RED HAT
DEVELOPERS

Reactive Microservices with Eclipse Vert.x

@burrsutter

vertx.io

http://developers.redhat.com

http://bit.ly/reactivemsa

Change History

1.0 - JavaOne 2016

2.0 - http://javaday.org.ua/kyiv/

2.1 - Added “Be This Tall” and 2 Gene Kim books slides

2.2 - Changed color scheme/art on several slides

2.3 - reordered slides, added links to mono2micro data book and Reactive Tutorial, updated getting started section

2.4 - adding slide for Clement’s book

2.5 - added slide for Balloon Popping demo

java -jar myapp.jar

DropWizard

www.dropwizard.io

JAX-RS API

First to market

DropWizard Metrics

Embeddable servers:
Jetty

Spring Boot

projects.spring.io/spring-boot

Spring API (@RestController)

'Starter' POMs:
start.spring.io

Embeddable servers:
Tomcat, Jetty, Undertow

WildFly Swarm

wildfly-swarm.io

Java EE 7 APIs

'Starter' POMs:
wildfly-swarm.io/generator

Embeddable servers:
WildFly (Undertow)

Vert.x

vertx.io

Reactive
Async/non-blocking

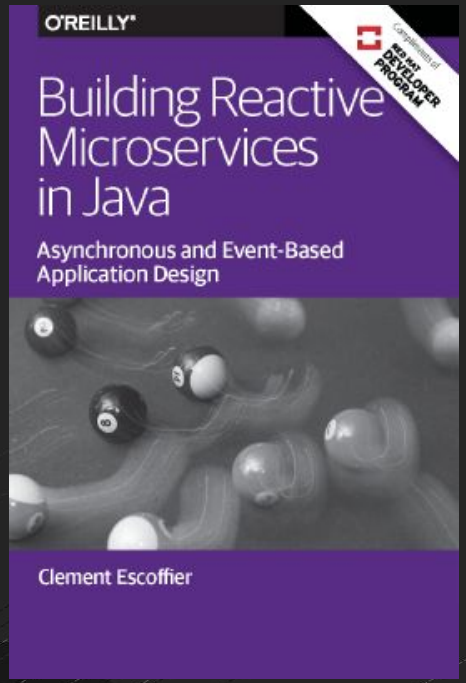
vertx run myhttp.java

HTTP, HTTP/2, TCP, UDP, Websockets, etc. (out of the box)

VERT.X

RED HAT DEVELOPERS

https://developers.redhat.com

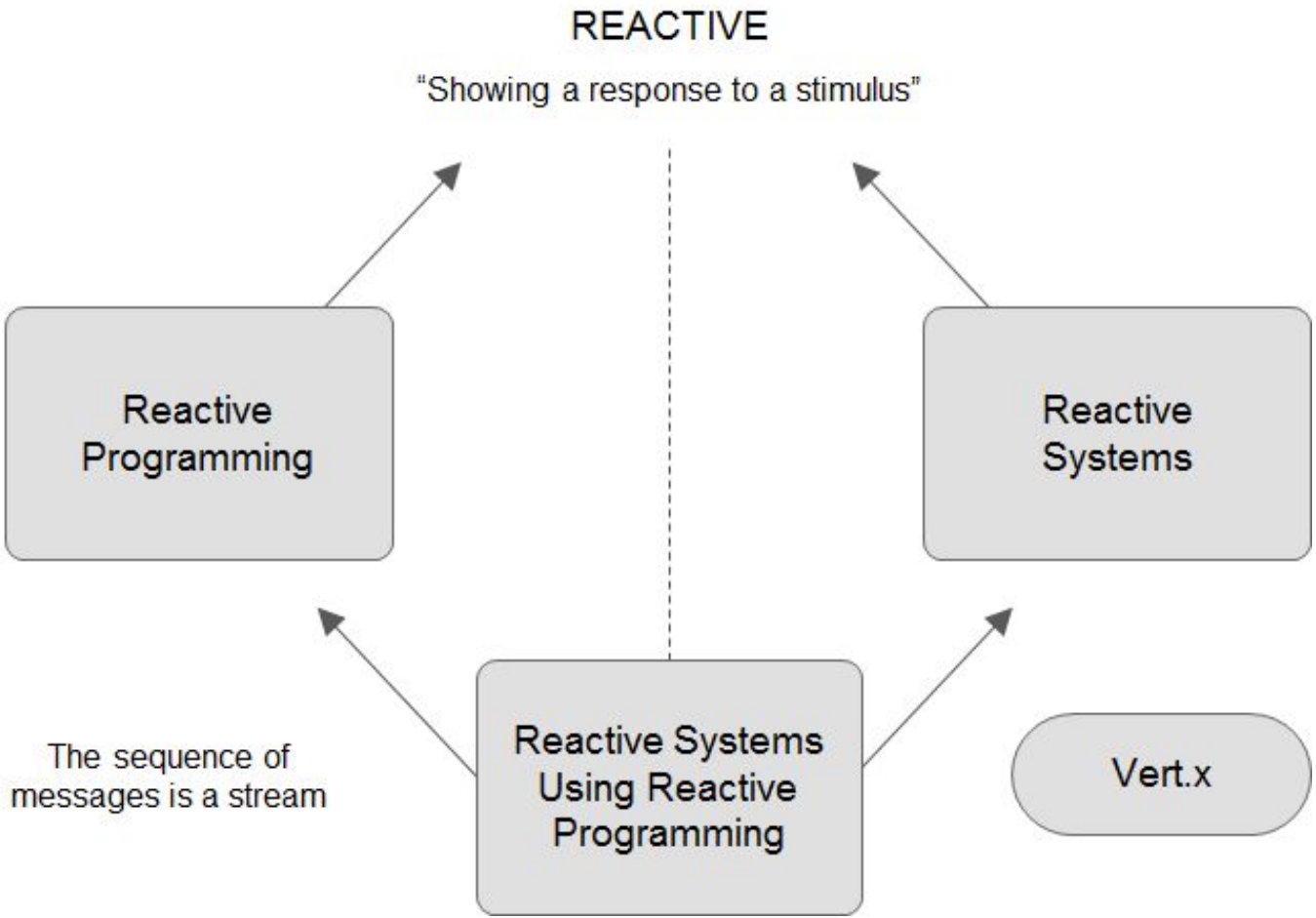


Download Free ebook

Developer Evolution :-)

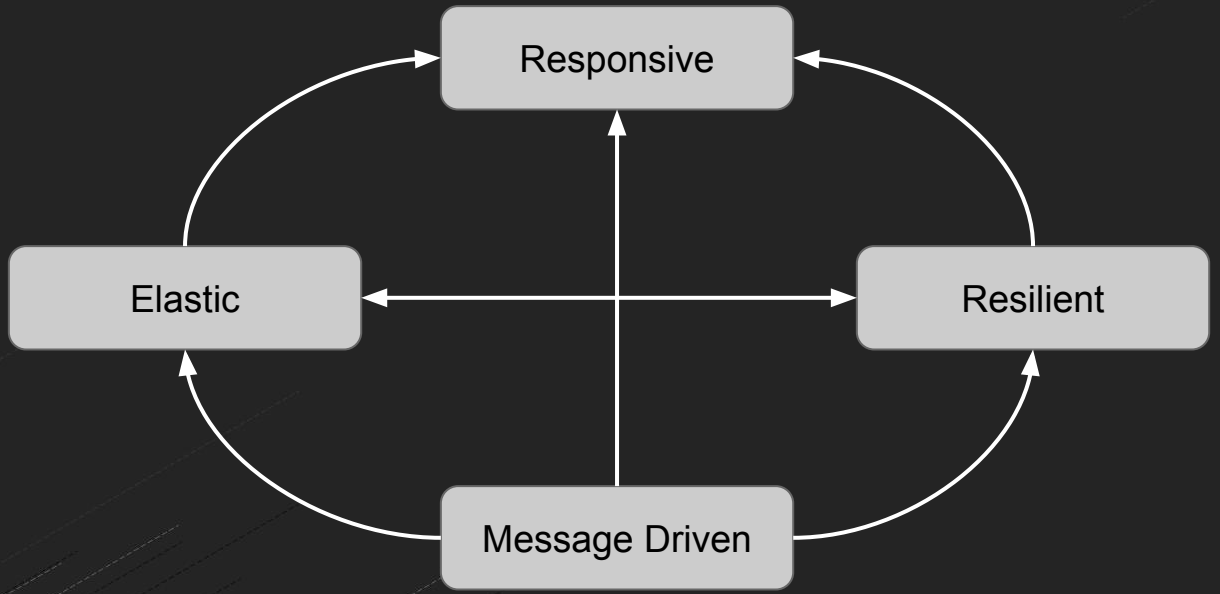
70s	80s	90s	00s	10s	
					
COBOL JCL WFL	C/C++ 4GLs CASE Netware RDBMS SQL Unix	HTTP/HTML CGI GET/POST Cookies Java Servlet EJB Windows NT Solaris/AIX OOP	MVC - Struts DI - Spring ORM - Hibernate XML WS-* JSF AJAX Agile Automated Testing CI SVN Linux	HTML5 Mobile iOS/Android Maven/Gradle Git Node.js MongoDB/Redis Hadoop/Spark *-aaS/Cloud **Reactive** Functional	Mythical Beast

Reactive


REACTIVE
"Showing a response to a stimulus"
Reactive Programming
Reactive Systems
The sequence of messages is a stream
Reactive Systems Using Reactive Programming
Vert.x

Reactive Manifesto

Reactive Systems (not Programming)



Reactive programming is programming with asynchronous data streams.

