Developing Micro-services with Kubernetes

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CODE EUROPE

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Slides & source code at https://mjbright.github.io/Talks

Michael Bright, @mjbright

Cloud Native Solution Architect

Trainer: Kubernetes, Serverless, Docker, CloudNative

Past researcher, dev, team lead, dev advocate

British, living in France for 25-years

Docker Community Lead, Python User Group

linkedin.com/in/mjbright github.com/mjbright

Outline

- Monoliths to Micro-services
- Micro-service design patterns
- Kubernetes
- Operations
- Demo
- Tools

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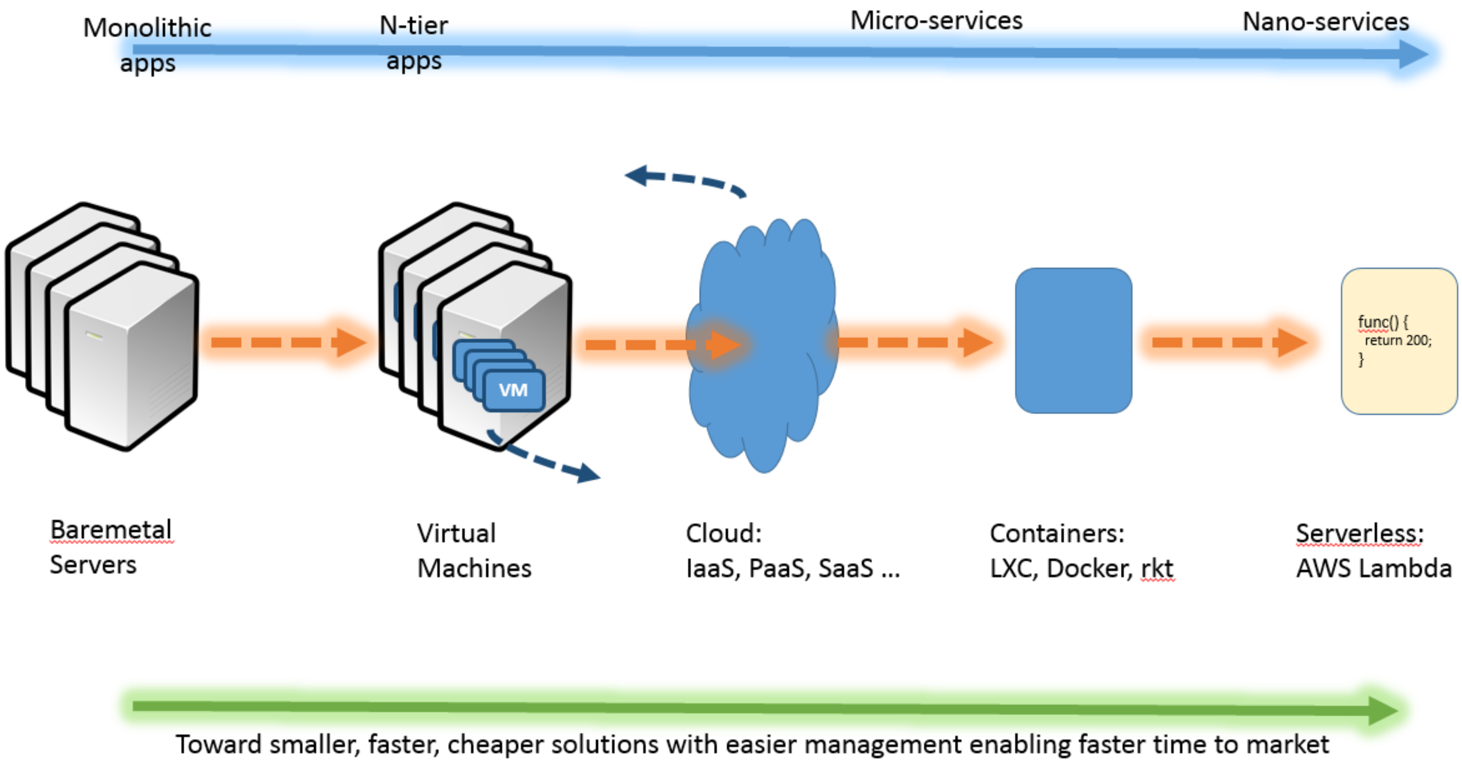
First ... a bit of history



Monolithic apps

N-tier apps

Micro-services

Nano-services

```
func() {
  return 200;
}
```

Baremetal Servers

Virtual Machines

Cloud:
IaaS, PaaS, SaaS ...

Containers:
LXC, Docker, rkt

Serverless:
AWS Lambda

Toward smaller, faster, cheaper solutions with easier management enabling faster time to market

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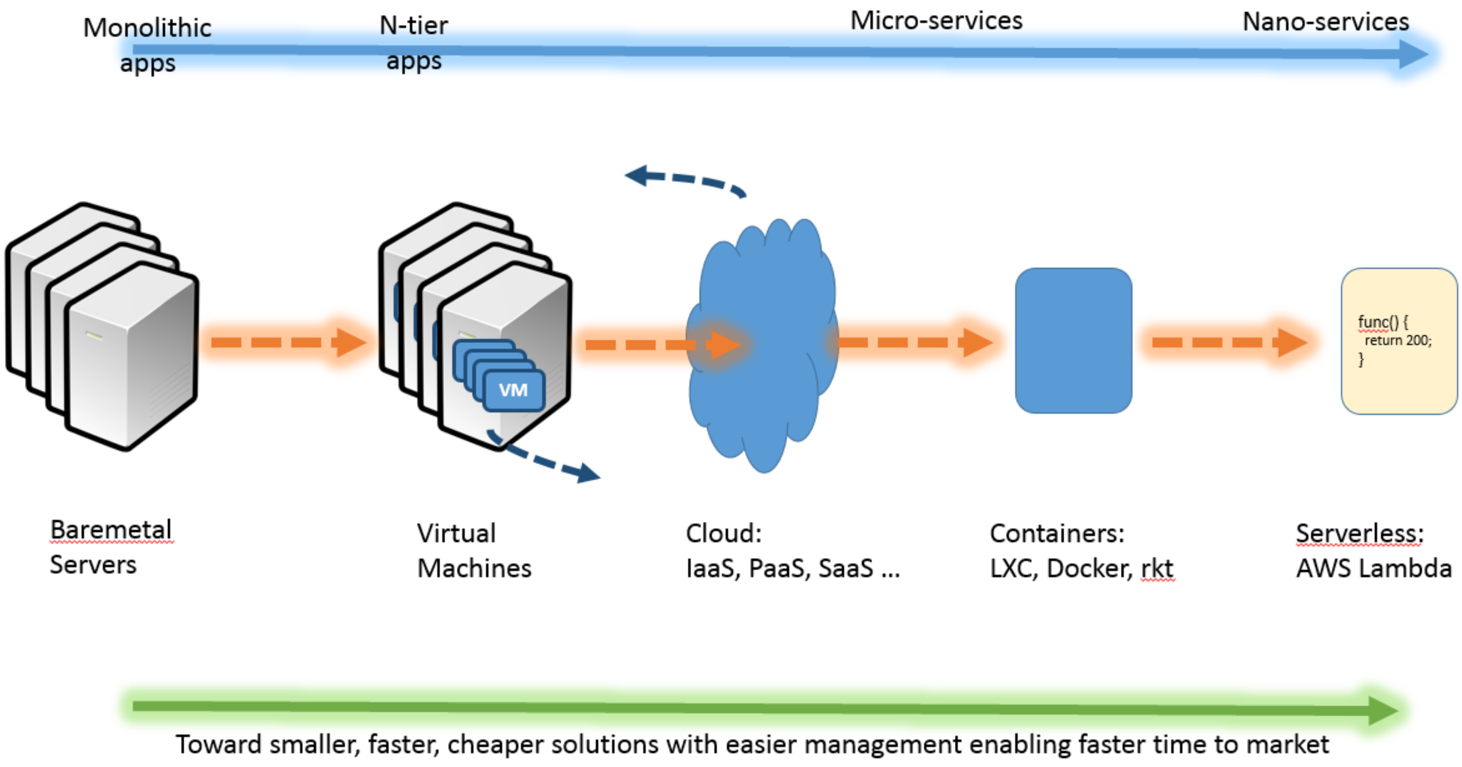
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N-tier apps
Micro-services
Nano-services
VM
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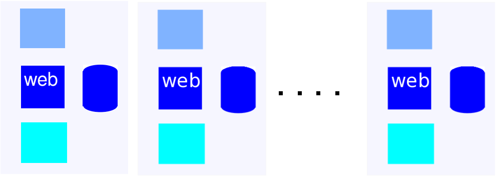
Baremetal Servers
Virtual Machines
Cloud: IaaS, PaaS, SaaS …
Containers: LXC, Docker, rkt
Serverless: AWS Lambda
Toward smaller, faster, cheaper solutions with easier management enabling faster time to market

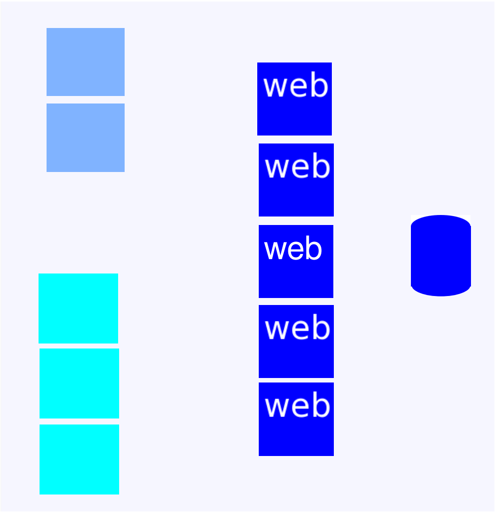
Note: But the future is hybrid …

Monoliths to Micro-services

Monoliths are **deployed, scaled, upgraded, reimplemented** as complete units



Individual μ-service components can be **deployed, scaled, upgraded, reimplemented** …



Advantages of Micro-services

Separation of Concerns - "do one thing well"

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Smaller Projects/teams

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Ease Scaling, Deployment, Testing, Evolution

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Allow for composition of new services

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So are they a panacea?

