools.yaml
apiVersion: metallb.io/v1beta1
kind: IPAddressPool
metadata:
name: production
namespace: metallb-system
spec:
addresses:
- 192.168.1.210-192.168.1.250
root@PineMaster:~/metallb#
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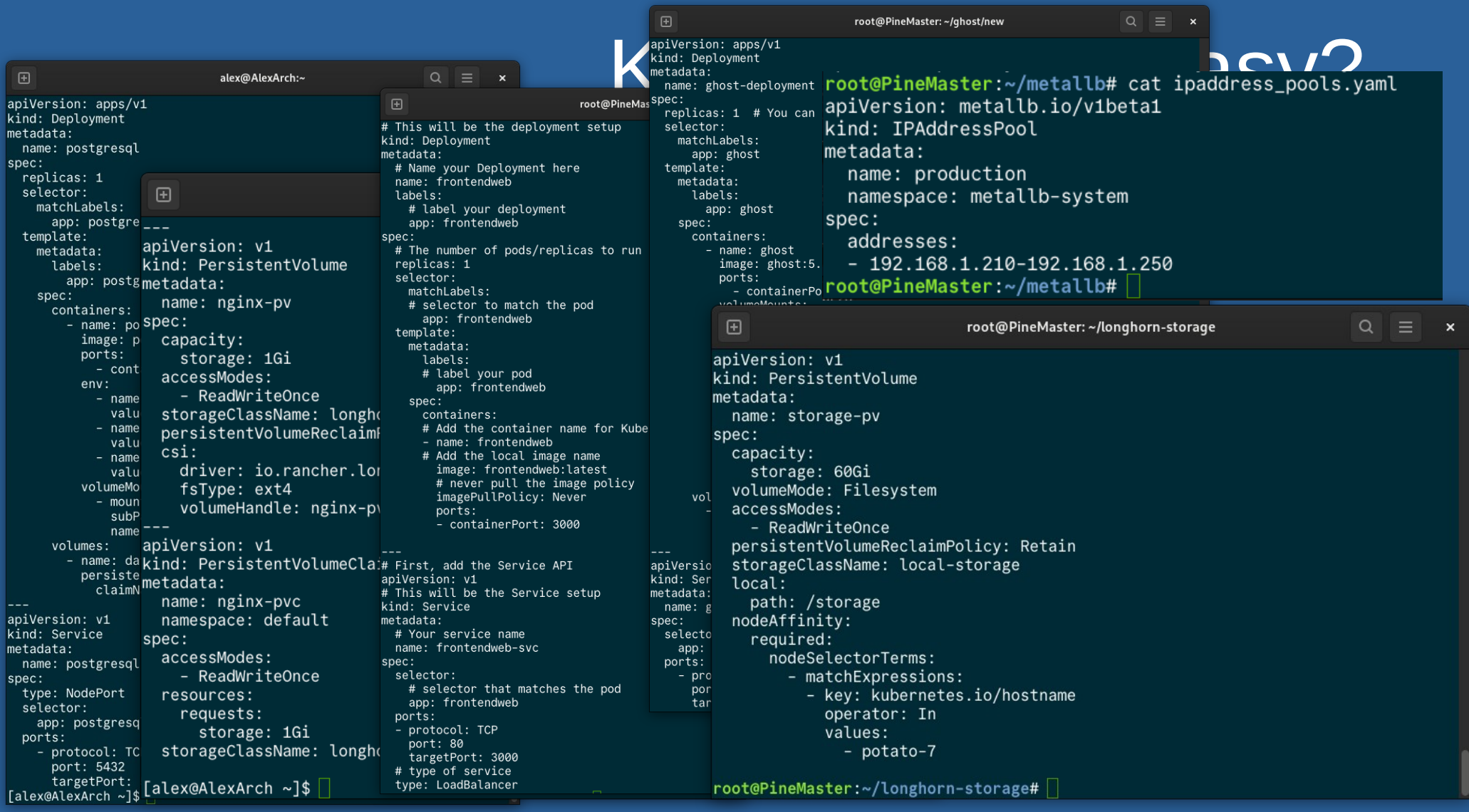
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metadata:
name: ghost-deployment
spec:
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selector:
