Kubernetes Best Practices

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Google Cloud Platform

Kubernetes is really flexible

But you might 🔫 yourself in the 👟

Building Containers

Don’t trust arbitrary base images!

Static Analysis of Containers

clair

https://github.com/coreos/clair

https://github.com/banyanops/collector

Use small base images

Overhead

Node.js App

Your App → 5MB
Your App's Dependencies → 95MB
Total App Size → 100MB

Docker Base Images:

node:8 → 667MB

node:8-wheezy → 521MB

node:8-slim → 225MB

node:8-alpine → 63.7MB

scratch → ~50MB

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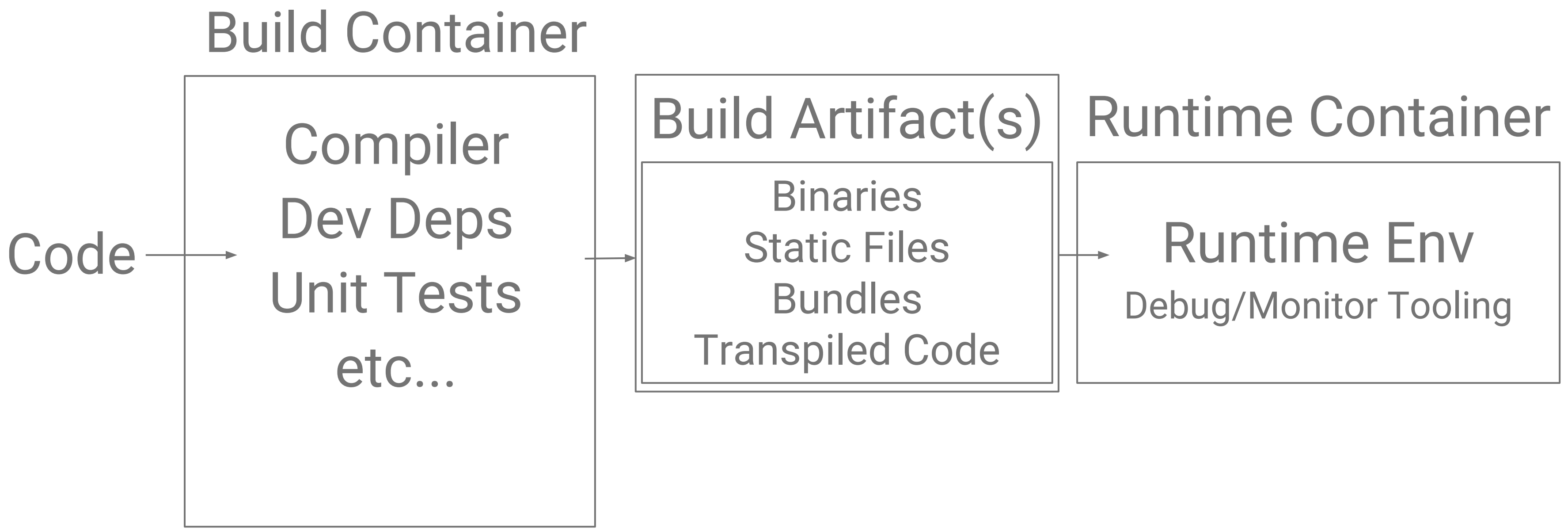
Pros:
Builds are faster
Need less storage
Cold starts (image pull) are faster
Potentially less attack surface

Cons:
Less tooling inside container
“Non-standard” environment

Use the “builder pattern”


Build Container
Code
Compiler
Dev Deps
Unit Tests
etc...
Build Artifact(s)
Binaries
Static Files
Bundles
Transpiled Code
Runtime Container
Runtime Env
Debug/Monitor Tooling

Docker bringing native support for multi-stage builds in Docker CE 17.05

Container Internals

Use a non-root user inside the container

Example Dockerfile

```
FROM node:alpine
RUN apk update && apk add imagemagick

RUN groupadd -r nodejs
RUN useradd -m -r -g nodejs nodejs
USER nodejs

ADD package.json package.json
RUN npm install
ADD index.js index.js
CMD npm start
```

Enforce it!

```yaml
apiVersion: v1
kind: Pod
metadata:
 name: hello-world
spec:
 containers:
 # specification of the pod's containers
 # ...
 securityContext:
   runAsNonRoot: true
```

Make the filesystem read-only

Enforce it!

```
apiVersion: v1
kind: Pod
metadata:
 name: hello-world
spec:
 containers:
 # specification of the pod's containers
 # ...
 securityContext:
   runAsNonRoot: true
   readOnlyRootFilesystem: true
```

One process per container

Don’t restart on failure. Crash cleanly instead.