Disadvantages

Greater complexity

- Requires more orchestration
- Greater organizational complexity
- Monitoring, debugging is more difficult

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- Network error handling
- Performance

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Still requires best practices

- Behaviour and Test-Driven Development
- CI/CD
- Documentation of interfaces/APIs
- Stable interfaces/APIs

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Architecture Design Patterns

Standard Component Patterns

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Fine-grained SOA - Micro-services(!)

Architecture Design Patterns

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Fine-grained SOA - Micro-services(!)

Strangler

Architecture Design Patterns

Standard Component Patterns

Fine-grained SOA - Micro-services(!)

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API Gateway

Architecture Design Patterns

Standard Component Patterns

Fine-grained SOA - Micro-services(!)

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API Gateway

Service Mesh

Architecture Design Patterns

Standard Component Patterns

Fine-grained SOA - Micro-services(!)

Strangler

API Gateway

Service Mesh

Hybrid Apps

Design Pattern - API Gateway

Exposes internal APIs via single external entry point.

- Offload common functions
  - rate limiting, security, authorisation
  - protection against DDoS
  - reduces µ-service complexity

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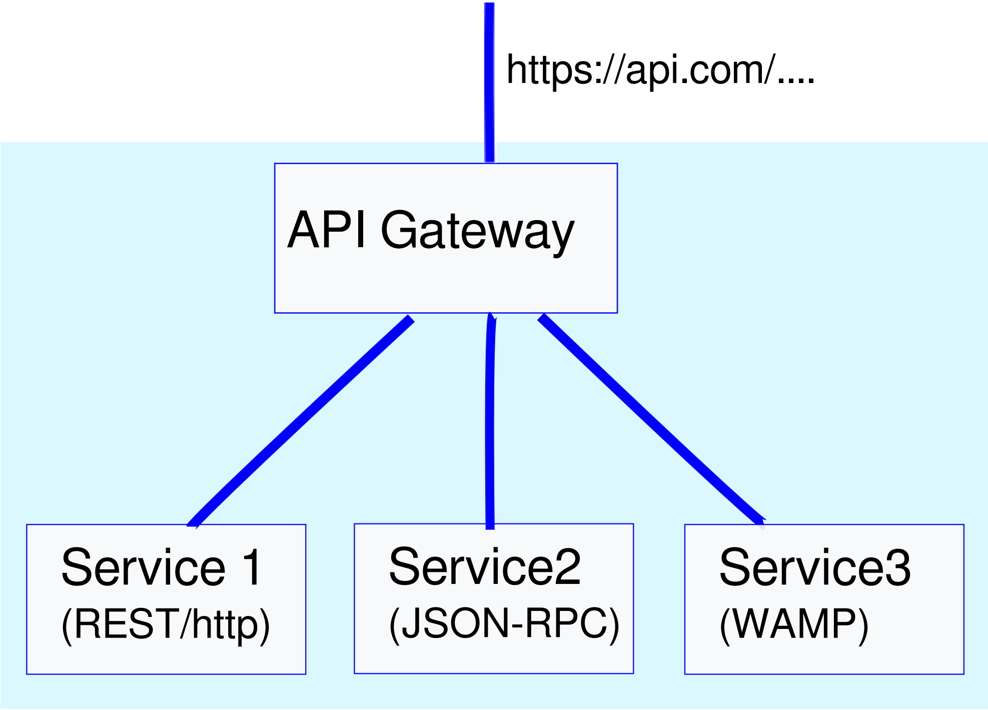
Needs to scale, be H.A.

Design Pattern - API Gateway



Design Pattern - Service Mesh

Abstraction above TCP/IP, secure reliable inter-service connectivity.

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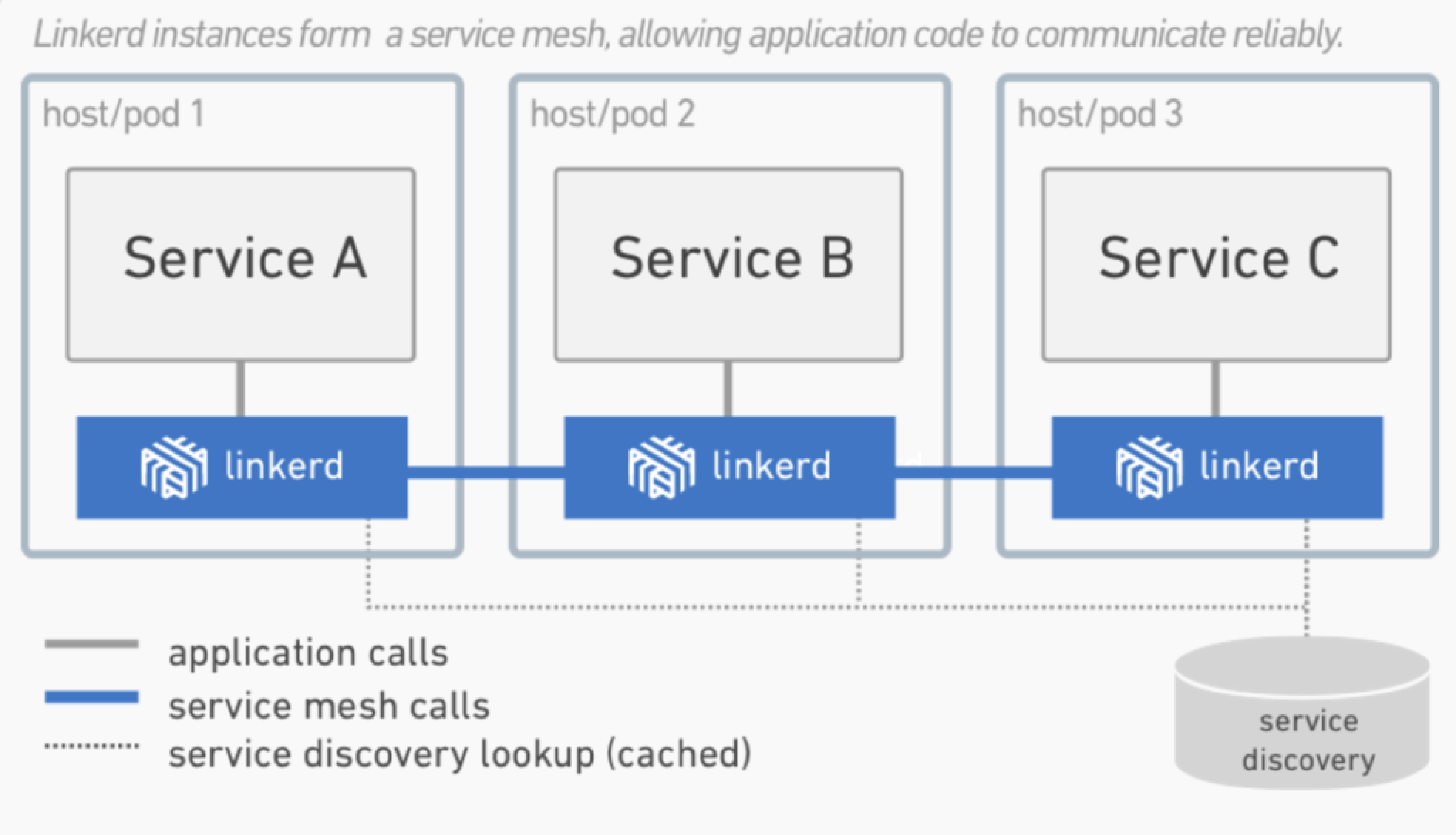
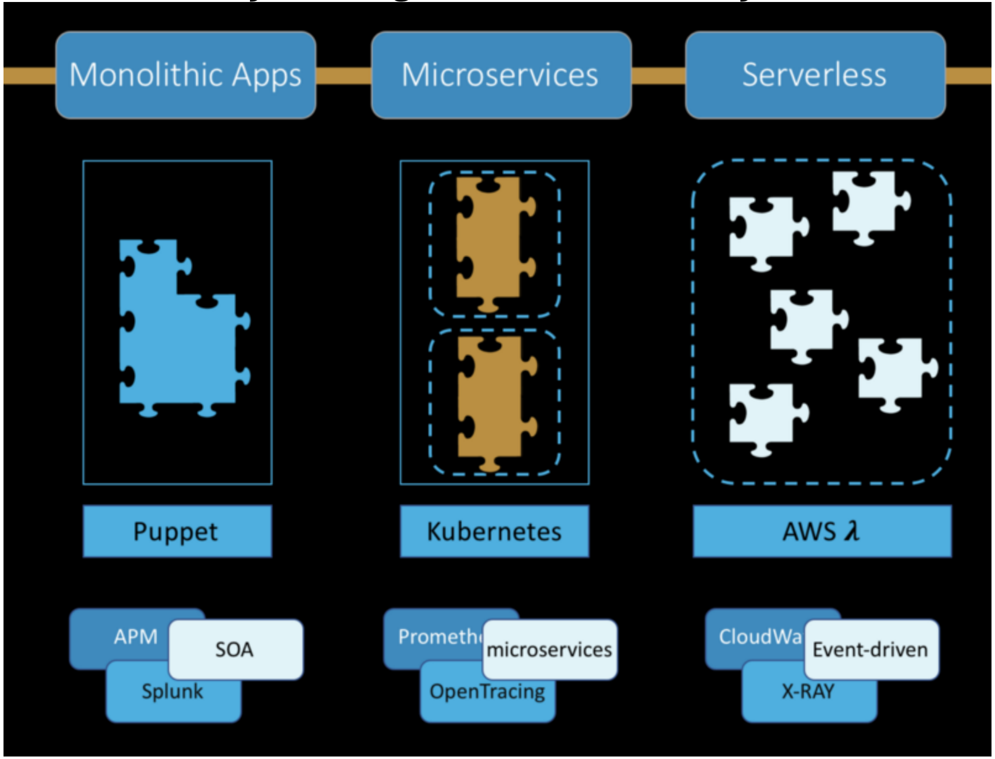