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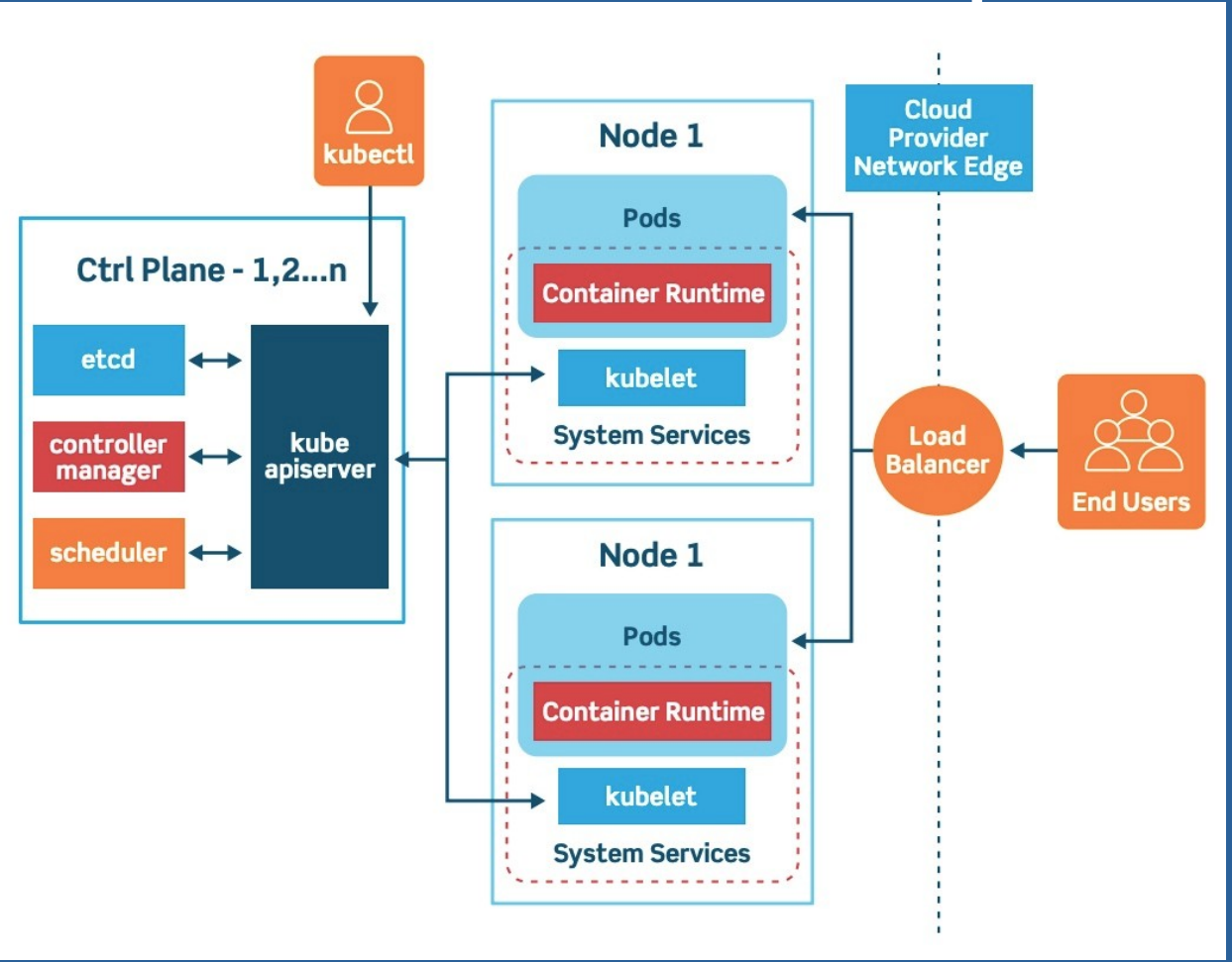
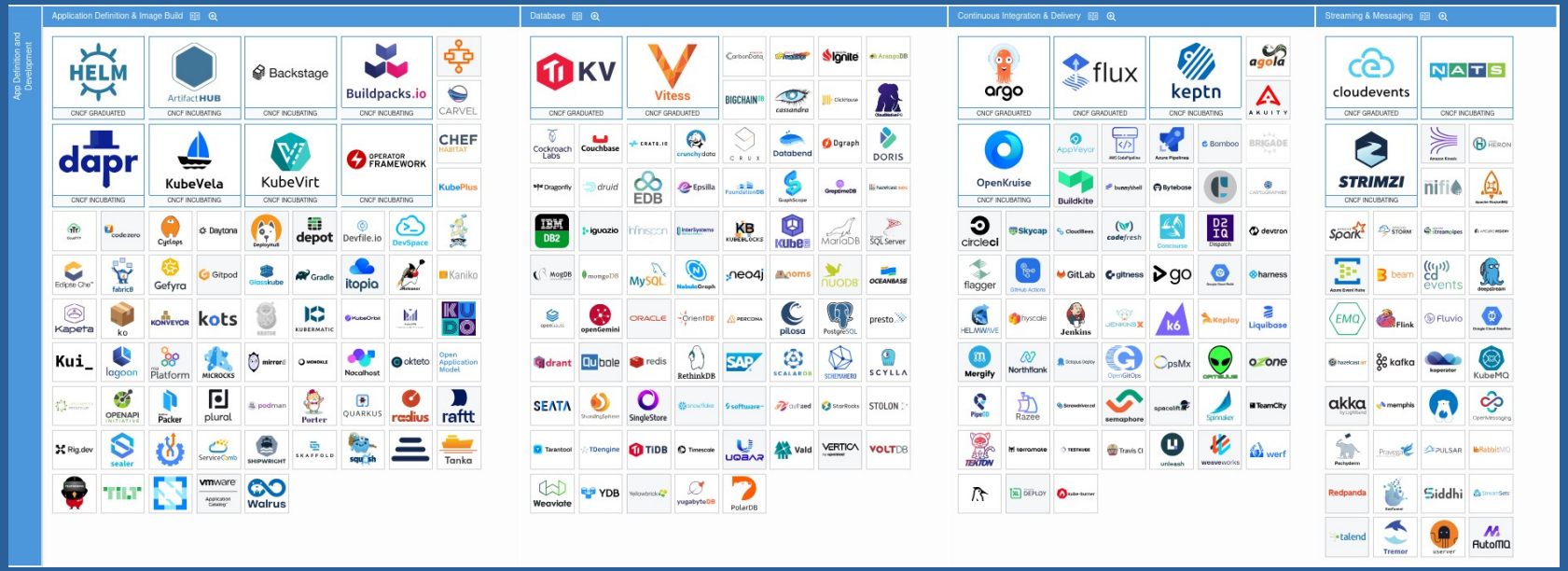
template:
metadata:
labels:
app: ghost
spec:
containers:
- name: ghost
image: ghost:5.
ports:
- containerPo
root@PineMaster:~/metallb# cat ipaddress_pools.yaml
apiVersion: metallb.io/v1beta1
kind: IPAddressPool
metadata:
name: production
namespace: metallb-system
spec:
addresses:
- 192.168.1.210-192.168.1.250
root@PineMaster:~/metallb#
root@PineMaster: ~/longhorn-storage
apiVersion: v1
kind: PersistentVolume
metadata:
name: storage-pv
spec:
capacity:
storage: 60Gi
volumeMode: Filesystem
accessModes:
- ReadWriteOnce
persistentVolumeReclaimPolicy: Retain
storageClassName: local-storage
local:
path: /storage
nodeAffinity:
required:
nodeSelectorTerms:
- matchExpressions:
- key: kubernetes.io/hostname
operator: In
values:
- potato-7
root@PineMaster:~/longhorn-storage#