Log to stdout and stderr

Add “dumb-init” to prevent zombie processes

Example Dockerfile

```
FROM node:alpine
RUN apk update && apk add imagemagick

RUN groupadd -r nodejs
RUN useradd -m -r -g nodejs nodejs
USER nodejs

ADD https://github.com/Yelp/dumb-init/releases/download/v1.2.0/dumb-init_1.2.0_amd64 \
   /usr/local/bin/dumb-init
RUN chmod +x /usr/local/bin/dumb-init
ENTRYPOINT ["/usr/bin/dumb-init", "--"]

ADD package.json package.json
RUN npm install
ADD index.js index.js
CMD npm start
```

Good News: No need to do this in K8s 1.7

Deployments

Use the “record” option for easier rollbacks

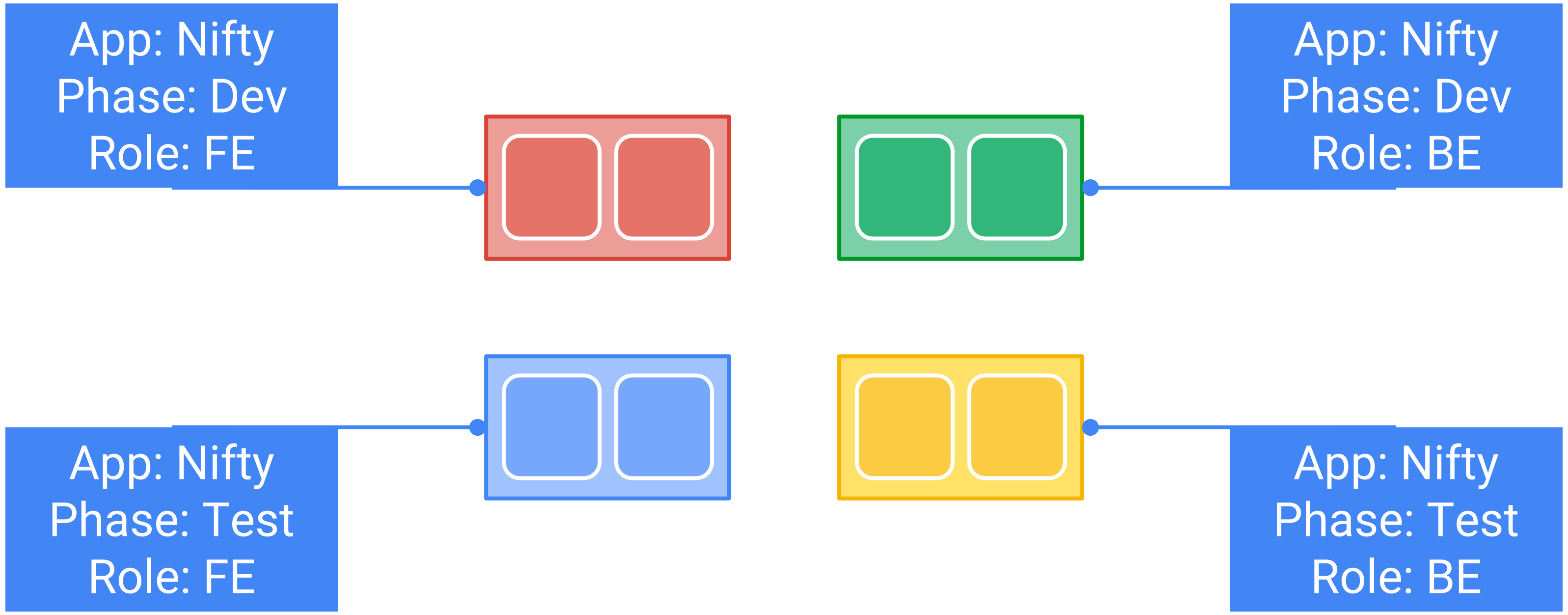
```
$ kubectl apply -f deployment.yaml --record

…

$ kubectl rollout history deployments my-deployment

deployments "ghost-recorded"

REVISION    CHANGE-CAUSE
1        kubectl apply -f deployment.yaml --record
2        kubectl edit deployments my-deployment
3        kubectl set image deployment/my-deplyoment my-container=app:2.0
```

