9 Steps to Awesome with Kubernetes

Burr Sutter (burrsutter.com)

github.com/burrsutter/9stepsawesome

Upcoming 3 hour classes/workshops

9 Steps to Awesome with Kubernetes

February 5, 2019
https://www.safaribooksonline.com/live-training/courses/9-steps-to-awesome-with-kubernetes/0636920231363/

March 12, 2019
https://www.safaribooksonline.com/live-training/courses/9-steps-to-awesome-with-kubernetes/0636920231783/

Istio on Kubernetes: Enter the Service Mesh

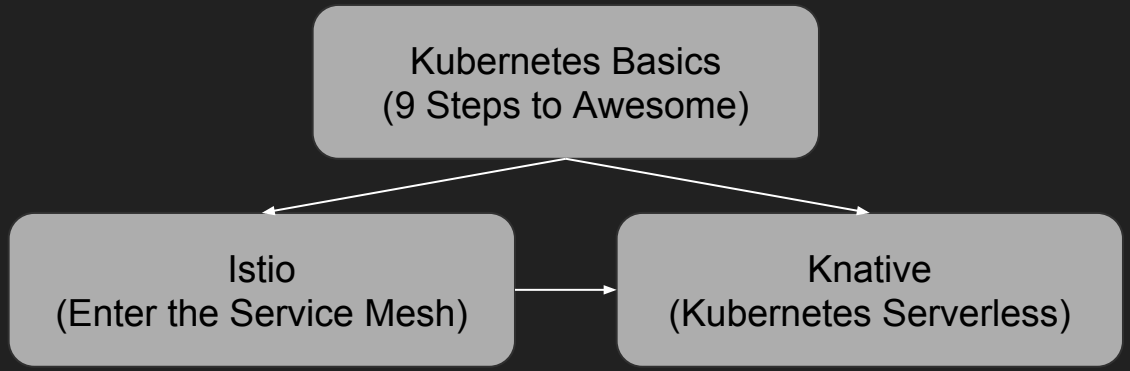
February 7, 2019
https://www.safaribooksonline.com/live-training/courses/istio-on-kubernetes-enter-the-service-mesh/0636920231318/

March 14, 2019
https://www.safaribooksonline.com/live-training/courses/istio-on-kubernetes-enter-the-service-mesh/0636920231745/

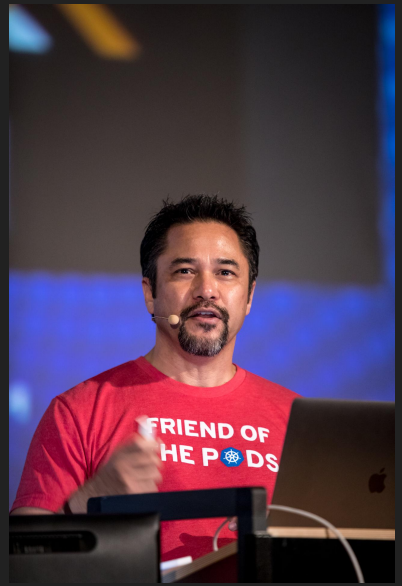
New 3-hour Deep Dive

Kubernetes Serverless with Knative

March 15, 2019
https://www.safaribooksonline.com/live-training/courses/kubernetes-serverless-with-knative/0636920257226/



Recording from Devoxx BE 2018: https://www.youtube.com/watch?v=ZpbXSdzp_vo



"excellent stuff.. worth 3 hours spending to watch this video.. Really loved it. Will give a complete picture on Kubernetes and how it works" - Pradeep

Setup

https://github.com/burrsutter/9stepsawesome/blob/master/1_installation_started.adoc

Tips on the Virtualization Drivers
https://docs.okd.io/latest/minishift/getting-started/setting-up-virtualization-environment.html

https://github.com/kubernetes/minikube/blob/master/docs/drivers.md

http://www.g-pop.net/fistoffury.htm

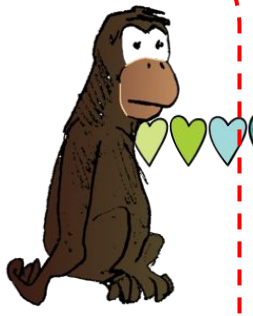
Your Journey to Awesomeness

Re-Org to DevOps

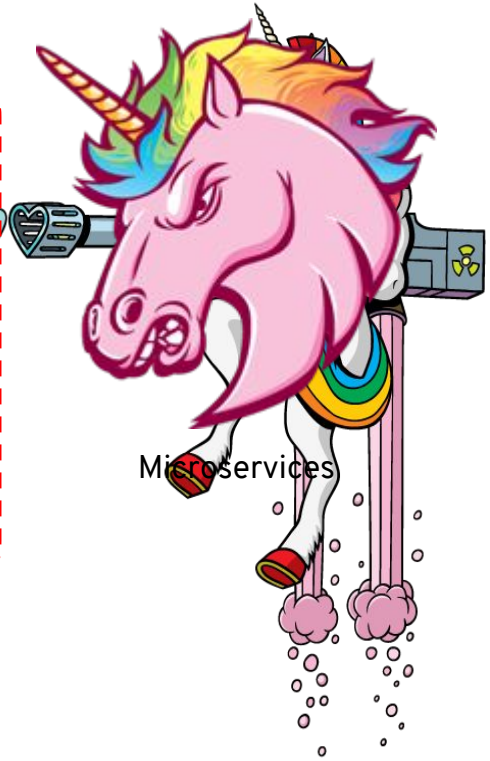
Self-Service, On-Demand, Elastic Infrastructure

Automation

CI & CD Deployment Pipeline



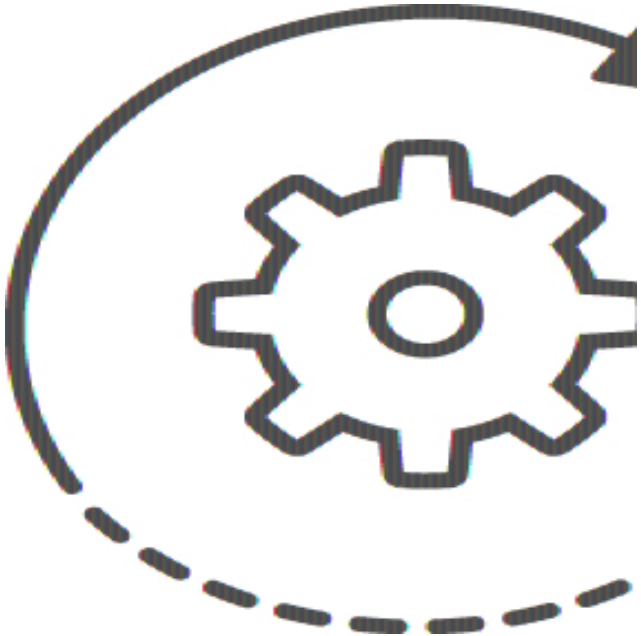
Advanced Deployment Techniques



Microservices

Agility

Continuous Delivery, Deployment, Improvement



3 Month Deployment Cycle
3 Months BEFORE you gain Feedback and Learn

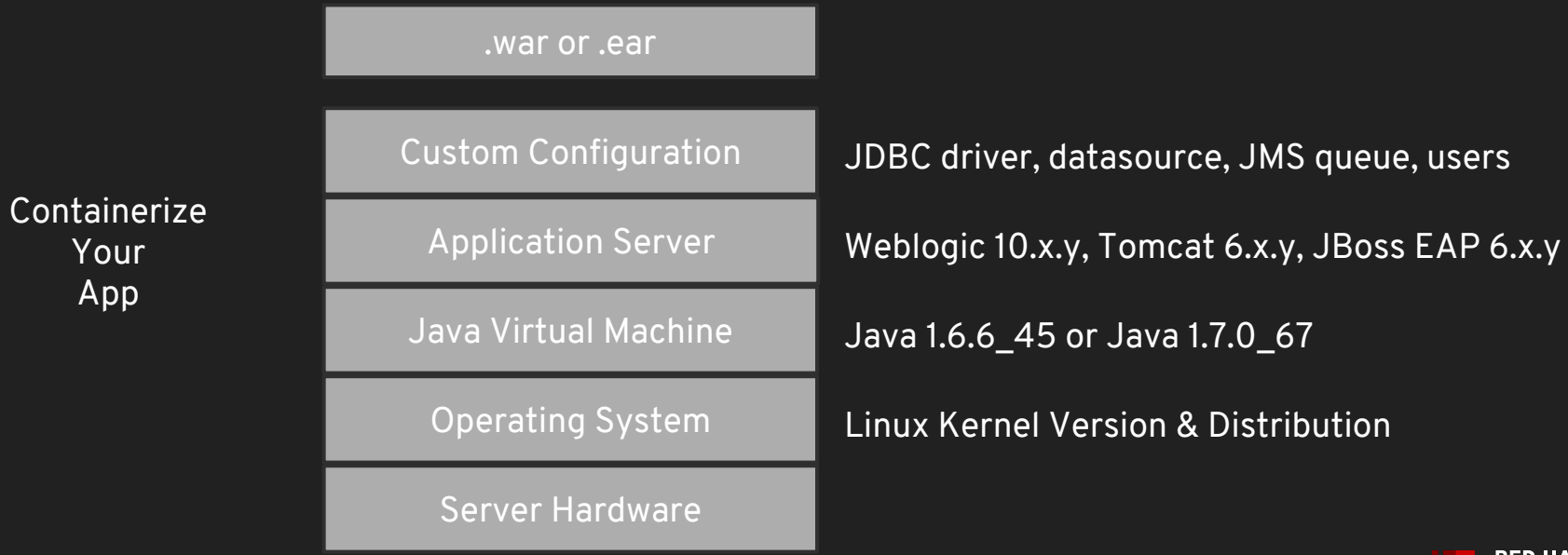
9 Steps

0 - Introduction
1 - Installation & Getting Started
2 - Building Images, Running Containers
3 - oc/kubectl exec magic
4 - Logs
5 - Configuration & Environment
6 - Service discovery & load-balancing
7 - Live & Ready
8 - Rolling updates, Canaries, Blue/Green
~~9 - Debugging~~ Databases
Bonus Items

Step 0: Introduction

A Challenge

Have you ever had “/” vs “\” break your app? Or perhaps needed a unique version of a JDBC driver? Or had a datasource with a slightly misspelled JNDI name? Or received a patch for the JVM or app server that broke your code?



Email

MyApp.war has been tested with the following

On my Windows 7 desktop

JDK 1.8.43

Wildfly 9

Configuration:

Datasource: MySQLDS

Tested with: mysql-connector-java-5.1.31-bin.jar

Production Environment

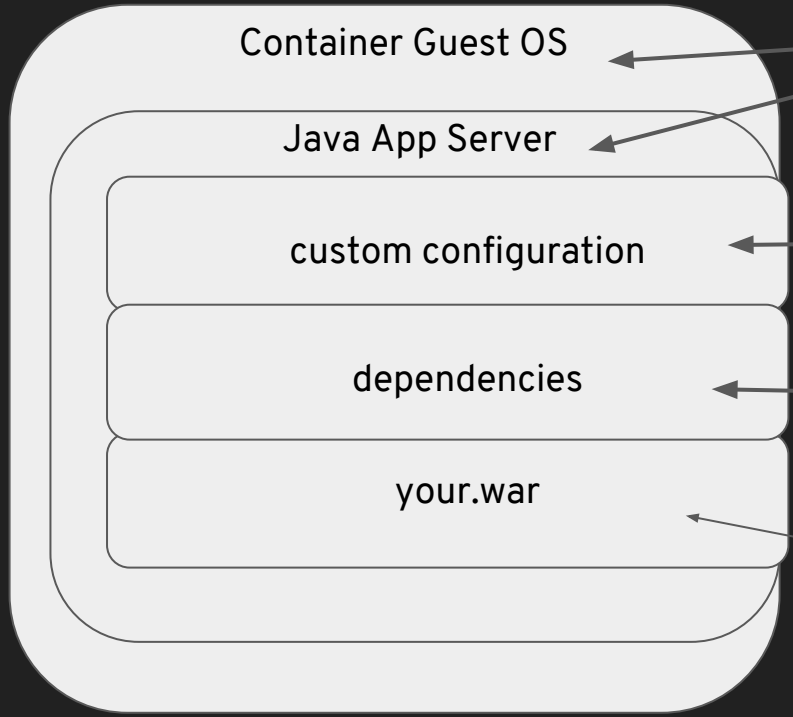
Red Hat Enterprise Linux 6.2

JRE 1.7.3

WebSphere 8.5.5

Oracle 9

Dockerfile



FROM centos/wildfly

COPY xyz.xml /opt/myserver/configuration/

COPY mysql-connector-java-5.1.31-bin.jar /opt/wildfly/standalone/deployments/

COPY mysql-sample-ds.xml /opt/wildfly/standalone/deployments/

COPY myapp/target/your.war /opt/wildfly/standalone/deployments/

DevOps Challenges for Multiple Containers

- How to scale?
- How to avoid port conflicts?
- How to manage them on multiple hosts?
- What happens if a host has trouble?
- How to keep them running?
- How to update them?
- Rebuild Container Images?

https://kubernetes.io/docs/concepts/overview/what-is-kubernetes/

Meet Kubernetes

- Greek for “Helmsman,” also the root of the word “Governor” (from latin: gubernator)
- Container orchestrator
- Supports multiple cloud and bare-metal environments
- Inspired by Google’s experience with containers
- Open source, written in Go
- Manage applications, not machines

OPENSHIFT

Key Capabilities

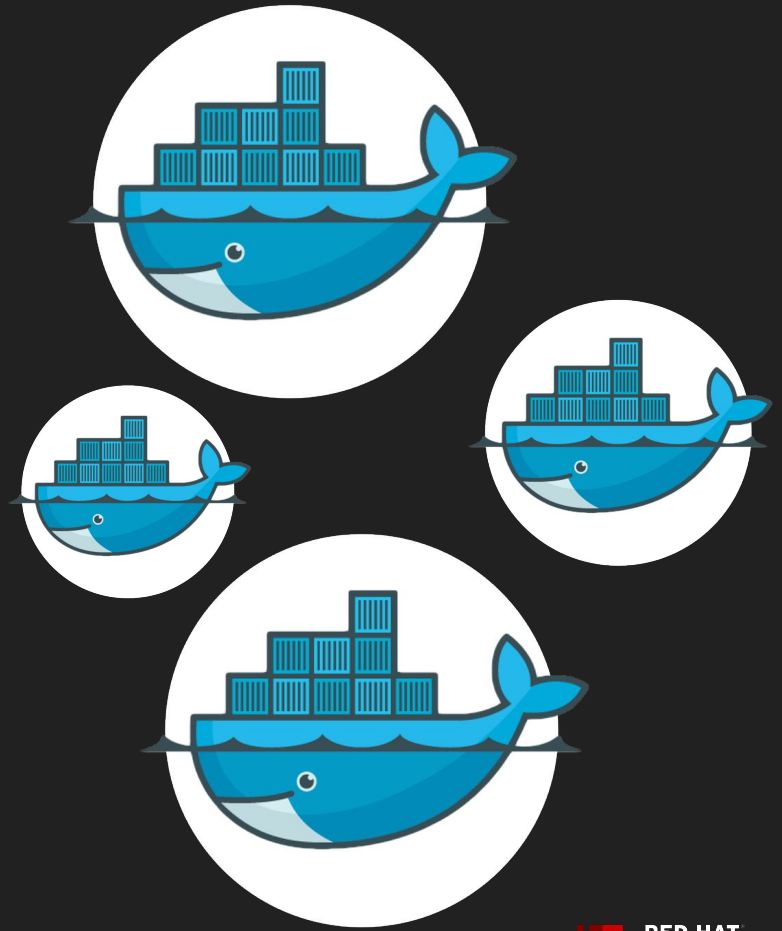
- Self-healing
- Horizontal Manual & Auto Scaling
- Automatic Restarting
- Scheduled across hosts
- Built-in load-balancer
- Rolling upgrades

Pods

A group of whales is commonly referred to as a pod and a pod usually consists a group of whales that have bonded together either because of biological reasons or through friendships developed between two or more whales.