https://gist.github.com/staltz/868e7e9bc2a7b8c1f754

Responsive Demo

https://github.com/redhat-helloworld-msa/goodbye

Microservices

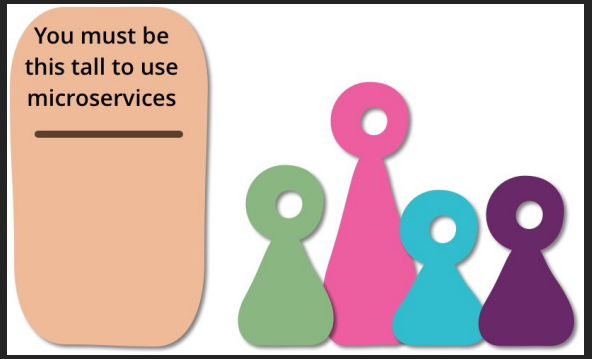
You Must Be This Tall

1. Self-Service, on-demand, elastic infrastructure as code

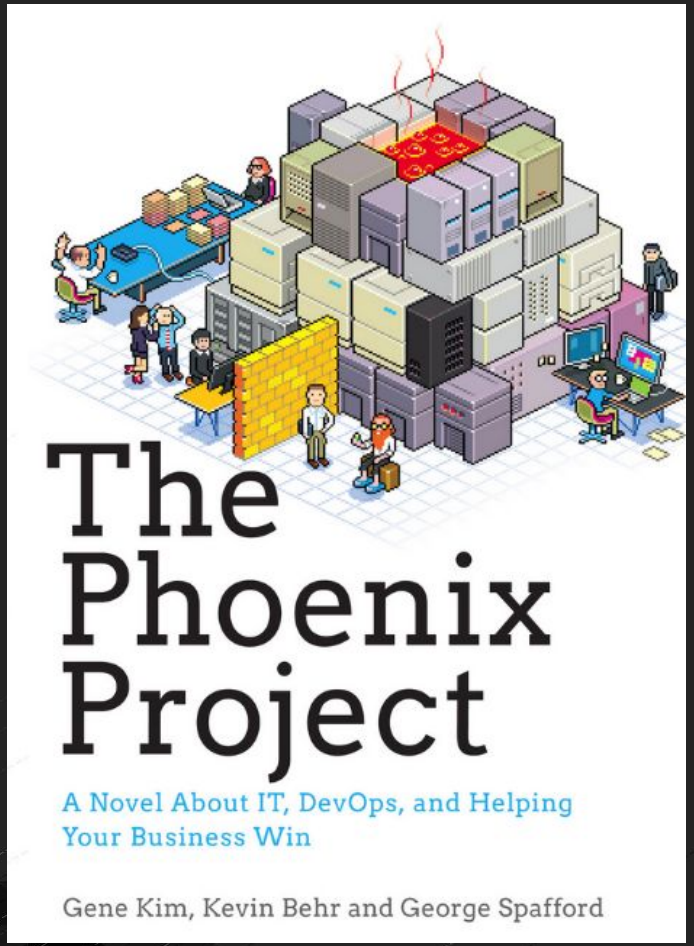
   (how many days/weeks to provision a new VM?)
2. Dev vs Ops

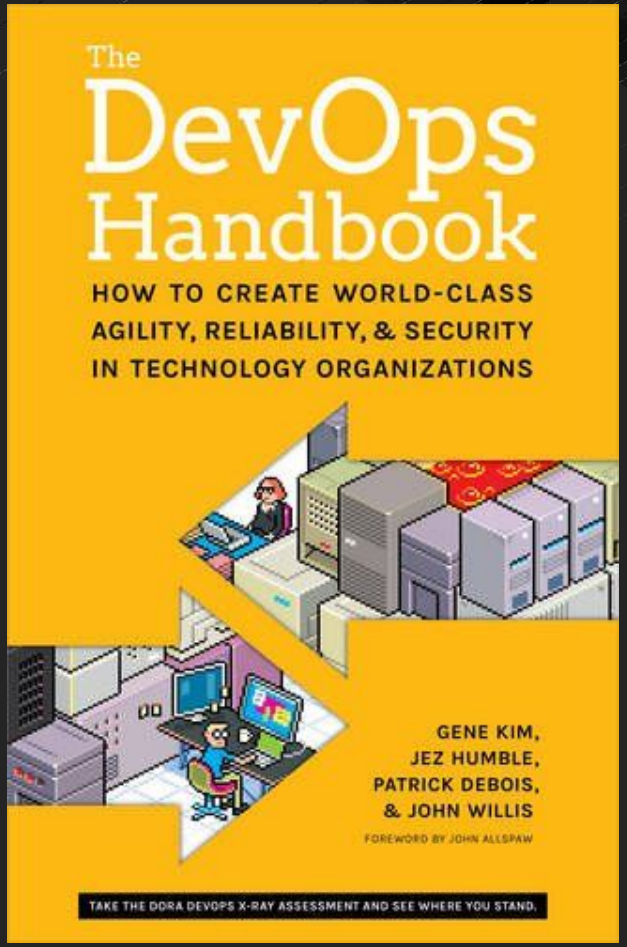
   (who is on the pager for production app outage?)
3. Automation

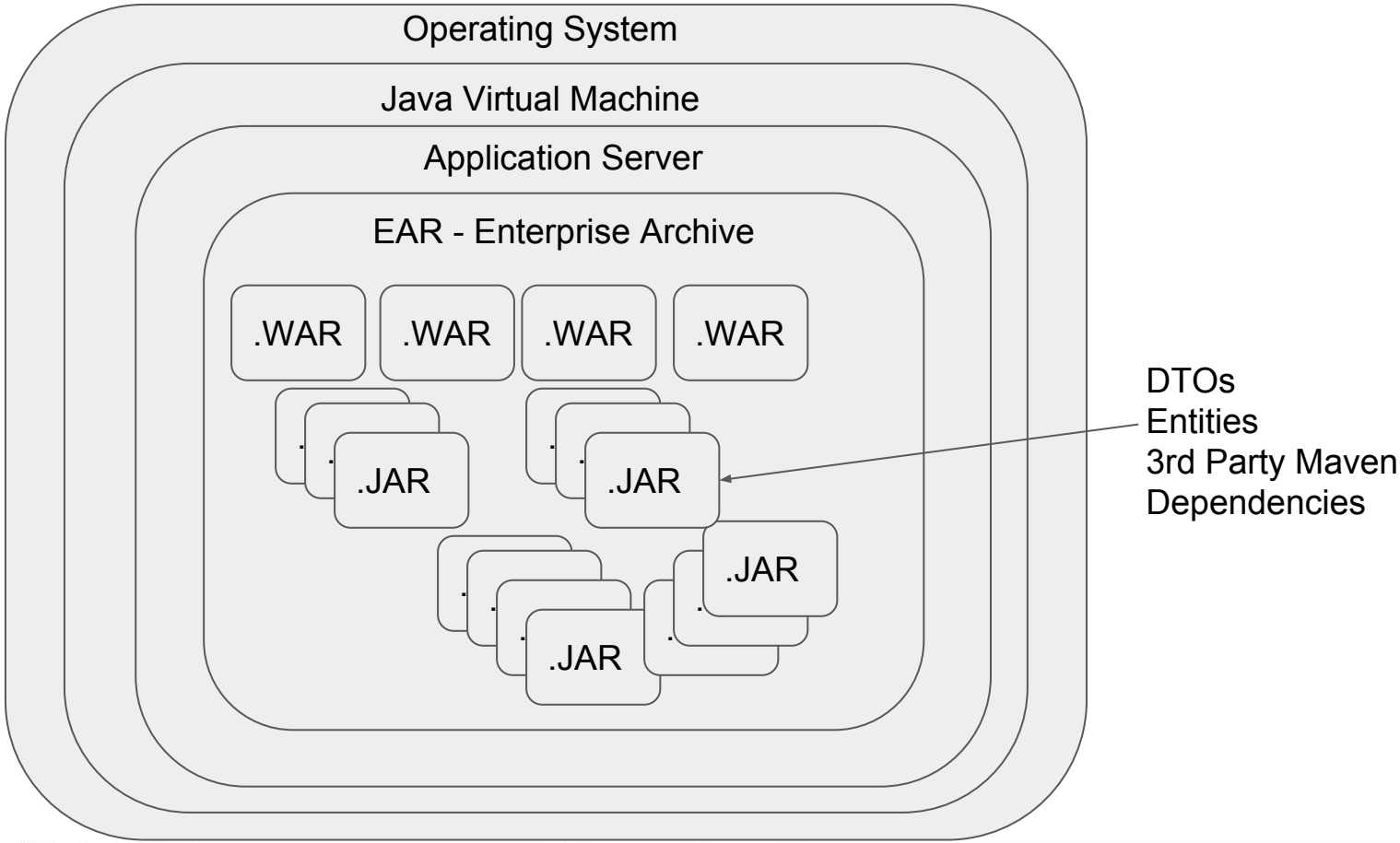
   (phoenix vs snowflake?)
4. CI & CD
5. Deployment Pipeline

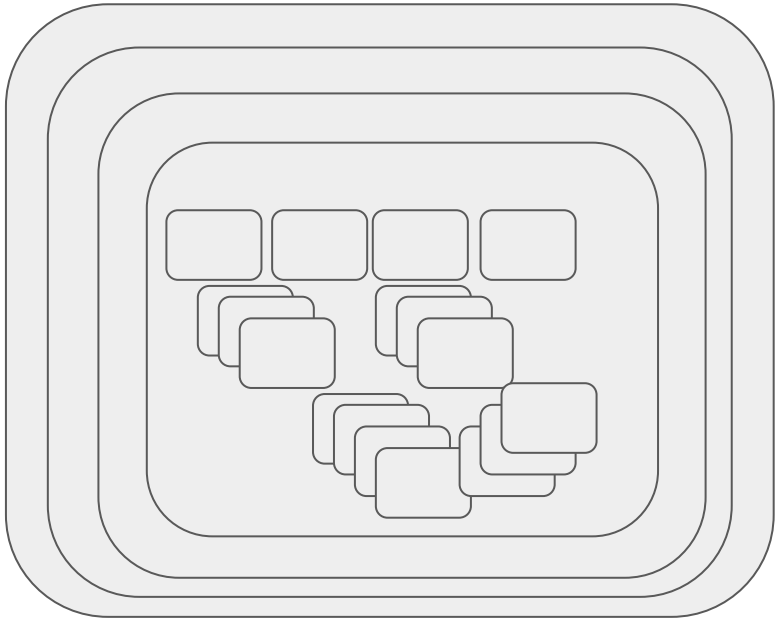


http://martinfowler.com/bliki/MicroservicePrerequisites.html









Programmers
(18)

Business
Analysts
(4)

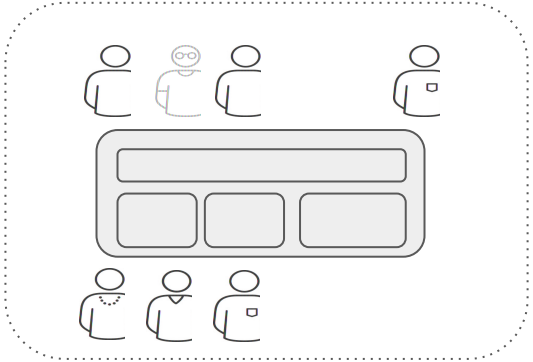
Project
Managers
(2)

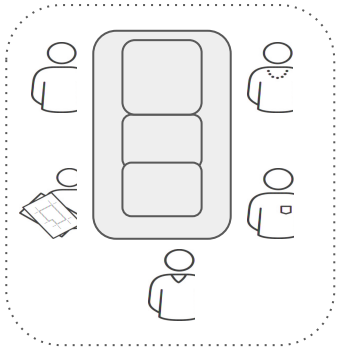
Quality
Assurance
(6)

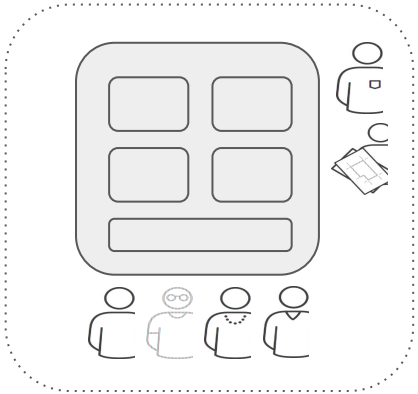
Compliance
(2)