Use plenty of descriptive labels

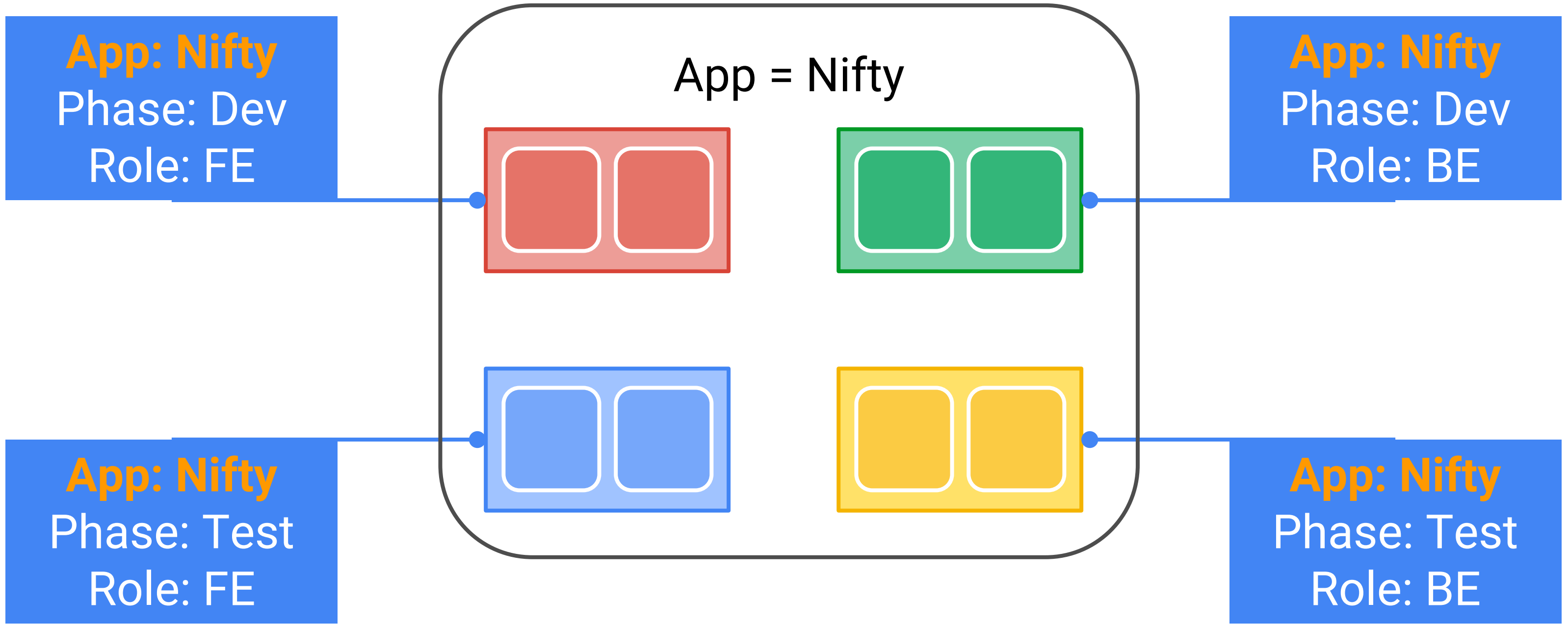
Labels

```
apiVersion: extensions/v1beta1
kind: Deployment
metadata:
name: web
spec:
replicas: 12
template:
  metadata:
    labels:
      name: web
      color: blue
      experimental: 'true'
```