Linkerd instances form a service mesh, allowing application code to communicate reliably.

Design Pattern - Hybrid Apps

Gloo allows to route between legacy apps, micro-services and serverless incrementally adding new functionality.



https://medium.com/solo-io/building-hybrid-apps-with-gloo-1eb96579b070

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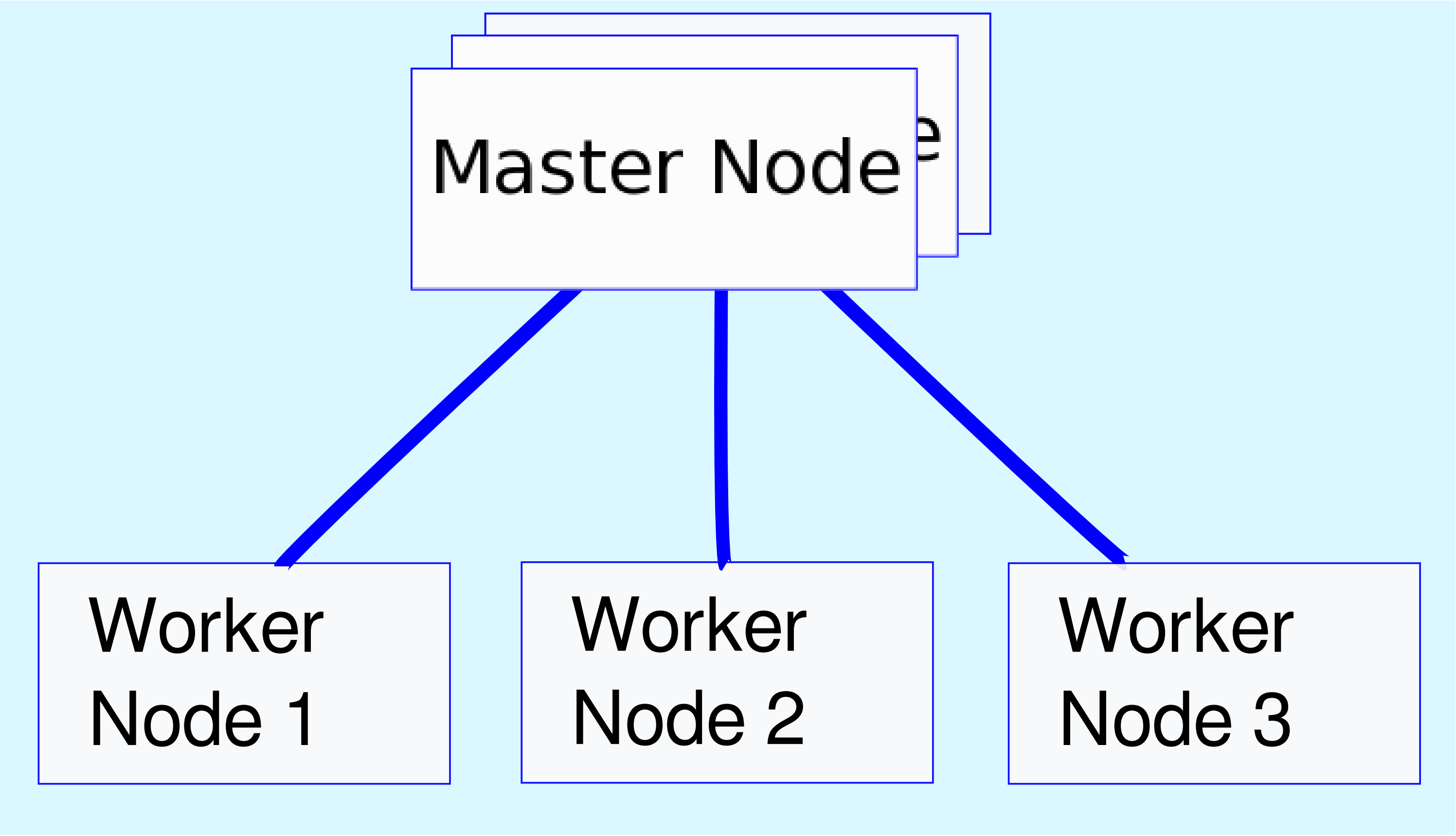
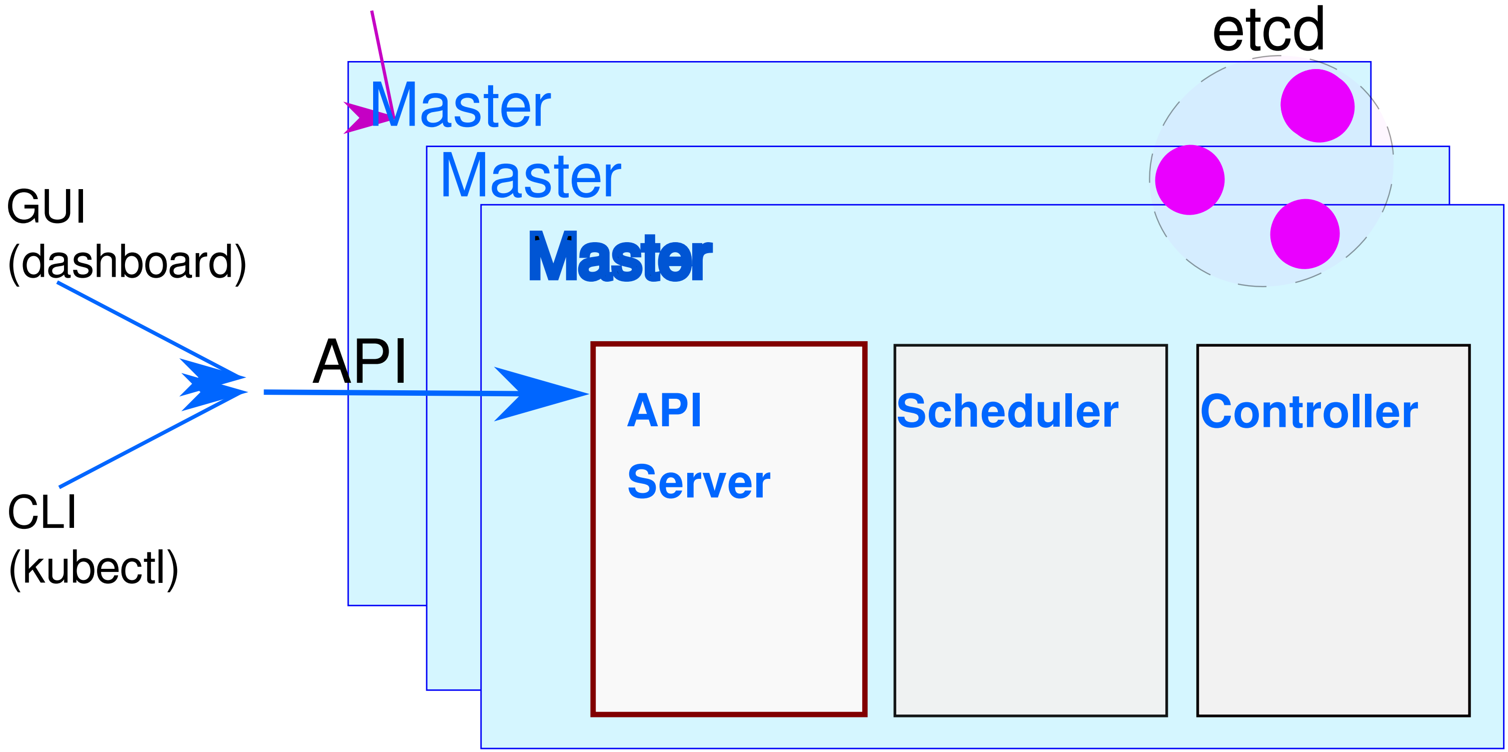
We need Orchestration