Operators
(6)

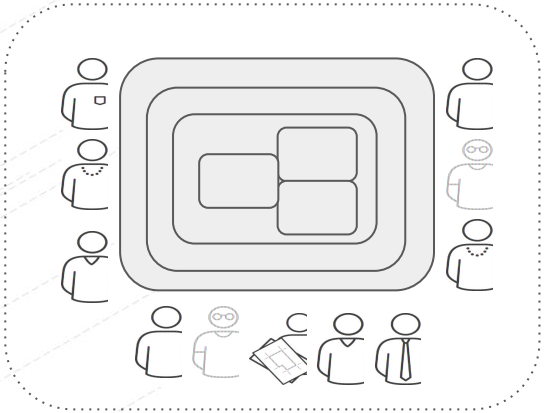
DBAs
(3)

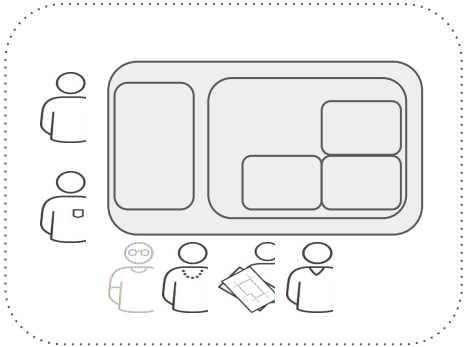


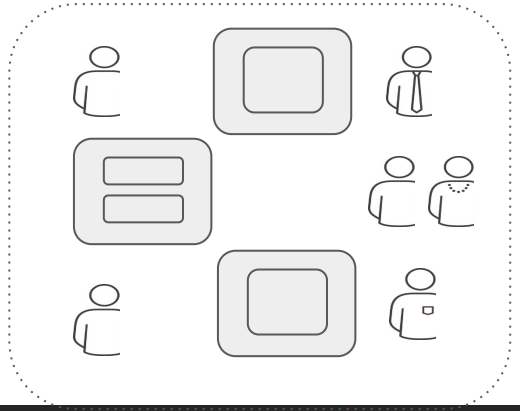




2-Pizza Teams
You Build It, You Own it

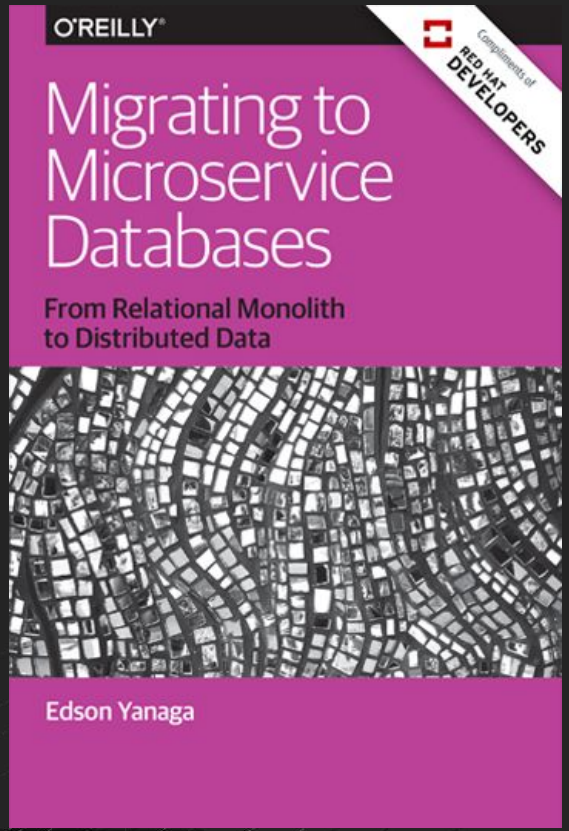






Microservice Principles/Characteristics

1. Deployment **Independence**: updates to an individual microservice have no negative impact to any other component of the system. Optimized for **Replacement**.
2. Organized around **business** capabilities
3. **Products** not Projects
4. **API**-Focused
5. **Smart** endpoints and dumb pipes
6. Decentralized Governance
7. Decentralized Data Management
8. Infrastructure Automation (infrastructure as code)
9. Design for failure
10. Evolutionary Design

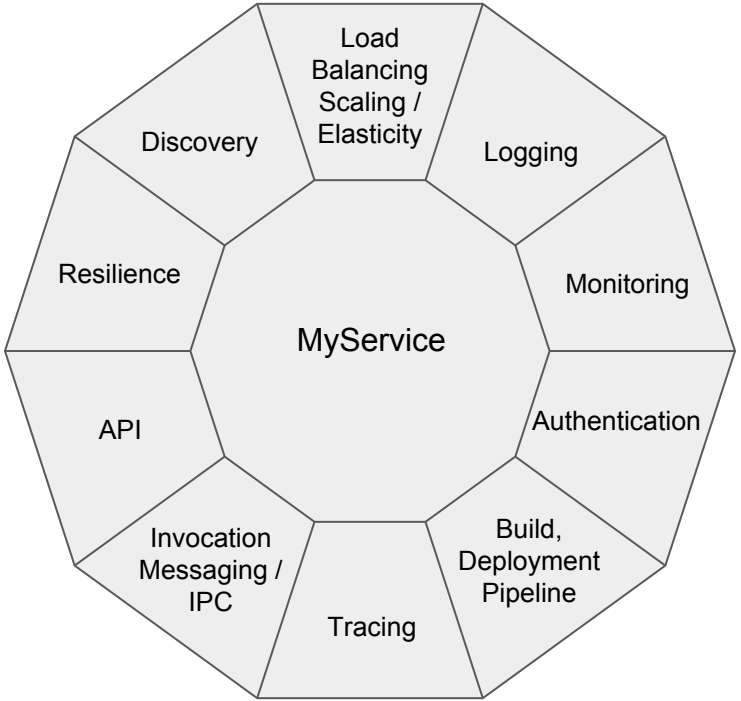


Decentralized Data Management

What?

