Goal of Spring Cloud

- Provide libraries to apply common patterns needed in distributed applications
  - Distributed / Versioned / Centralized Configuration Management
  - Service Registration and Discovery
  - Load Balancing
  - Service-to-service Calls
  - Circuit Breakers
  - Routing
  - ...

Where Does NETFLIX Fit Into All of This?

- Netflix reinvented itself since early 2007
  - Moved from DVD mailing to video-on-demand
    - Once USPS largest first-class customer
    - Now biggest source of North American Internet traffic in evenings.
- Became Trailblazers in Cloud Computing
  - All Running on Amazon Web Services
- Chose to publish many general-use technologies as Open-Source projects
  - Proprietary video-streaming technologies are still secret.

Spring and NETFLIX

- The Spring Team has always been forward looking
  - Trying to Focus on Applications of Tomorrow
- Netflix OSS Mature and Battle-Tested; Why Reinvent?
- Netflix OSS Not Necessarily Easy and Convenient
  - Spring Cloud provides easy interaction
    - Dependencies
    - Annotations

Required Dependencies

- Replace Spring Boot Parent
  - Spring Cloud projects are based on Spring Boot

```
<parent>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-parent</artifactId>
    <version>Angel.SR4</version>
</parent>

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

Other Challenges

- Microservices → large # of dependent services
- Dynamic updates
  - Changes to services or environment variables require restage or restart
- Version control

Desired Solution for Configuration

- Platform/Cloud-Independent solution
  - Language-independent too
- Centralized
  - Or a few discrete sources of our choosing
- Dynamic
  - Ability to update settings while an application is running
- Controllable
  - Same SCM choices we use with software
- Passive
  - Services (Applications) should do most of the work themselves by self-registering

Solution:

- Spring Cloud Config
  - Provides centralized, externalized, secured, easy-to-reach source of application configuration
- Spring Cloud Bus
  - Provides simple way to notify clients to config changes
- Spring Cloud Netflix Eureka
  - Service Discovery – Allows applications to register themselves as clients

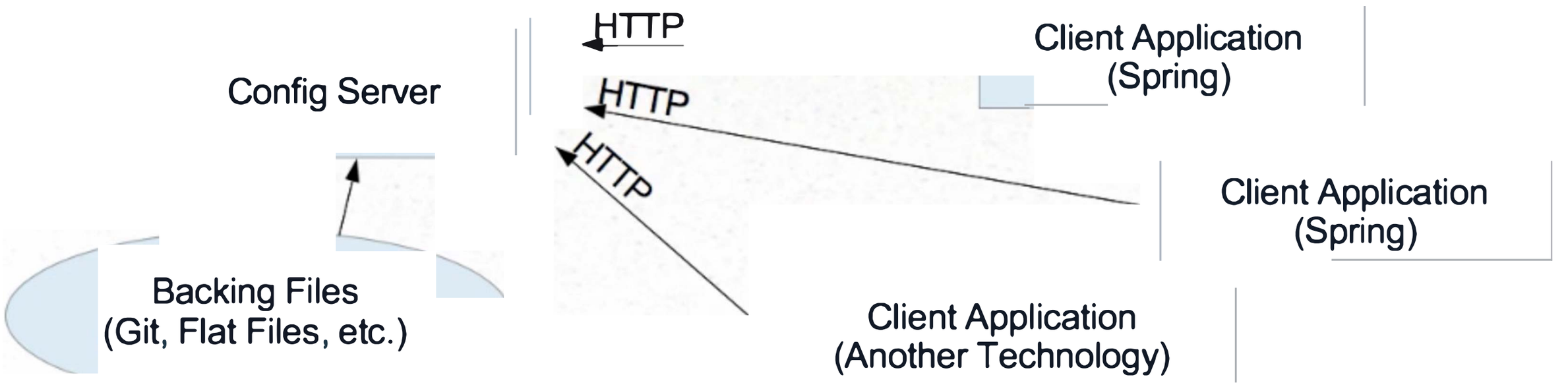
Spring Cloud Config

Designates a centralized server to serve-up configuration information

- Configuration itself can be backed by source control

Clients connect over HTTP and retrieve their configuration settings

- In addition to their own, internal sources of configuration



Spring Cloud Config Server

Include minimal dependencies in your POM (or Gradle)

- Spring **Cloud** Starter Parent
- Spring Cloud Config Server

