INDEX

SAN FRANCISCO

Discover. Collaborate. Deploy.

What is a Cloud Native application, anyway?

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Cloud Native

An **application architecture** designed to leverage the **strengths** and accommodate the **challenges** of a **standardized** cloud environment, including concepts such as **elastic** scaling, **immutable** deployment, **disposable** instances, and **less predictable infrastructure**.

Cloud Native applications

CLOUD NATIVE
COMPUTING FOUNDATION

- Container packaged
  - Resource isolation
  - Simplified operations
- Dynamically managed / orchestrated
- Microservice oriented
  - Loosely coupled
  - Declared external dependencies

Twelve Factor Applications

- Methodology for building SaaS applications

- The Twelve Factors can be applied to applications
  - In any programming language
  - With any backing services (or cloud provider..)

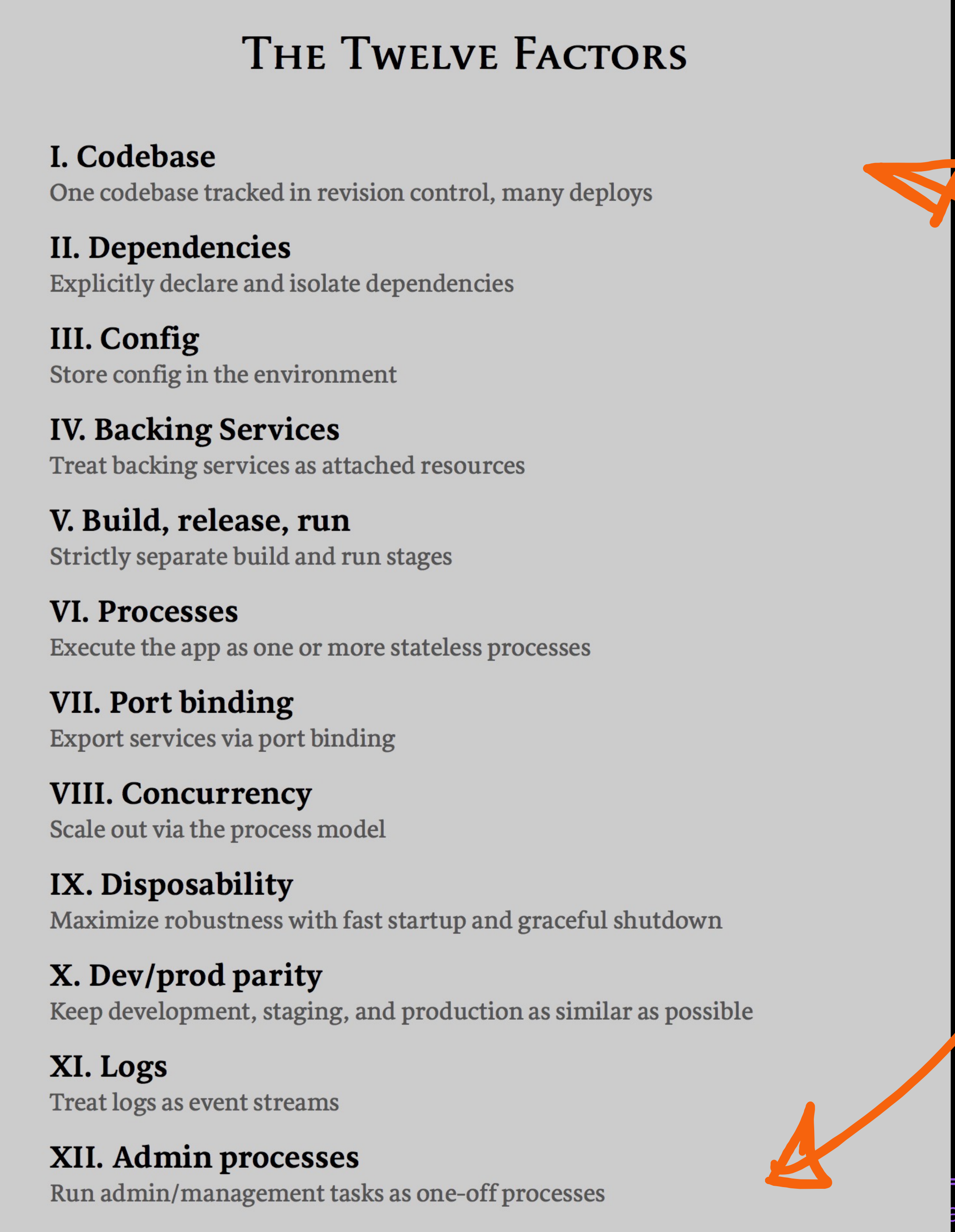
- http://12factor.net/

Key characteristics of 12 Factor apps

- Use **declarative formats** for setup automation
- Have a **clean contract** with the underlying OS

- **Minimum divergence** between **development and test** environments

- **Can scale up** without significant work
- Maintained in a **continuous delivery** pipeline



The Twelve Factors

I. Codebase
One codebase tracked in revision control, many deploys

II. Dependencies
Explicitly declare and isolate dependencies

III. Config
Store config in the environment

IV. Backing Services
Treat backing services as attached resources

V. Build, release, run
Strictly separate build and run stages

VI. Processes
Execute the app as one or more stateless processes

VII. Port binding
Export services via port binding

VIII. Concurrency
Scale out via the process model

IX. Disposability
Maximize robustness with fast startup and graceful shutdown

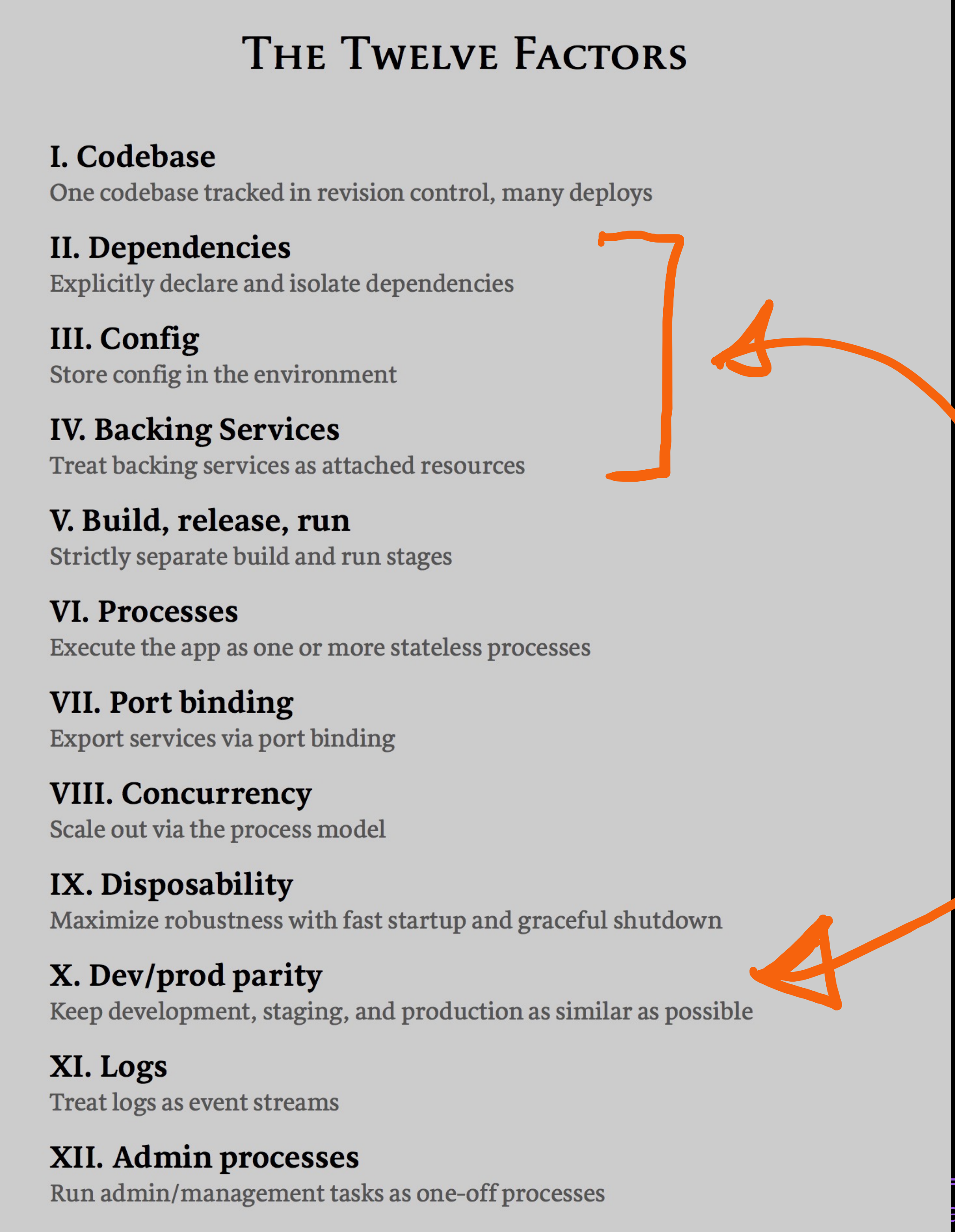
X. Dev/prod parity
Keep development, staging, and production as similar as possible