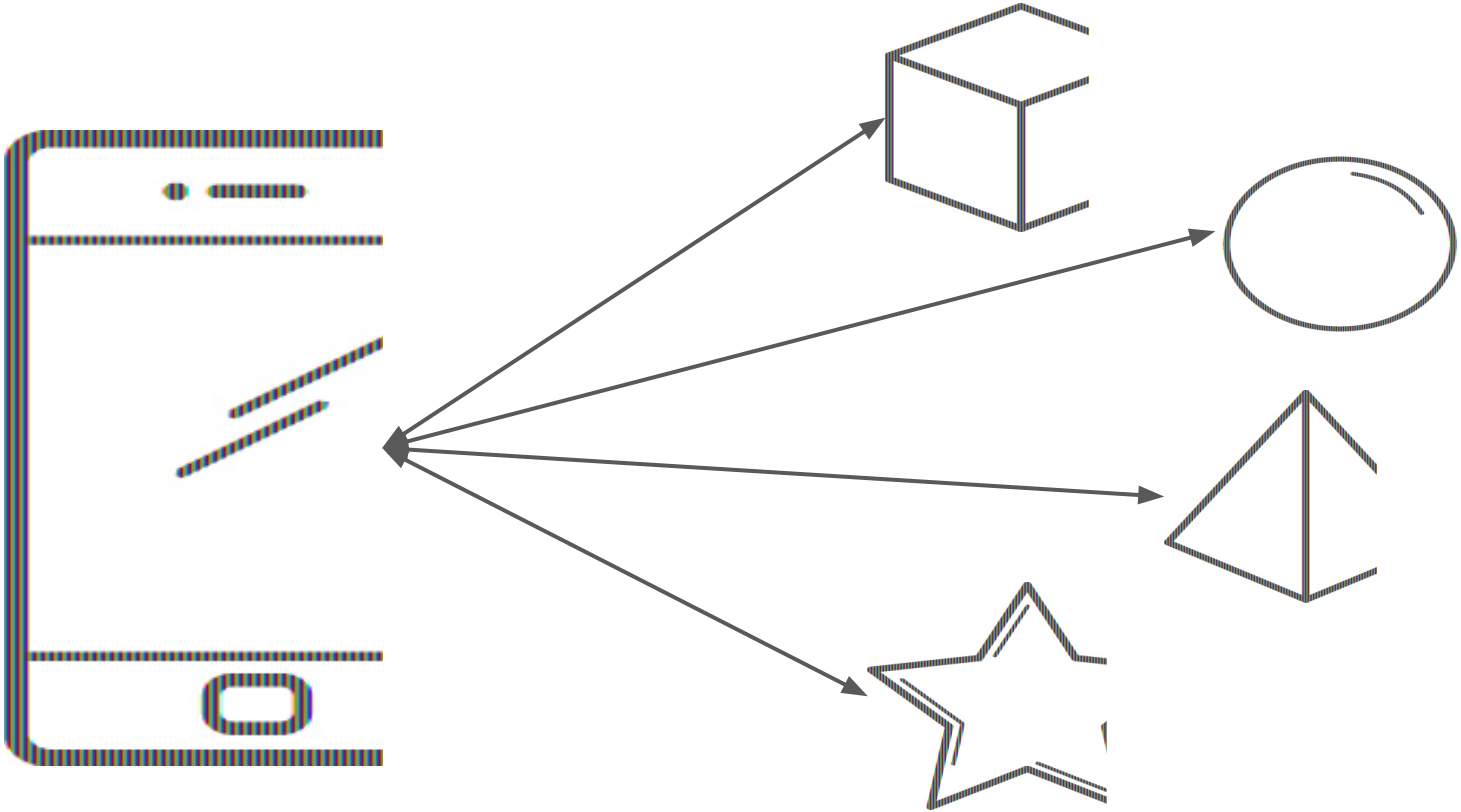
http://bit.ly/mono2microdb

Microservice Concerns



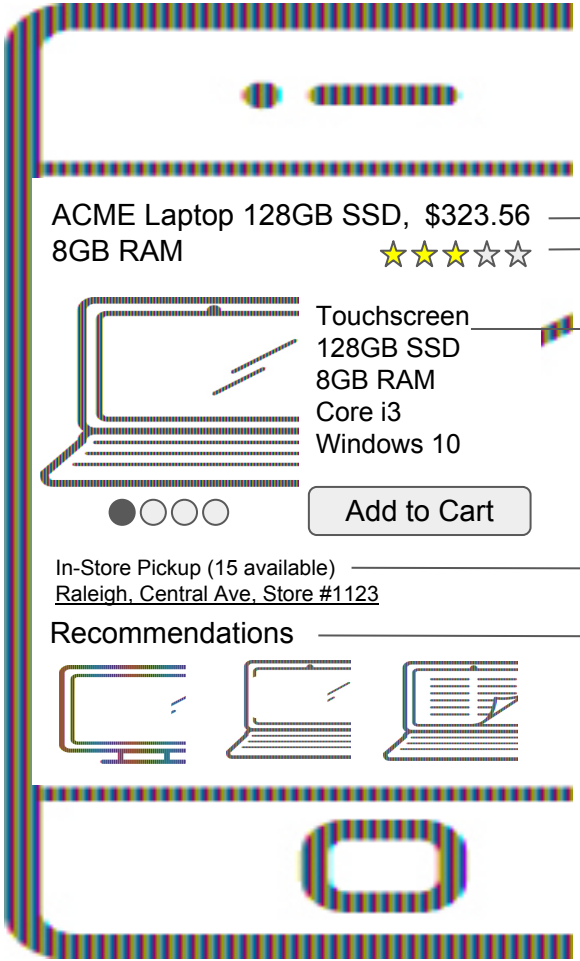
Microservice Patterns

Browser

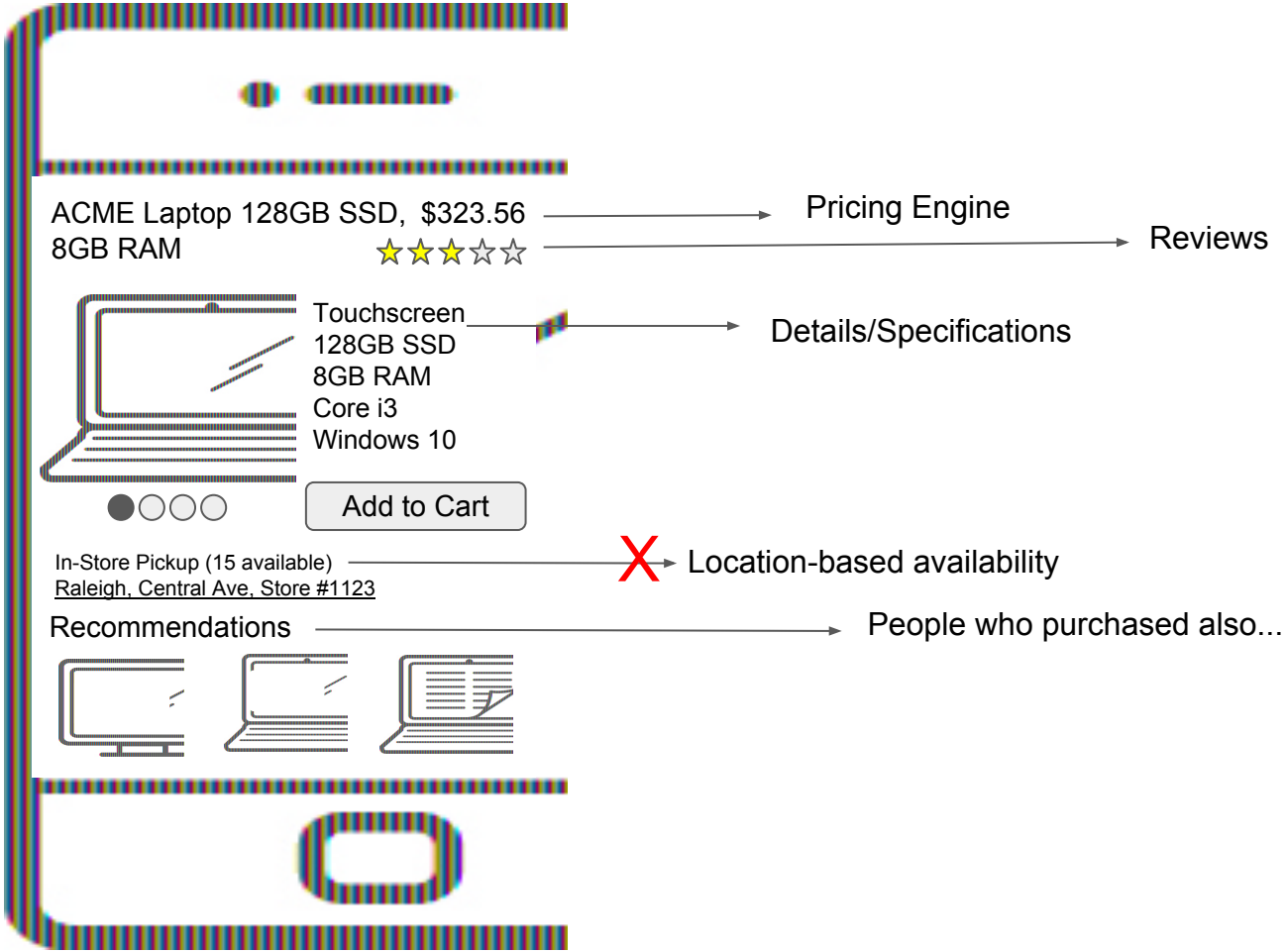


Example

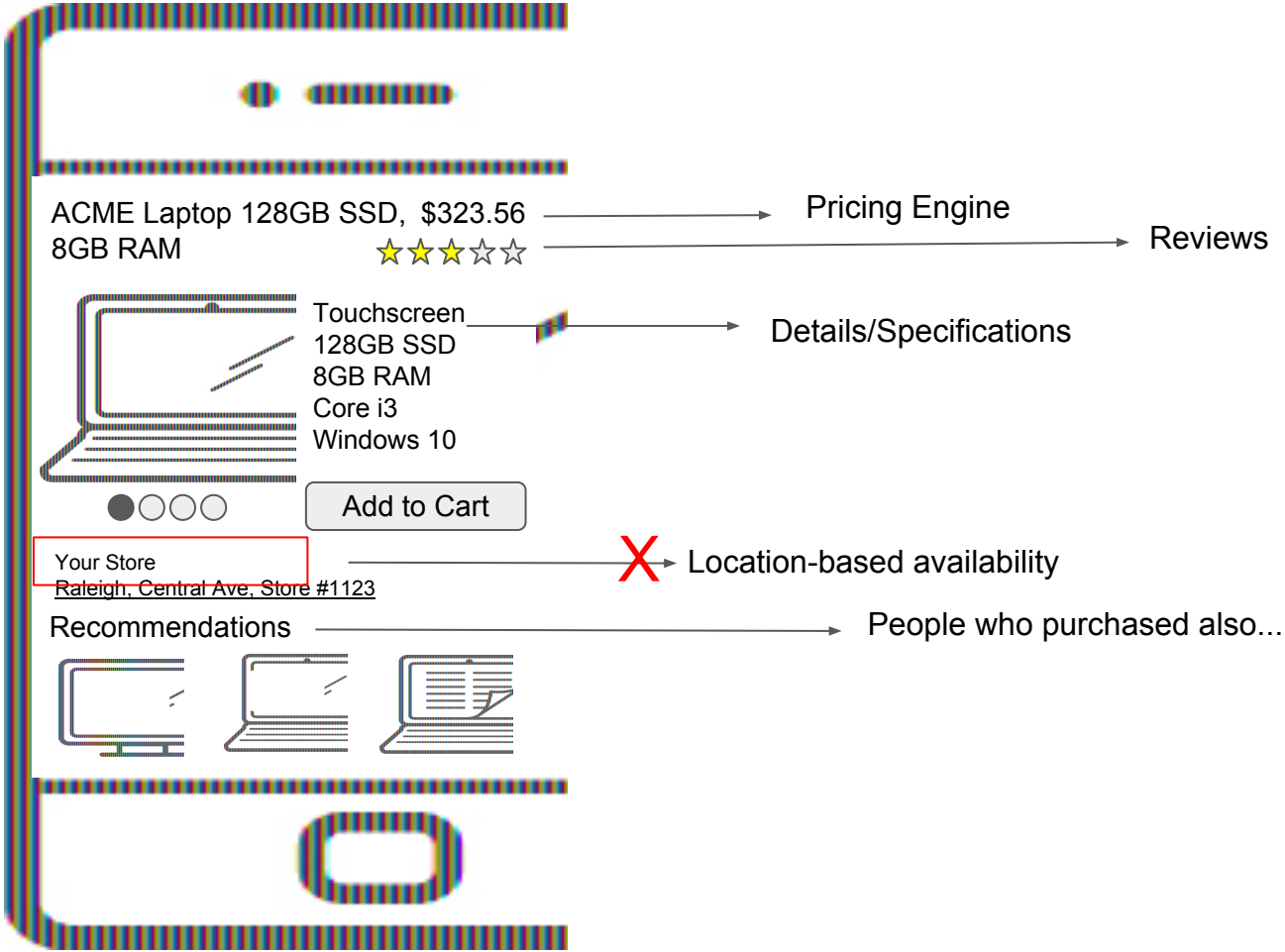
Example



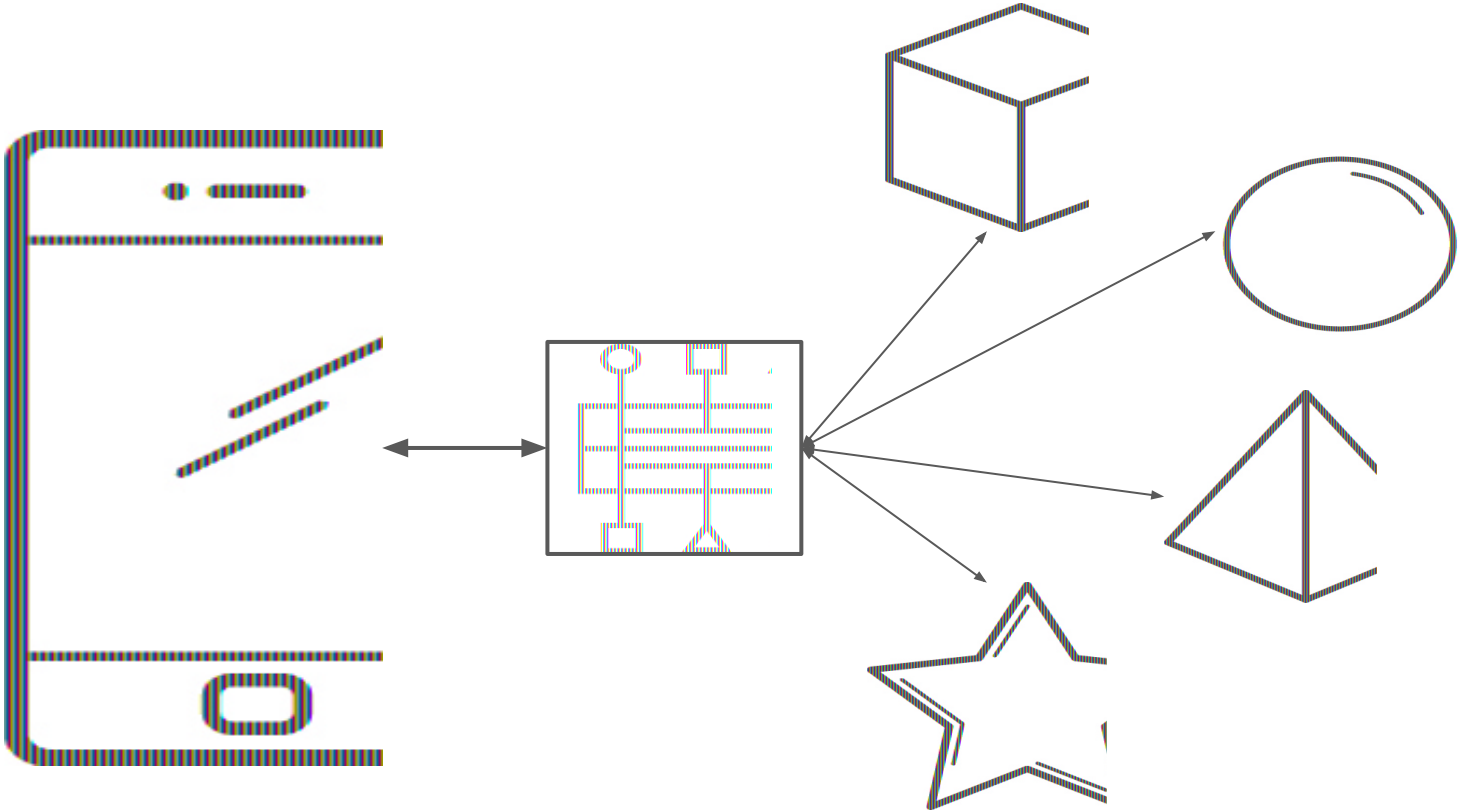
Example (Fail)