Kubernetes is simple?



Kubernetes is straightforward?



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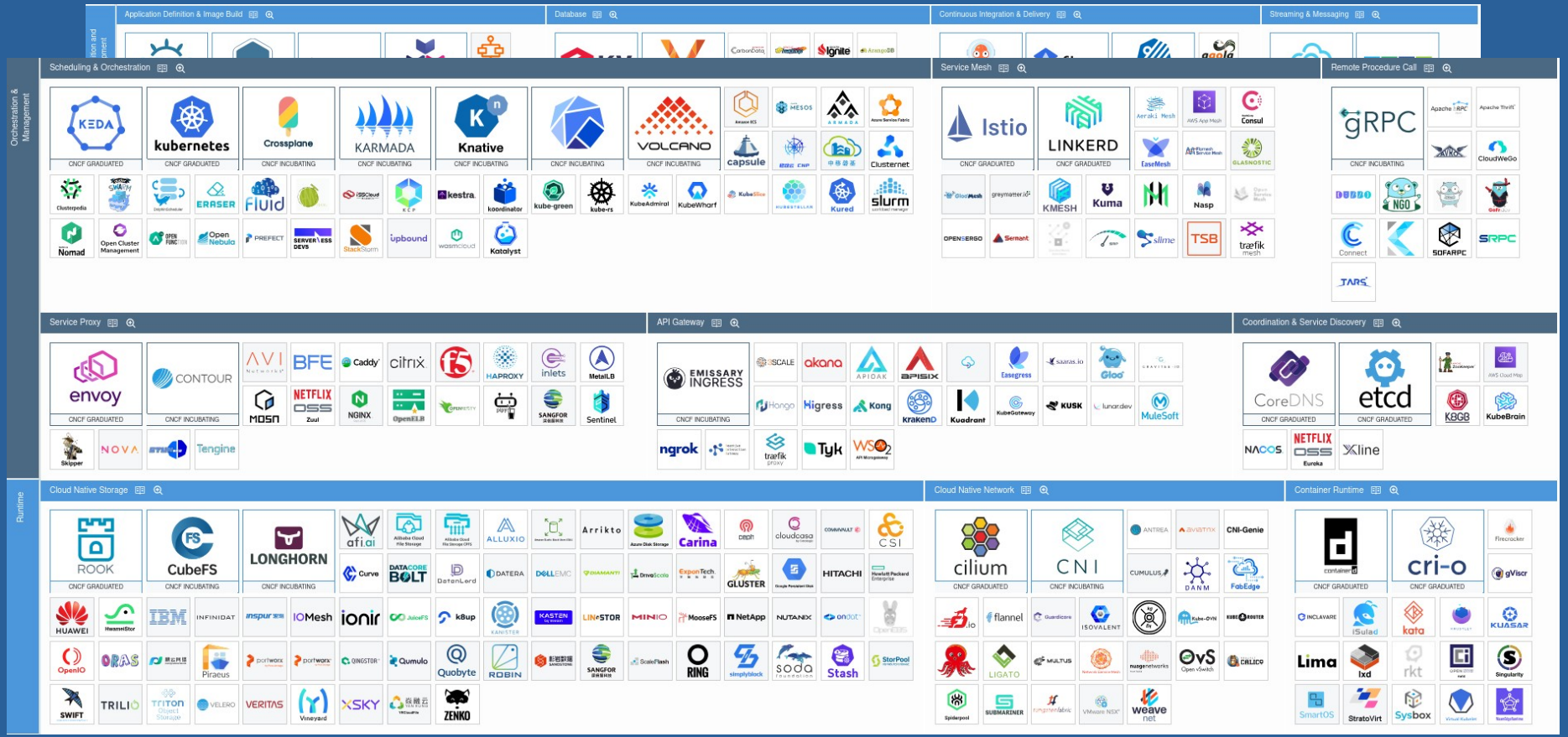