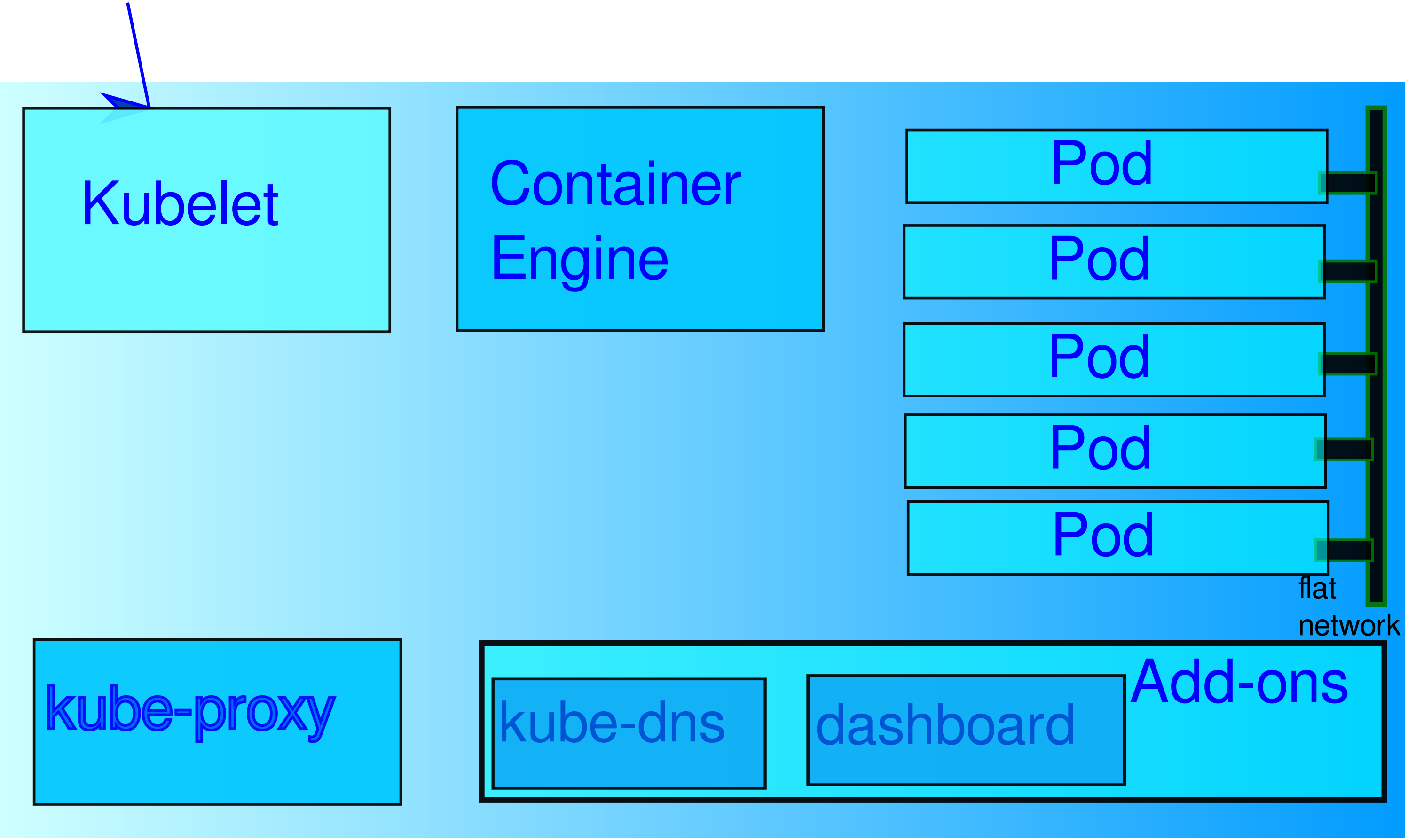
Kubernetes - Architecture



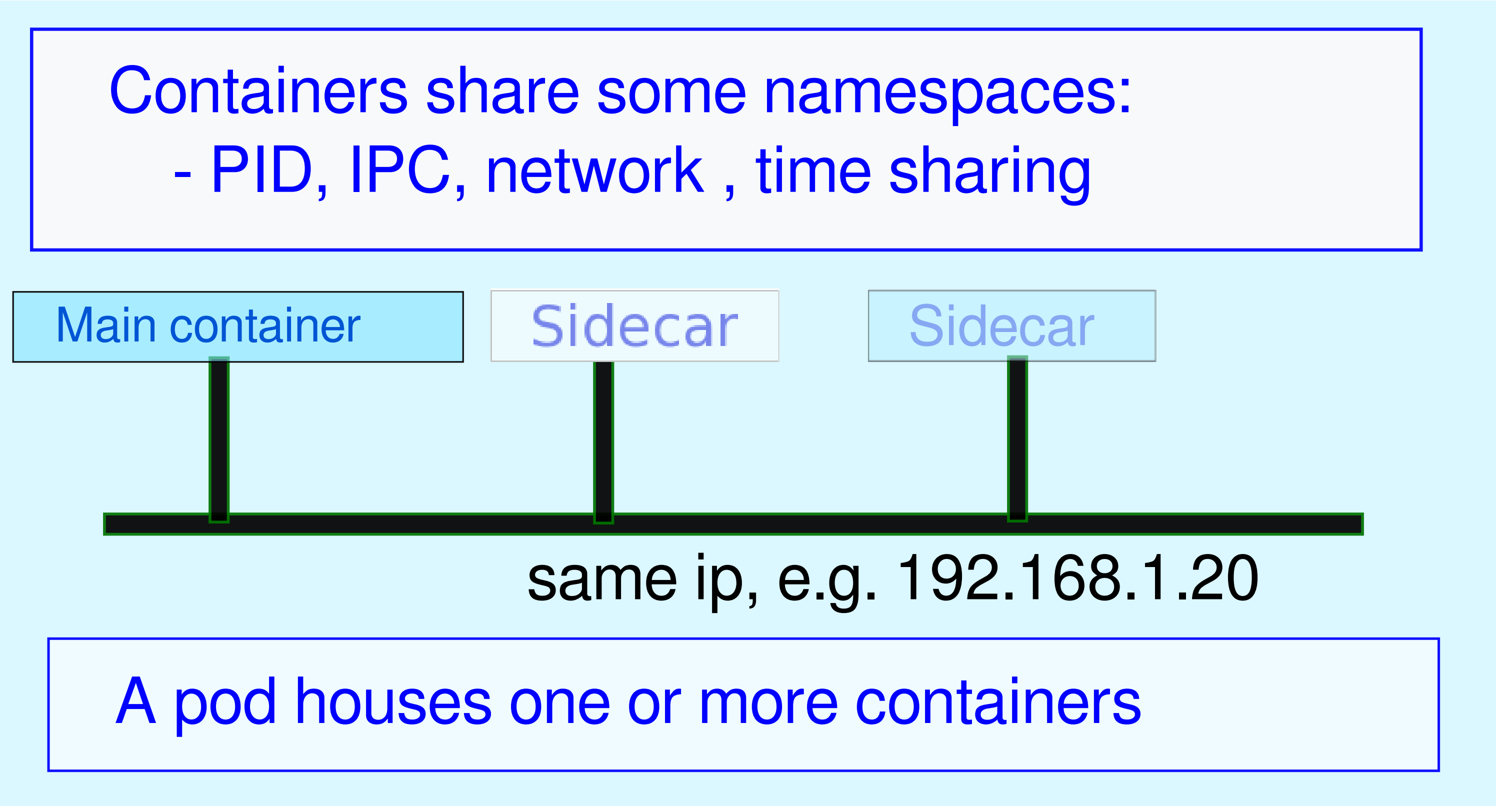
Kubernetes - Master Nodes



Kubernetes - Worker Nodes



Kubernetes - Pods



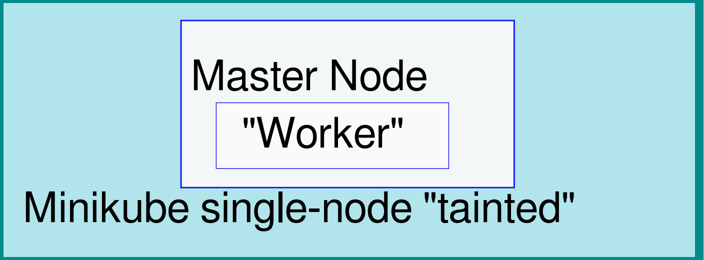
Containers share some namespaces:

- PID, IPC, network , time sharing

same ip, e.g. 192.168.1.20

A pod houses one or more containers

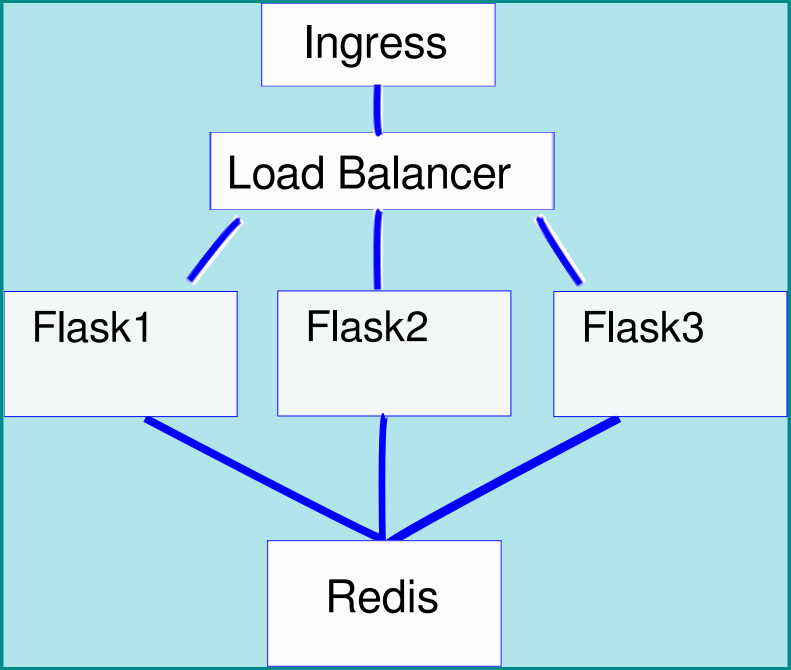
Kubernetes Demo



Master Node

"Worker"

Minikube single-node "tainted"



Ingress

Load Balancer

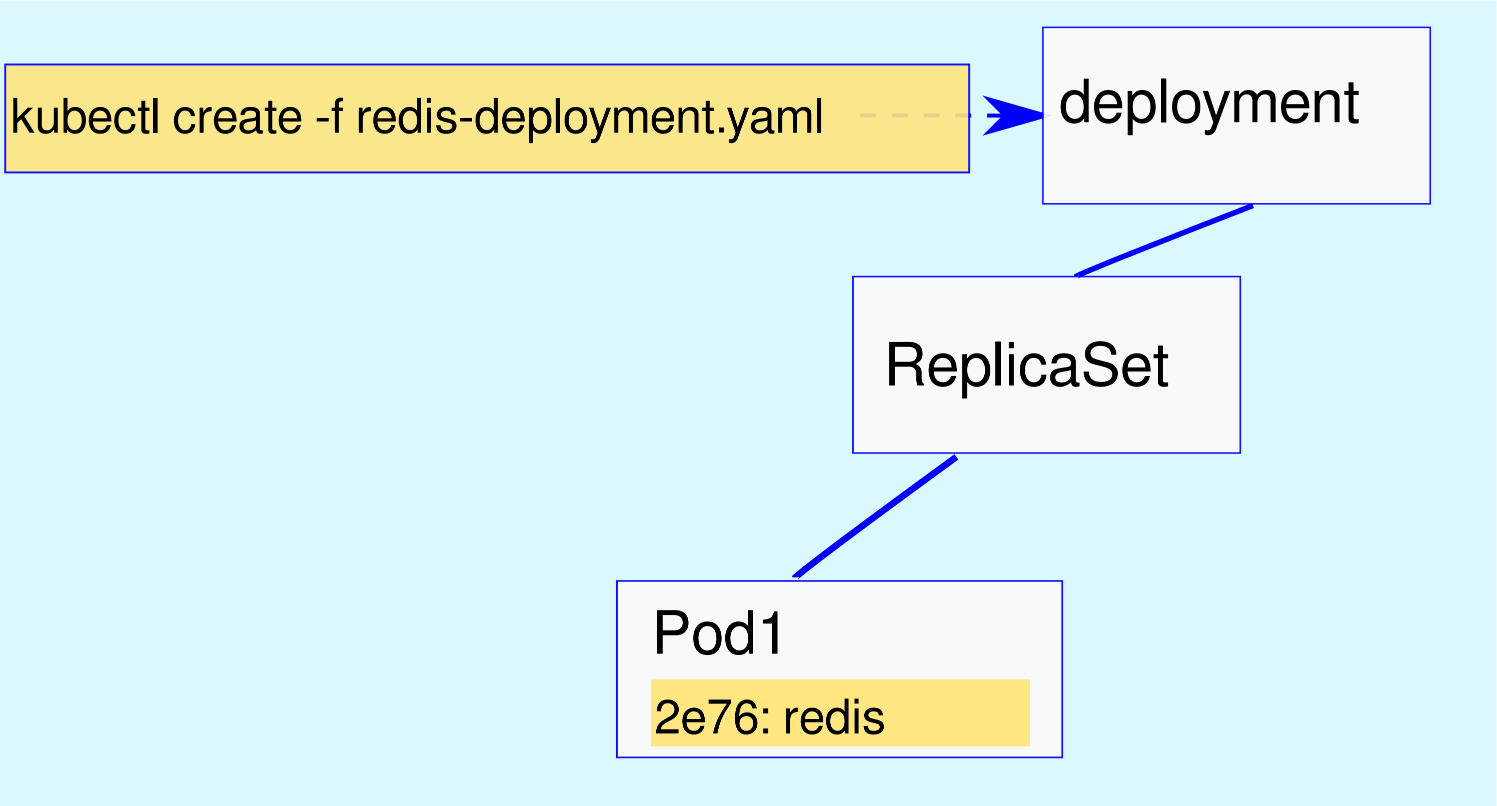
Flask1

Flask2

Flask3

Redis

Kubernetes - Deploying Redis



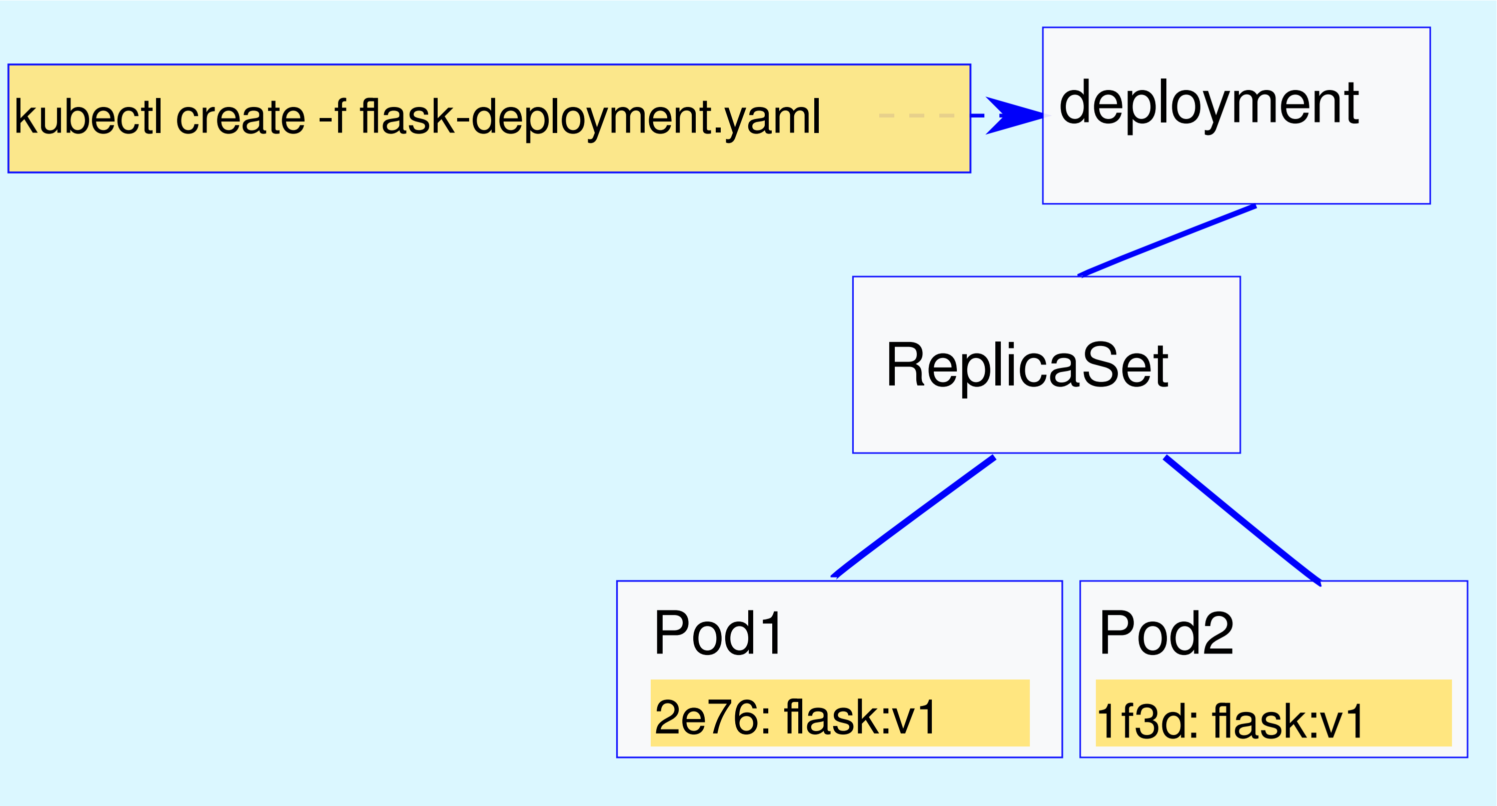
Kubernetes - Deploying Redis

```
# kubectl run redis --image=redis:latest --port=6379

$ kubectl apply -f redis-deployment.yaml
deployment.extensions "redis" created

$ kubectl get pods
NAME                     READY     STATUS              RESTARTS   AGE
redis-68595c4d95-rr4pr   0/1       ContainerCreating   0          1s
```