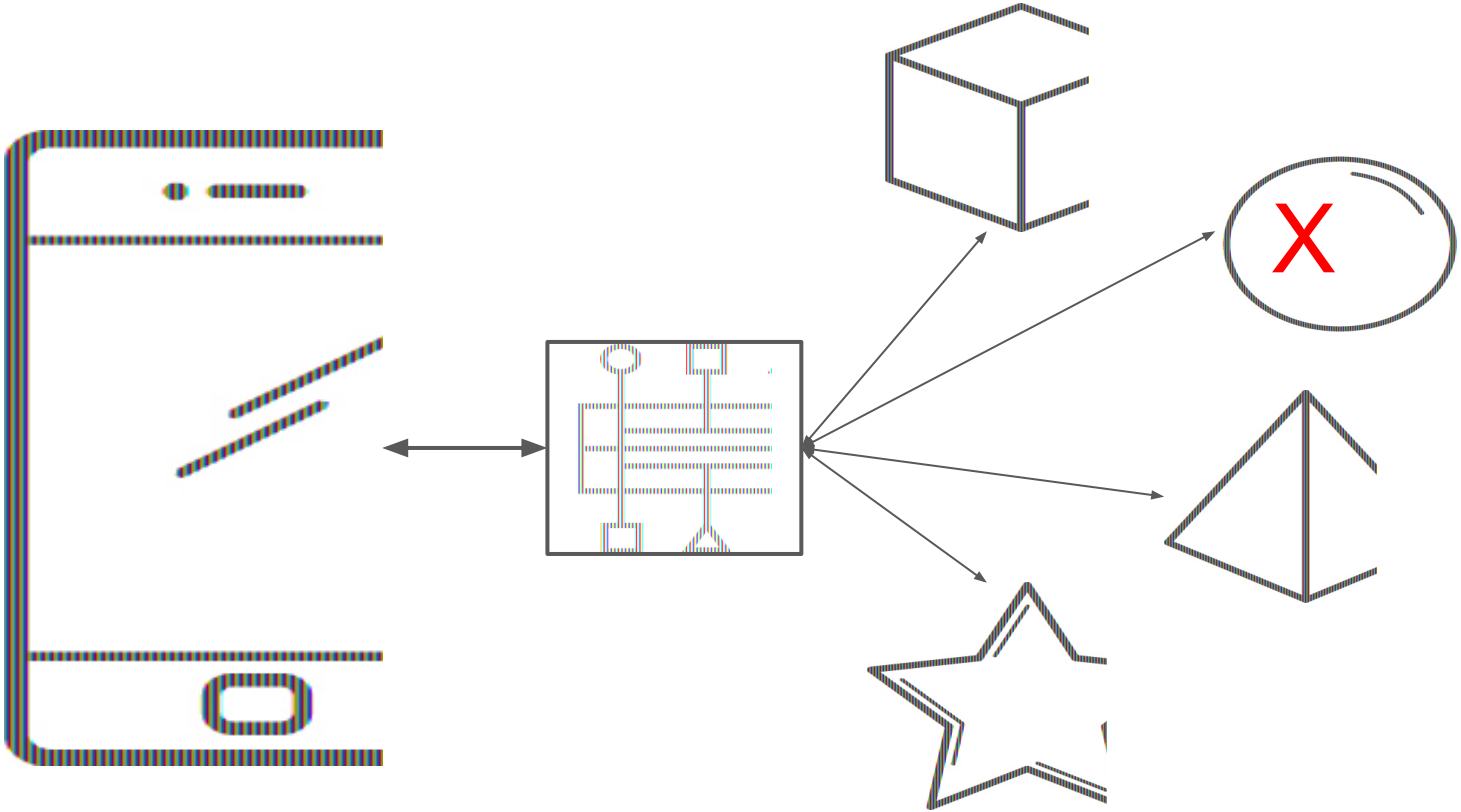
Example (Fallback)



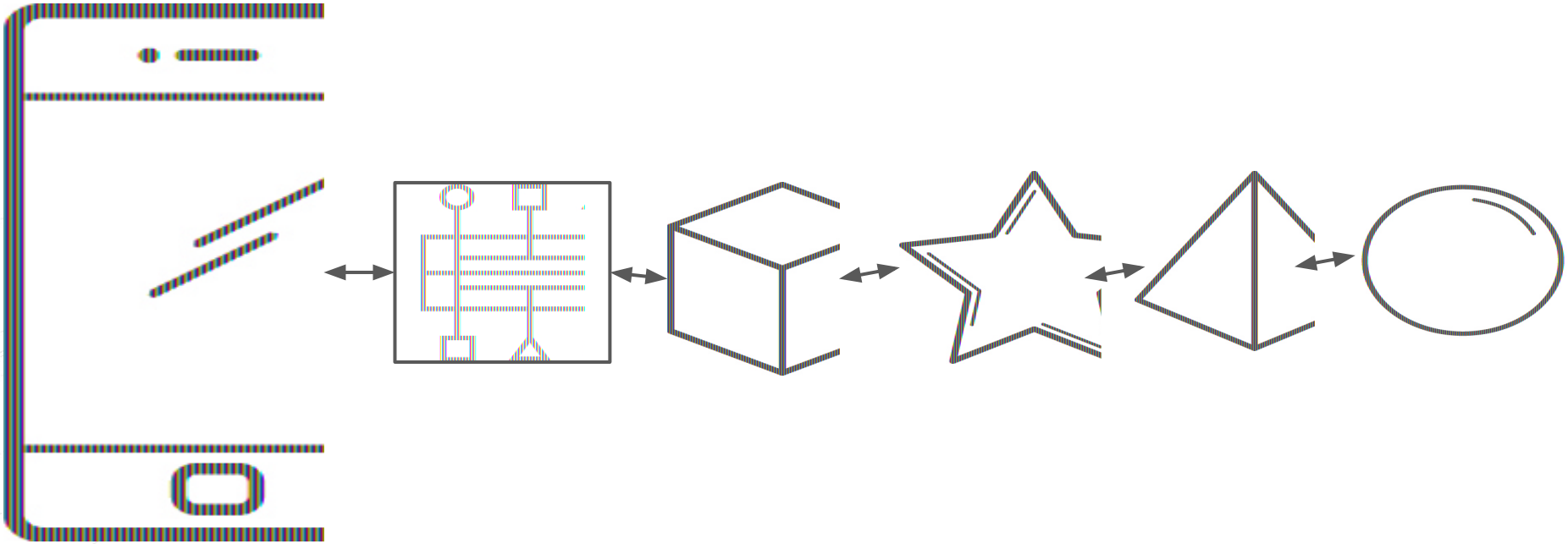
API “Gateway”



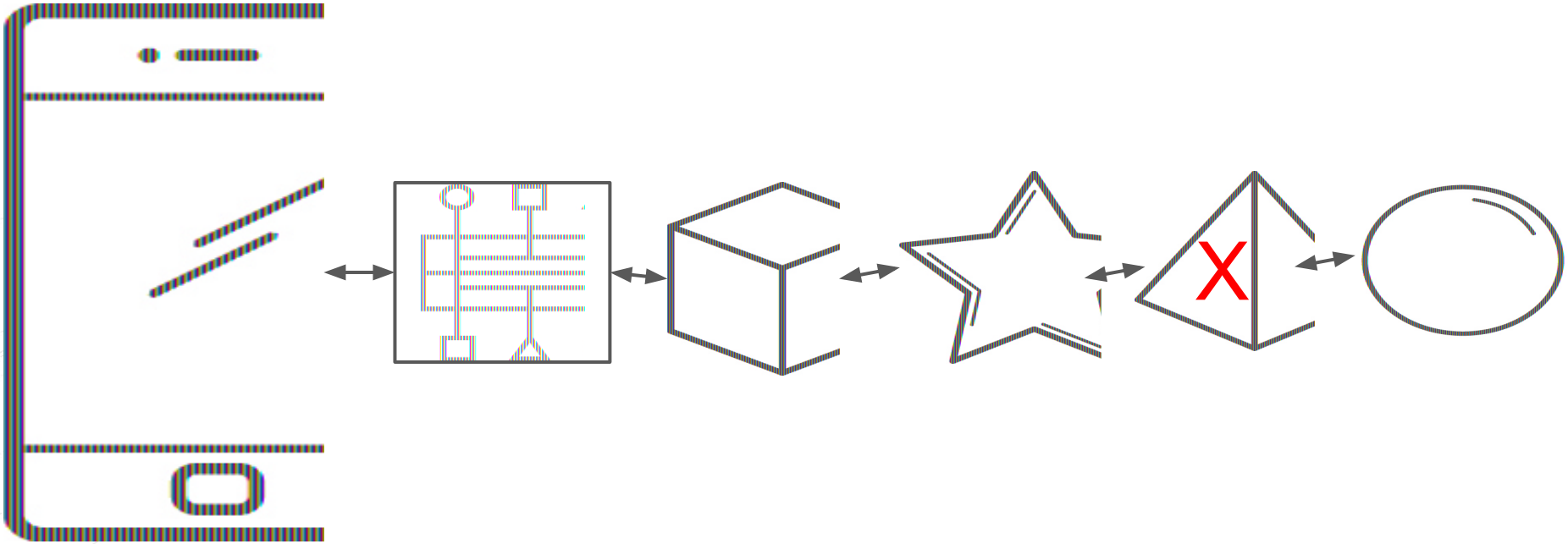
API “Gateway” (Fail)