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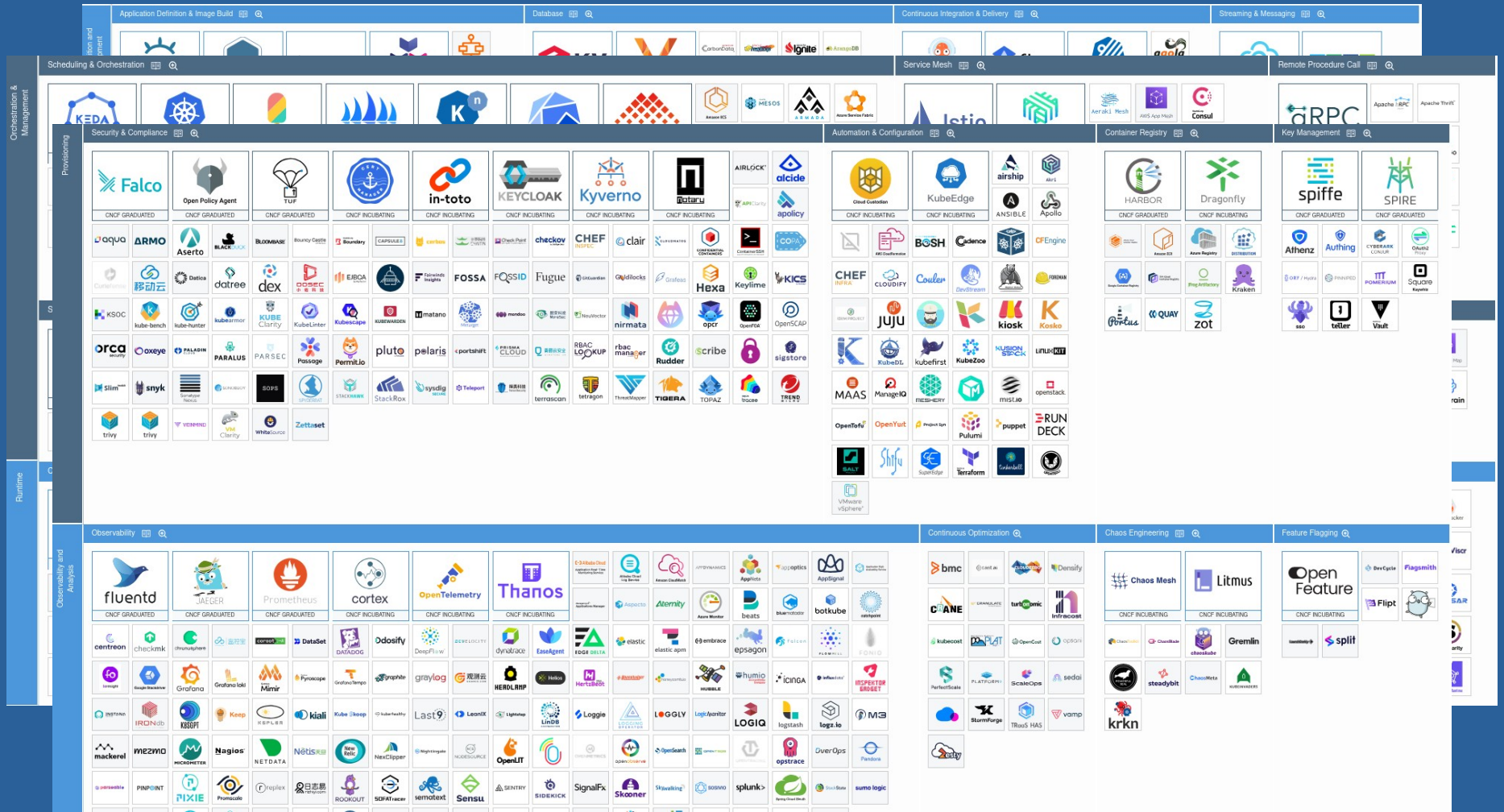


What Is Kubernetes?

- “K8S is a system for automating deployment, scaling and management of containerised applications”
  - Simply an abstraction/framework to run a cluster of computers
- Industry standard with a whole ecosystem behind
- Platform for 200~ Cloud Native Applications
- Former Google product, now Open Source held by CNCF (Linux Foundation project)

Why is Kubernetes a Thing?

- Need for cluster computing solutions which don’t suck (Docker Swarm 🤮)
- High Availability, Redundancy, Easy to Manage
- CSP agnostic (AWS / Azure / GCP / Bare Metal)
- Offers a platform suited to both admins and devs

Kubernetes Components Simplified

- Nodes
- Pods
- ReplicaSets
- Deployments
- Namespaces

- Services
  - NodePort
  - LoadBalancer
  - ClusterIP
- Persistent Volumes
- Persistent Volume Claims

and many more...