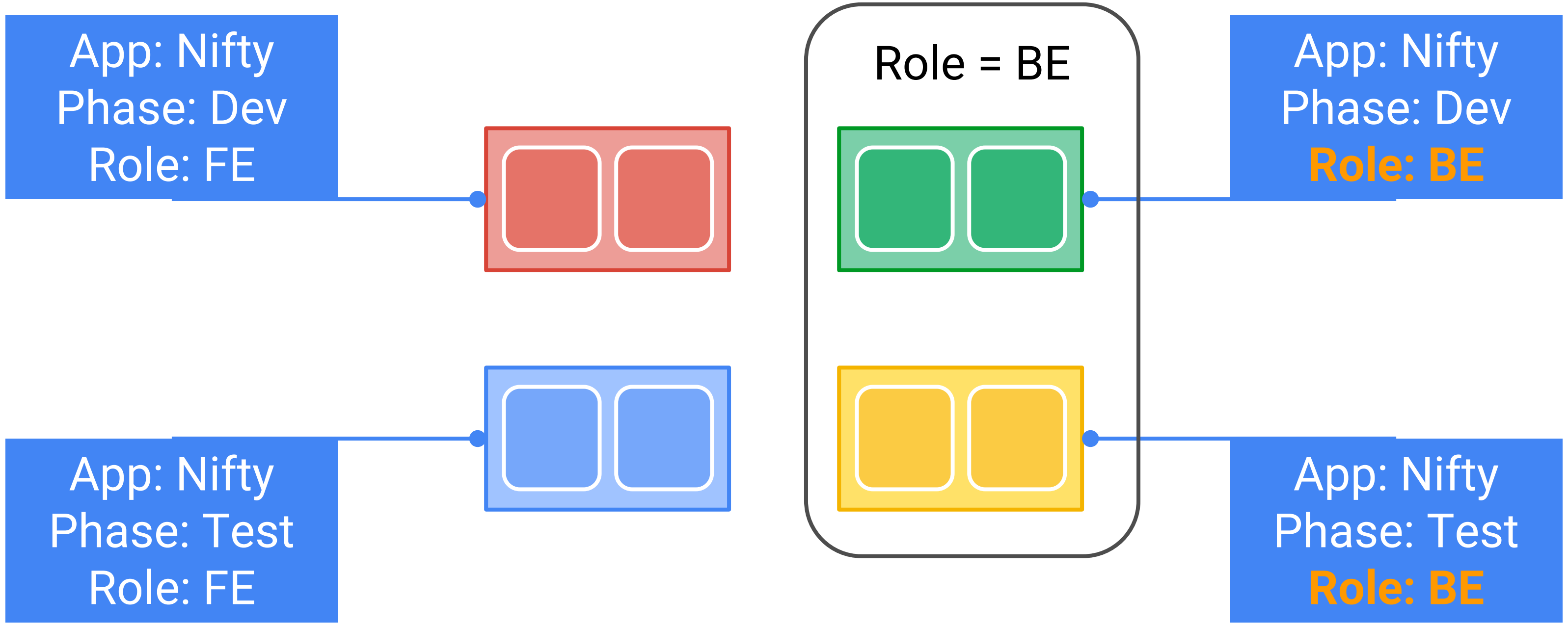
Labels


App: Nifty
Phase: Dev
Role: FE
App: Nifty
Phase: Dev
Role: BE
App: Nifty
Phase: Test
Role: FE
App: Nifty
Phase: Test
Role: BE

Labels


App: Nifty
Phase: Dev
Role: FE
App = Nifty
App: Nifty
Phase: Dev
Role: BE
App: Nifty
Phase: Test
Role: FE
App: Nifty
Phase: Test
Role: BE