XI. Logs
Treat logs as event streams

XII. Admin processes
Run admin/management tasks as one-off processes

① no code living on someone's laptop

② Infrastructure as code



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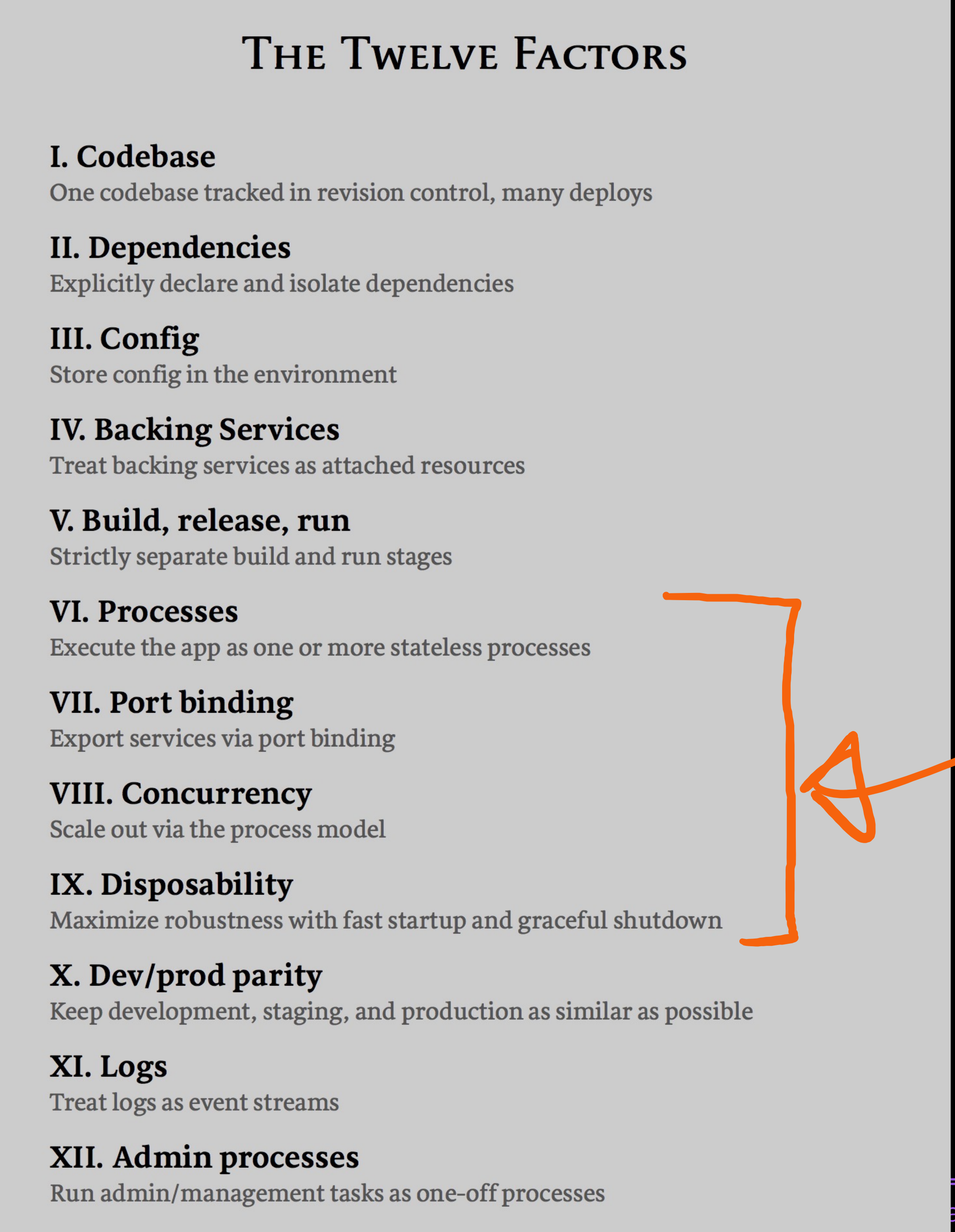
portability