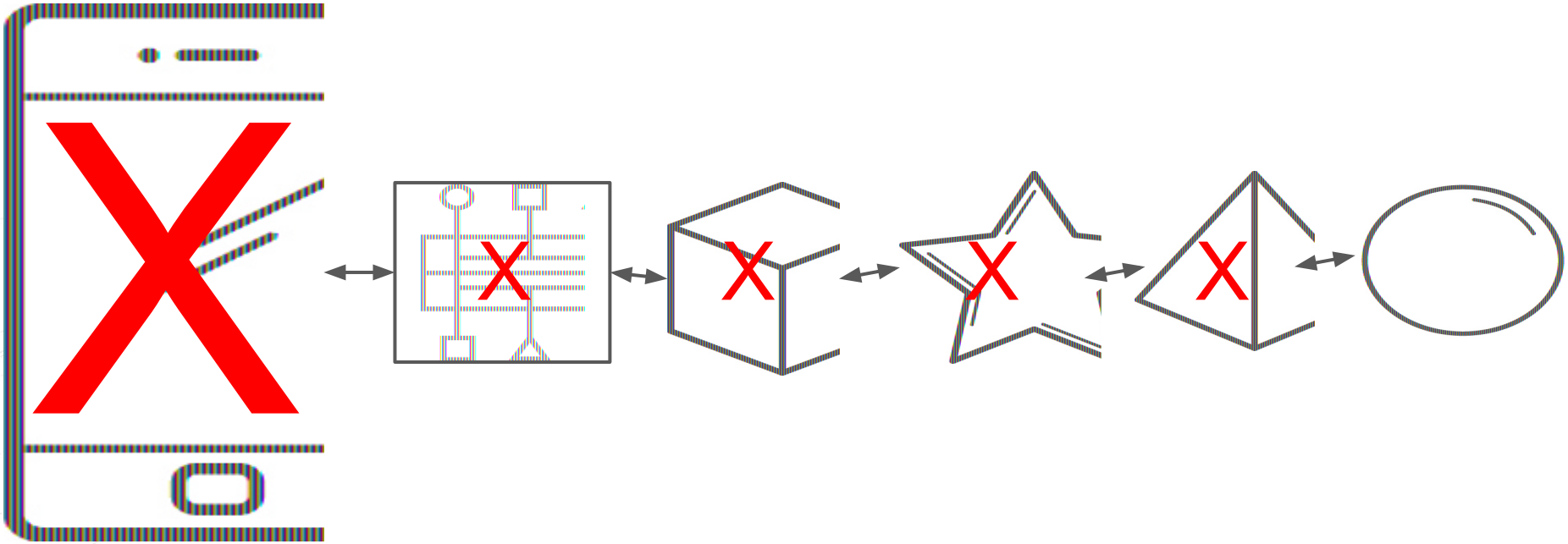
Chaining



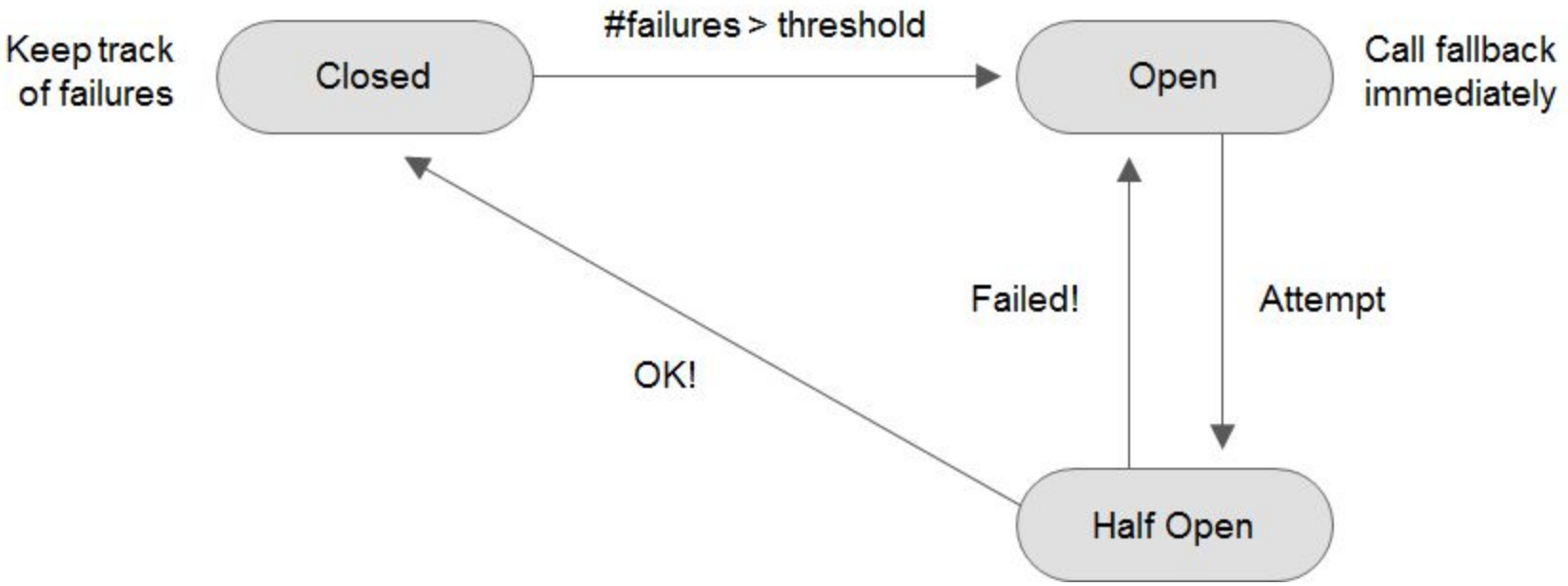
Chaining (Fail)



Chaining (Cascading Fail)



Circuit Breaker



Demo

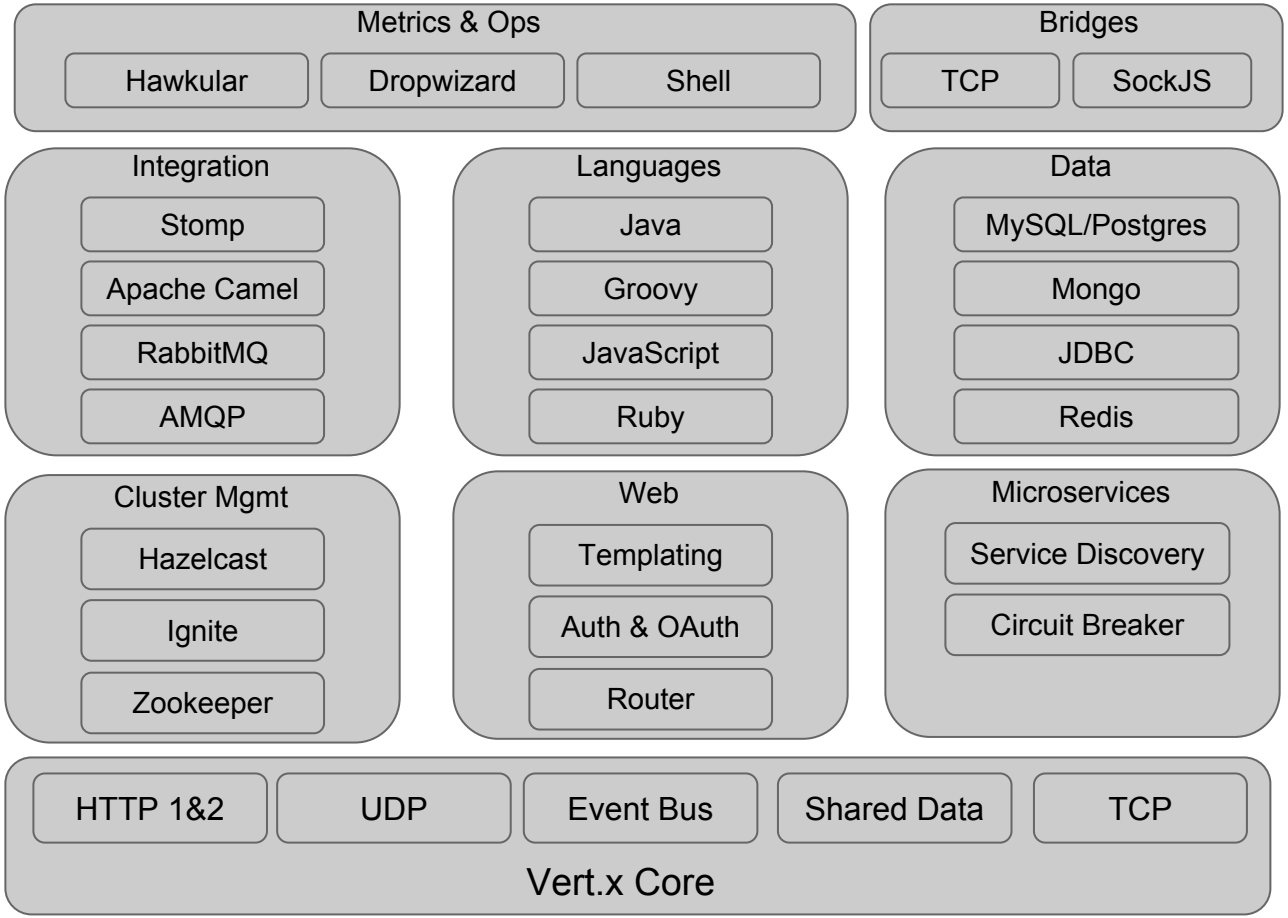
bit.ly/msa-instructions

https://github.com/burrsutter/kube4docker

Videos:
https://www.youtube.com/watch?v=SPATMHP-xw8&list=PLuWlr4oKSRUYjjwDOaZOX-54X4_OIUUeS

Vertx.io—an Eclipse project

Vert.x is a toolkit
for building reactive
applications on the JVM.