Labels


App: Nifty
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Role = BE
App: Nifty
Phase: Dev
Role: BE
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Role: FE
App: Nifty
Phase: Test
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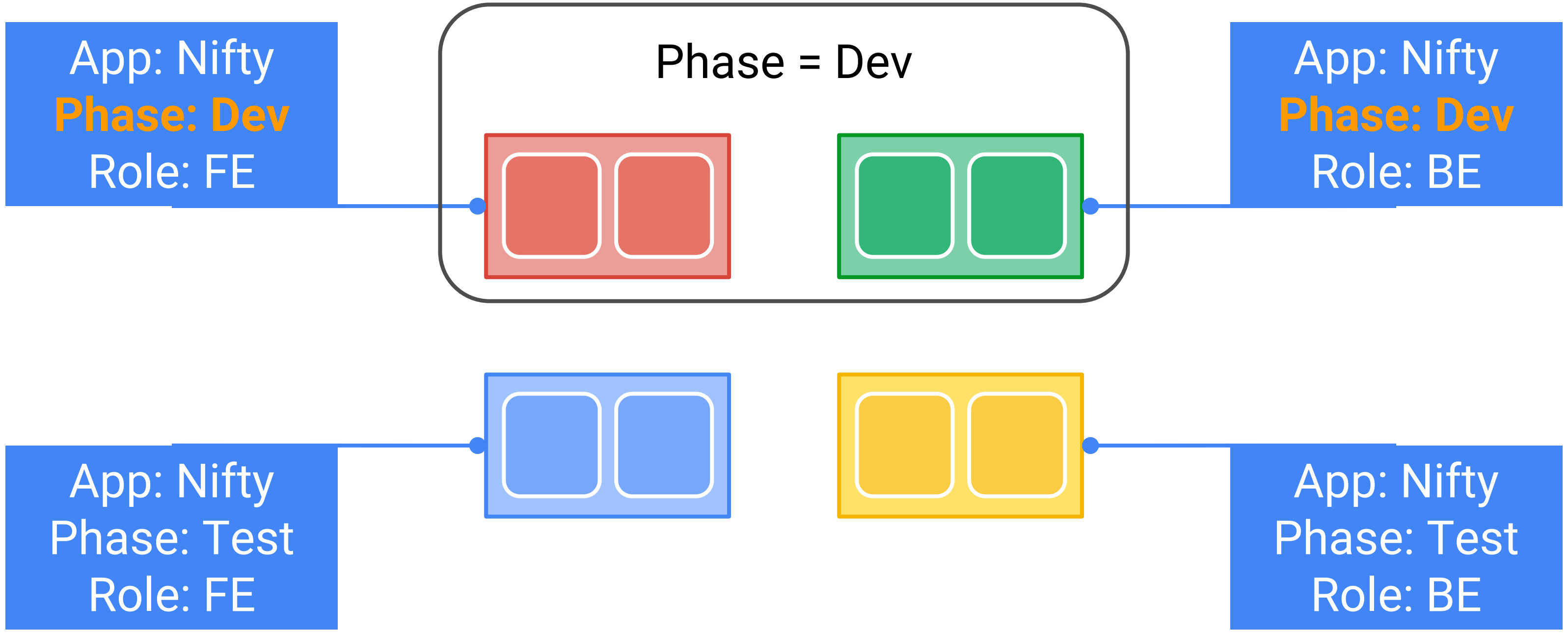
Labels