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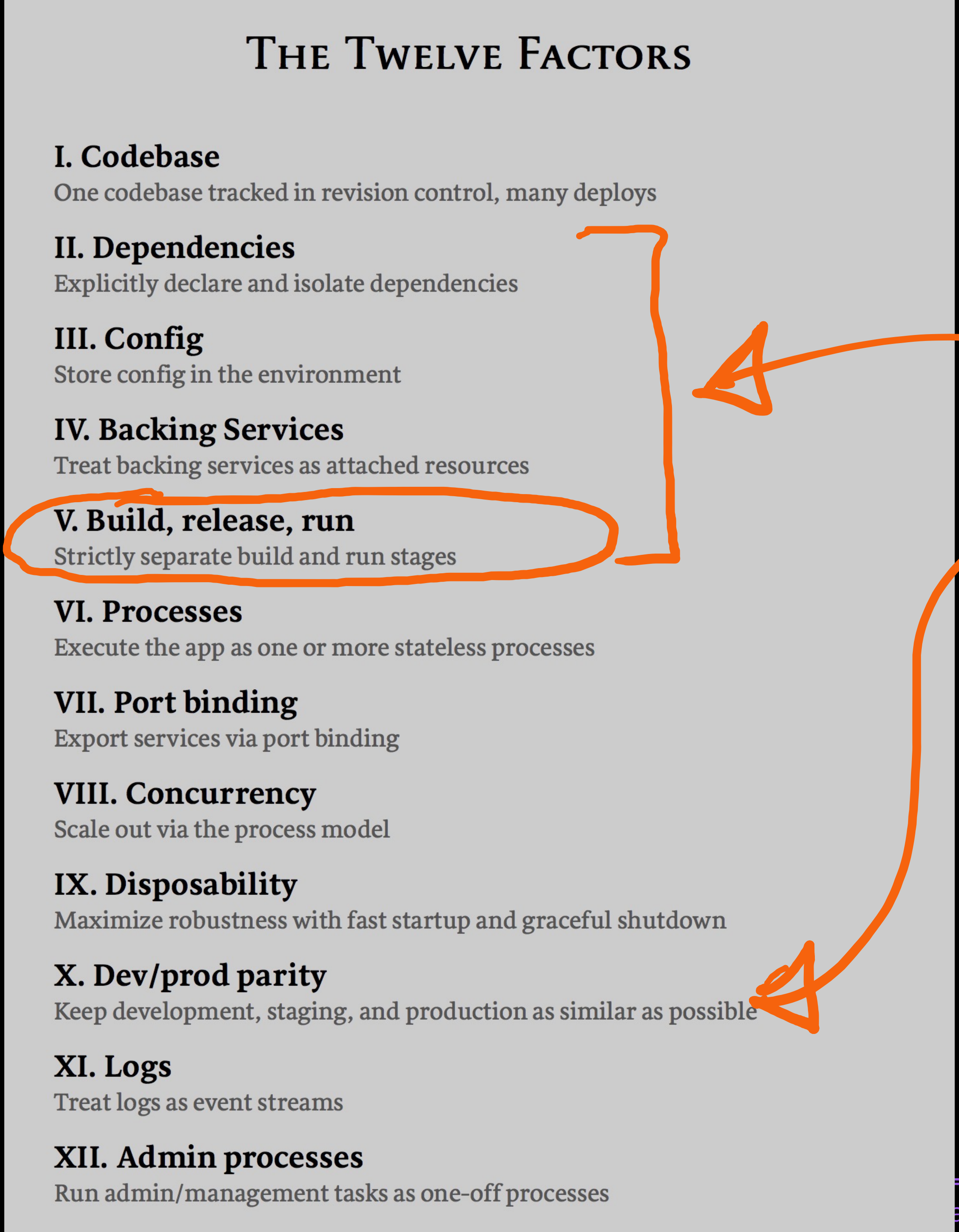
scalability



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devOps

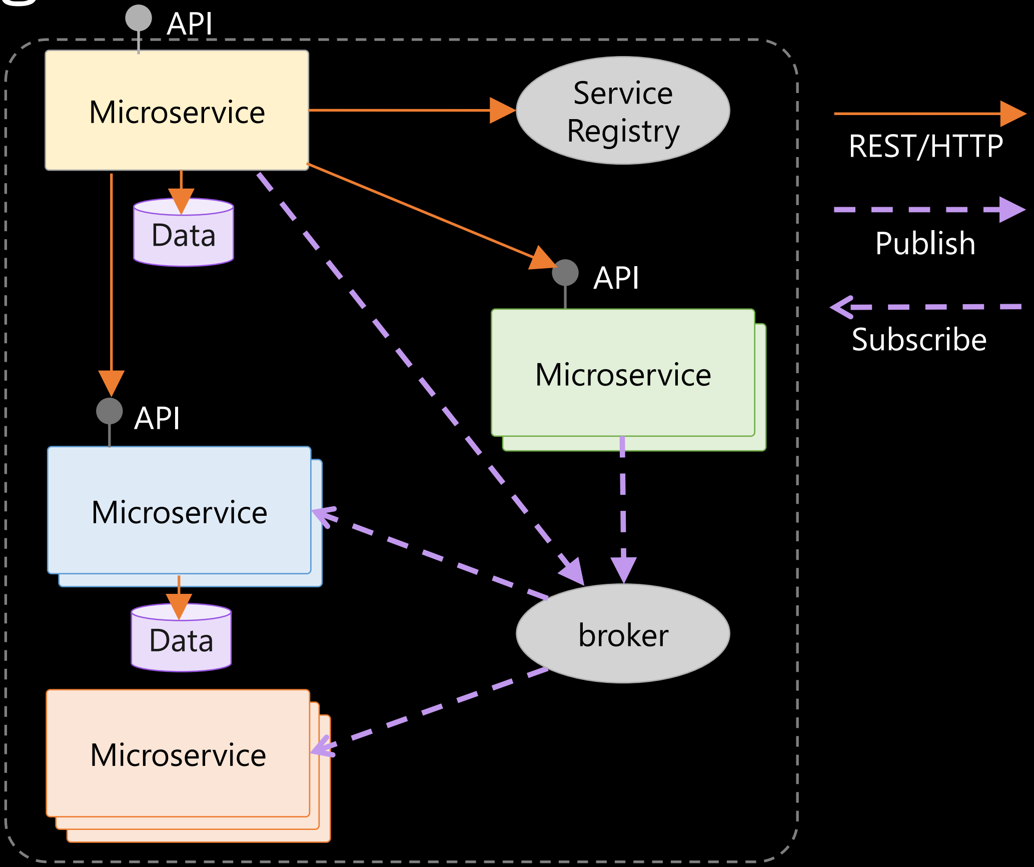
- immutable artifacts

- reproducible builds

Microservices are used to…

- compose a complex application using
  - “small”
  - independent (autonomous)
  - replaceable
  - processes

- that communicate via
  - language-agnostic APIs



Essential characteristics - Services

Autonomy
&
Independence

- Encapsulated by API
  - Language-agnostic protocols
  - Replaceable
- Decentralized
  - Data (eventual consistency)
  - Security (zones)

Fallacies of distributed computing

- The network is reliable
- Latency is zero
- Bandwidth is infinite
- The network is secure
- Topology doesn’t change
- There is one administrator
- Transport cost is zero
- The network is homogenous

-- L Peter Deutsch, 1994

https://en.wikipedia.org/wiki/Fallacies_of_distributed_computing

Essential characteristics - Services

Resilient

- Fault tolerant
  - Fail *fast*, gracefully
  - Expect rubbish
  - Fallback: retry vs. cached data
- Prevent cascading failures
  - Timeouts, Fallbacks
  - Circuit Breakers / Bulkheads

Essential characteristics - System

Automated

- Provisioning / Deployment
  - Zero-downtime upgrades
- Load balancing / Scaling
- Health Management
  - Cattle not Pets
- Real-time Monitoring
  - Logging / Metrics

“Twitter microservices map looks just like the Netflix one. “We called this the ‘Death Star’ diagram”