Pod

- The smallest unit in Kubernetes
- May contain 1 or more containers
- Ephemeral – can be created, destroyed, and recreated dynamically
- No self-healing or scaling capabilities
- Docker run – but complicated

Deployment

- Encapsulates Pods through ReplicaSets
- Ensures desired state is maintained (eg replicas)
- Self Healing
- Scalability
- Revision history for rollbacks
- Powerful update strategies
  (RollingUpdate, Recreate, etc...)

Service

- How do you access pods regardless of where they are in the cluster?
- Services provide constant routes to variable pods through internal networking
- Different types for different traffic types (internal, external)
- Supports load balancing
- Detailed control over traffic routing policies

Service

- ClusterIP – communication inside cluster
  uses: Constant routing within cluster
- NodePort – exposing app through port on cluster nodes
  uses: Exposing application through dedicated port
- LoadBalancer – offered by CSPs
  uses: Dedicated IP for application running on K8S

Persistent Volume (Claim)

- Abstraction for persistent volume in Kubernetes
- Deployments are stateless
  - Restart container = drop tables
- PV can be NFS, iSCSI, or even S3 compatible
- PVC is an interface for PVs
- PVC types
  - Read (Only/Write) Many
  - Read Write Once (Node/Pod)

Why Use Kubernetes

- Single PC has limited upgradeability
- Expand horizontally not vertically
  Quantity over quality
- Redundancy
- Exploiting microservices and containers
- Better upgradeability, availability, portability

Building on Kubernetes

- The power of Kubernetes is the CN Landscape
- ~ 200 Cloud Native projects and counting

- CI/CD
- App Definition & Image Build
- Databases
- Streaming & Messaging
- Scheduling & Orchestration
- API Gateway

- Discovery
- Cloud Native Storage
- Cloud Native Network
- Service Mesg
- Remote Procedure Call
- Service Proxy
- Chaos Engineering
- Continuous Optimisation

- Container Runtime
- Security & Compliance
- Container Registry
- Automation & Configuration
- Key Management
- Observability
- Feature Flagging
- Coordination & Service

Physical Scaling

- One server cannot be upgraded indefinitely
- Physical limitations in compute power
- Instead of 1 server, why not have 10? Kubernetes unifies multiple servers
- Kubernetes spreads pods across all nodes to best use resources

Virtual Scaling

- Scaling microservices
  Possible due to lack of state
- Allows optimal use of resources
- Scale up/down to accomodate demand
- Horizontal Pod Autoscaler for hands-off scaling
- Automatic load balancing of applications