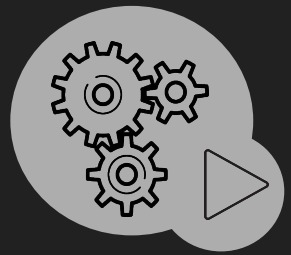
In many cases a typical whale pod consists of anywhere from 2 to 30 whales or more.*

*http://www.whalefacts.org/what-is-a-group-of-whales-called/



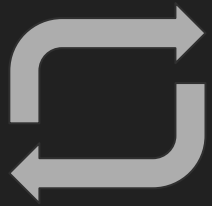
Kubernetes Terms

Pod



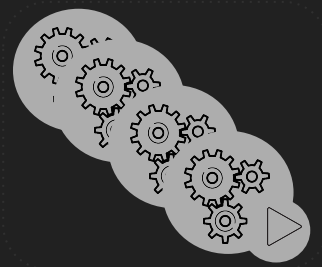
- ✓ 1+ containers
- ✓ Shared IP
- ✓ Shared storage (ephemeral)
- ✓ Shared resources
- ✓ Shared lifecycle

Replicaset/ Deployment



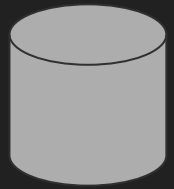
- ✓ The Desired State - replicas, pod template: health checks, resources, image

Service



- ✓ Grouping of pods (acting as one) has stable virtual IP and DNS name

Persistent Volume

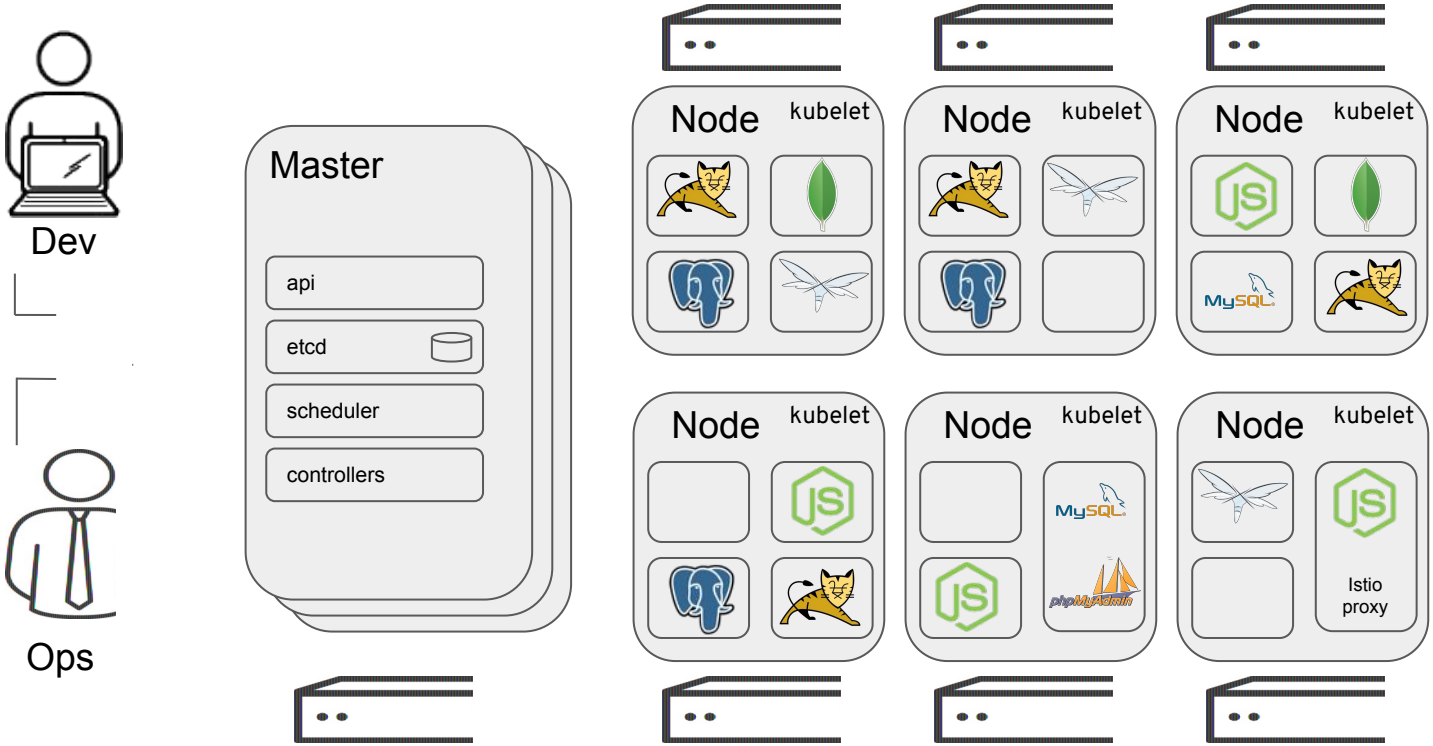


- ✓ Network available storage
- ✓ PVs and PVCs

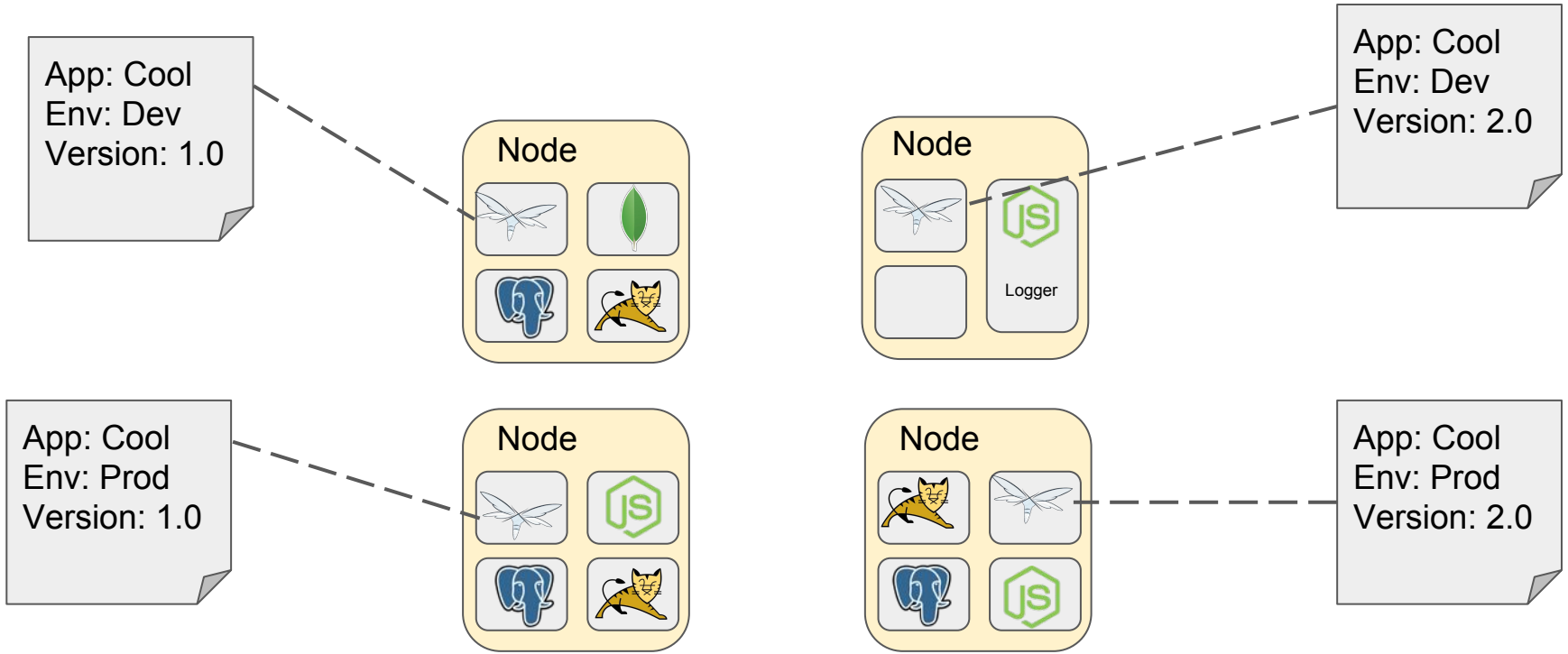
Label

- ✓ Key/Value pairs associated with Kubernetes objects (env=production)