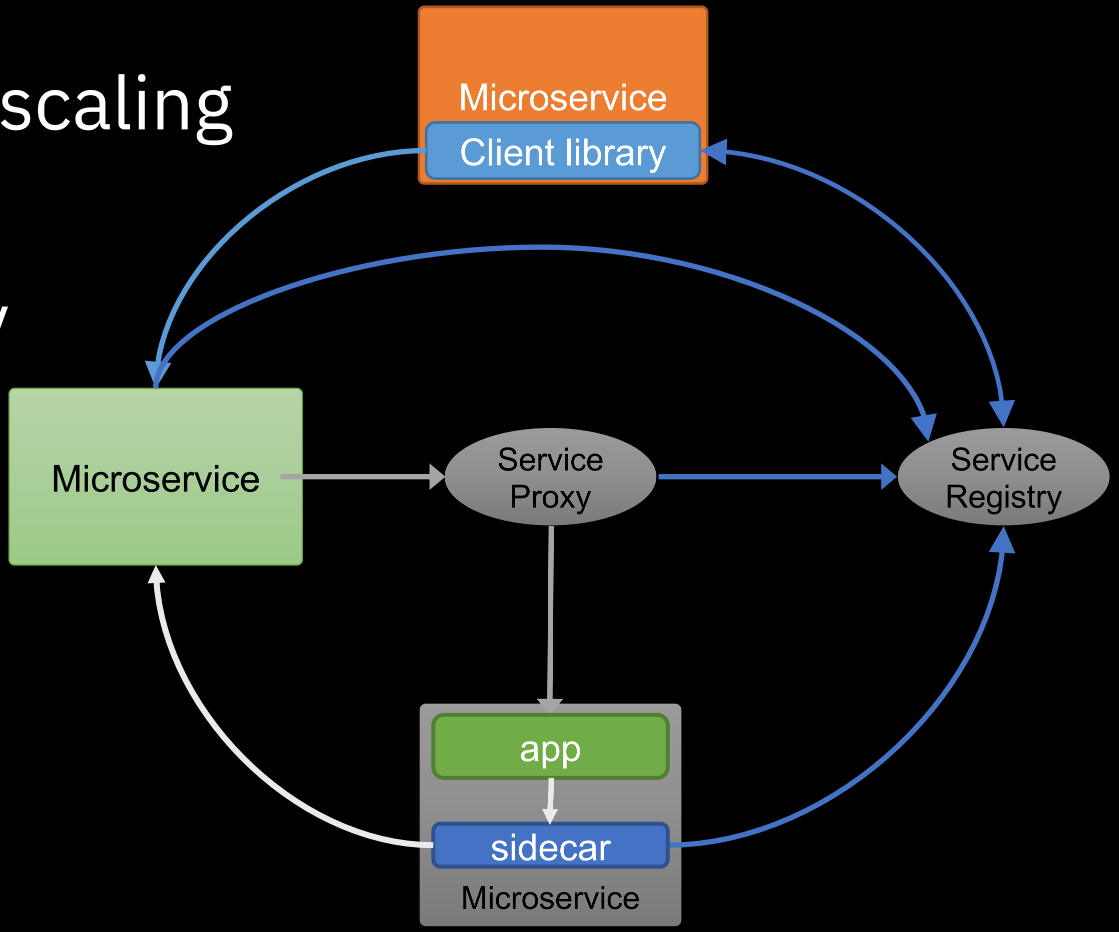
— Adrian Cockcroft via twitter

https://twitter.com/adrianco/status/441883572618948608

Service registration and discovery

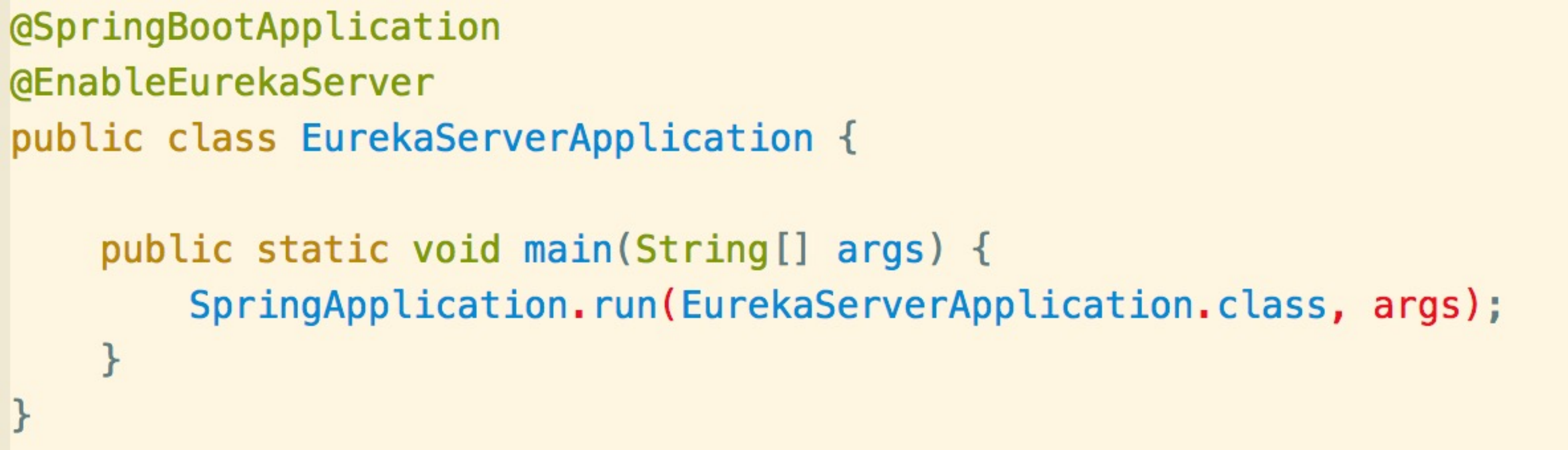
- Required for load balancing and scaling
- Services need to find each other
- Environment changes constantly

- Client-side or server-side?
- Client library, sidecar, or proxy?