Kubernetes - Deploying Redis (yaml)

```
apiVersion: extensions/v1beta1
kind: Deployment
metadata:
  labels:
    run: redis
  name: redis
spec:
  replicas: 1
  selector:
    matchLabels:
      run: redis
  template:
    metadata:
      labels:
        run: redis
    spec:
      containers:
      - image: redis:latest
        name: redis
        ports:
        - containerPort: 6379
```

Kubernetes - Deploying Flask



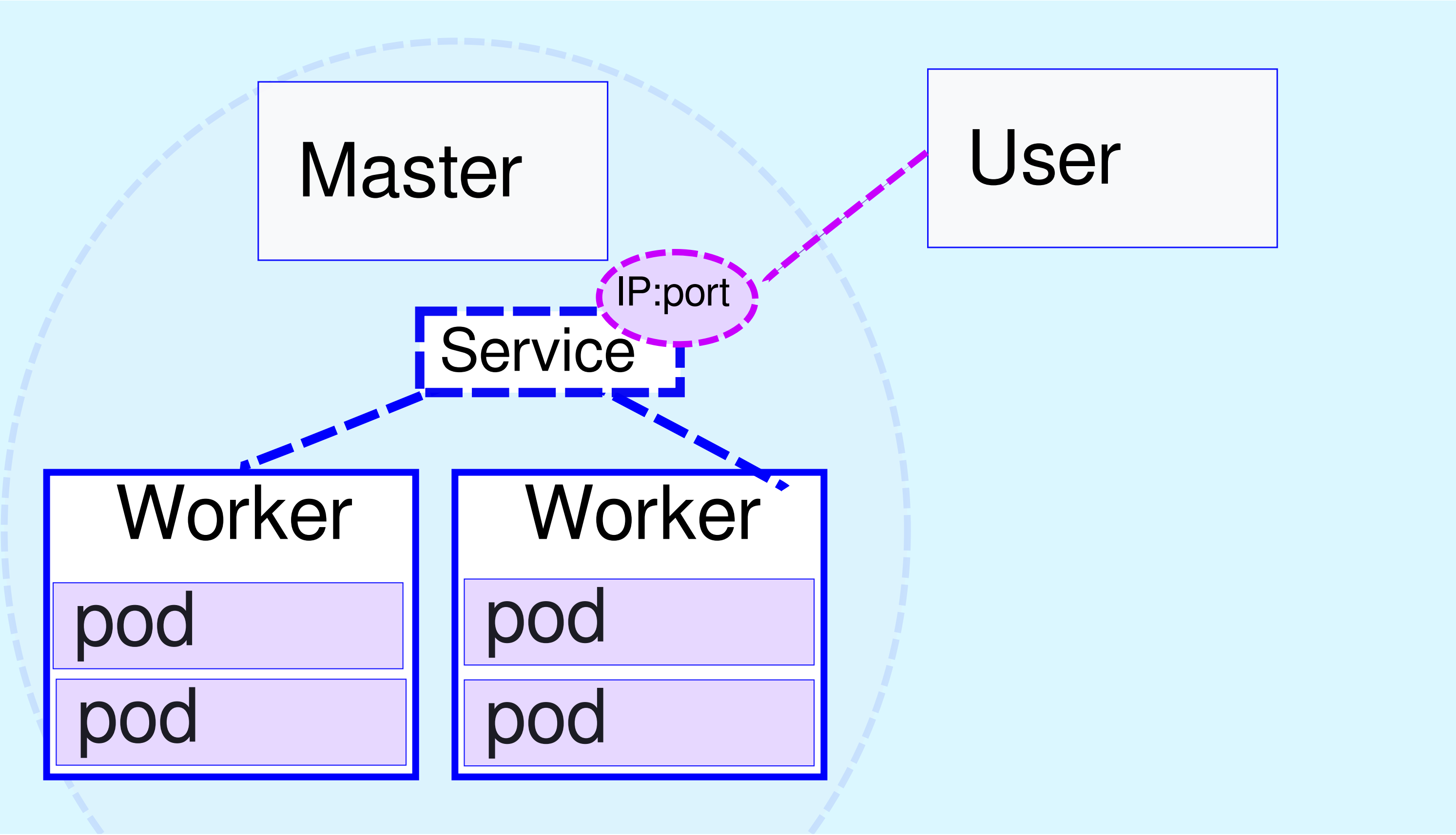
Kubernetes - Deploying Flask

```
# kubectl run flask-app --image=$IMAGE --port=5000

$ kubectl apply -f flask-deployment.yaml
deployment.extensions "flask-app" created

$ kubectl get pods
NAME                        READY     STATUS              RESTARTS   AGE
flask-app-8577b44db-96cht   0/1       Pending             0          1s
redis-68595c4d95-rr4pr      0/1       ContainerCreating   0          1s
```

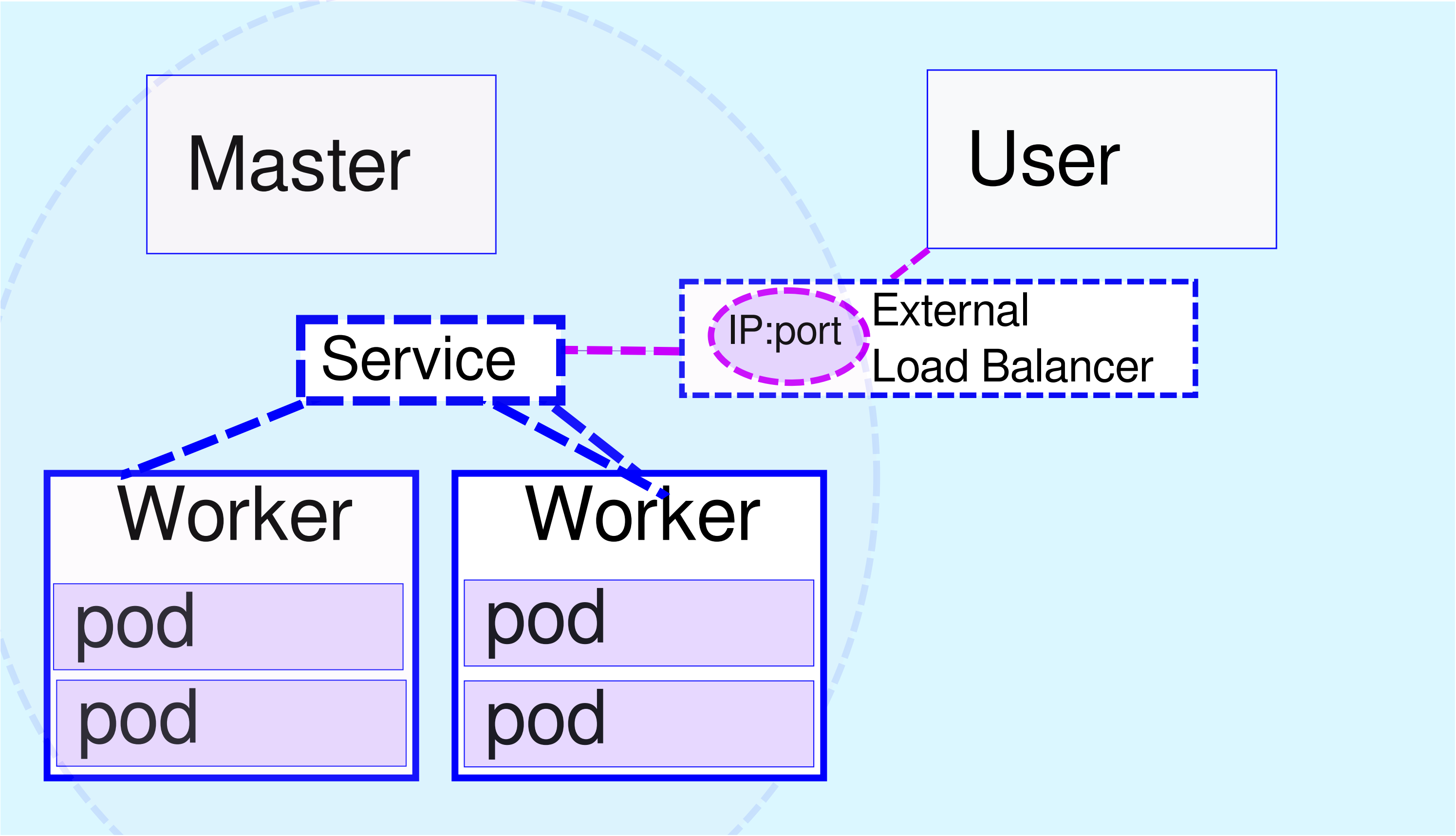
Kubernetes - Deploying Flask (yaml)

```yaml
apiVersion: extensions/v1beta1
kind: Deployment
metadata:
  labels:
    run: flask-app
  name: flask-app
spec:
  replicas: 1
  selector:
    matchLabels:
      run: flask-app
  template:
    metadata:
      labels:
        run: flask-app
    spec:
      containers:
      - image: mjbright/flask-web:v1
        name: flask-app
        ports:
        - containerPort: 5000
```