```
<parent>
 <groupId>org.springframework.cloud</groupId>
 <artifactI    spring-cloud-starter-parent</artifactId>
 <version>Angel.SR4  /version>
</parent>

<dependencies>
 <dependency>
  <groupId  org.springframework.cloud</groupId>
  <artifactId  spring-cloud-config-server</artifactId>
 </dependency>
</dependencies>
```

Spring Cloud Config Server –

- application.yml – indicates location of configuration repository

```
spring:
  cloud:
    config:
      server:
        git:
          uri: https://github.com/pradeepkrishnamurthy/
          searchPaths: ConfigData
```

  - ...or application.properties

Spring Cloud Config Server –

- Add @EnableConfigServer

```
@SpringBootApplication
@EnableConfigServer
public class Application {

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

}
```

EnvironmentRepository - Choices

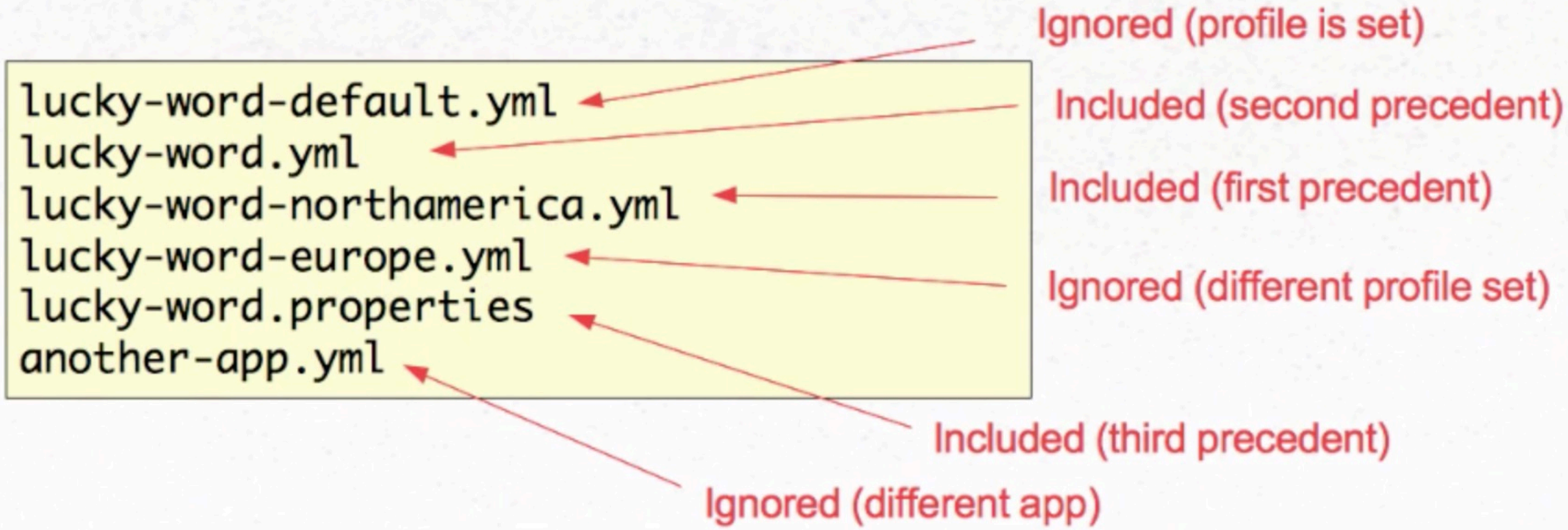
- Spring Cloud Config Server uses an `EnvironmentRepository`
  - Two implementations available: Git and Native (local files)
- Implement `EnvironmentRepository` to use other sources.

Environment Repository - Organization

- Configuration file naming convention:
  - <spring.application.name>-<profile>.yml
    - Or .properties (yml takes precedence)
  - spring.application.name – set by client application's bootstrap.yml (or .properties)
  - Profile – Client's spring.profiles.active
    - (set various ways)
- Obtain settings from server:
  - http://<server>:<port>/<spring.application.name>/<profile>
  - Spring clients do this automatically on startup

Environment Repository – Organization Example

- Assume client application named “lucky-word” and profile set to “northamerica”
  - Spring client (automatically) requests
    - /lucky-word/northamerica



.yml vs .properties

- Settings can be stored in either YAML or standard Java properties files
  - Both have advantages
  - Config server will favor .yml over .properties