App: Nifty
Phase: Dev
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Role: BE
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Phase: Test
Role: FE
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Phase: Test
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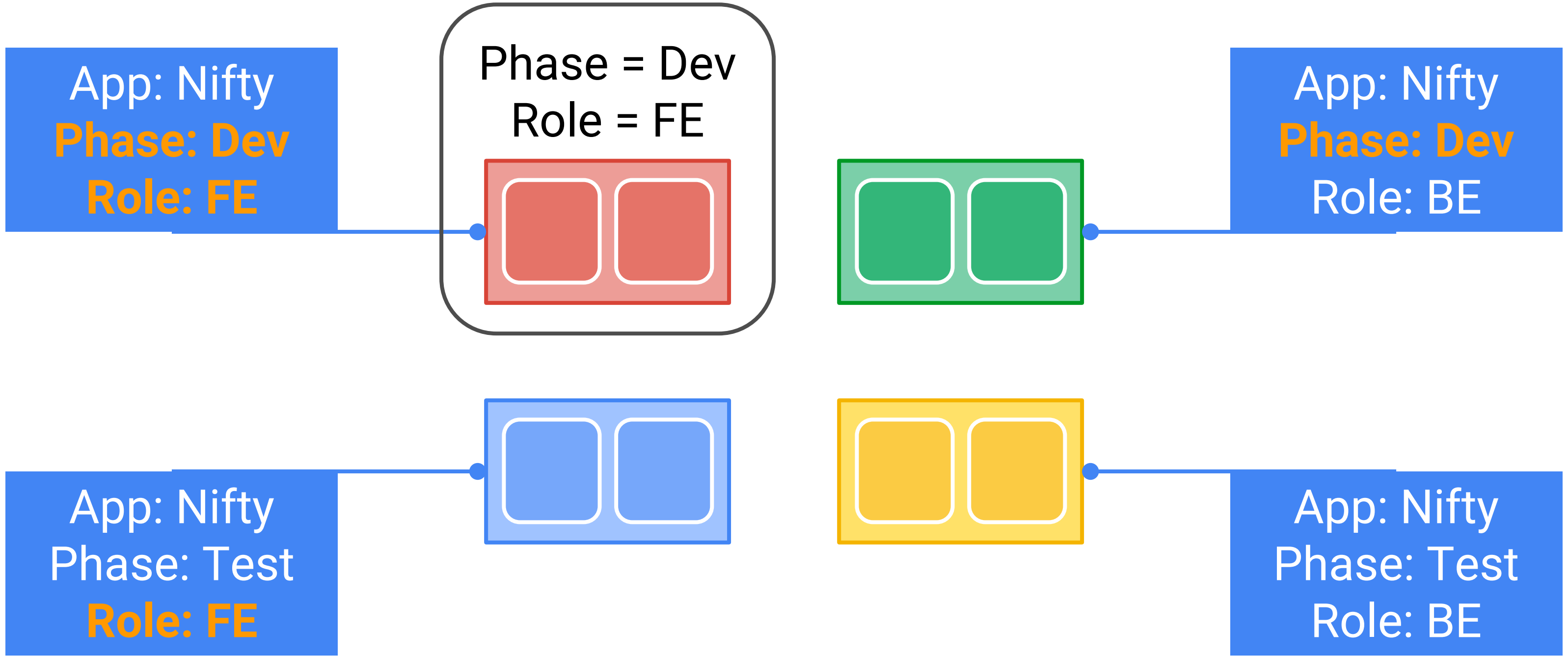
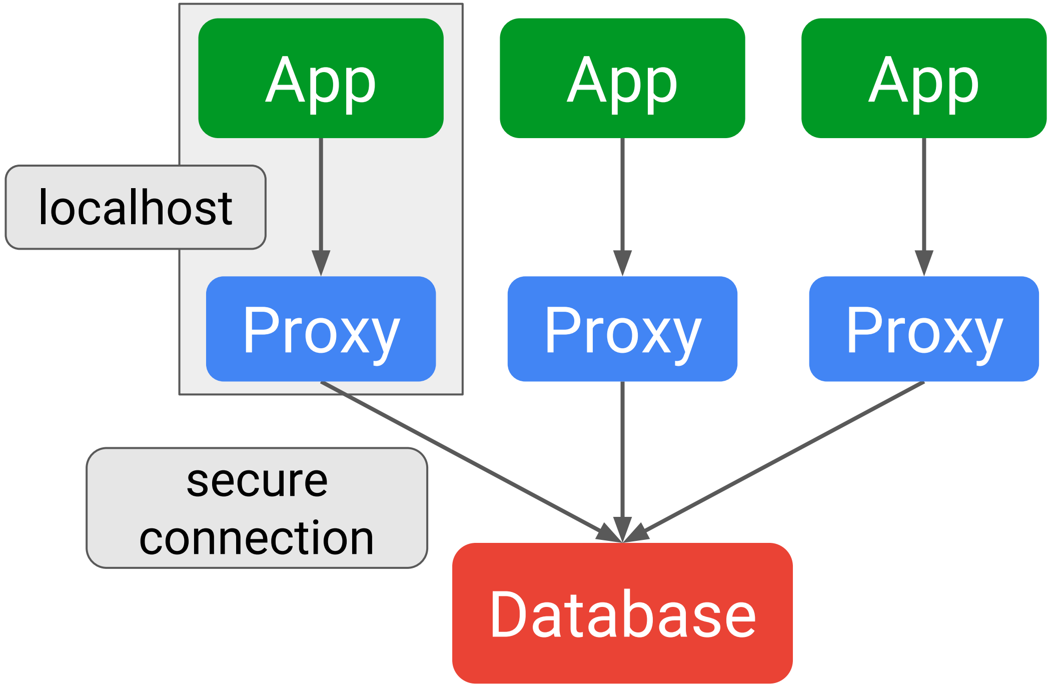
Labels