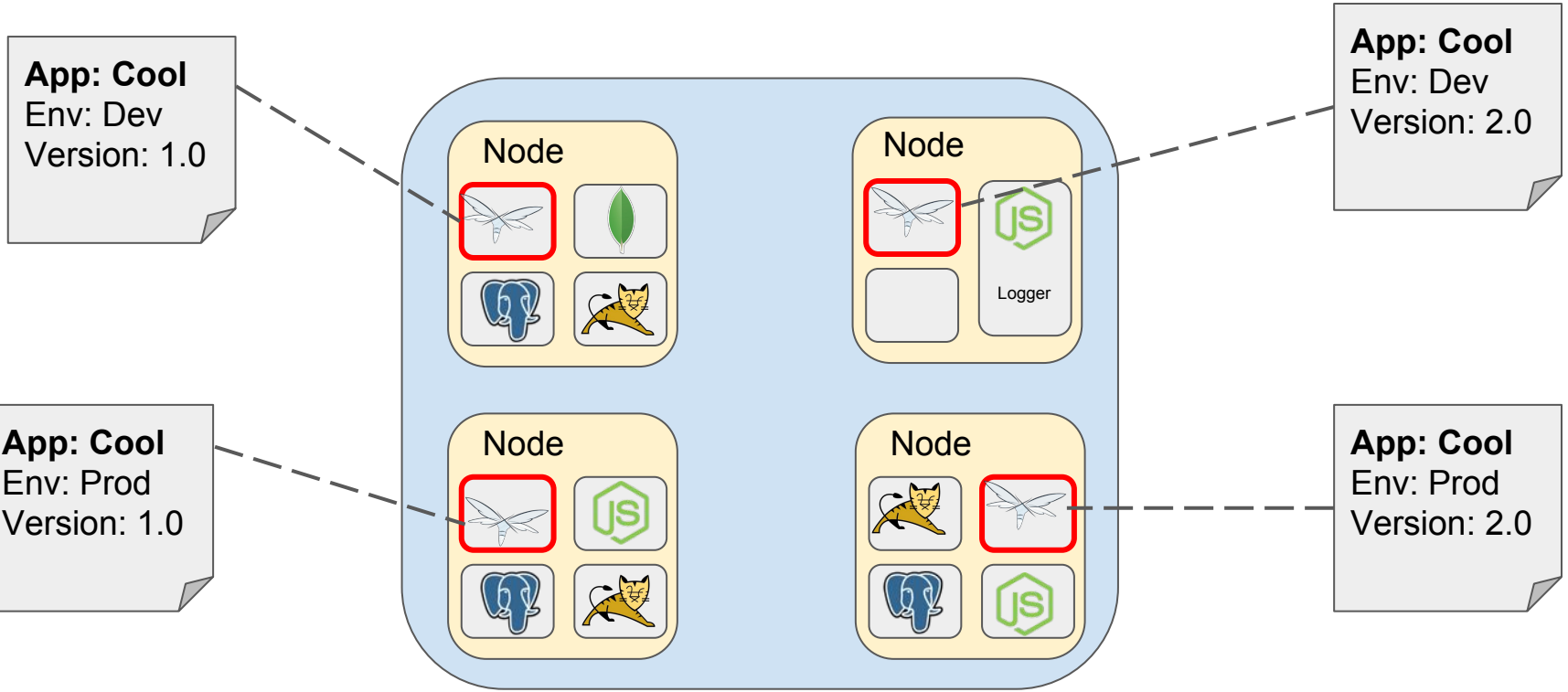
Kubernetes Cluster



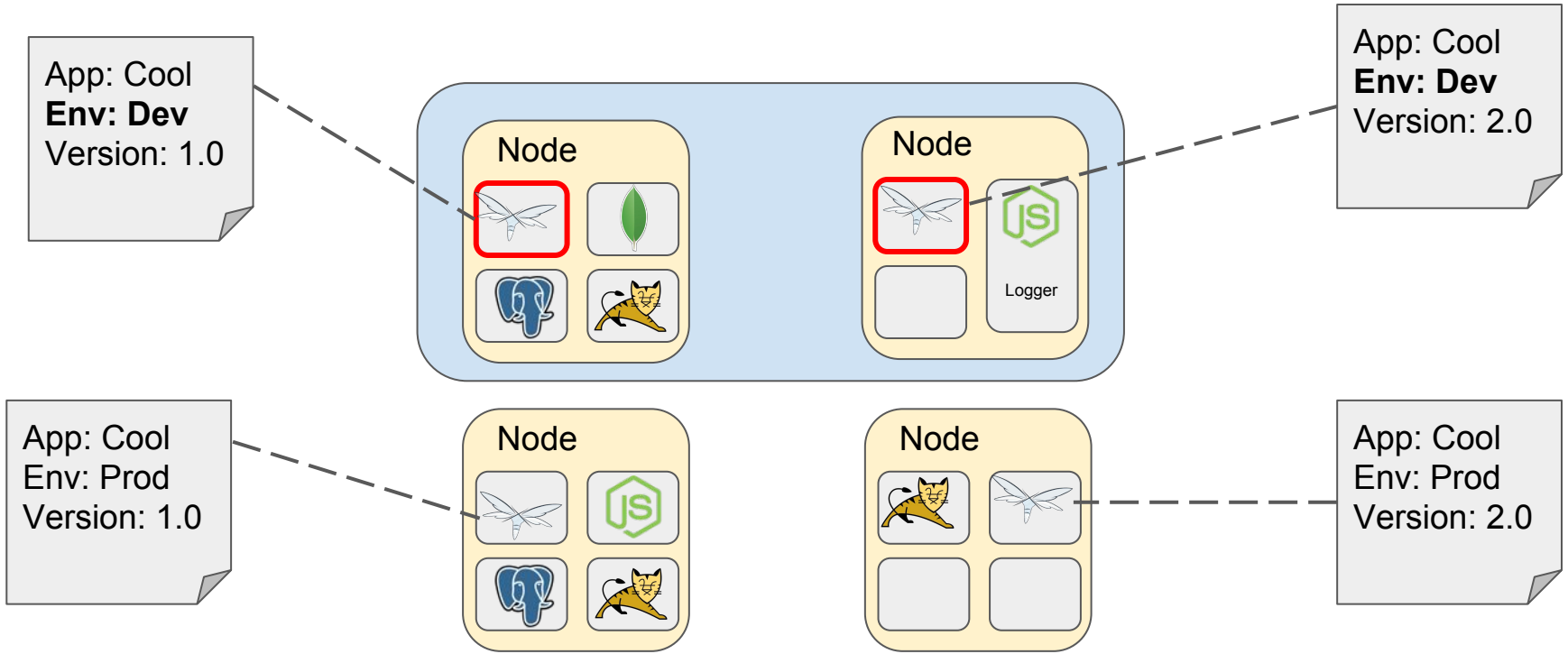
Labels



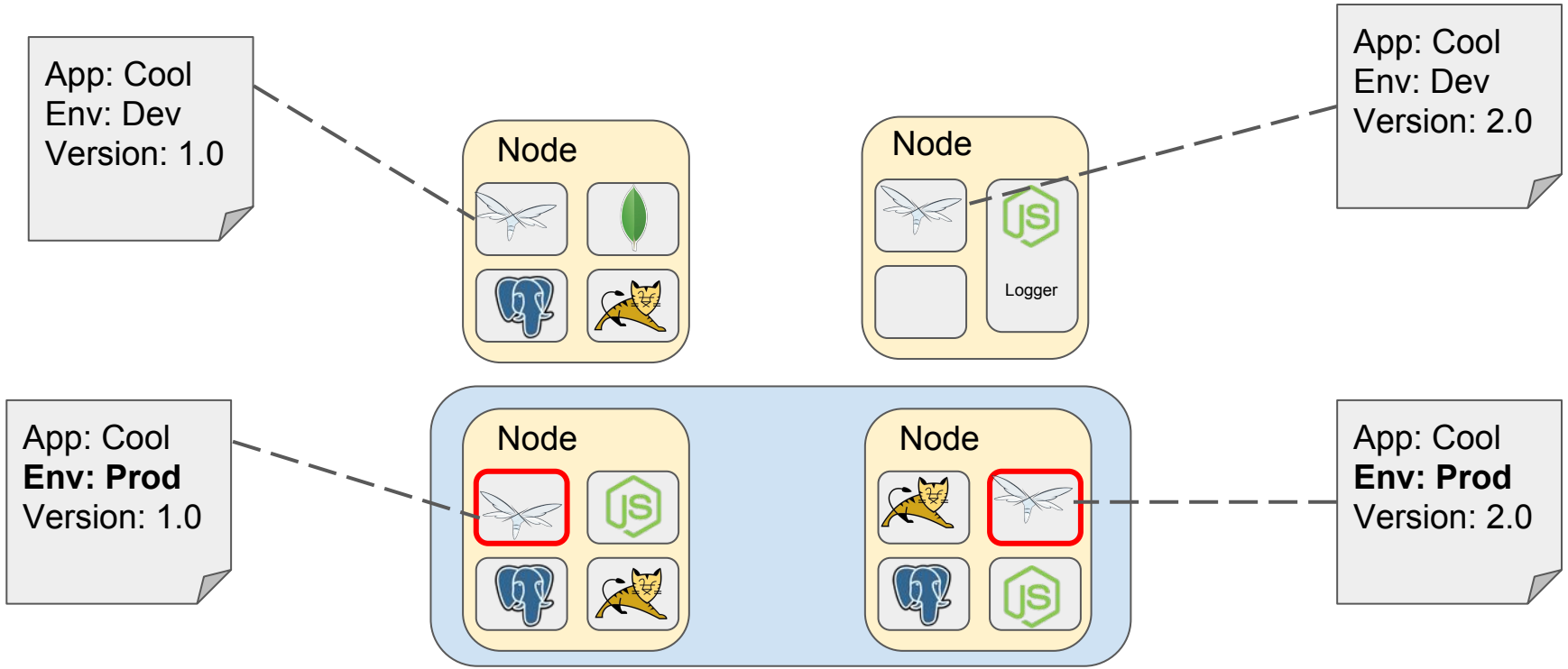
Labels App:Cool



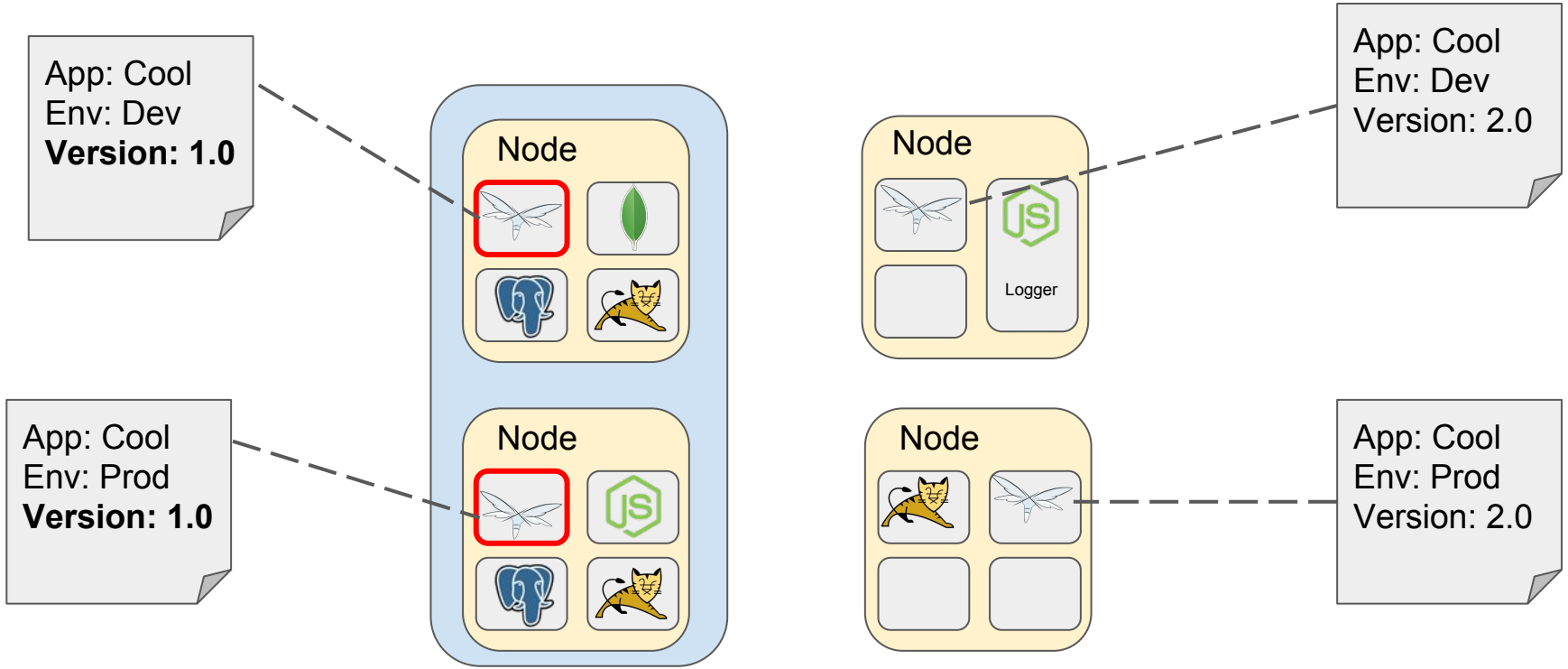
Labels Env:Dev



Labels Env:Prod



Labels Version:1.0

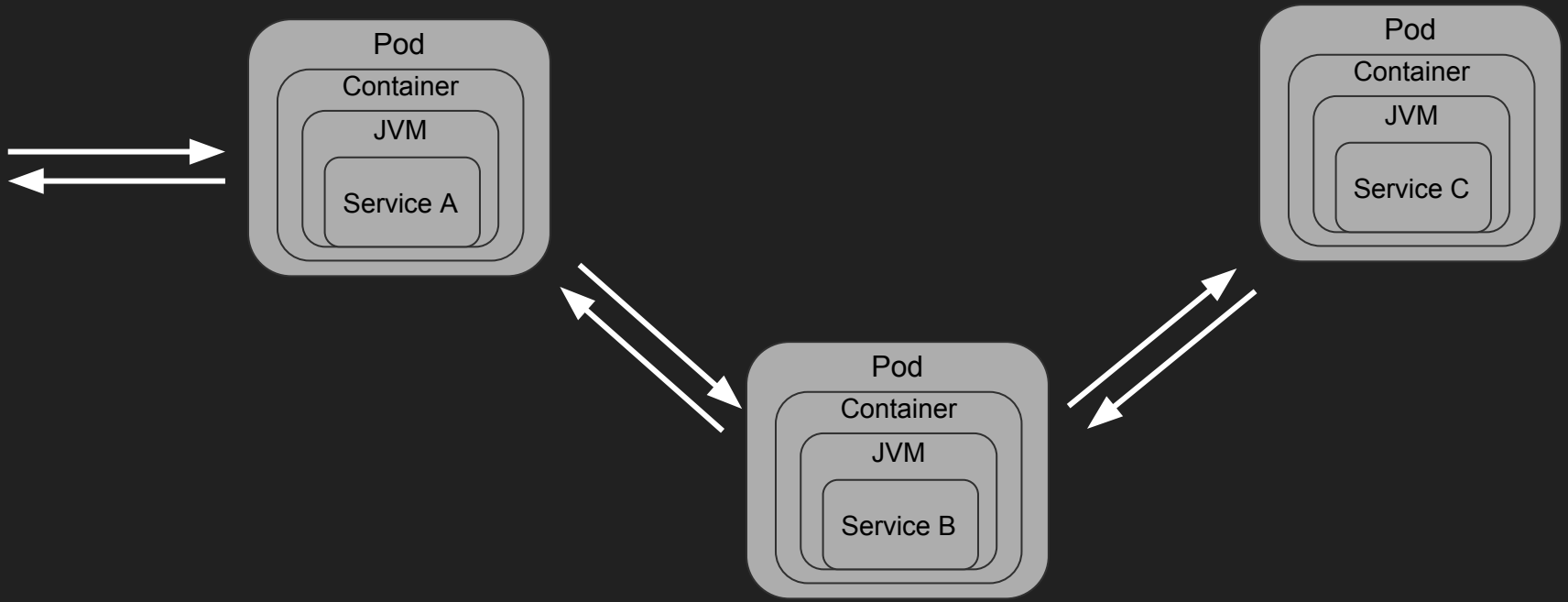


kubectl commands

https://kubernetes.io/docs/user-guide/kubectl/
https://kubernetes.io/docs/reference/kubectl/cheatsheet

```
kubectl get namespaces

kubectl get pods -n mynamespace

kubectl run myvertx --image=burr/myvertx:v1 --port=8080

kubectl logs myvertx-kk605

kubectl expose deployment --port=8080 myvertx --type=LoadBalancer

kubectl scale deployment myvertx --replicas=3

kubectl set image deployment/myvertx myvertx=burr/myvertx:v2
```

Microservices == Distributed Computing



java -jar myapp.jar

DropWizard

www.dropwizard.io

JAX-RS API

First to market

DropWizard Metrics

Vert.x

vertx.io

Reactive
Async
non-blocking

RxJava

vertx run myhttp.java

VERT.X

Spring Boot

spring.io/projects/spring-boot

Spring API
(@RestController)

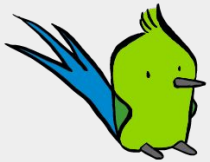
'Starter' POMs:
start.spring.io

Thorntail

thorntail.io

MicroProfile.io

'Starter' POMs:
thorntail.io/generator



Micronaut

micronaut.io

"Compile-time"
dependency
injection

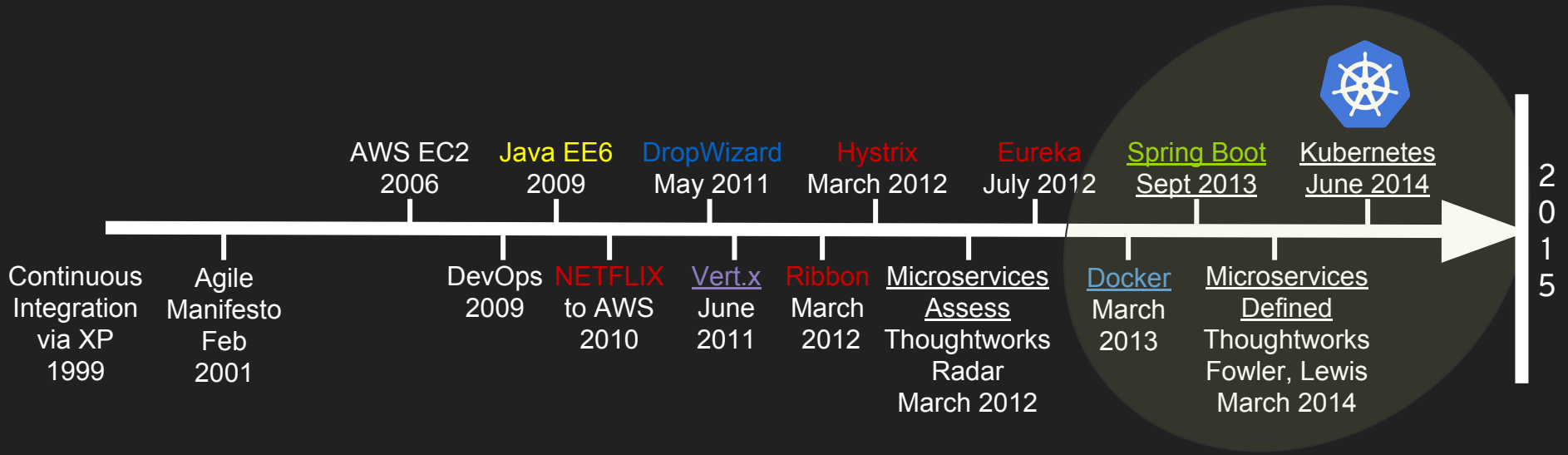
MICROPROFILE™

OPTIMIZING ENTERPRISE JAVA

- Defines **open source** Java **microservices** specifications
- Industry Collaboration - Red Hat, IBM, Payara, Tomitribe, London Java Community, SouJava, Oracle, Hazelcast, Fujitsu, SmartBear...
- **WildFly Swarm** is **Red Hat's** implementation
- Minimum footprint for Enterprise Java cloud-native services (v1.3) :

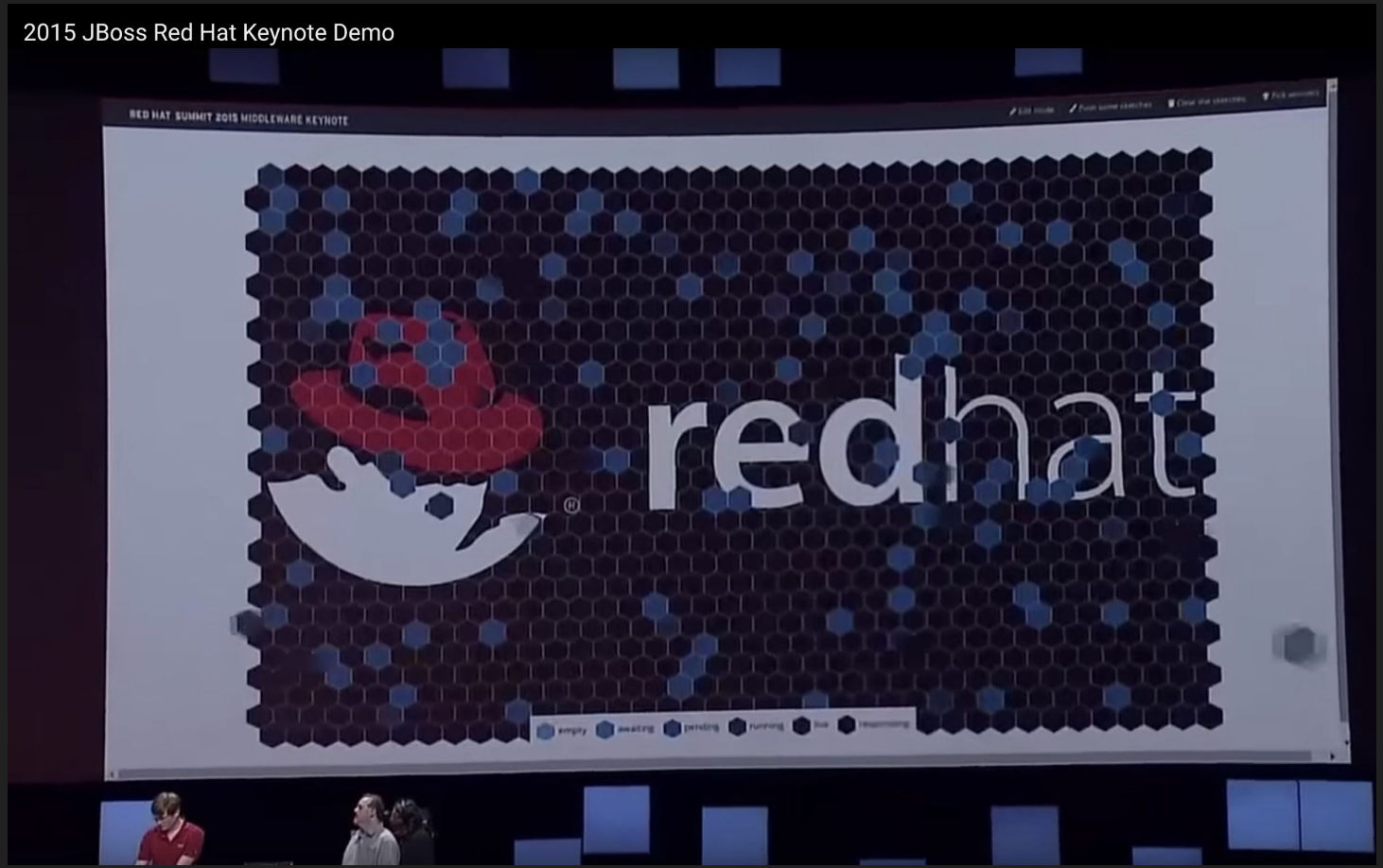
JSON-P 1.0	Health Check	JWT Propagation	Config	OpenAPI	REST Client
CDI 1.2	JAX-RS 2.0	Fault Tolerance	Metrics	Open Tracing	

History of Microservices



NETFLIX | OSS

RED HAT DEVELOPER



2015

Launch 1000+ Containers

Audience Claims a Container

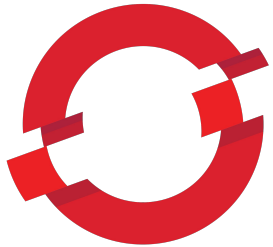
https://www.youtube.com/watch?v=GCtpncA0Ea0&feature=youtu.be&t=1031

Java Microservices Platform circa 2015

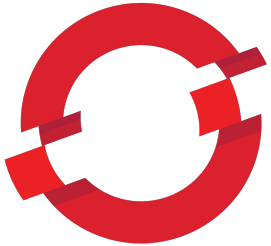
Config Server

NETFLIX Ribbon

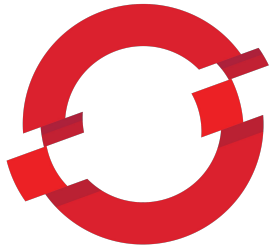
Better Microservices Platform circa 2016



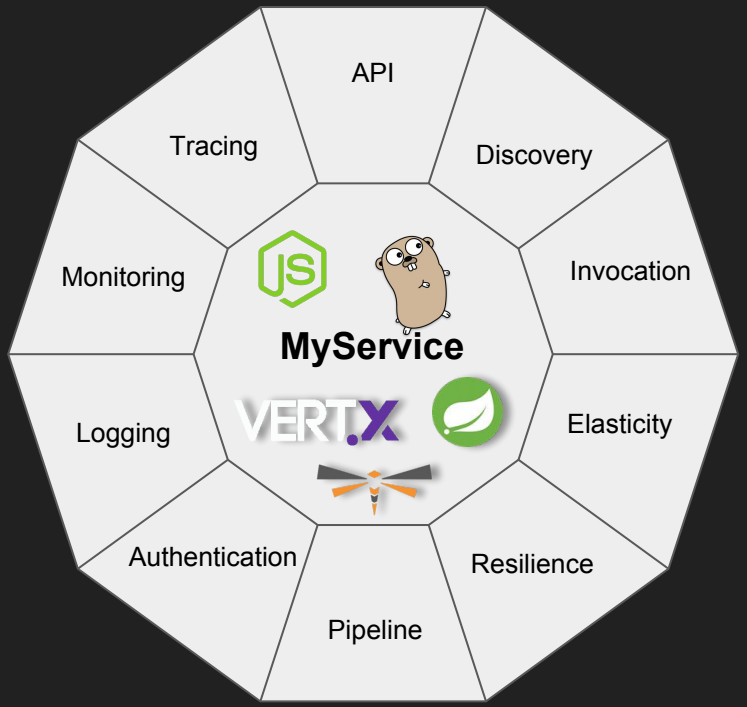
Better Microservices Platform circa 2017