Vert.x

(**Un**-Opinionated) Toolkit for reactive, async applications

Every user has their own Vert.x way

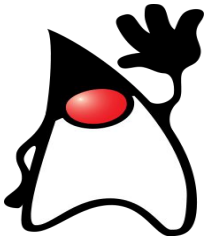
Low-latency microservices that interact using the EventBus

Built in elasticity and resiliency

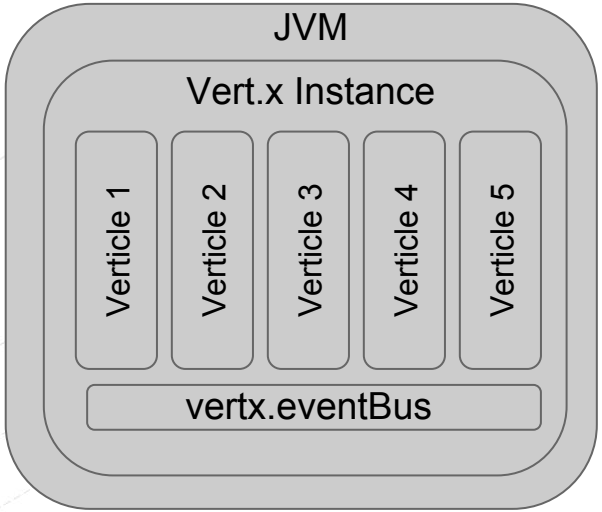
Polyglot: Java, JavaScript, Groovy, Ruby, Ceylon

vertx.io

http://vertx.io/blog/my-first-vert-x-3-application/



Vert.x Verticle

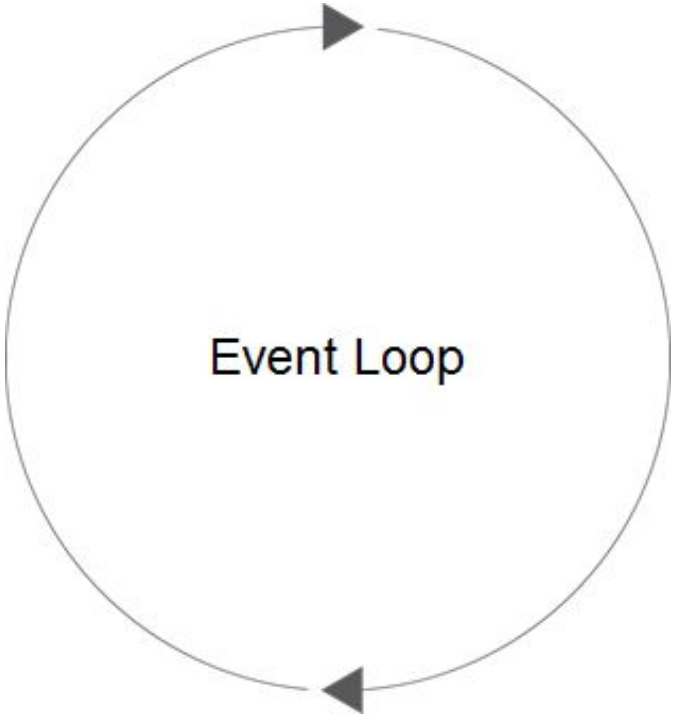


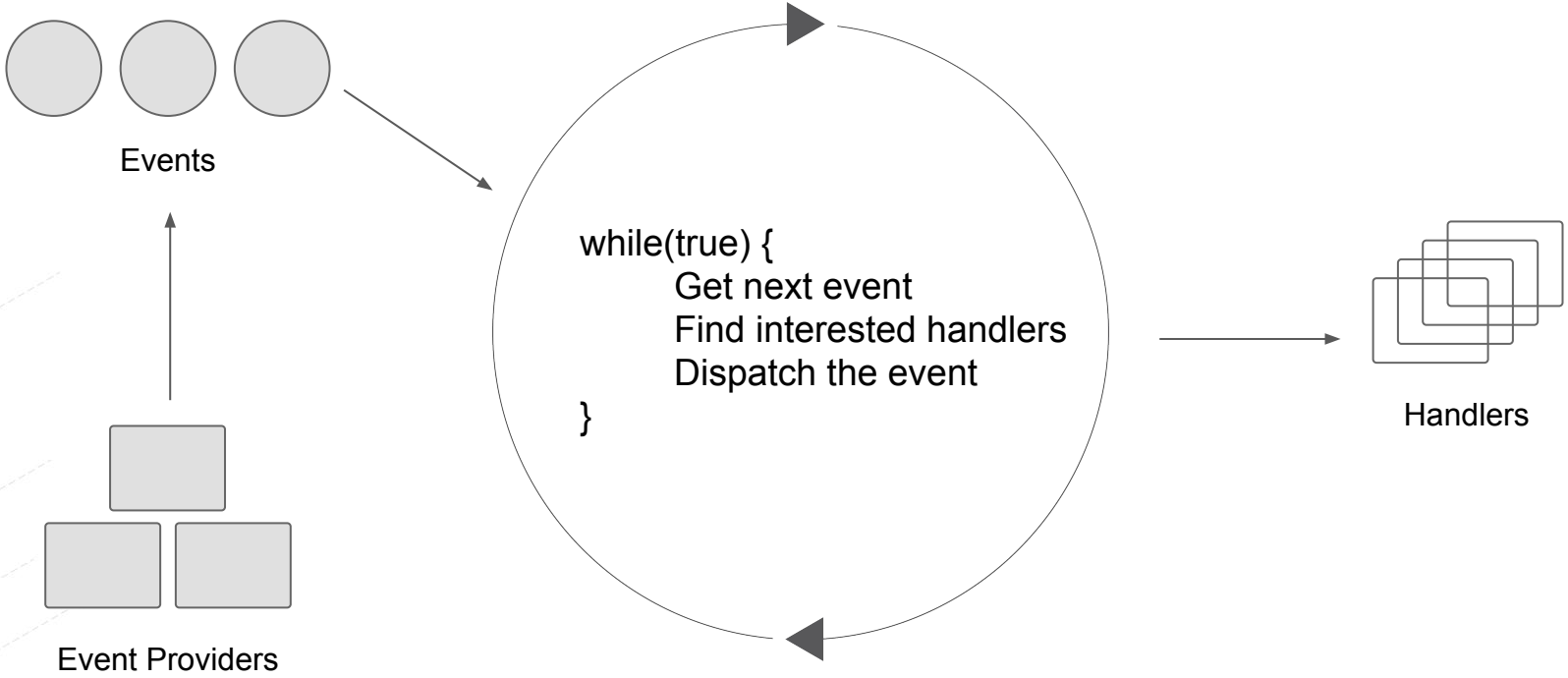
A Verticle is the programmable unit – a component

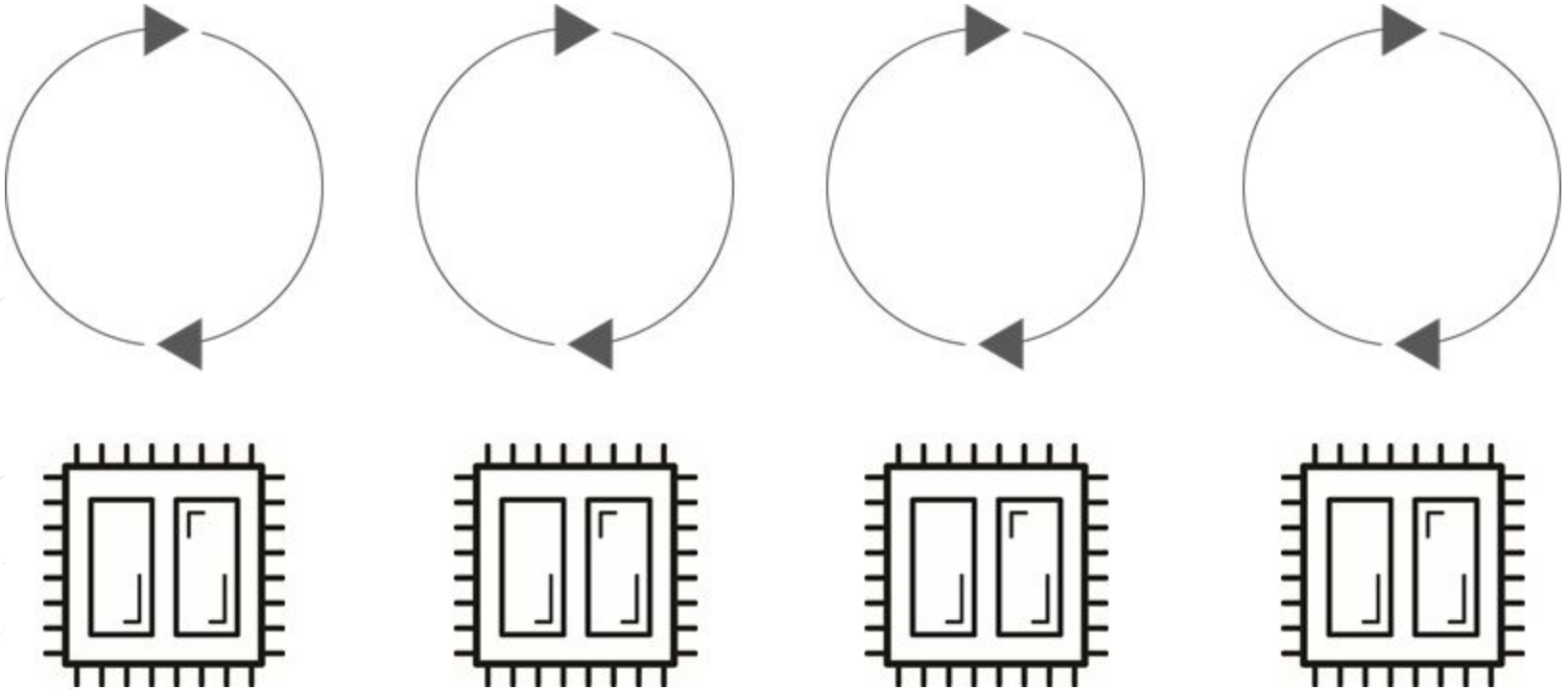
A Verticle is always executed on the same thread

A single thread may execute several verticles – event loop

A Verticle Instance normally starts 1 thread/event-loop per core




Events
while(true) {
Get next event
Find interested handlers
Dispatch the event
}
Handlers
Event Providers



Vert.x HTTP Verticle

```
import io.vertx.core.AbstractVerticle;

public class MainVerticle extends AbstractVerticle {

  @Override
  public void start() {
    vertx.createHttpServer()
        .requestHandler(req ->
          req.response().end("Hello Vert.x v3!"))
        .listen(8080);
  }
}
```

Super-Fast Getting Started: Step 1

```
mkdir stuff

cd stuff

mvn io.fabric8:vertx-maven-plugin:1.0.13:setup
-DvertxVersion=3.4.2 -Ddependencies=web

mvn compile vertx:run
```

Super-Fast Getting Started: Step 2

```
package stuff;

import io.vertx.core.AbstractVerticle;
import io.vertx.ext.web.Router;

public class MainVerticle extends AbstractVerticle {

    @Override
    public void start() {
        Router router = Router.router(vertx);
        router.get("/").handler(request -> {
           String hostname = System.getenv().getOrDefault("HOSTNAME", "unknown");
           request.response().end("Hello " + new java.util.Date() + " on " + hostname);
        });
        vertx.createHttpServer()
                .requestHandler(router::accept)
                .listen(8080);
    }  // start
}  // MainVerticle
```

Super-Fast Getting Started: Step 3

```
localhost:8080 (mvn compile vertx:run will hot redeploy)
```