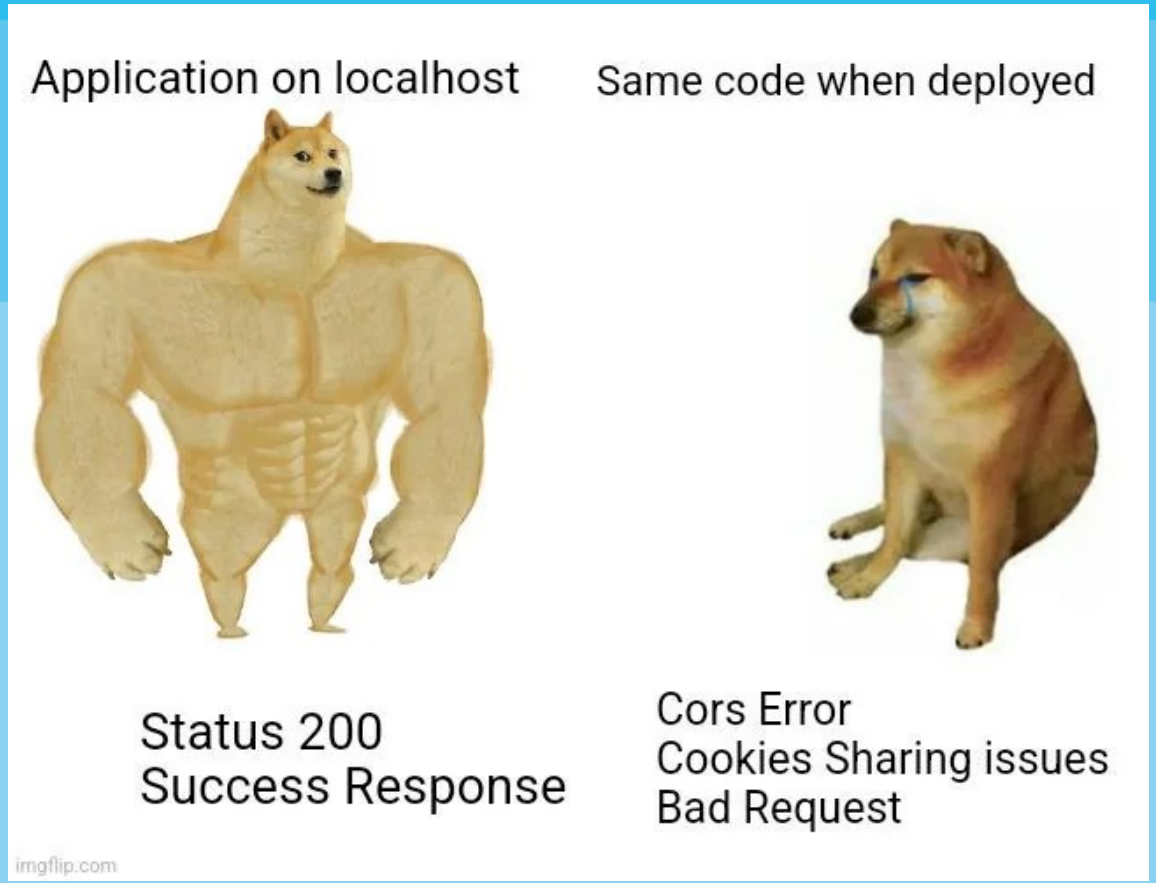
Redundancy

- 1 server = 1 point of failure
- Self-healing of deployments in case of failure
  - Pods independent from nodes
  - Services “follow” pods
- Longhorn/Rook+Ceph allows distributed block storage for data redundancy
- Multi-cloud cluster for added redundancy
- Benefits physical upgrades or OS updates

Easy Management

- Containerised means consistent between local, test & prod
- GitOps and CI/CD pipelines for automatic deployment
- No need to beg someone to deploy your app
  apologies to my colleagues
- Simpler scaling and resource management
  - Can ensure my app doesn’t eat all the RAM

Easy Management



Fancy Deployment Strategies

- Deployments can have different rollout strategies
- Algorithms like *Canary* deployment, *Rolling* update
- Blue/Green deployment concept
- Detailed control over rollout to minimise customer impact

Rolling Update

- Starts a new pod
- Once new pod is running, takes down one old
- Number upgraded at a time can be set
- Works through all pods until they are all up to date
- Traffic loadbalanced to both old & new pods