```
# .properties file
spring.config.name=aaa
spring.config.location=bbb
spring.profiles.active=ccc
spring.profiles.include=ddd
```

```
# .yml file
---
spring:
  config:
    name: aaa
    location: bbb
  profiles:
    active: ccc
    include: ddd
```

Profiles

YAML Format can hold multiple profiles in a single file

```
# lucky-word-east.properties
lucky-word: Clover
```

```
# lucky-word-west.properties
lucky-word: Rabbit's Foot
```

```
# luckyword.yml
---
spring:
  profiles: east
lucky-word: Clover

---
spring:
  profiles: west
lucky-word: Rabbit's Foot
```

The Client Side

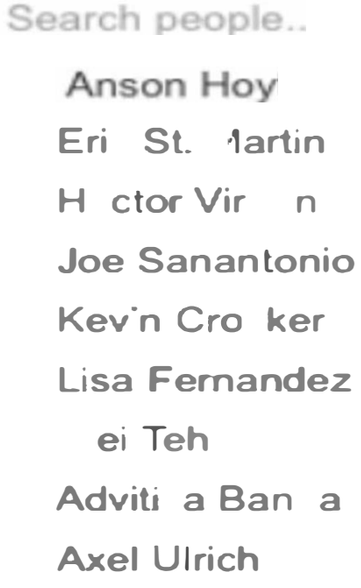
- How Properties work in Spring Applications
  - Spring apps have an `Environment` object
  - `Environment` object contains multiple `PropertySources`
    - Typically populated from environment variables, system properties, JNDI, developer-specified property files, etc.
  - Spring Cloud Config Client library simply adds another `PropertySource`
    - By connecting to server over HTTP
    - http://<server>:<port>/<spring.application.name>/<profile>
  - Result: Properties described by server become part of client application's environment

What if the Config Server is Down?

- Spring Cloud Config Server should typically run on several instances
  - So downtime should be a non-issue
- Client application can control policy of how to handle missing config server
  - spring.cloud.config.failFast=true
  - Default is false
- Config Server settings override local settings
  - Strategy: provide local fallback settings.

Service Discovery - Analogy

- When you sign into a chat client, what happens?
  - Client 'registers' itself with the server – server knows you are online.
  - The server provides you with a list of all the other known clients
- In essence, you client has “discovered” the other clients
  - ...and has itself been “discovered” by others



Service Discovery

- Microservice architectures result in large numbers of inter-service calls
  - Very challenging to configure
- How can one application easily find all of the other runtime dependencies?
  - Manual configuration – Impractical, brittle
- Service Discovery provides a single 'lookup' service.
  - Clients register themselves, discover other registrants.
  - Solutions: Eureka, Consul, Etcd, Zookeeper, SmartStack, etc.

Eureka –
Service Discovery Server and Client

- Part of Spring Cloud Netflix
  - Battle tested by Netflix
- Eureka provides a 'lookup' server.
  - Generally made highly available by running multiple copies
  - Copies replicate state of registered services.
- “Client” Services register with Eureka
  - Provide metadata on host, port, health indicator URL, etc.
- Client Services send heartbeats to Eureka
  - Eureka removes services without heartbeats.

Making a Eureka Server

- Just a regular Spring Boot web application with dependencies and @EnableEurekaServer:

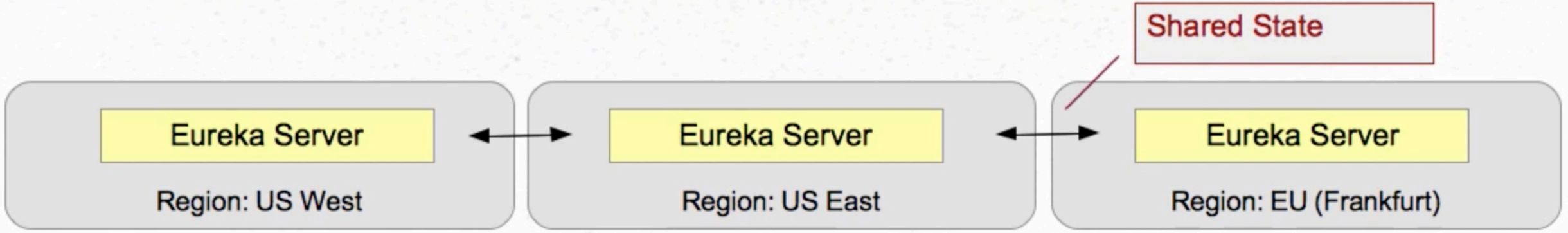
```
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-eureka-server</artifactId>
</dependency>
```