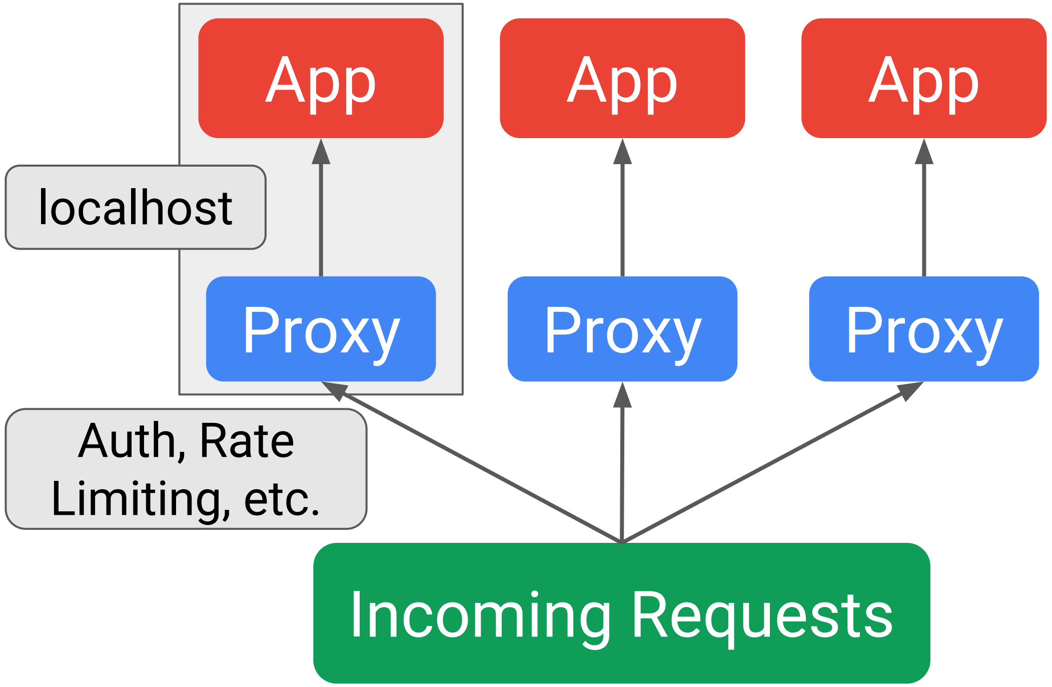

App: Nifty
Phase: Dev
Role: FE
Phase = Dev
Role = FE
App: Nifty
Phase: Dev
Role: BE
App: Nifty
Phase: Test
Role: FE
App: Nifty
Phase: Test
Role: BE

Use sidecar containers for proxies, watchers, etc

Examples


App
App
App
localhost
Proxy
Proxy
Proxy
secure connection
Database

Examples


App
App
App
localhost
Proxy
Proxy
Proxy
Auth, Rate Limiting, etc.
Incoming Requests

Don’t use sidecars for bootstrapping!

Use init containers instead!

```
apiVersion: v1
kind: Pod
metadata:
 name: awesomeapp-pod
 labels:
   app: awesomeapp
 annotations:
   pod.beta.kubernetes.io/init-containers: '[
       {
           "name": "init-myapp",
           "image": "busybox",
           "command": ["sh", "-c", "until nslookup myapp; do echo waiting for myapp; sleep 2; done;"]
       },
       {
           "name": "init-mydb",
           "image": "busybox",
           "command": ["sh", "-c", "until nslookup mydb; do echo waiting for mydb; sleep 2; done;"]
       }
   ]'
spec:
 containers:
 - name: awesomeapp-container
   image: busybox
   command: ['sh', '-c', 'echo The app is running! && sleep 3600]
```

Don’t use `:latest` or no tag

Readiness and Liveness probes are your friend

Health Checks

Readiness → Is the app ready to start serving traffic?

- Won’t be added to a service endpoint until it passes
- Required for a “production app” in my opinion

Liveness → Is the app still running?