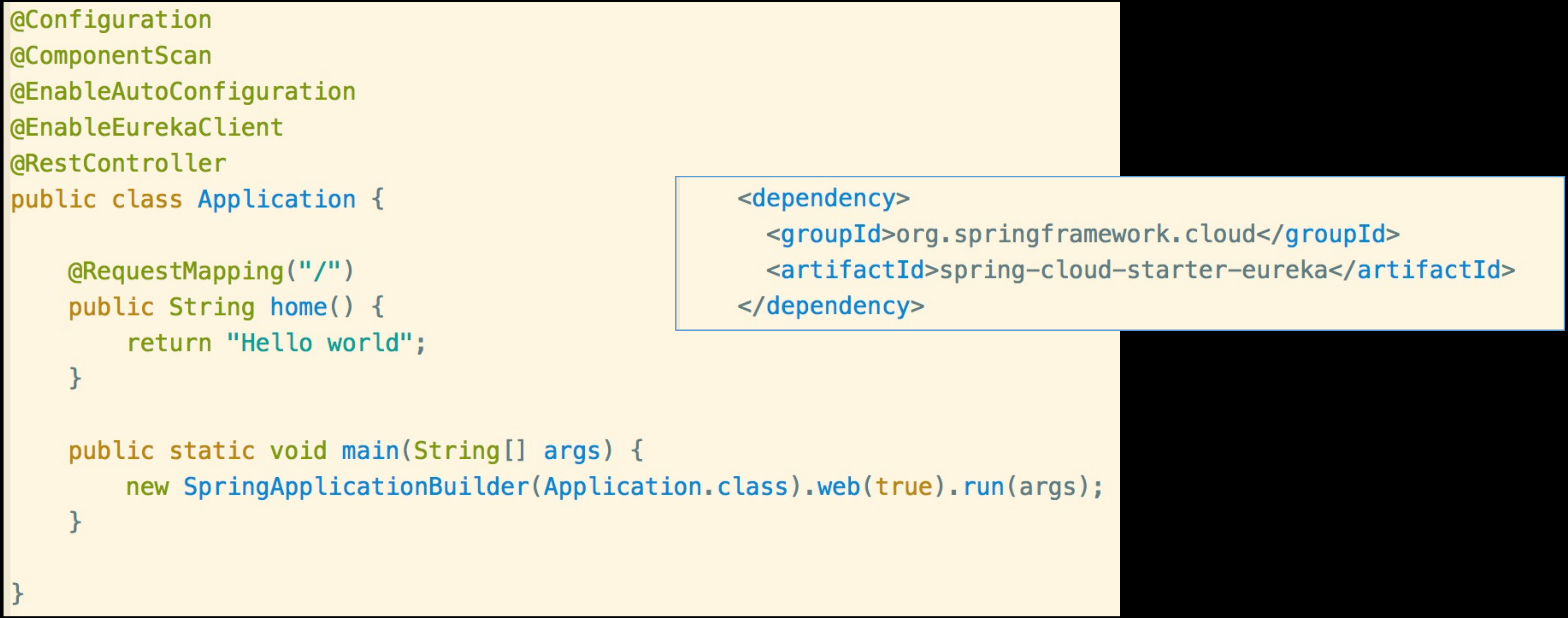
Service Registry and Discovery: Eureka

- Netflix Eureka
  - Stand-alone / self-contained service registry
  - HA, zones, regions… or stand-alone



```java
@SpringBootApplication
@EnableEurekaServer
public class EurekaServerApplication {

    public static void main(String[] args) {
        SpringApplication.run(EurekaServerApplication.class, args);
    }
}
```

Spring Cloud: Service Registration



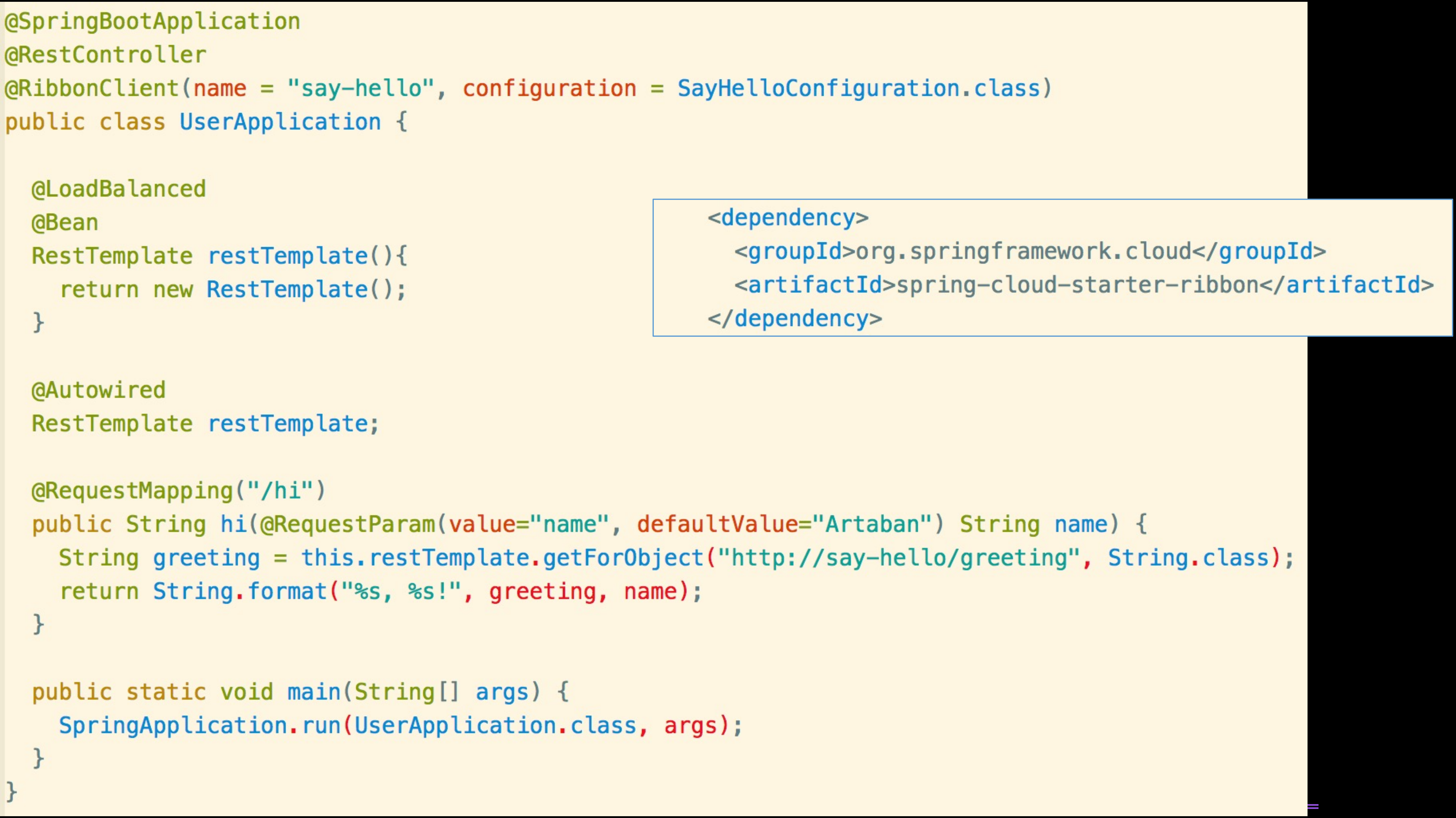
```java
@Configuration
@ComponentScan
@EnableAutoConfiguration
@EnableEurekaClient
@RestController
public class Application {

    @RequestMapping("/")
    public String home() {
        return "Hello world";
    }

    public static void main(String[] args) {
        new SpringApplicationBuilder(Application.class).web(true).run(args);
    }

}
```

```xml
    <dependency>
      <groupId>org.springframework.cloud</groupId>
      <artifactId>spring-cloud-starter-eureka</artifactId>
    </dependency>
```

Netflix Ribbon

- Client-side: load balancer integrated in the client
- Rule-based load balancing
  - round robin, response time weighted, random load balancing
  - More via plugins
- ribbon-eureka uses Netflix Eureka for service discovery
- Integrated with Spring Cloud

- Maintenance mode



```java
@SpringBootApplication
@RestController
@RibbonClient(name = "say-hello", configuration = SayHelloConfiguration.class)
public class UserApplication {

  @LoadBalanced
  @Bean
  RestTemplate restTemplate(){
    return new RestTemplate();
  }

  @Autowired
  RestTemplate restTemplate;

  @RequestMapping("/hi")
  public String hi(@RequestParam(value="name", defaultValue="Artaban") String name) {
    String greeting = this.restTemplate.getForObject("http://say-hello/greeting", String.class);
    return String.format("%s, %s!", greeting, name);
  }

  public static void main(String[] args) {
    SpringApplication.run(UserApplication.class, args);
  }
}
```

```xml
    <dependency>
      <groupId>org.springframework.cloud</groupId>
      <artifactId>spring-cloud-starter-ribbon</artifactId>
    </dependency>
```