Better Microservices Platform circa 2018



Polyglot Microservices Platform circa 2018



Polyglot Microservices Platform

9 Steps

Step 1: Installation

Step 1: Installation

Lots of Options

1. Localhost Development
   a. minikube (kubectl) (docs)
   b. minishift (oc) (docs)
2. Hosted Kubernetes Cluster
   a. GKE from Google Cloud Platform
   b. AKS from Microsoft Azure
   c. EKS from Amazon Web Services
3. Many more…
   https://kubernetes.io/docs/setup/pick-right-solution/#turnkey-cloud-solutions

Step 1 Demo

https://github.com/burrsutter/9stepsawesome/blob/master/1_installation_started.adoc

Step 2: Building Images

Running your App on Kubernetes

1. Find a base Image: Docker Hub, Quay.io, gcr.io, access.redhat.com/containers
2. Craft your `Dockerfile`
3. Build your Image: `docker build -t mystuff/myimage:v1 .`
4. `kubectl create -f myDeployment.yml`
5. `kubectl create -f myService.yml`
6. Expose a URL via your Kubernetes distribution's load-balancer

Step 2: Building Images

Options Include:

A. **docker build** then kubectl run or kubectl create -f deploy.yml
B. Fabric8 maven plugin (fabric8.io)
C. Jib - Maven/Gradle plugin
D. Helm Charts - but for Tiller (Tiller going away in 3)
E. Kompose - converts docker-compose.yml to kubernetes yaml
F. s2i - source to image
G. No d-o-c-k-e-r
    a. Red Hat's podman, Google's kaniko, Uber's makisu
H. Buildpacks - similar to Heroku & Cloud Foundry

Dockerfile for Java projects

```
FROM fabric8/java-jboss-openjdk8-jdk:1.4.0
ENV JAVA_APP_DIR=/deployments
EXPOSE 8080 8778 9779
COPY target/my.jar /deployments/
```

https://github.com/fabric8io-images/java/tree/master/images/jboss/openjdk8/jdk

docker build, kubectl run

```
minikube(docker-env) or minishift(docker-env)
docker build -t burr/myimage:v1 .
docker run -it -p 8080:8080 burr/myimage:v1
curl $(minishift ip):8080
# now run it on Kubernetes
kubectl run myapp --image burr/myimage:v1 --port 8080
kubectl expose deployment --port=8080 myapp --type=LoadBalancer
oc expose service myapp
curl myapp-stuff.$(minishift ip).nip.io
# scale up
kubectl scale --replicas=2 deploy/myapp
# create an updated image
docker build -t burr/myimage:v2 .
# rollout update
kubectl set image deployment/myapp myapp=burr/myimage:v2
```

Fabric8 Maven Plugin

https://maven.fabric8.io/#fabric8:setup (no **Dockerfile, Deployment.yml**)

```
oc new-project stuff (or kubectl create namespace)

mvn clean compile package

mvn io.fabric8:fabric8-maven-plugin:3.5.40:setup

mvn fabric8:deploy
```

Do NOT Java + Docker == FAIL

Slides: bit.ly/javadockerfail

Recording from JBCNConf 2017

```
docker run -m 100MB openjdk:8u121 java
-XshowSettings:vm -version

docker run -m 100MB openjdk:8u131 java
-XX:+UnlockExperimentalVMOptions
-XX:+UseCGroupMemoryLimitForHeap -XshowSettings:vm
-version
```

Step 2 Demo

https://github.com/burrsutter/9stepsawesome/blob/master/2_building_running.adoc
https://github.com/burrsutter/kube4docker

Step 3: oc or kubectl exec

Step 3: oc or kubectl exec

"ssh" into your containers and explore

```
kubectl get pods --namespace=microworld
kubectl exec -it --namespace=microworld $POD cat /sys/fs/cgroup/memory/memory.limit_in_bytes
Or
kubectl exec -it --namespace=microworld microspringboot1-2-nz8f8 /bin/bash
ps -ef | grep java
Note: the following apply if using the fabric8 generated image, otherwise consult your Dockerfile
java -version
javac -version
# now find that fat jar
find / -name *.jar
cd /deployments (based on use of the fabric8 maven plugin)
ls
exit
```

Step 3 Demo

https://github.com/burrsutter/9stepsawesome/blob/master/3_kubectl_exec.adoc
https://github.com/burrsutter/javadockerfail

Step 4: logs

Step 4: logs

```
System.out.println("Where am I?");
Or console.log("Node logs");

kubectl get pods
kubectl logs microspringboot1-2-nz8f8
kubectl logs microspringboot1-2-nz8f8 -p # last failed pod

OR ./kubetail.sh
https://raw.githubusercontent.com/johanhaleby/kubetail/master/kubetail

OR stern (brew install stern)
https://github.com/wercker/stern

OR kail (https://github.com/boz/kail)
```

Step 4 Demo

https://github.com/burrsutter/9stepsawesome/blob/master/4_logs.adoc

Step 5: env and configmaps

Step 5: env vars & configmaps

An app's config is everything that is likely to vary between deploys (staging, production, developer environments, etc). [*12 Factor Apps*]

```
kubectl set env deployment/myboot DBCONN="jdbc:sqlserver://45.91.12.123:1443;user=MyUserName;password=*****;"

kubectl create cm my-config --from-env-file=config/some.properties
```

Step 5 Demo

https://github.com/burrsutter/9stepsawesome/blob/master/5_configuration.adoc

Step 6: service discovery & load-balancing

Step 6: Service Discovery

1. Services are internal to the cluster and can be mapped to pods via a label selector
2. Just refer to a Service by its name, it is just DNS

```
String url = "http://producer:8080/";

ResponseEntity<String> response =
restTemplate.getForEntity(url, String.class);
```

Step 6 Demo

https://github.com/burrsutter/9stepsawesome/blob/master/6_discovery.adoc
https://github.com/burrsutter/kube4docker/tree/master/discovery
https://github.com/redhat-developer-demos/microspringboot1
https://github.com/redhat-developer-demos/microspringboot2
https://github.com/redhat-developer-demos/microspringboot3

Step 7: Live and Ready

Step 7: Live and Ready

```
kubectl create -f Deployment.yml
```

```
resources:
  requests:
    memory: "300Mi"
    cpu: "250m" # 1/4 core
  limits:
    memory: "400Mi"
    cpu: "1000m" # 1 core
livenessProbe:
  httpGet:
      port: 8080
      path: /
  initialDelaySeconds: 10
  periodSeconds: 5
  timeoutSeconds: 2
readinessProbe:
  httpGet:
    path: /health
    port: 8080
  initialDelaySeconds: 10
  periodSeconds: 3
```

Step 7 Demo

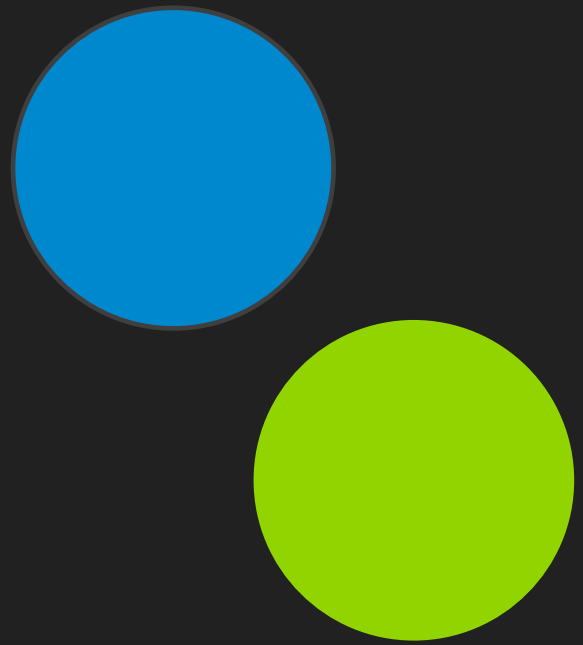
https://github.com/burrsutter/9stepsawesome/blob/master/7_live_ready.adoc

https://github.com/redhat-developer-demos/popular-movie-store/blob/master/src/main/java/org/workspace7/moviestore/controller/HomeController.java#L158-L159

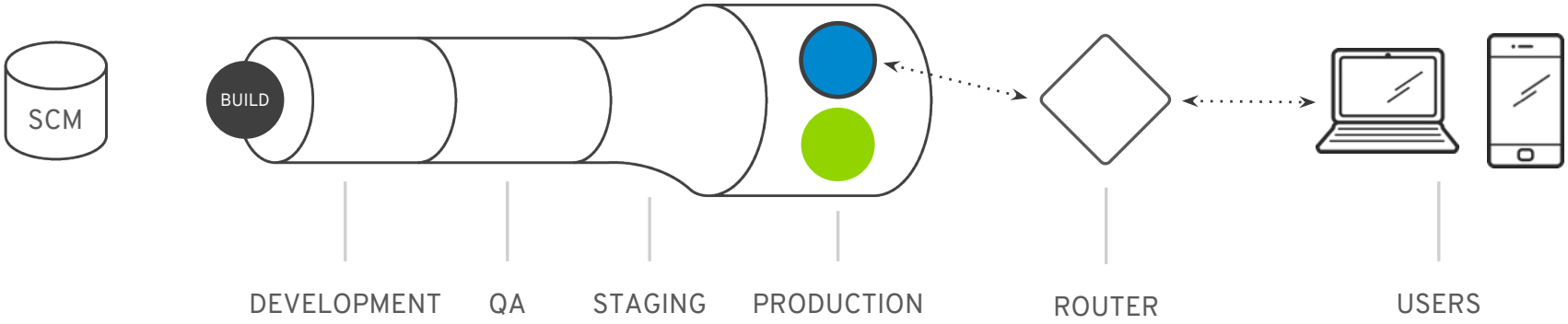
https://github.com/redhat-developer-demos/popular-movie-store/blob/master/src/main/fabric8/deployment.yml#L38-L42