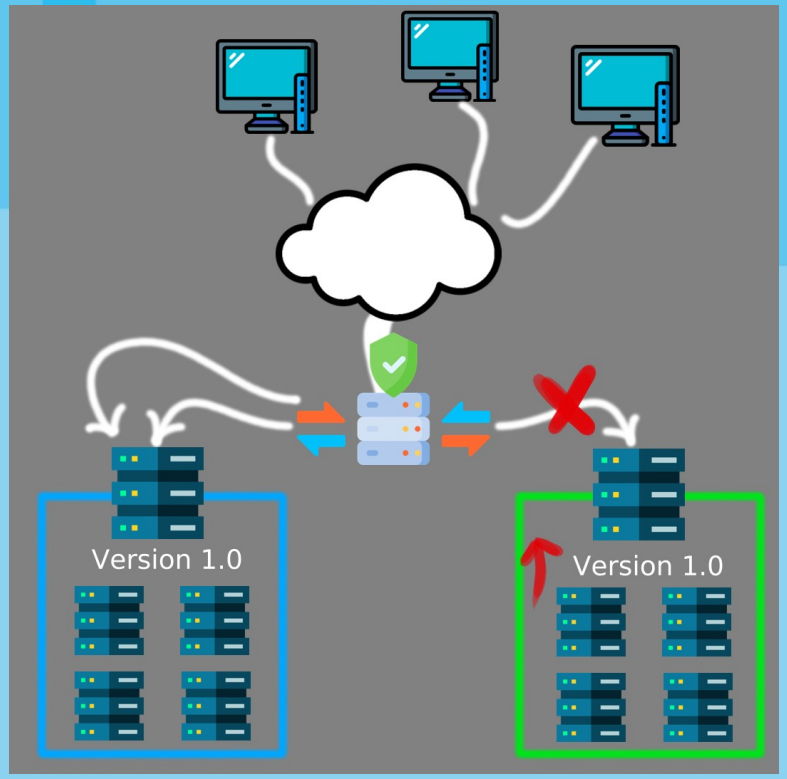
Canary Deployment

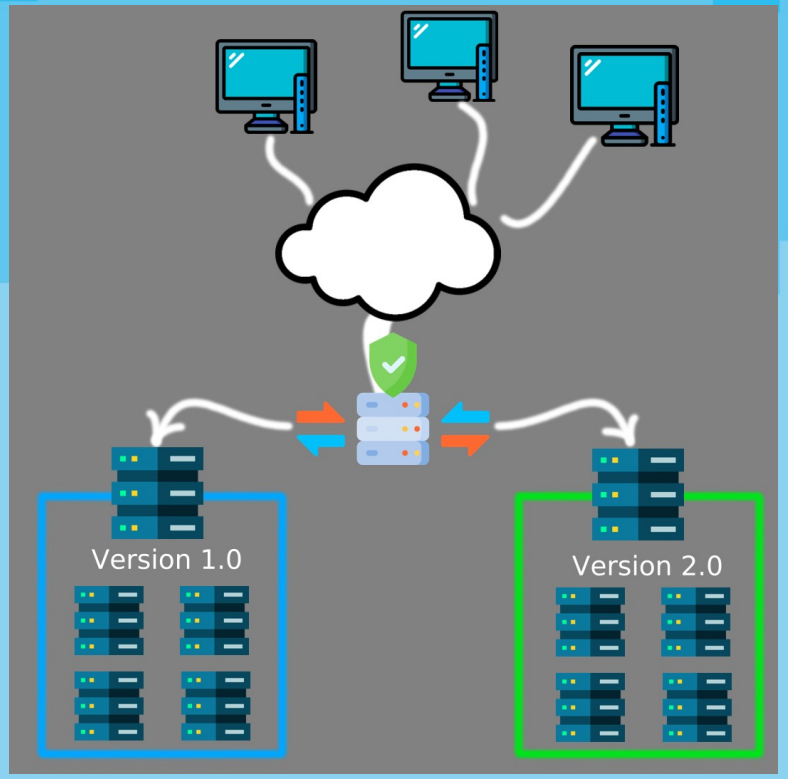
- Initially deploy a small number of new pods
- Gradually increase traffic to latest set
- In case of errors, deployment automatically rolled back
- Requires additional CN tools, such as ArgoCD, Istio or Linkerd

Blue-Green Deployment

- 2 environments created – Blue and Green
- All traffic routed to Blue
- Green group is upgraded and tested
- Traffic rerouted to Green
- Easy reroute back to Blue if Green has issues
- Upgrade Blue in turn
- 0 downtime, consistent application for users

Blue-Green Deployment





Shadow Deployment

- Create a new mirrored deployment
- Traffic is mirrored to new version
- Both versions process traffic
- Only Old returns responses
- Allows live testing with real world data
  (now you can test on “prod”)

What’s not so cool about Kubernetes

- Cost
- Expertise
- Keep it up to date
  K8S has support for last 3 versions
  Tool/plugin dependencies
- Steep learning curve
- Legacy monolith projects
  Not cloud-optimised, lose out on cost benefits

Thank You!

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