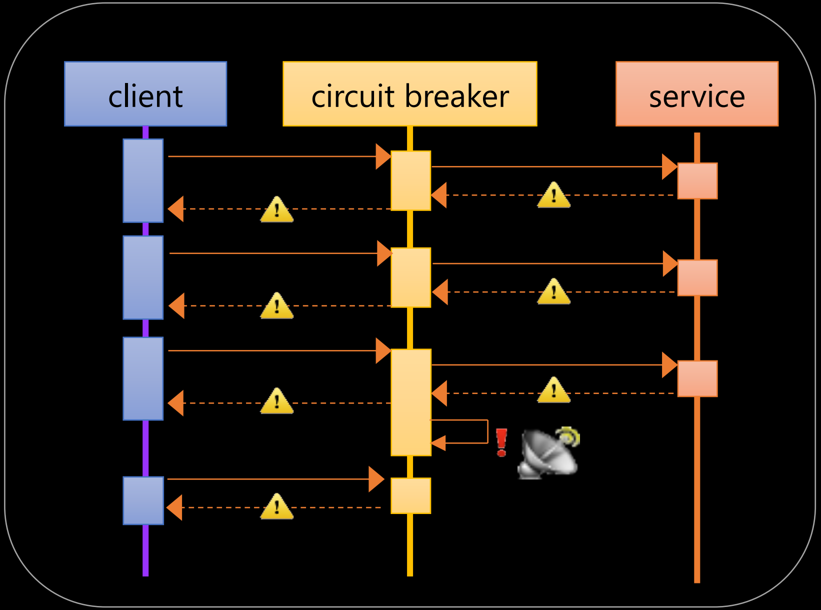
Service Registry and Discovery

- Discovery via DNS
  - Kubernetes DNS
  - Docker DNS
  - Consul – services must register
- Sidecar load balancers
  - Istio: Envoy proxy within Kubernetes pod

Fault Tolerance

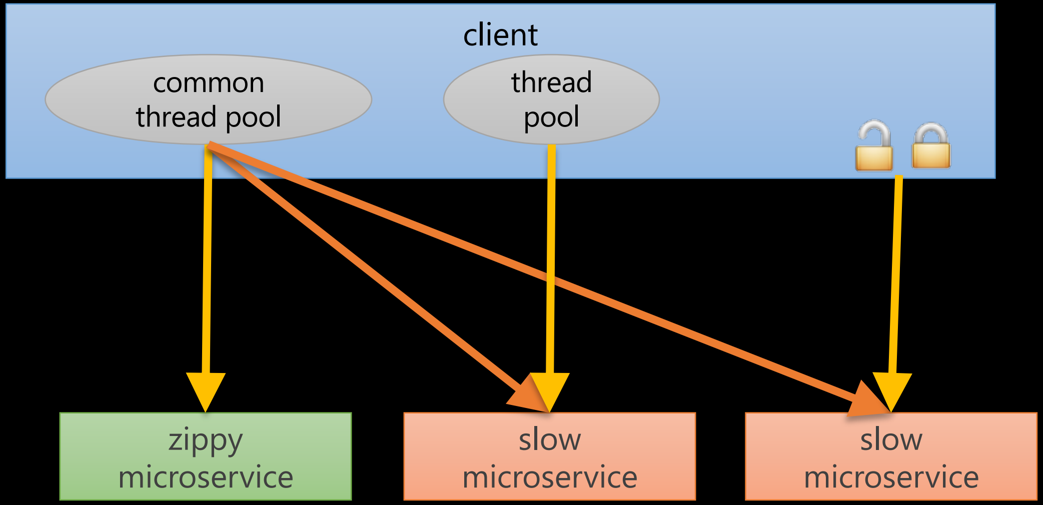
Circuit Breakers

- Wrap remote calls
- Monitor for failures
- Notify when circuit is tripped
- Retry or Fallback?
- When is circuit reset?



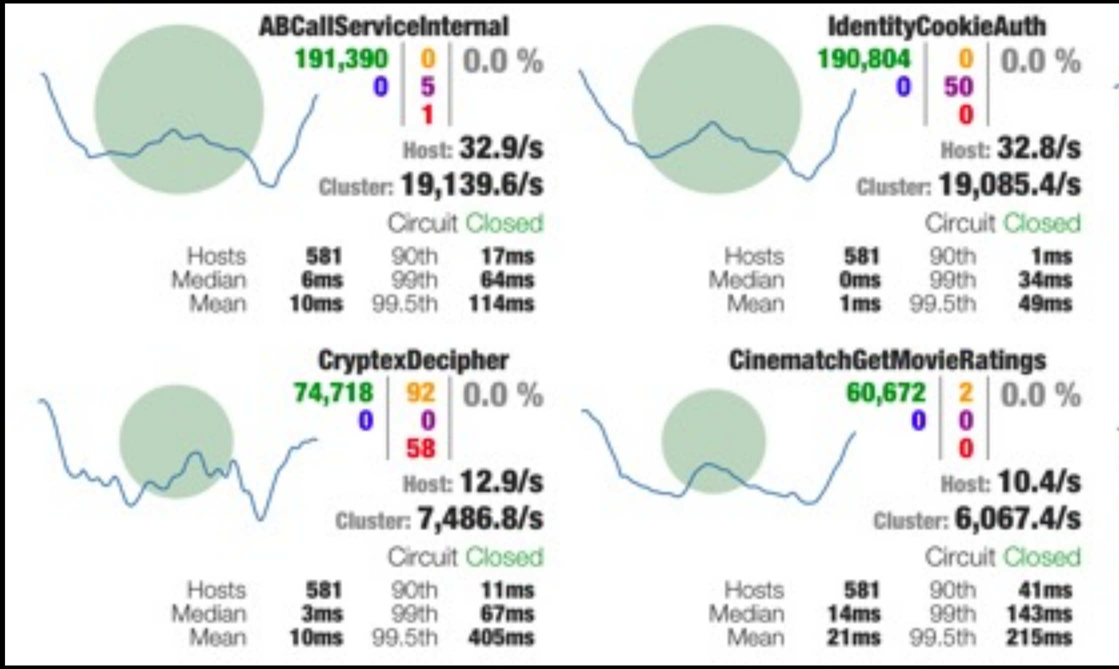
Bulkheads

- Ensure at most ‘n’ threads waiting for a slow resource
  - Thread isolation
    - With or without a queue
    - Timeout / fallback
  - Semaphore isolation
    - Request sent if lock obtained