Step 8: Rolling Updates, Blue/Green Canary

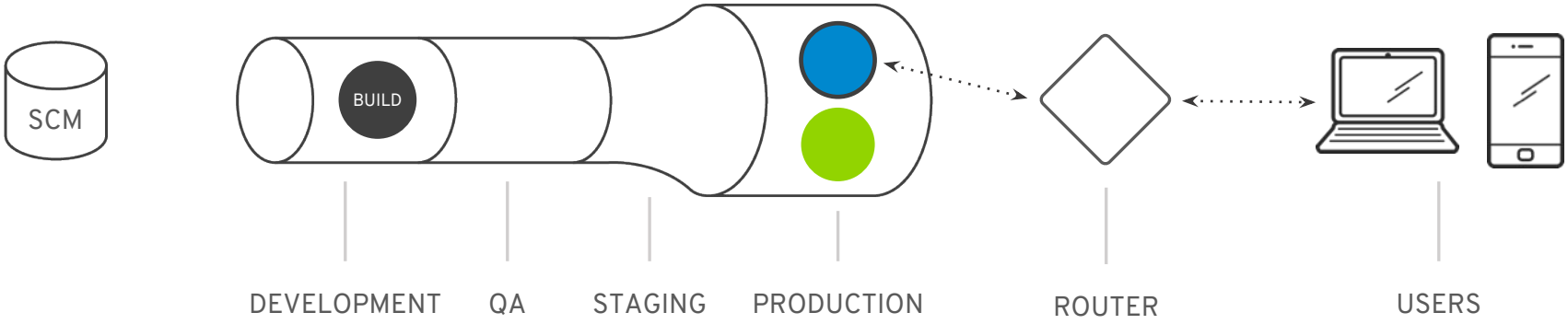
Blue/Green Deployment



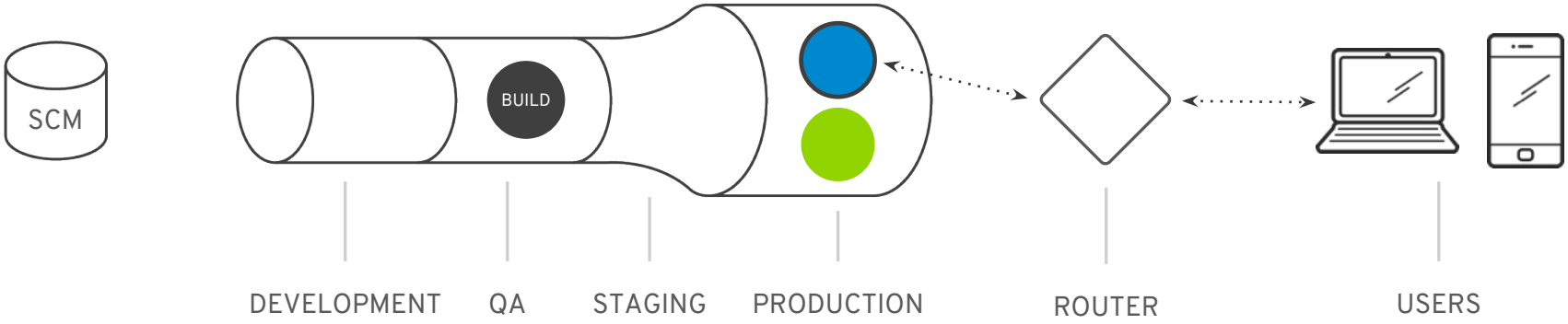
Blue/Green Deployment



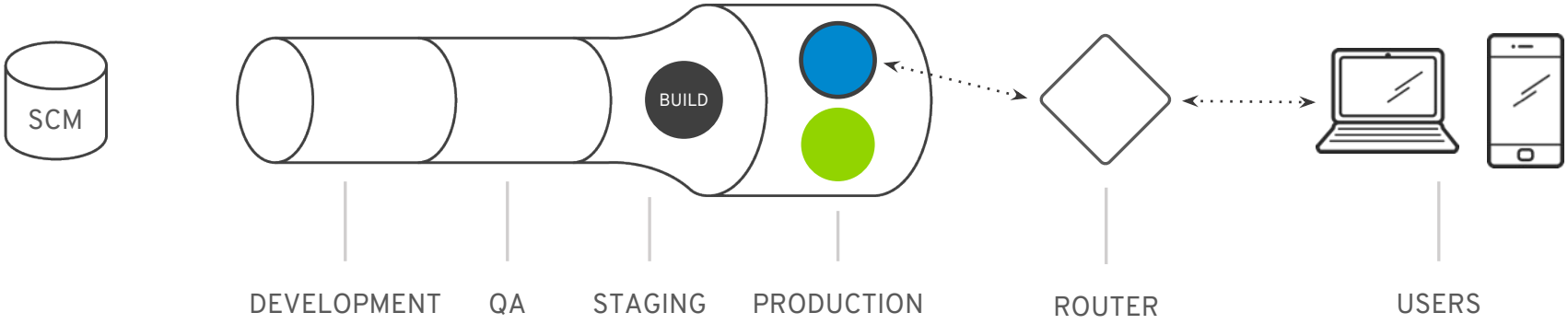
Blue/Green Deployment



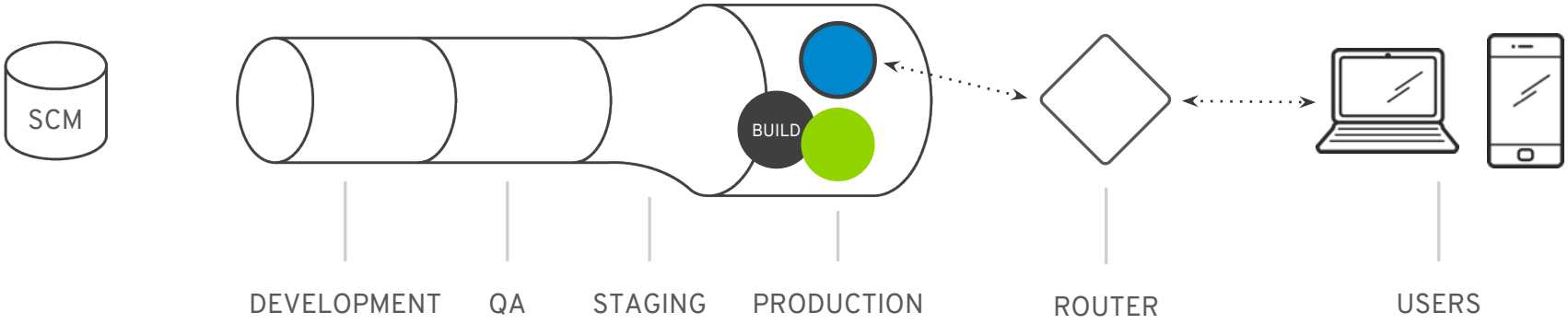
Blue/Green Deployment



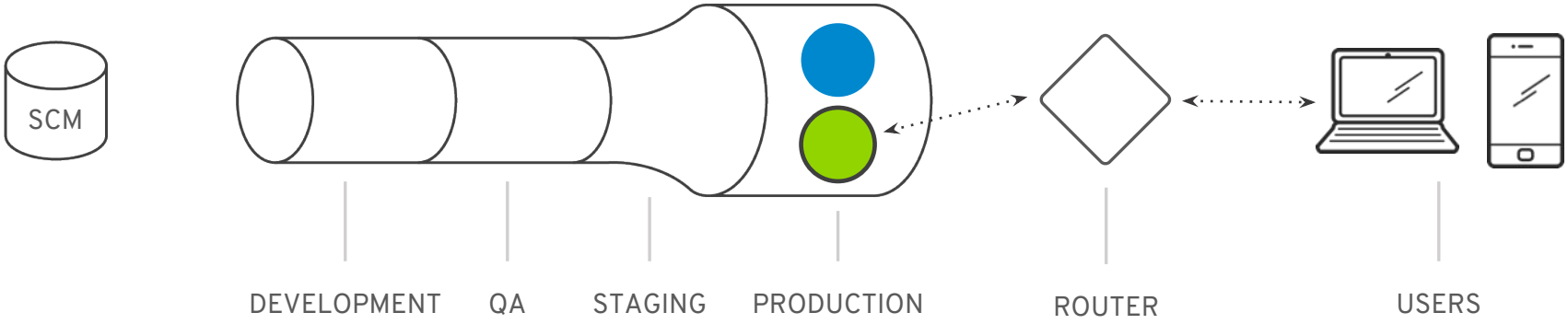
Blue/Green Deployment



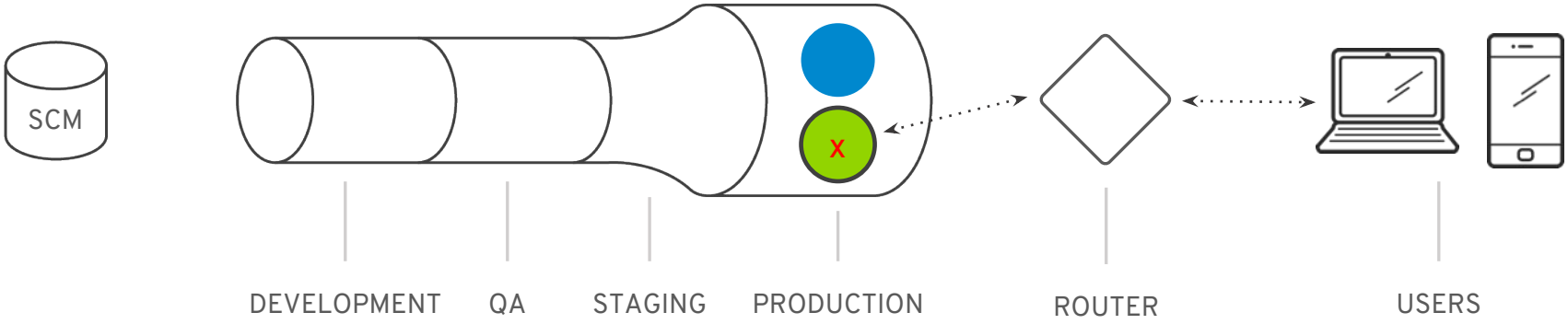
Blue/Green Deployment



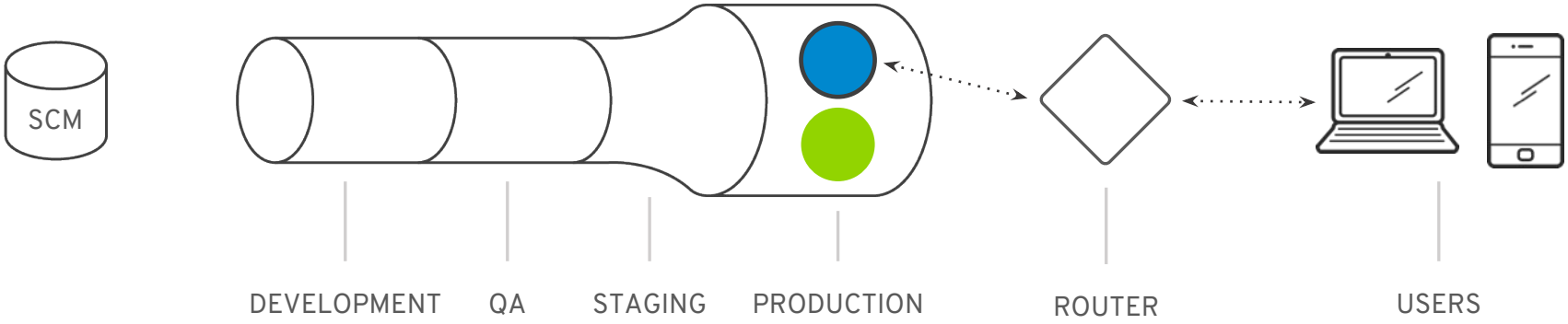
Blue/Green Deployment



Blue/Green Deployment

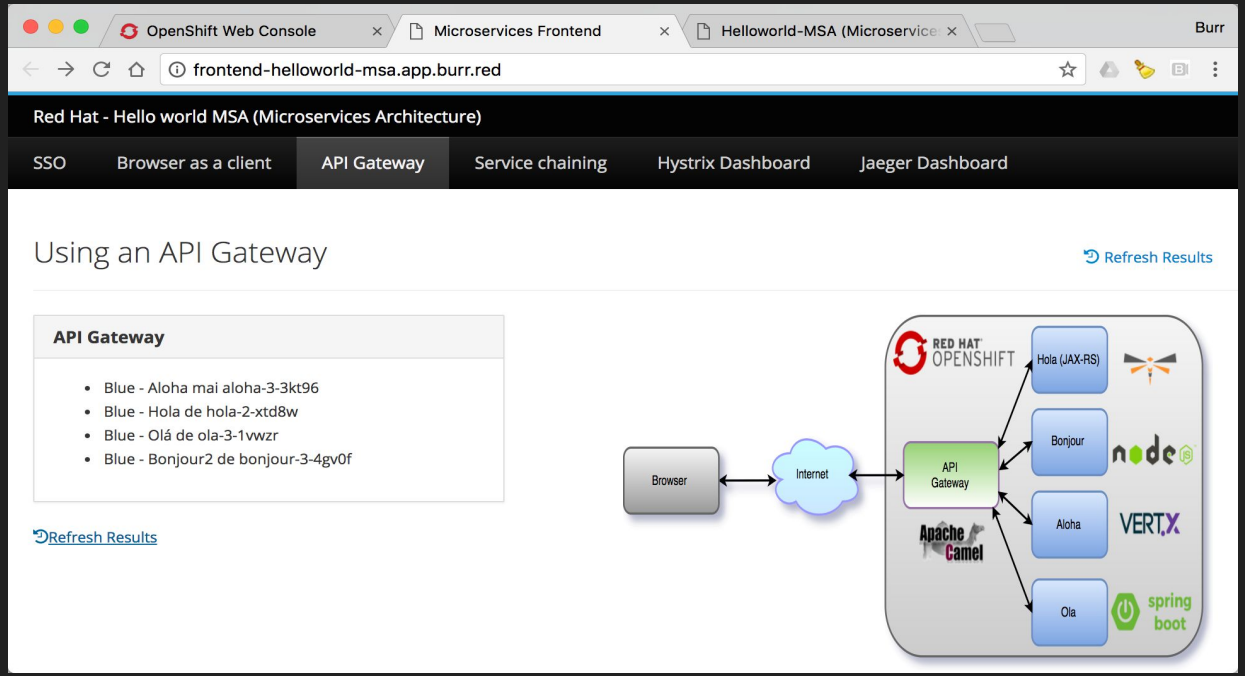


Blue/Green Deployment



Step 8: Blue/Green & Canary

bit.ly/msa-tutorial



Step 8 Demo

https://github.com/burrsutter/9stepsawesome/blob/master/8_deployment_techniques.adoc

New Step 9: Databases

Step 9: Databases

1. Persistent Volume
2. Persistent Volume Claim
3. Deployment
4. Service

https://github.com/burrsutter/9stepsawesome/blob/master/9_databases.adoc

Old Step 9: Debugging

Step 9: Debugging

https://maven.fabric8.io/#fabric8:debug

mvn fabric8:deploy

mvn fabric8:debug

https://code.visualstudio.com/blogs/2017/09/28/java-debug

https://github.com/VeerMuchandi/openshift-local/blob/master/DebuggingUsingIDE.md

Step 9 Demo

https://github.com/burrsutter/9stepsawesome/blob/master/9_debugging.adoc

Bonus: Istio

Istio - Sail

(Kubernetes - Helmsman or ship's pilot)

learn.openshift.com/servicemesh

bit.ly/istio-intro

bit.ly/istio-tutorial

Next Generation - Service Mesh

Code Independent

- Intelligent Routing and Load-Balancing
  - Canary Releases
  - Dark Launches
- Distributed Tracing
- Circuit Breakers
- Fine grained Access Control
- Telemetry, metrics and Logs
- Fleet wide policy enforcement

Bonus: Serverless/FaaS

bit.ly/faas-tutorial

learn.openshift.com/serverless

What is Knative?

"Kubernetes-based platform to build, deploy, and manage modern serverless workloads."

"Essential base primitives for all"

"Knative provides a set of middleware components that are essential to build modern, source-centric, and container-based applications that can run anywhere: on premises, in the cloud, or even in a third-party data center"

Bonus: Eclipse Che

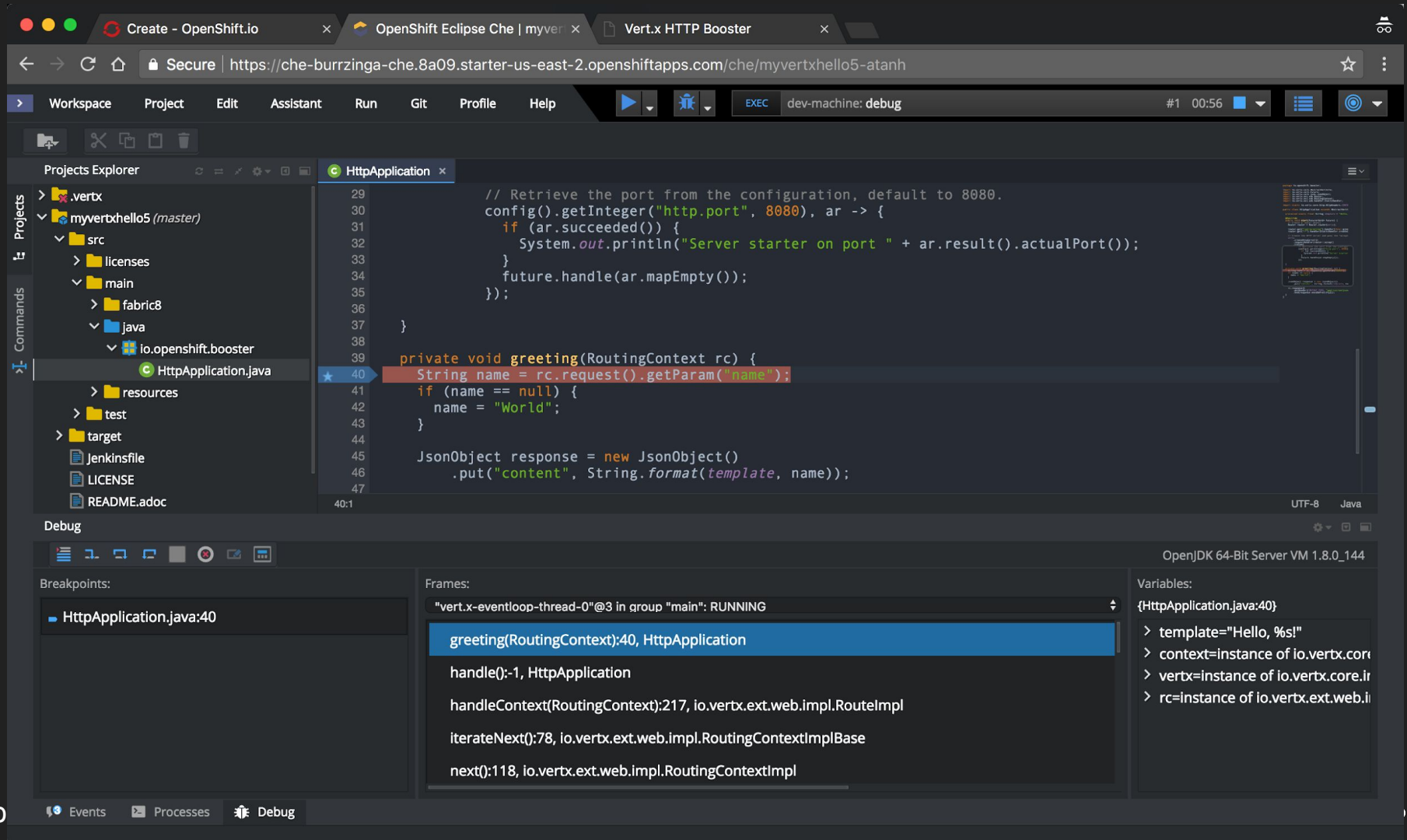
Container Native IDE

Allows you to launch a browser-based IDE inside of a Linux container that matches your production environment

https://www.eclipse.org/che/docs/kubernetes-single-user.html

https://www.eclipse.org/che/docs/openshift-single-user.html

Try it bit.ly/che-workshop


Create - OpenShift.io
OpenShift Eclipse Che | myver
Vert.x HTTP Booster
Secure | https://che-burrzinga-che.8a09.starter-us-east-2.openshiftapps.com/che/myvertxhello5-atanh
Workspace Project Edit Assistant Run Git Profile Help
EXEC dev-machine: debug #1 00:56
Projects Explorer
.vertx
myvertxhello5 (master)
src
licenses
main
fabric8
java
io.openshift.booster
HttpApplication.java
resources
test
target
Jenkinsfile
LICENSE
README.adoc
HttpApplication
// Retrieve the port from the configuration, default to 8080.
config().getInteger("http.port", 8080), ar -> {
if (ar.succeeded()) {
System.out.println("Server starter on port " + ar.result().actualPort());
}
future.handle(ar.mapEmpty());
});
}
private void greeting(RoutingContext rc) {
String name = rc.request().getParam("name");
if (name == null) {
name = "World";
}
JsonObject response = new JsonObject()
.put("content", String.format(template, name));
40:1 UTF-8 Java
Debug
OpenJDK 64-Bit Server VM 1.8.0_144
Breakpoints:
HttpApplication.java:40
Frames:
"vert.x-eventloop-thread-0"@3 in group "main": RUNNING
greeting(RoutingContext):40, HttpApplication
handle():-1, HttpApplication
handleContext(RoutingContext):217, io.vertx.ext.web.impl.RouteImpl
iterateNext():78, io.vertx.ext.web.impl.RoutingContextImplBase
next():118, io.vertx.ext.web.impl.RoutingContextImpl
Variables:
{HttpApplication.java:40}
template="Hello, %s!"
context=instance of io.vertx.cor
vertx=instance of io.vertx.core.i
rc=instance of io.vertx.ext.web.i
Events Processes Debug

@b ER

http://strimzi.io/

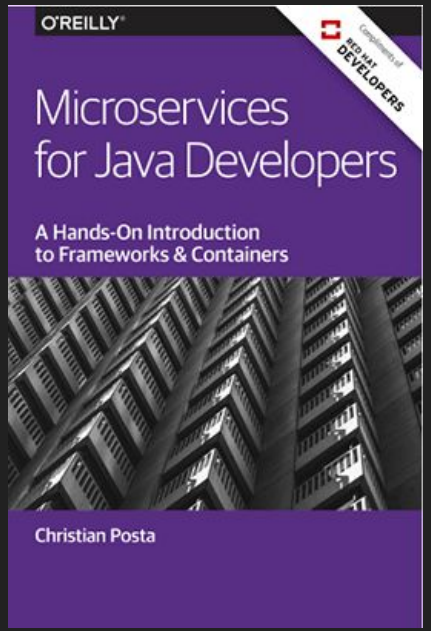
Apache Kafka on Kubernetes & OpenShift

Postgres on Kubernetes

https://info.crunchydata.com/blog/using-kubernetes-deployments-for-running-postgresql