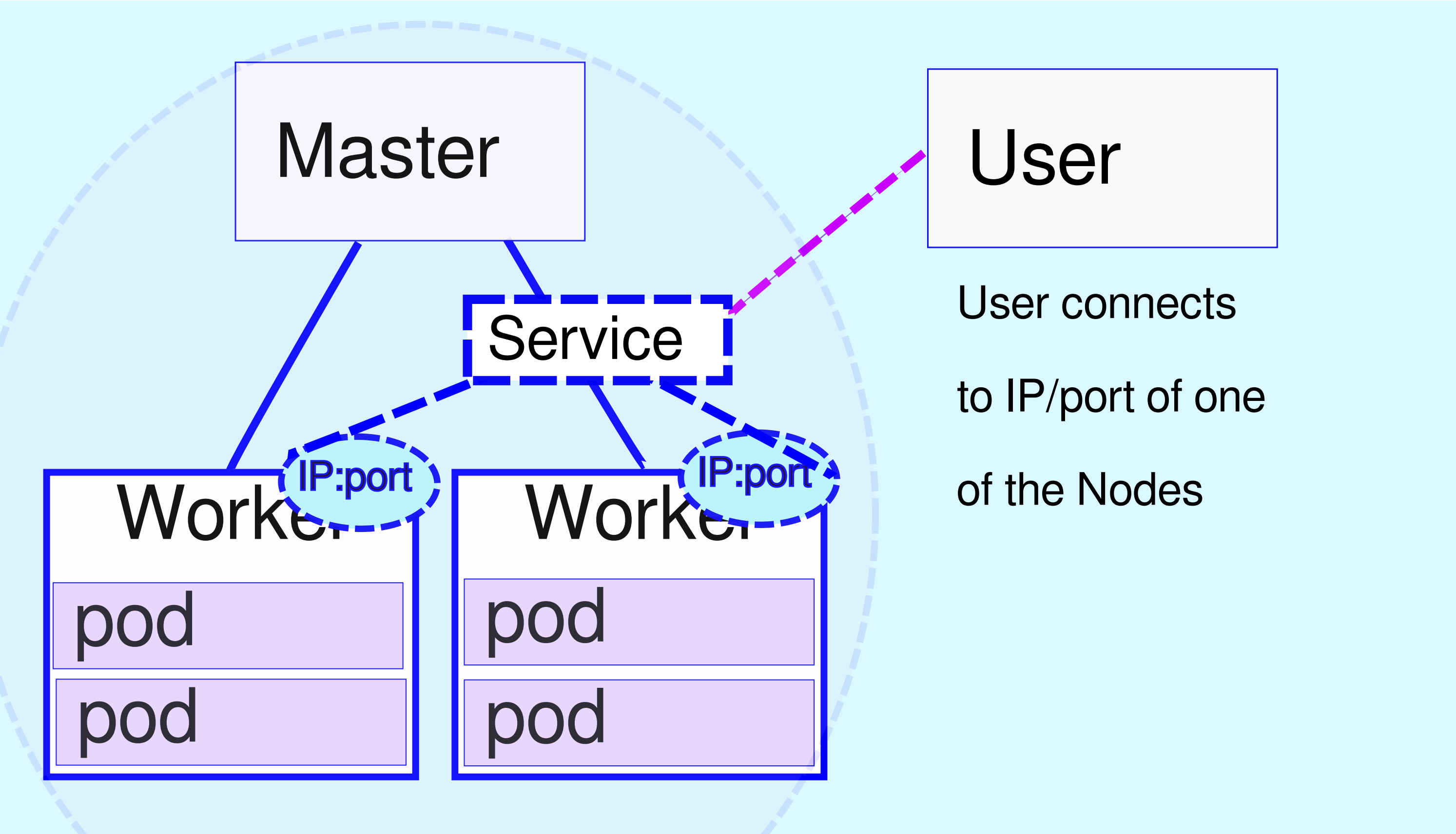
Kubernetes - Exposing Services



Exposing Services (LoadBalancer)



Exposing Services (NodePort)

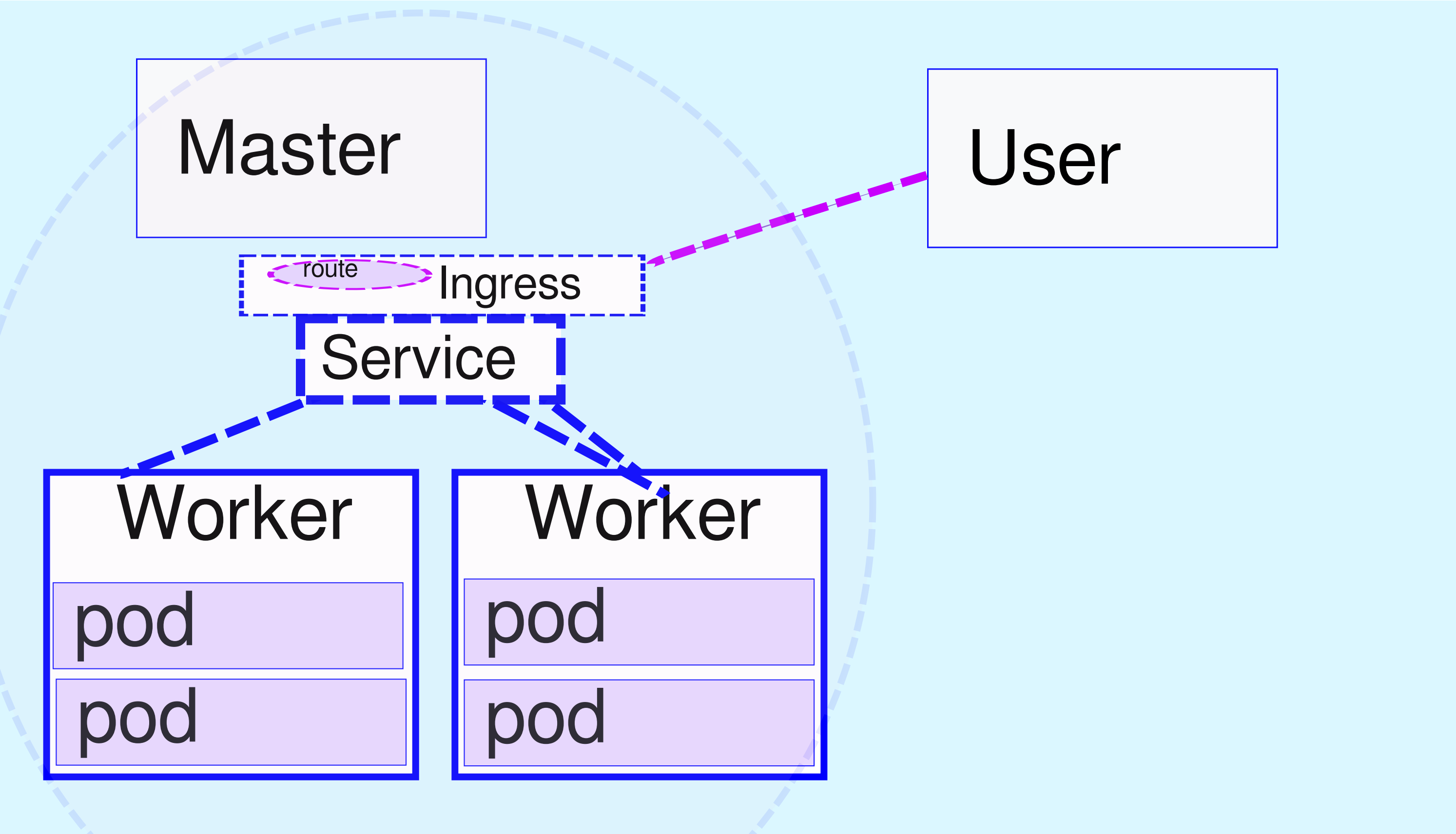


User connects

to IP/port of one

of the Nodes

Exposing Services (IngressController)