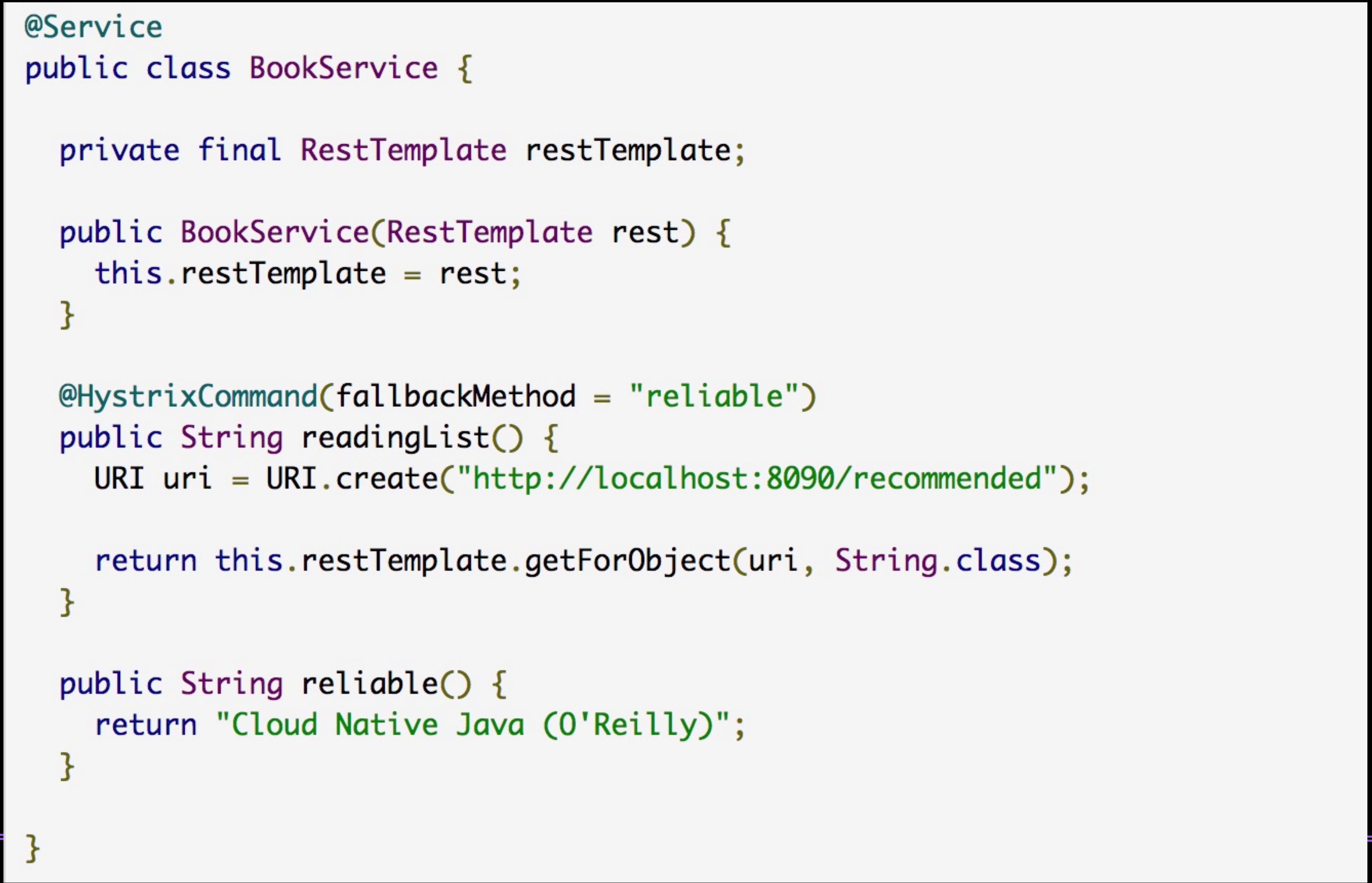


Fault Tolerance Library: Hystrix

- Circuit Breaker
- Bulk Head
  - Thread & Semaphore
- Fallbacks
- Request batching
- Real time monitoring:
  - Client-side metrics gathering



Spring Cloud with Hystrix



```java
@Service
public class BookService {

  private final RestTemplate restTemplate;

  public BookService(RestTemplate rest) {
    this.restTemplate = rest;
  }

  @HystrixCommand(fallbackMethod = "reliable")
  public String readingList() {
    URI uri = URI.create("http://localhost:8090/recommended");

    return this.restTemplate.getForObject(uri, String.class);
  }

  public String reliable() {
    return "Cloud Native Java (O'Reilly)";
  }

}
```

Fault Tolerance with Istio

- Circuit breaker
- Retries
- Timeouts
- Can not specify fallbacks
    - Lose some context

Configuration

- Environment Variables
  - VCAP_SERVICES?
  - Kubernetes Config Maps?

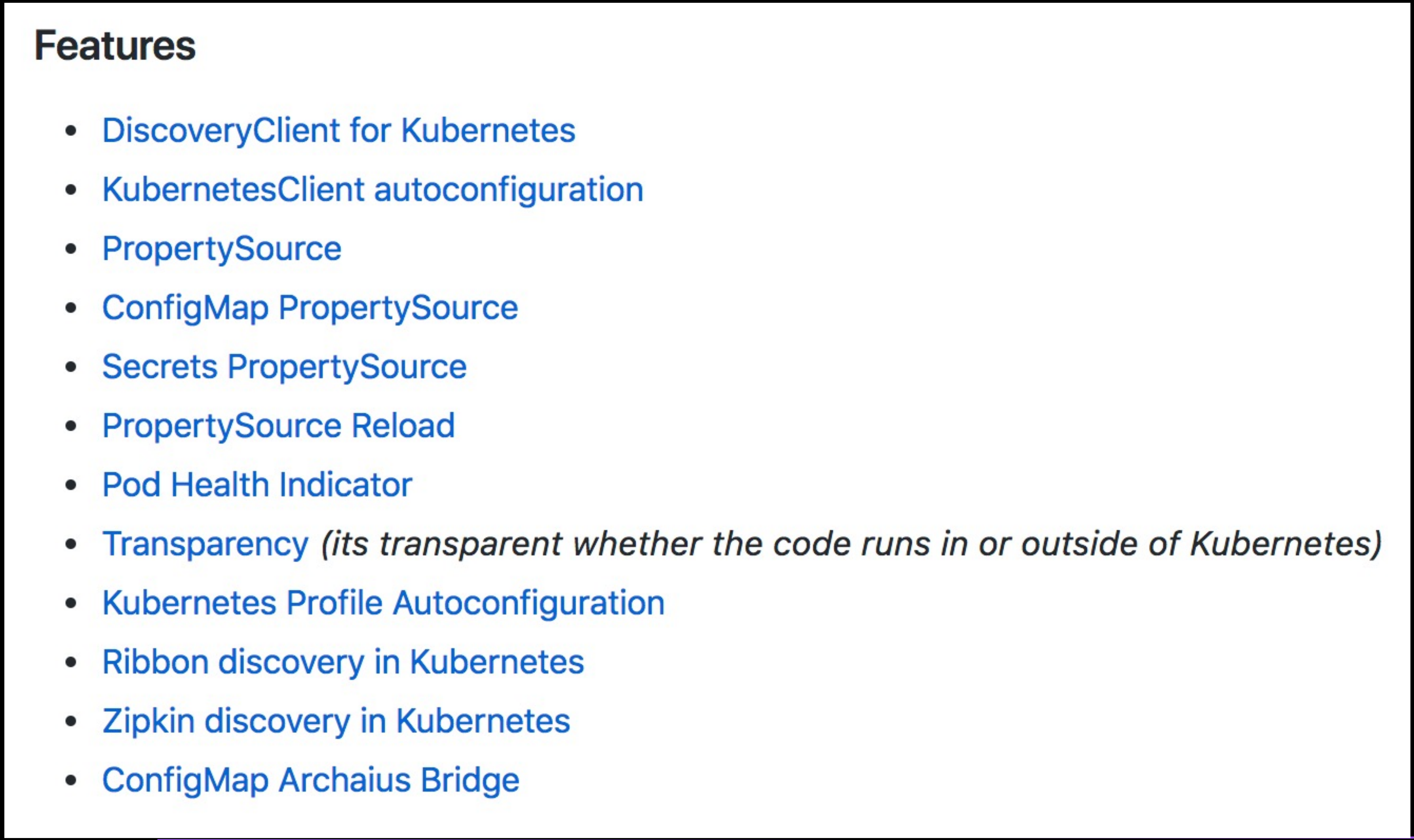
- How do you maintain configuration across environments?
- JSON structures with service bindings.. Are they the same?