Free Resources

bit.ly/javamicroservicesbook



Free eBooks from developers.redhat.com

Microservices Introductory Materials

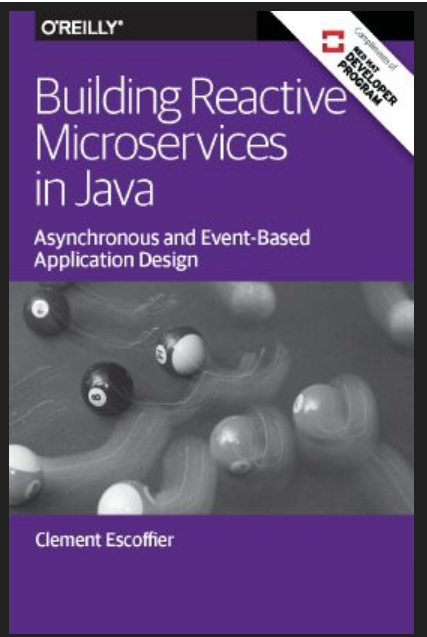
Demo: bit.ly/msa-tutorial

Slides: bit.ly/microservicesdeepdive

Video Training: bit.ly/microservicesvideo

Kubernetes for Java Developers

bit.ly/reactivemicroservicesbook



Advanced Materials

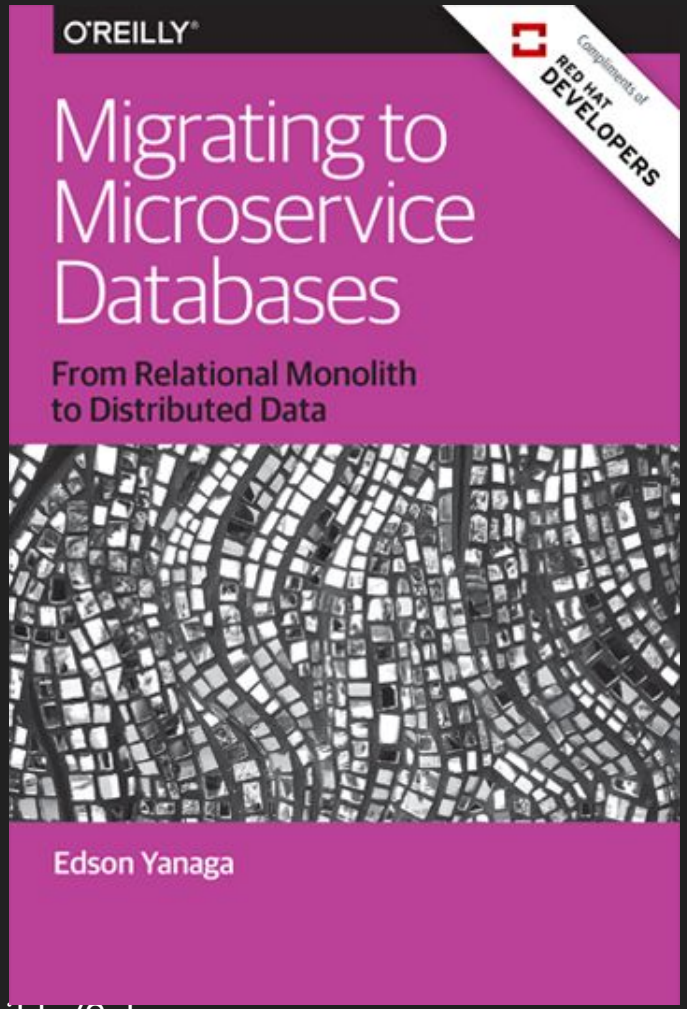
bit.ly/istio-tutorial

learn.openshift.com/servicemesh

bit.ly/faas-tutorial

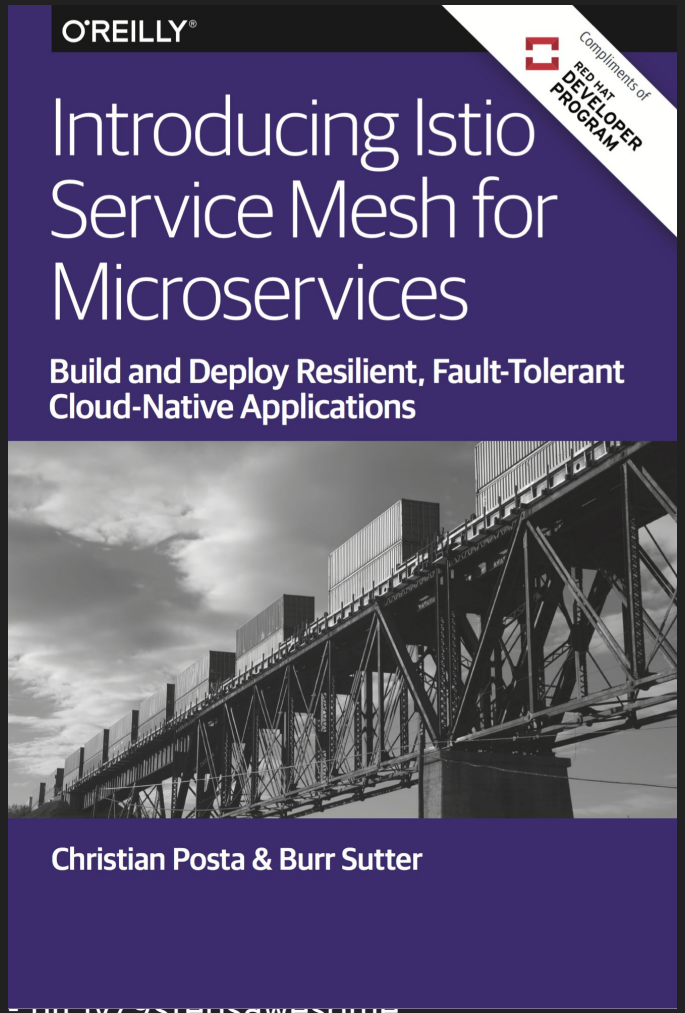
learn.openshift.com/serverless

RED HAT DEVELOPER



bit.ly/mono2microdb

RED HAT DEVELOPER

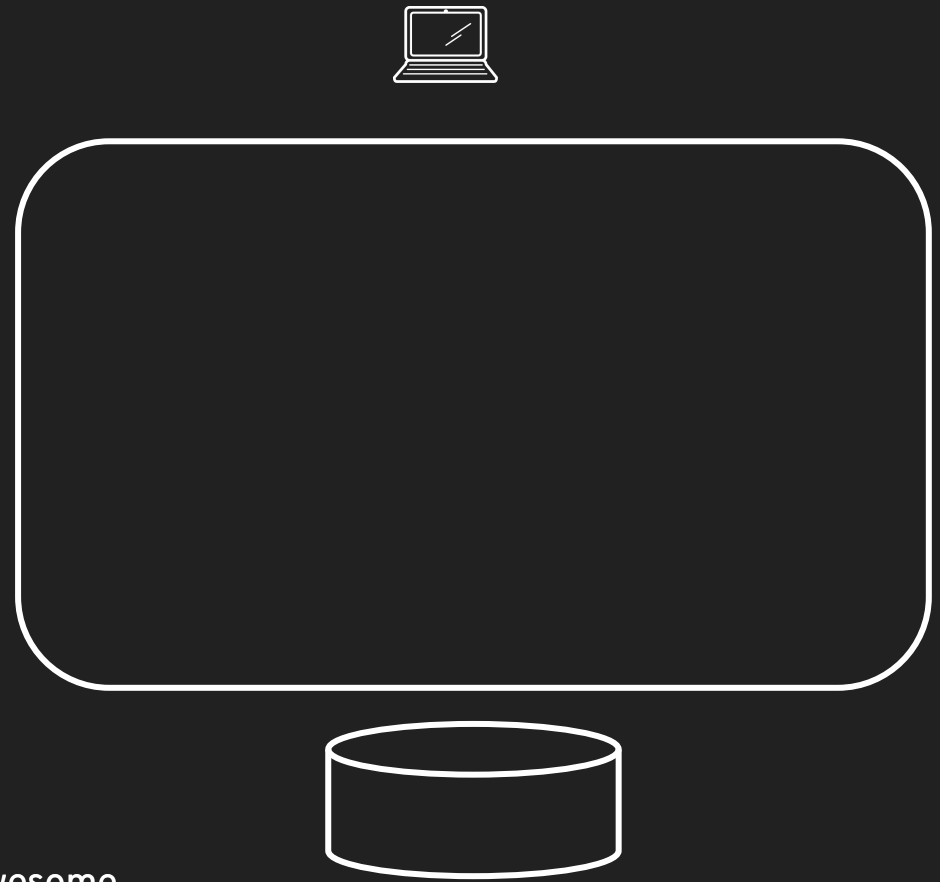


bit.ly/istio-book

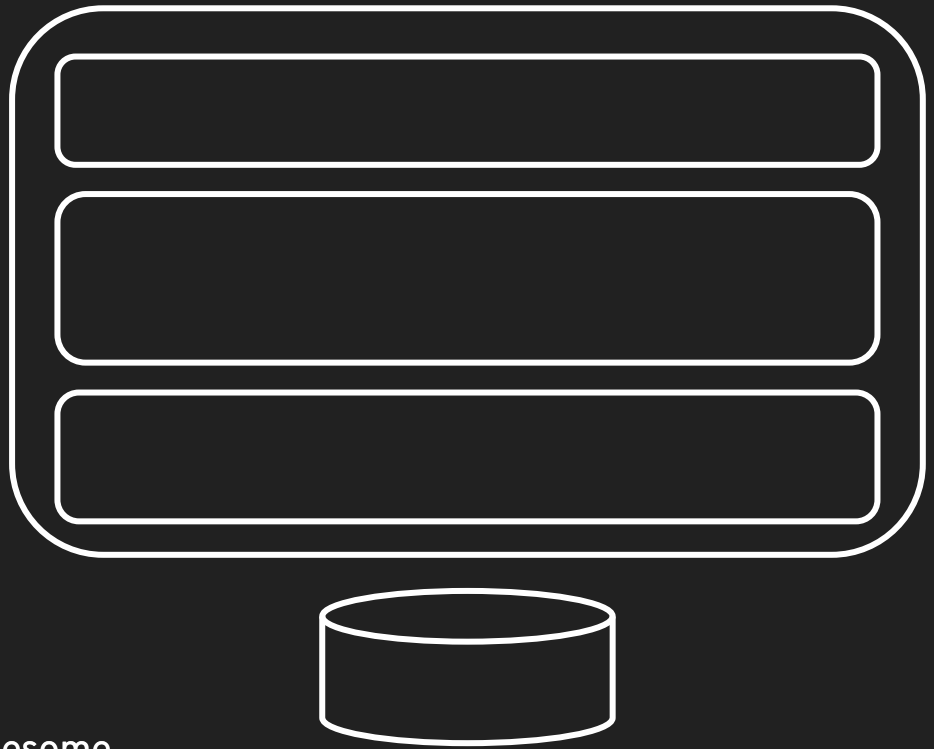
The End
(Istio is Next)