Exposing Redis Service (LoadBalancer)

```
# kubectl expose deployment redis --type=LoadBalancer

$ kubectl apply -f redis-service.yaml
service "redis" created

$ kubectl get svc
NAME         TYPE           CLUSTER-IP      EXTERNAL-IP   PORT(S)          AGE
kubernetes   ClusterIP      10.96.0.1       <none>        443/TCP          5h
redis        LoadBalancer   10.101.158.201  <pending>     6379:31218/TCP   1s
```

Exposing Redis Service (LoadBalancer)

```
apiVersion: v1
kind: Service
metadata:
  labels:
    run: redis
  name: redis
spec:
  ports:
  - port: 6379
    protocol: TCP
    targetPort: 6379
  selector:
    run: redis
  type: LoadBalancer
```

Exposing Flask Service (LoadBalancer)

```
# kubectl expose deployment flask-app --type=LoadBalancer

$ kubectl apply -f flask-service.yaml
service "flask-app" created

$ kubectl get svc
NAME         TYPE           CLUSTER-IP       EXTERNAL-IP   PORT(S)          AGE
flask-app    LoadBalancer   10.103.154.19    <pending>     5000:32201/TCP   1s
kubernetes   ClusterIP      10.96.0.1        <none>        443/TCP          5h
redis        LoadBalancer   10.101.158.201   <pending>     6379:31218/TCP   2s
```

Exposing Flask Service (LoadBalancer)

```
apiVersion: v1
kind: Service
metadata:
  labels:
    run: flask-app
  name: flask-app
spec:
  ports:
  - port: 5000
    protocol: TCP
    targetPort: 5000
  selector:
    run: flask-app
  type: LoadBalancer
```

Exposing Services (Ingress)

```
$ minikube addons enable ingress
ingress was successfully enabled

$ kubectl apply -f misc/ingress-definition.yaml
ingress.extensions "ingress-definitions" created

$ sudo vi /etc/hosts
...
192.168.99.100  minikube.test flaskapp.test
```

Exposing Services (Ingress)

```yaml
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: ingress-definitions
  annotations:
    nginx.ingress.kubernetes.io/rewrite-target: /
spec:
  backend:
    serviceName: default-http-backend
    servicePort: 80
  rules:
  - host: minikube.test
    http:
      paths:
      - path: /
        backend:
          serviceName: k8sdemo
          servicePort: 8080
  - host: flaskapp.test
    http:
      paths:
      - path: /flask
        backend:
          serviceName: flask-app
          servicePort: 5000
```

Exposing Services (Ingress)

```
$ minikube service list
|-------------|----------------------|-----------------------------|
|  NAMESPACE  |         NAME         |             URL             |
|-------------|----------------------|-----------------------------|
| default     | flask-app            | http://192.168.99.100:32201 |
| default     | k8sdemo              | http://192.168.99.100:31280 |
| default     | redis                | http://192.168.99.100:31218 |
| kube-system | kubernetes-dashboard | http://192.168.99.100:30000 |
|-------------|----------------------|-----------------------------|

$ curl http://192.168.99.100:31280

$ curl http://minikube.test/k8sdemo
```

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|-------------|----------------------|-----------------------------|
|  NAMESPACE  |         NAME         |             URL             |
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| kube-system | kubernetes-dashboard | http://192.168.99.100:30000 |
|-------------|----------------------|-----------------------------|

$ curl http://192.168.99.100:32201
[flask-app-8577b44db-kbwpn] Redis counter value=214

$ curl http://flaskapp.test/flask
[flask-app-8577b44db-kbwpn] Redis counter value=215
```

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Operations

- H.A.
- Scaling
- Rolling Upgrade
- Strategies
- Health Checks

Operations - achieving High Availability

Achieved through running multiple instances across multiple nodes of the data center

- resilience to node outages
- resilience to pod outages or poor response times

Operations - Scaling

```
# kubectl scale deploy flask-app --replicas=4

$ kubectl edit -f flask-deploy.yaml
```

```
...
spec:
  replicas: 4
```

Operations - Rolling Upgrades

Several strategies exist

`recreate` - terminate old version before releasing new one

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recreate - terminate old version before releasing new one

ramped - gradually release a new version on a rolling update fashion

blue/green - release new version alongside old version then switch

canary - release new version to subset of users, proceed to full rollout

a/b testing - release new version to subset of users in a precise way (HTTP headers, cookie, weight, etc.).

Operations - Rolling Upgrade

Ramped

```
# kubectl set image deploy flask-app flask-app=mjbright/flask-web:v2

$ kubectl edit -f flask-deploy.yaml
$ kubectl rollout status deployment/flask-app
```

```
...
    spec:
      containers:
      - image: mjbright/flask-web:v2
```

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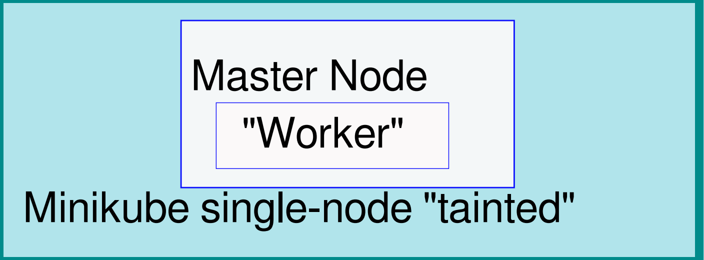
Demo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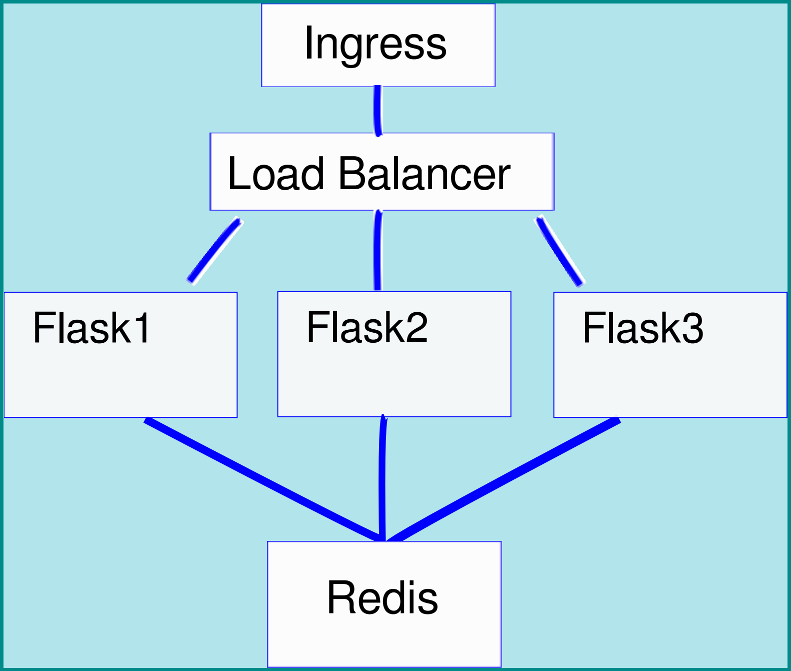
Ingress
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Tools

- Tools
  - Helm (use to install tools)
  - Prometheus
  - Squash
  - Gloo
  - Istio / Service Meshes / Envoy

Summary

Getting started with Micro-services

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- Transform technology and your organization
- Automate, automate, automate ...

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Start by learning Docker principles

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Experiment by Dockerizing some applications

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Getting started with Kubernetes

- Start by learning Docker principles
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- Learn about Container Orchestration

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Getting started with Kubernetes

- Start by learning Docker principles
- Experiment by Dockerizing some applications
- Learn about Container Orchestration
- Hands-on with Kubernetes online or Minikube(*)

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Micro-services offer new deployment possibilities

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- ease of deployment

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- "Best in Class" polyglot implementation

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Micro-services offer new deployment possibilities

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- "Best in Class" polyglot implementation

Hybrid approaches will be adopted

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Micro-services offer new deployment possibilities

- ease of deployment

- ease of scaling

- ease of upgrades

- "Best in Class" polyglot implementation

Hybrid approaches will be adopted

- combining container-based micro-services, VMs, Serverless ...

Thank you !

Questions ?

Michael Bright, @mjbright

linkedin.com/in/mjbright github.com/mjbright

Training classes available

Slides & source code at https://mjbright.github.io/Talks

Resources

minikube

Download	https://github.com/kubernetes/minikube/releases
Documentation	https://kubernetes.io/docs/getting-started-guides/minikube/
Hello Minikube	https://kubernetes.io/docs/tutorials/stateless-application/hello-minikube/

Resources - Articles

Martin Fowler	https://martinfowler.com/articles/microservices.html
MuleSoft, "The top 6 Microservices Patterns"	https://www.mulesoft.com/lp/whitepaper/api/top-microservices-patterns
FullStack Python	https://www.fullstackpython.com/microservices.html
Idit Levine	https://medium.com/solo-io/building-hybrid-apps-with-gloo-1eb96579b070
SSola	https://medium.com/@ssola/building-microservices-with-python-part-i-5240a8dcc2fb
Deployment	http://container-solutions.com/kubernetes-deployment-strategies/

Resources - Books

Publisher		Title, Author
O'Reilly		"Building Microservices", Sam Newman, July 2015
PacktPub		"Python Microservices Development", Tarek Ziade, July 2017