Configuration

- Spring Cloud Config
  - External source for Spring configuration
  - Environment specific configuration
  - Handles secrets
  - Supports dynamic reconfiguration without restart

- Kubernetes ConfigMaps and Secrets

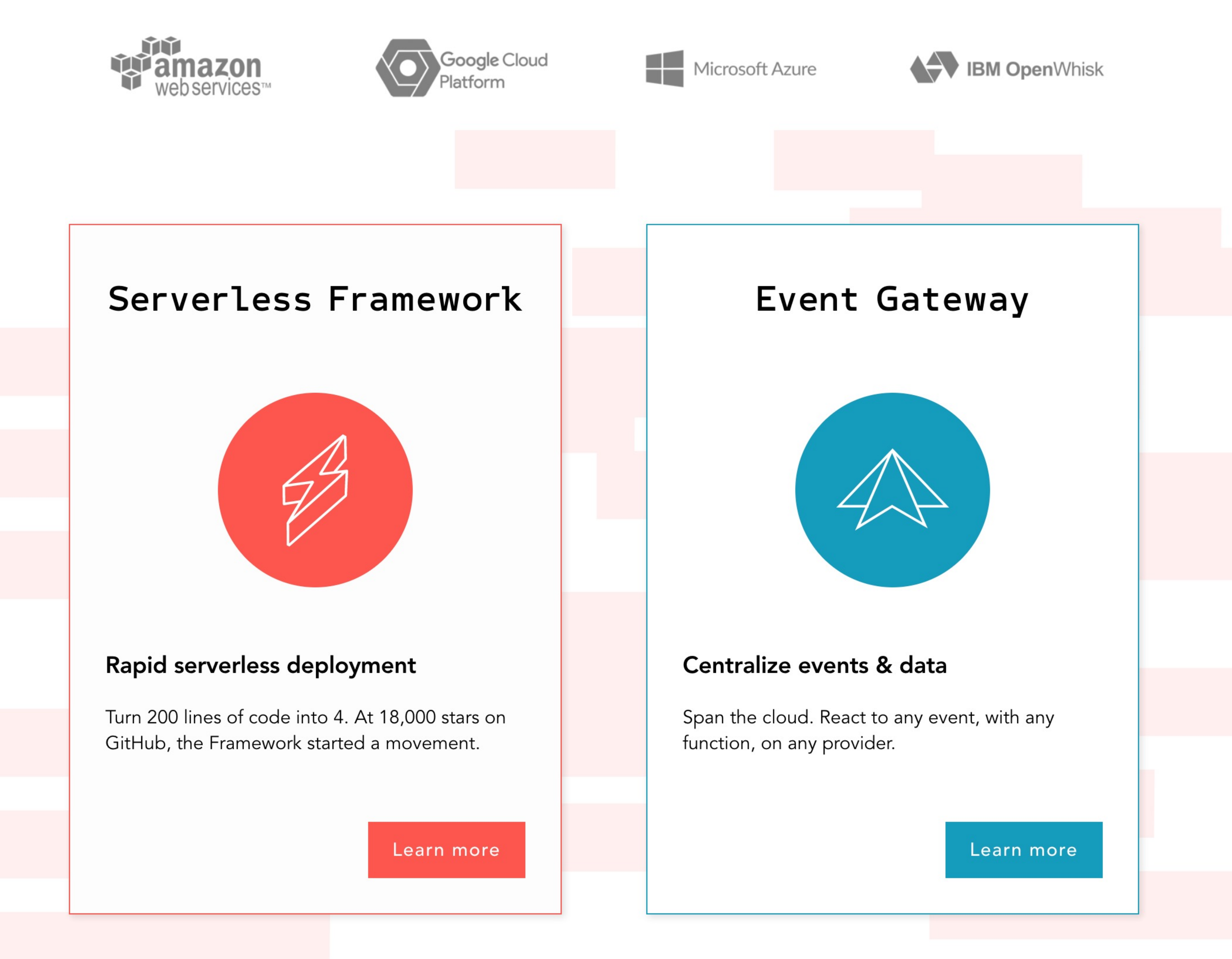
spring-cloud-kubernetes



Features

- DiscoveryClient for Kubernetes
- KubernetesClient autoconfiguration
- PropertySource
- ConfigMap PropertySource
- Secrets PropertySource
- PropertySource Reload
- Pod Health Indicator
- Transparency *(its transparent whether the code runs in or outside of Kubernetes)*
- Kubernetes Profile Autoconfiguration
- Ribbon discovery in Kubernetes
- Zipkin discovery in Kubernetes
- ConfigMap Archaius Bridge

So what is a cloud native application?



Serverless Framework

Rapid serverless deployment

Turn 200 lines of code into 4. At 18,000 stars on GitHub, the Framework started a movement.

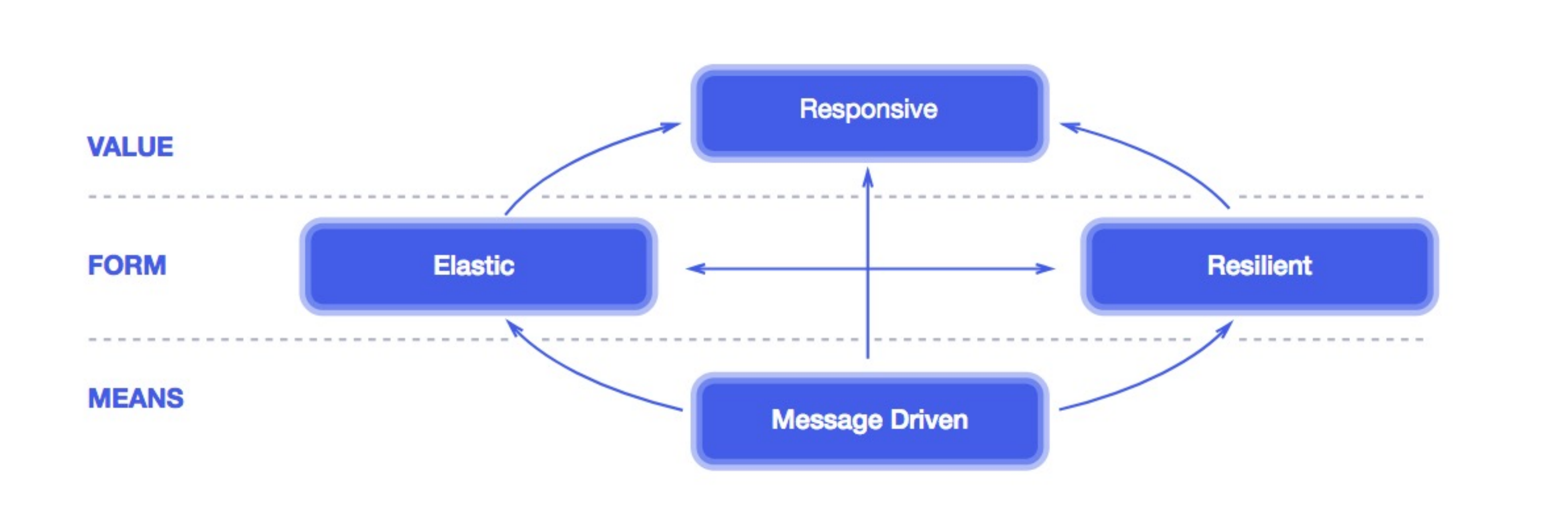
Event Gateway

Centralize events & data

Span the cloud. React to any event, with any function, on any provider.

Reactive Systems

- Asynchronous
- Non-blocking
- Event-driven (non-directed)



So what is a cloud native application?

what do you think?

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