Backup Content

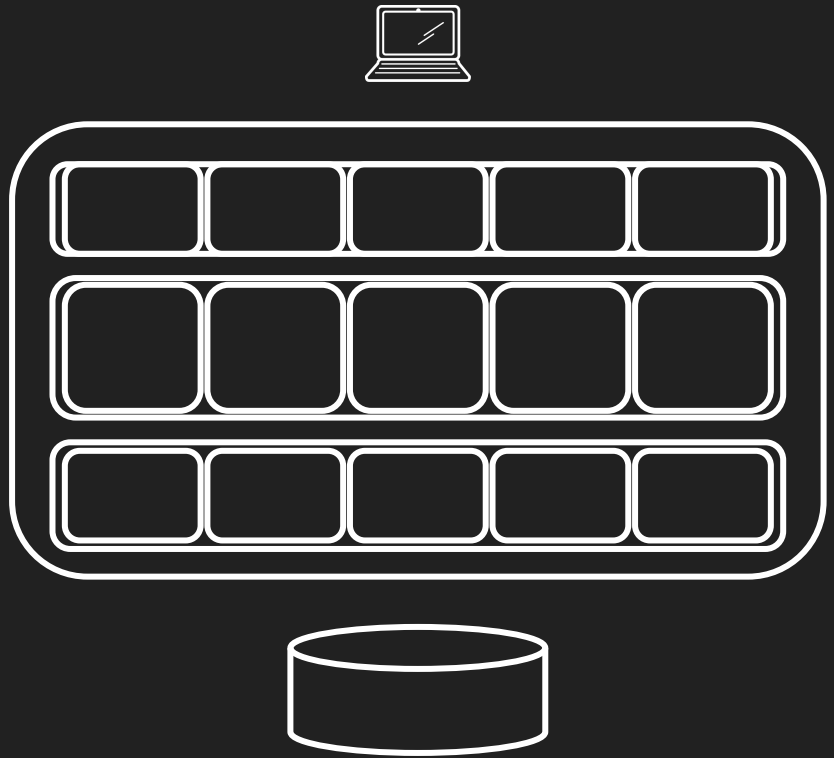
Application on Whiteboard



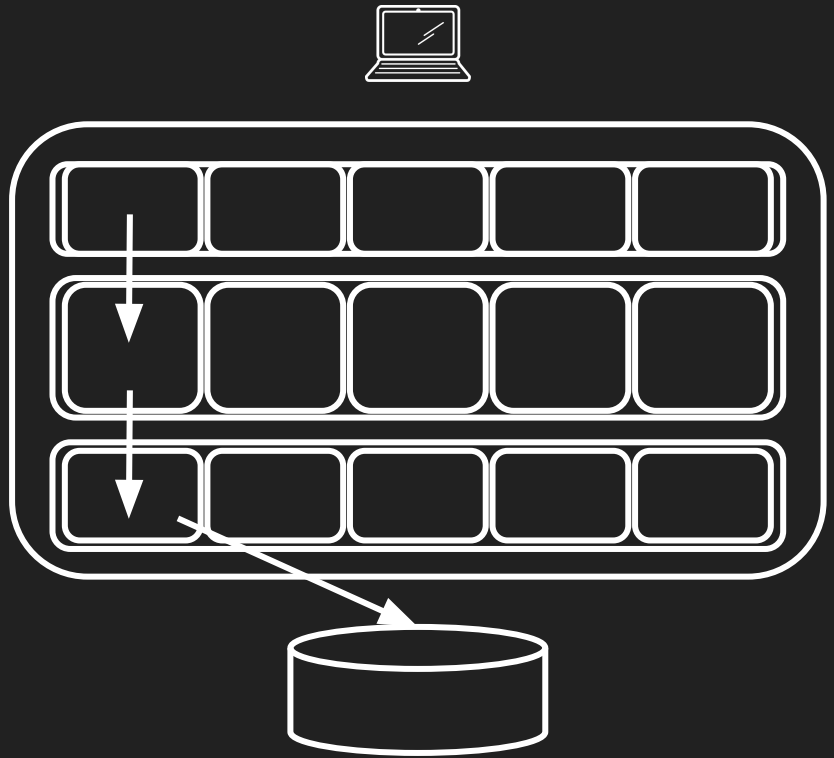
Whiteboard had 3 Tiers



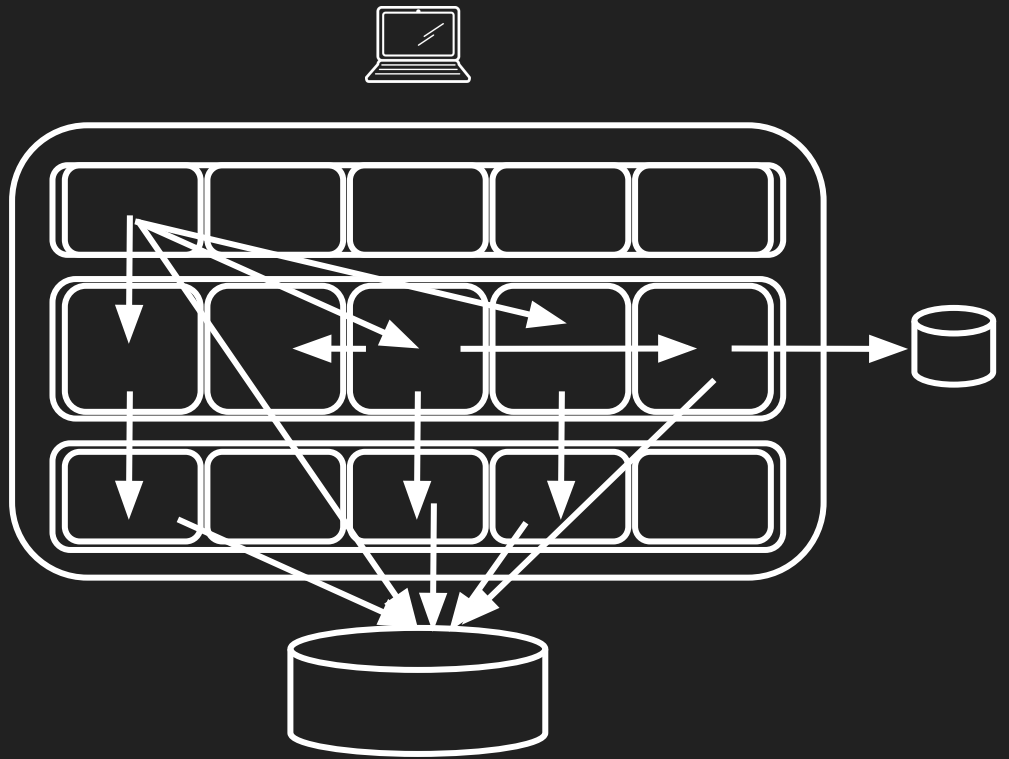
UI, Logic, Data



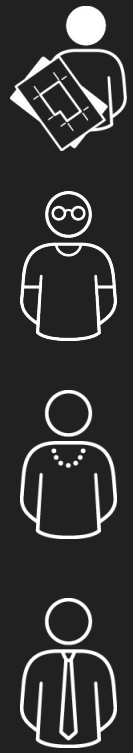
Clean Architecture

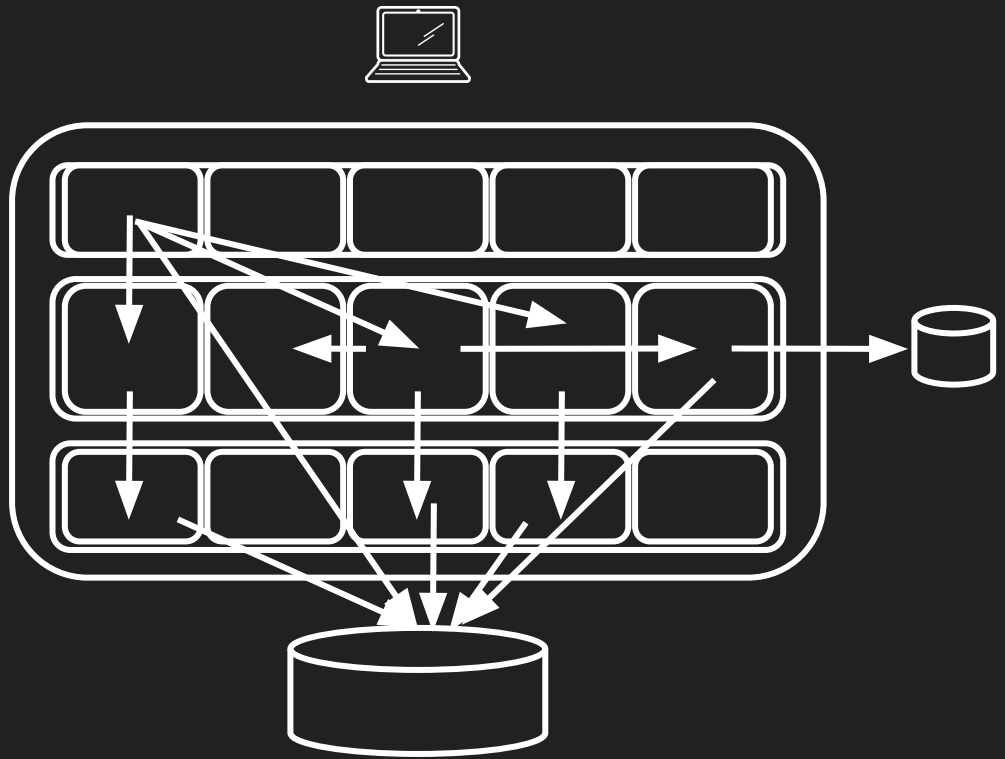


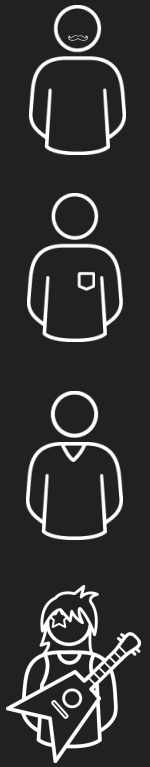
Real Life: Non-Majestic Monolith



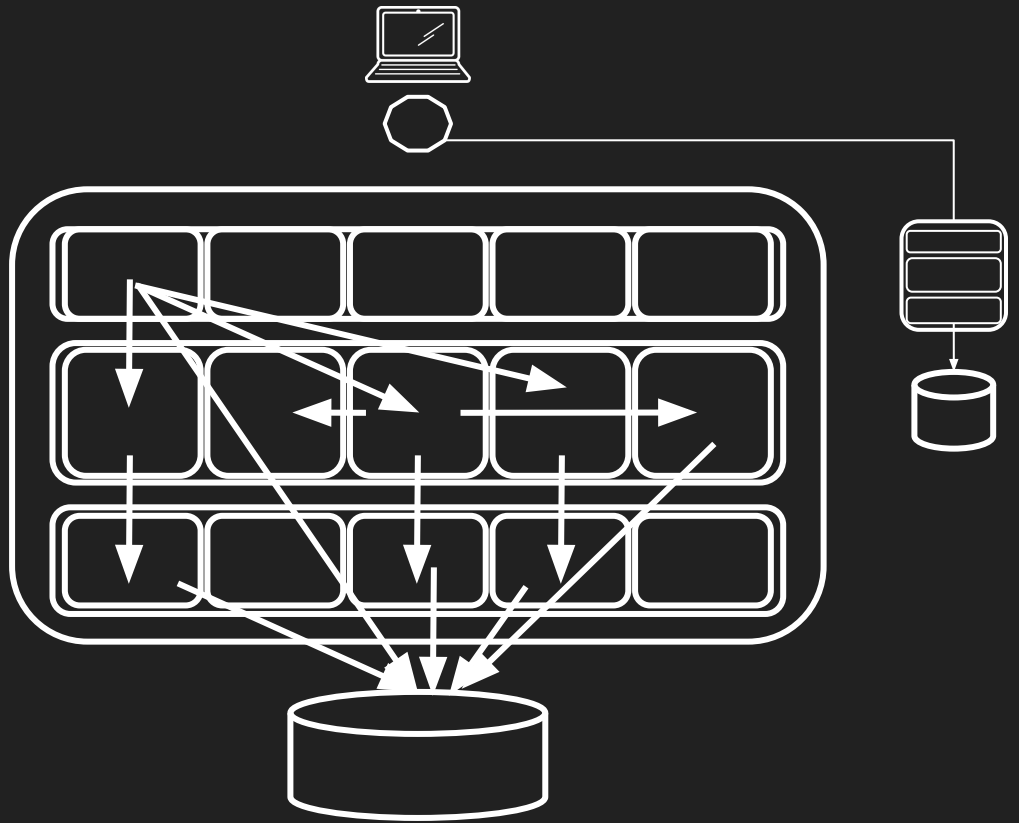
Large Team



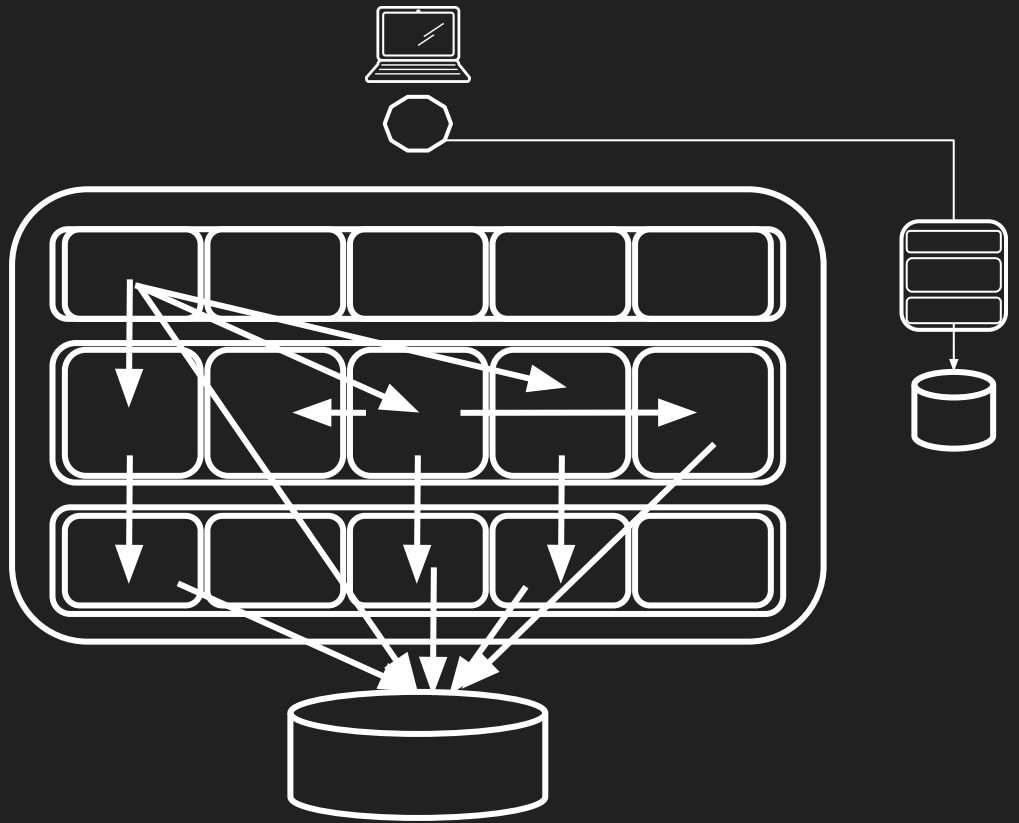




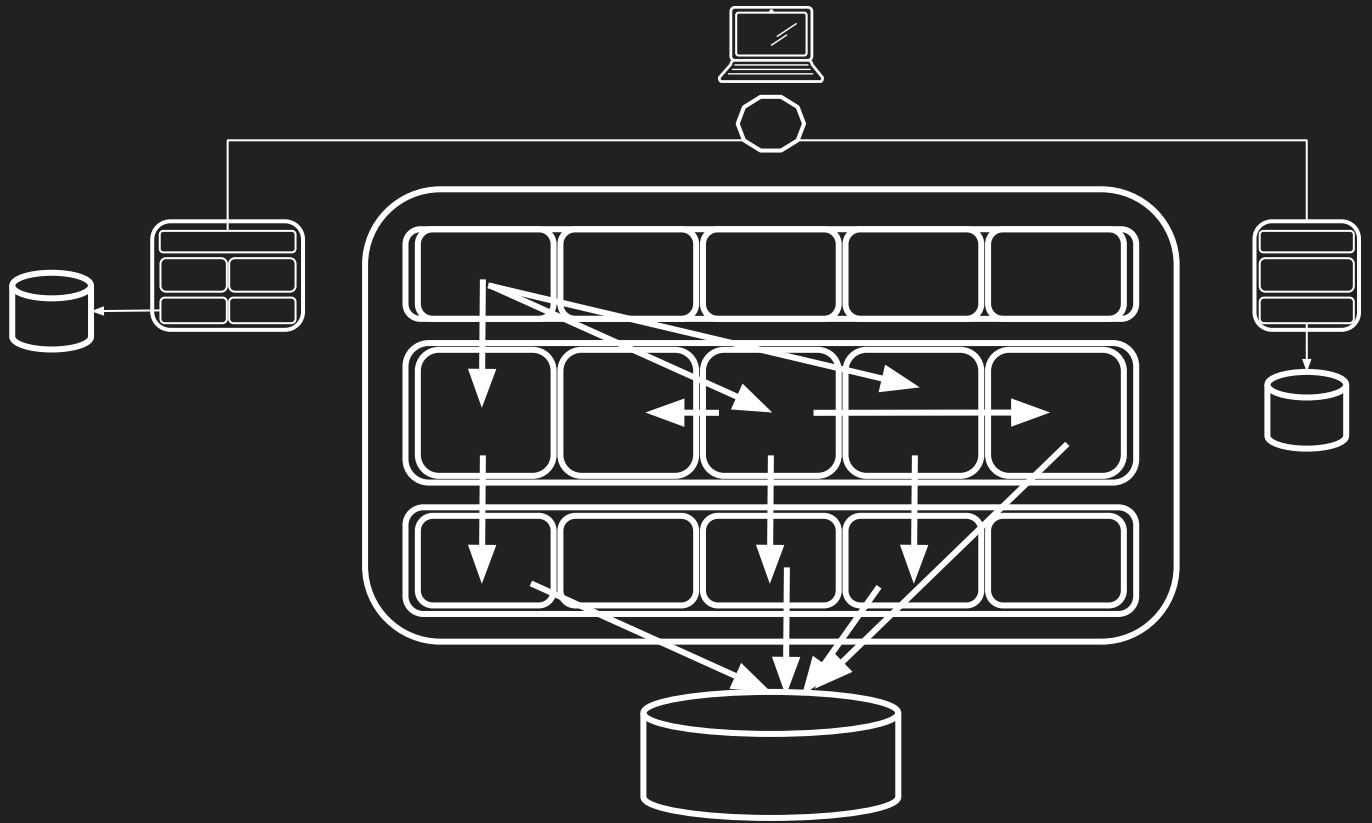