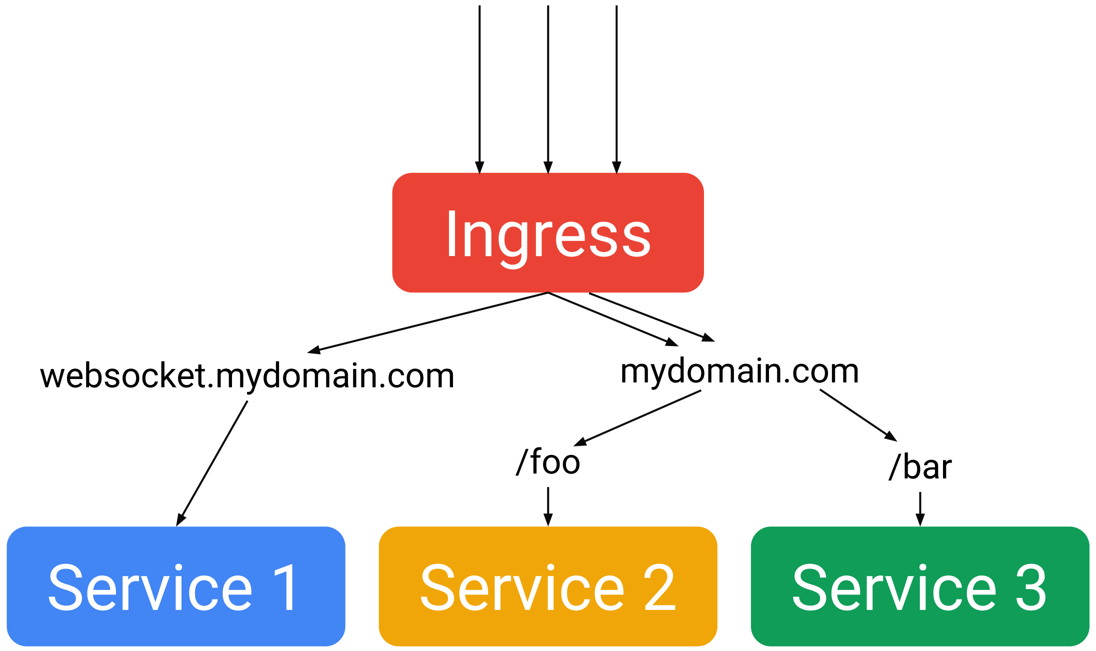
- Default is “process is running”
- Possible that the process can be running but not working correctly
- Good to define, might not be 100% necessary

These can sometimes be the same endpoint, but not always

Services

Don’t always use `type: LoadBalancer`

Ingress is great


Ingress
websocket.mydomain.com
mydomain.com
/foo
/bar
Service 1
Service 2
Service 3

`type: NodePort` can be “good enough”

Use Static IPs. They are free[*]!

```
$ gcloud compute addresses create ingress --global
…
$ gcloud compute addresses create myservice --region=us-west1
Created …
address: QQQ.ZZZ.YYY.XXX
…
$
```

```
apiVersion: v1
kind: Service
metadata:
 name: myservice
spec:
 type: LoadBalancer
 loadBalancerIP: QQQ.ZZZ.YYY.XXX
 ports:
   - port: 80
     targetPort: 3000
     protocol: TCP
 selector:
   name: myapp
```

```
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
 name: myingress
 annotations:
   kubernetes.io/ingress.global-static-ip-name: "ingress"
spec:
 backend:
   serviceName: myservice
   servicePort: 80
```

Map external services to internal ones

External Services

Hosted Database

```yaml
kind: Service
apiVersion: v1
metadata:
 name: mydatabase
 namespace: prod
spec:
 type: ExternalName
 externalName: my.database.example.com
 ports:
 - port: 12345
```

Database outside cluster but inside network

```yaml
kind: Service
apiVersion: v1
metadata:
 name: mydatabase
spec:
 ports:
   - protocol: TCP
     port: 80
     targetPort: 12345
```

```yaml
kind: Endpoints
apiVersion: v1
metadata:
 name: mydatabase
subsets:
 - addresses:
     - ip: 10.128.0.2
   ports:
     - port: 12345
```

Application Architecture

Use Helm Charts

ALL downstream dependencies are unreliable

Make sure your microservices aren’t too micro

Use a “Service Mesh”

Istio

https://github.com/istio/istio

linkerd

https://github.com/linkerd/linkerd

Use a PaaS?

DEIS

OPENSHIFT®

by Red Hat®

Kel™

Cluster Management

Use Google Container Engine 😉

Resources, Anti-Affinity, and Scheduling

Node Affinity

hostname

zone

region

instance-type

os

arch

custom!

Node Taints / Tolerations

special hardware

dedicated hosts

etc

Pod Affinity / Anti-Affinity

hostname

zone

region

Use Namespaces to split up your cluster

Role Based Access Control

Unleash the Chaos Monkey

More Resources

- http://blog.kubernetes.io/2016/08/security-best-practices-kubernetes-deployment.html
- https://github.com/gravitational/workshop/blob/master/k8sprod.md
- https://nodesource.com/blog/8-protips-to-start-killing-it-when-dockerizing-node-js/
- https://www.ianlewis.org/en/using-kubernetes-health-checks
- https://www.linux.com/learn/rolling-updates-and-rollbacks-using-kubernetes-deployments
- https://kubernetes.io/docs/api-reference/v1.6/

Questions?

What best practices do you have?