Or

```
mvn clean compile package

java -jar target/demo-1.0-SNAPSHOT.jar
```

Now, launch into Kubernetes/OpenShift

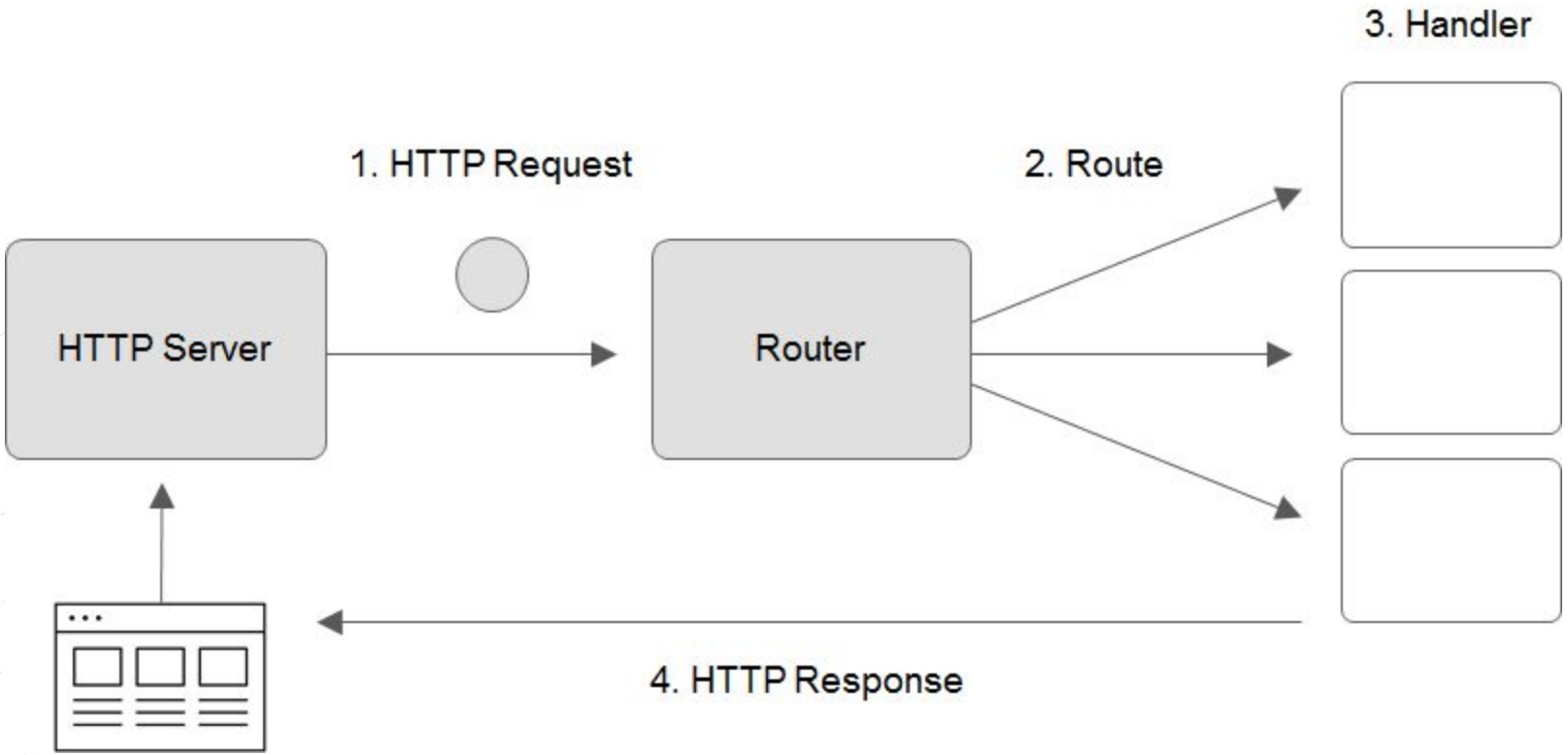
```
mvn io.fabric8:fabric8-maven-plugin:3.5.31:setup

oc login -u username -p userpassword https://openshift.acme.com:8443

oc new-project demo

mvn fabric8:deploy
```

Web Apps & REST

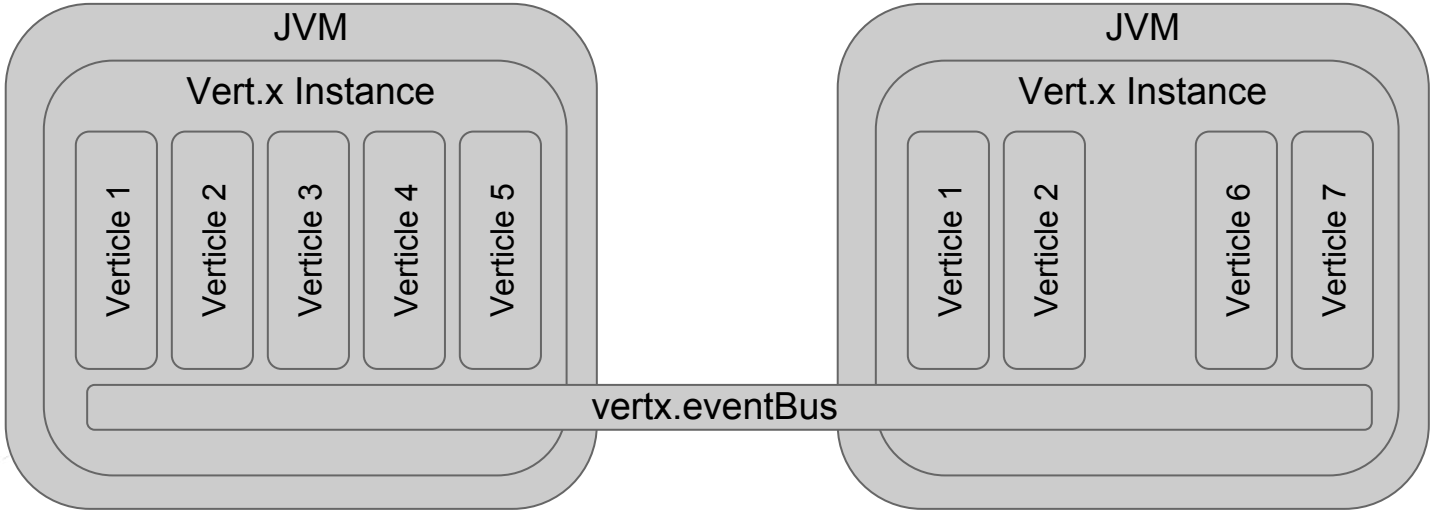

3. Handler
1. HTTP Request
2. Route
HTTP Server
Router
4. HTTP Response

Vert.x HTTP Router

```
router.get("/api/whiskies").handler(this::getAll);
router.get("/api/whiskies/:id").handler(this::getOne);
router.post("/api/whiskies").handler(this::addOne);
router.delete("/api/whiskies/:id").handler(this::deleteOne);
router.put("/api/whiskies/:id").handler(this::updateOne);
// Serve static resources from the /assets directory
router.route("/assets/*").handler(StaticHandler.create("assets"));

vertx
  .createHttpServer()
  .requestHandler(router::accept)
  .listen(8080, result -> {
    if (result.succeeded()) {
      future.complete();
    } else {
      // could be something else is running on our port
      future.fail(result.cause());
    }
  });
```

Vert.x EventBus



Demo

https://github.com/burrsutter/vertx3_introduction

HTTP getNow() Circuit Breaker

```
CircuitBreakerOptions options = new
  CircuitBreakerOptions()
   .setMaxFailures(5)
   .setTimeout(5000)
   .setFallbackOnFailure(true);

CircuitBreaker breaker =
    CircuitBreaker.create("my-circuit-breaker", vertx,
        options)
    .openHandler(v -> {
      System.out.println("Circuit opened");
    }).closeHandler(v -> {
      System.out.println("Circuit closed");
    });
```

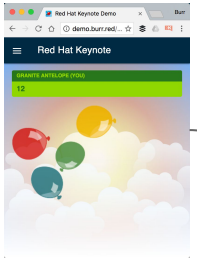
```
Future<String> result = breaker.executeWithFallback(future -> {
  vertx.createHttpClient().getNow(8080, "localhost", "/",
    response -> {
    if (response.statusCode() != 200) {
      future.fail("HTTP error");
    } else {
      response.exceptionHandler(future::fail).bodyHandler(buffer
       -> {
        future.complete(buffer.toString());
      });
    }
  });
}, v -> {
  // Executed when the circuit is opened
  return "Hello (fallback)";
});
```

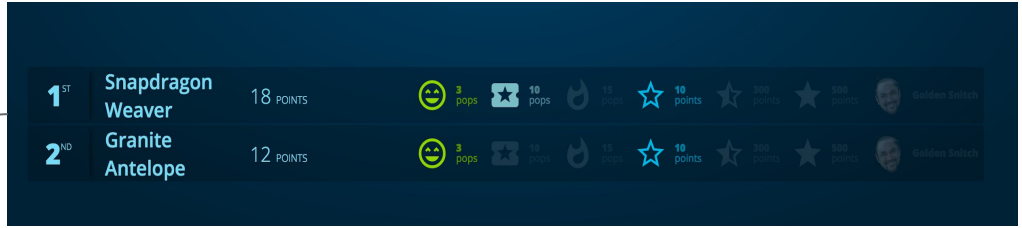
https://github.com/burrsutter/vertx3_introduction/blob/master/7_httpinvoker/Client.java#L13

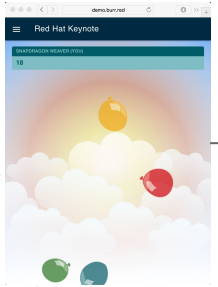
Demos

https://github.com/redhat-reactive-msa
https://github.com/burrsutter/reactive_tutorial_jfokus17

Recording: https://youtu.be/ooA6FmTL4Dk?t=1739

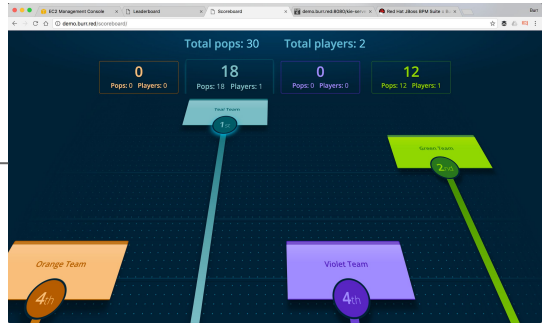




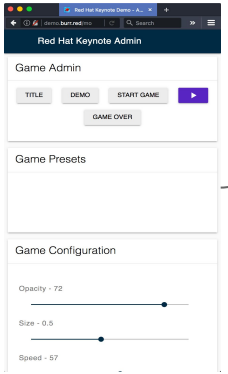


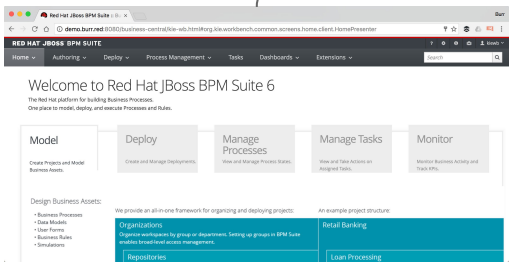
vertx-game-server

vertx-achievement-server



Java EE on JBoss with Drools+jBPM





Balloon Repos

Email me at burr@redhat.com for setup

https://github.com/burrsutter/vertx-game-server

https://github.com/burrsutter/score-server

https://github.com/burrsutter/vertx-achievement-service

https://github.com/burrsutter/mobile-app

https://github.com/burrsutter/mobile-app-admin

https://github.com/burrsutter/leaderboard

https://github.com/burrsutter/scoreboard

RED HAT
DEVELOPERS

Reactive Microservices with Eclipse Vert.x

@burrsutter

http://developers.redhat.com
http://bit.ly/reactivemsa