Strangle



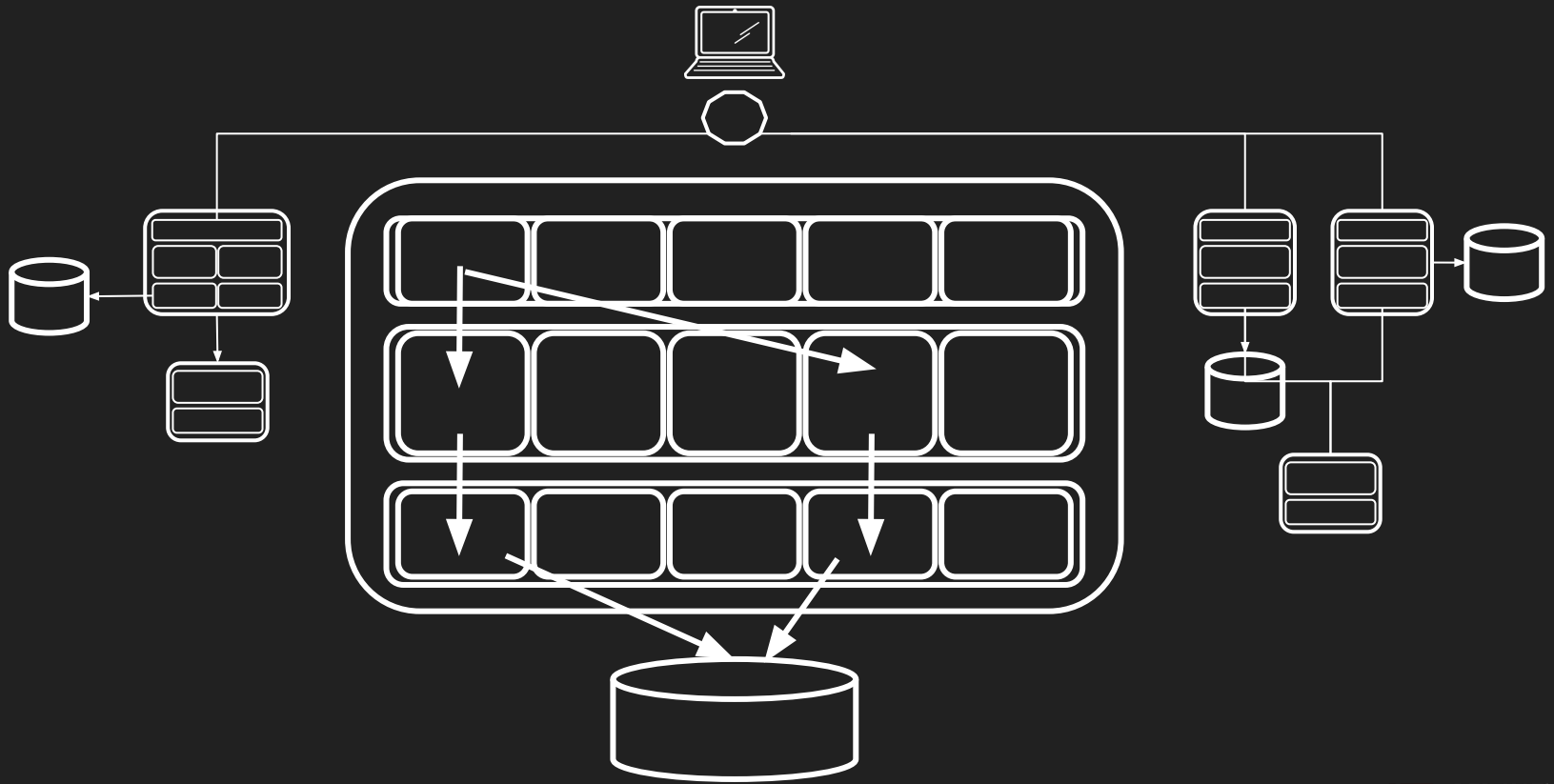
~~Strangle~~ Hug



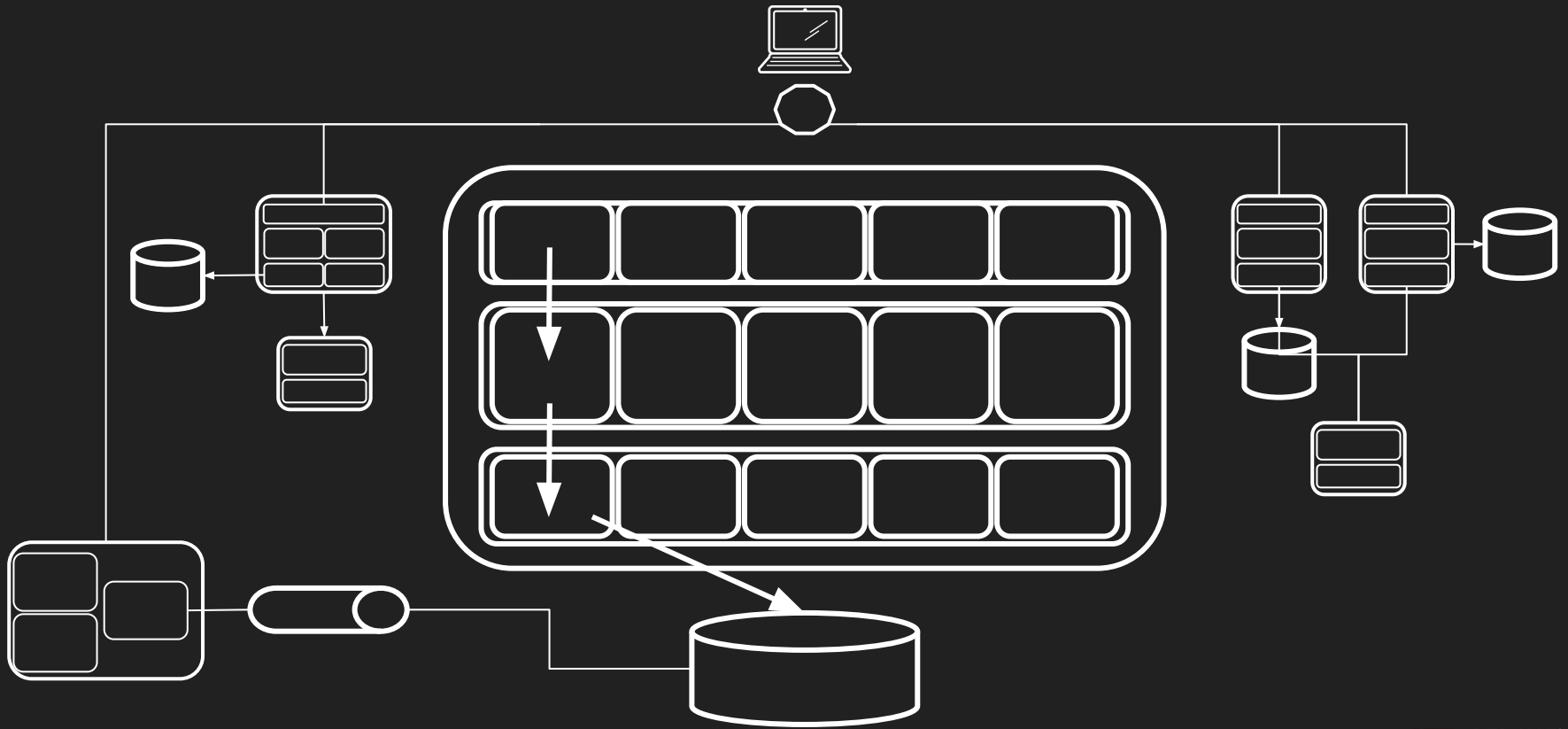
Friend Hug



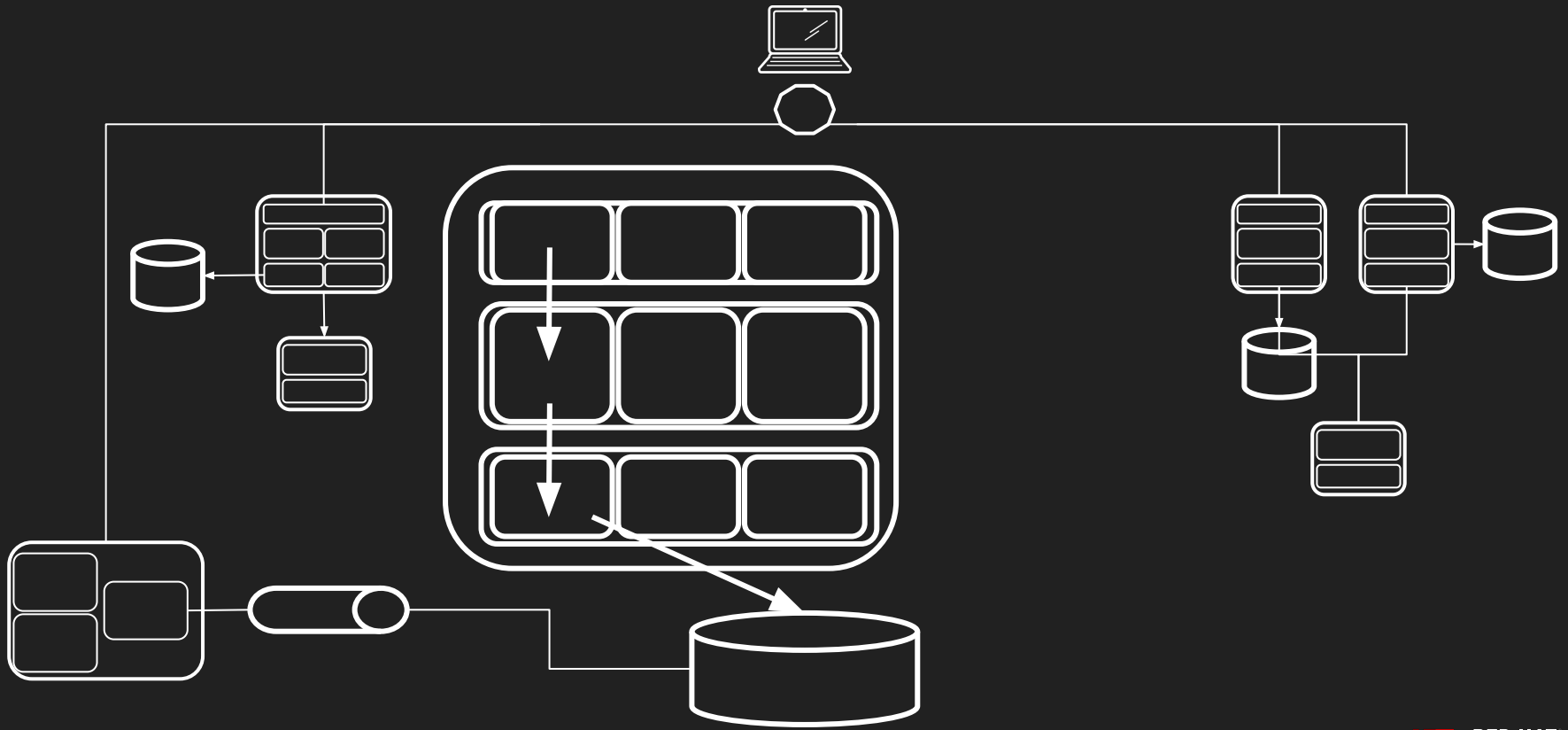
Family Hug



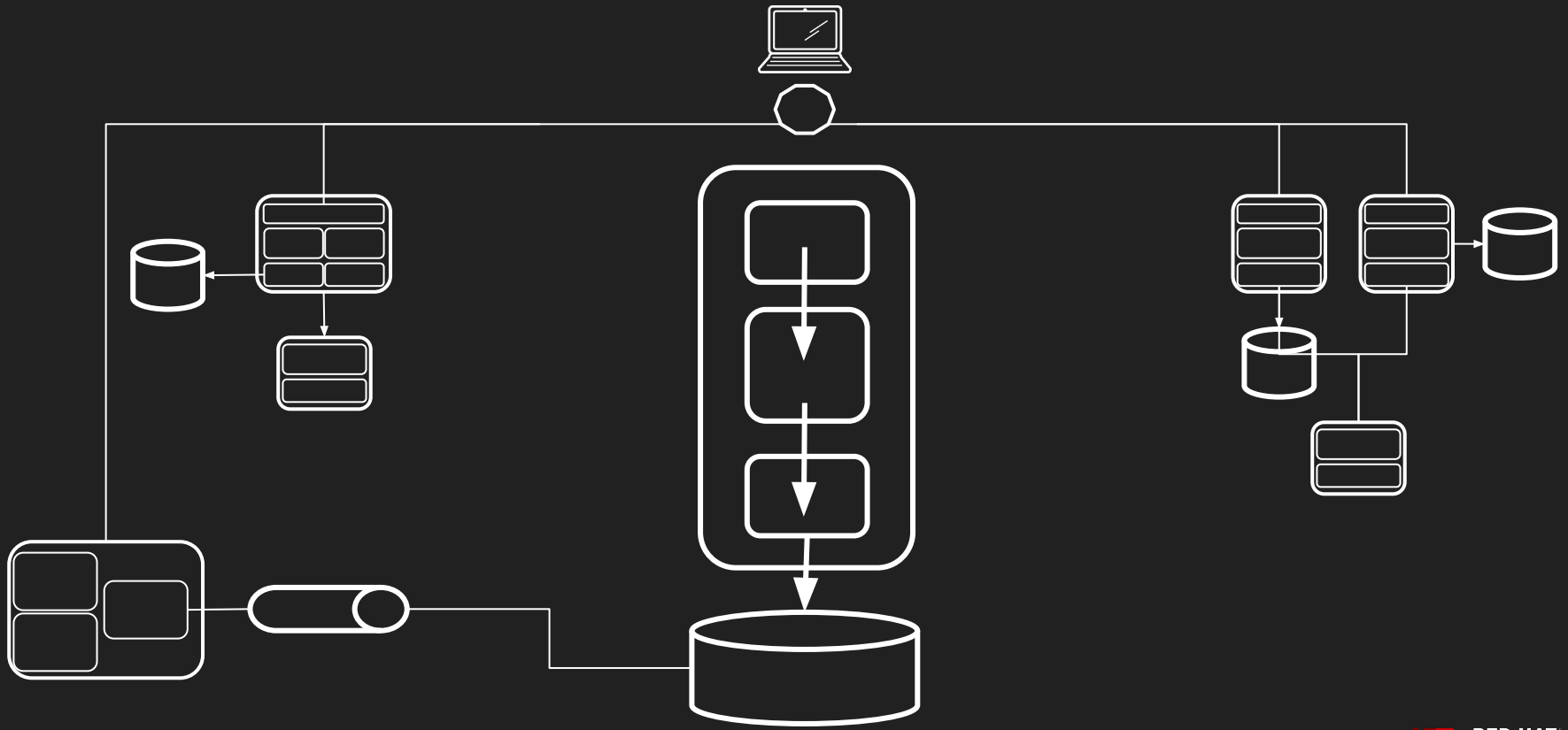
Bear Hug



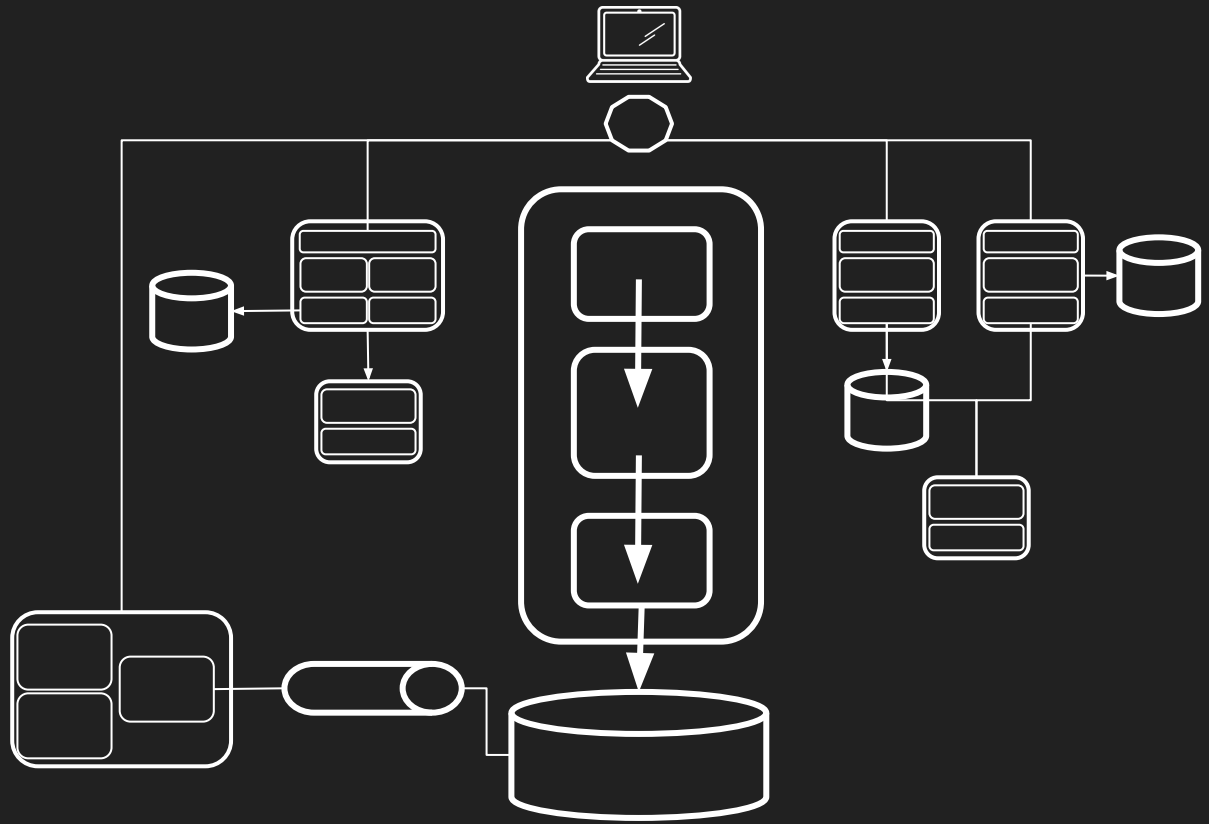
"Refactor"



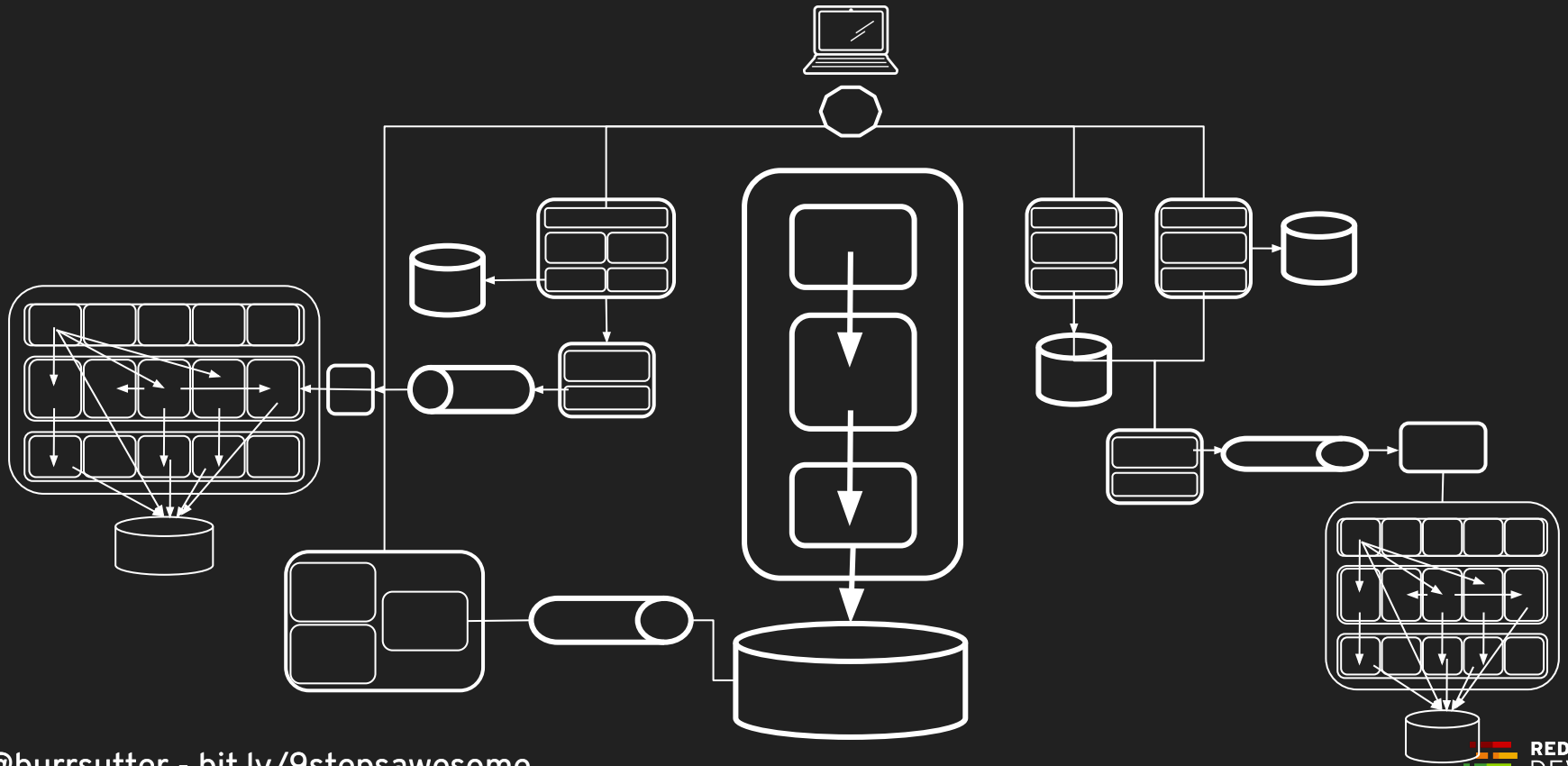
Squeeze



Streamline



Embrace Others



Raffle Rules (applicable in the real)

1. Follow: @burrsutter 
2. With picture of the session
3. Mention @burrsutter
4. With hashtag #devoxx