```
@SpringBootApplication
@EnableEurekaServer
public class Application {

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

Multiple Servers

- Typically, multiple Eureka servers should be run simultaneously
  - Otherwise, you'll get many warnings in the log
  - Eureka servers communicate with each other to share state
  - Provides High Availability
- Each server should know URL to the others
  - Can be provided by Config Server
  - One server (JAR), multiple profiles



Multiple Servers
Configuration

- Common Configuration Options for Eureka Server:
  - See https://github.com/Netflix/eureka/wiki/Configuring-Eureka for full list.

Control http port (any boot application)

```
server:
  port: 8011
eureka:
  instance:
    statusPageUrlPath: ${management.contextPath}/info
    healthCheckUrlPath: ${management.contextPath}/health
    hostname: localhost
  client:
    registerWithEureka: false
    fetchRegistry: false
    serviceUrl:
      defaultZone: http://server:port/eureka/,http://server:port/eureka/
```

Comma separated list

Registering with Eureka

- From a Spring Boot application
  - Add Dependency:

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

  - Only the location of Eureka itself requires explicit configuration.

```
@SpringBootApplication
@EnableDiscoveryClient
public class Application {


}
```

```
# application.properties
eureka.client.serviceUrl.defaultZone:  http://server:8761/eureka/
```

Default fallback.
Any Eureka instance will do
(we usually want several comma-separated URLs)

@EnableDiscoveryClient

- Automatically registers client with Eureka server
  - Registers the application name, host, and port
    - Using values from the Spring `Environment`.
    - But can be overridden.
    - Give your application a spring.application.name
- Makes this app an “instance” and a “client”
  - It can locate other services

Service ID (Eureka VIP)
Corresponds to
spring.application.name

```
@Autowired DiscoveryClient client;
public URI storeServiceUrl() {
    List<ServiceInstance> list = client.getInstances("STORES");
    if (list != null && list.size() > 0 ) {
      return list.get(0).getUri();
    }
    return null;
}
```

What is a Zone?

- Eureka server designed for multi-instance use
  - Standalone mode will actually warn you when it runs without any peers!
- Eureka Server does not persist service registrations
  - Relies on client registrations; always up to date, always in memory
    - Stateful application.
- Typical production usage – many Eureka server instances running in different availability zones / regions
  - Connected to each other as “peers”

Which Comes First?
Eureka or Config Server?

Config First Bootstrap (default) – Use Config Server to configure location of Eureka server

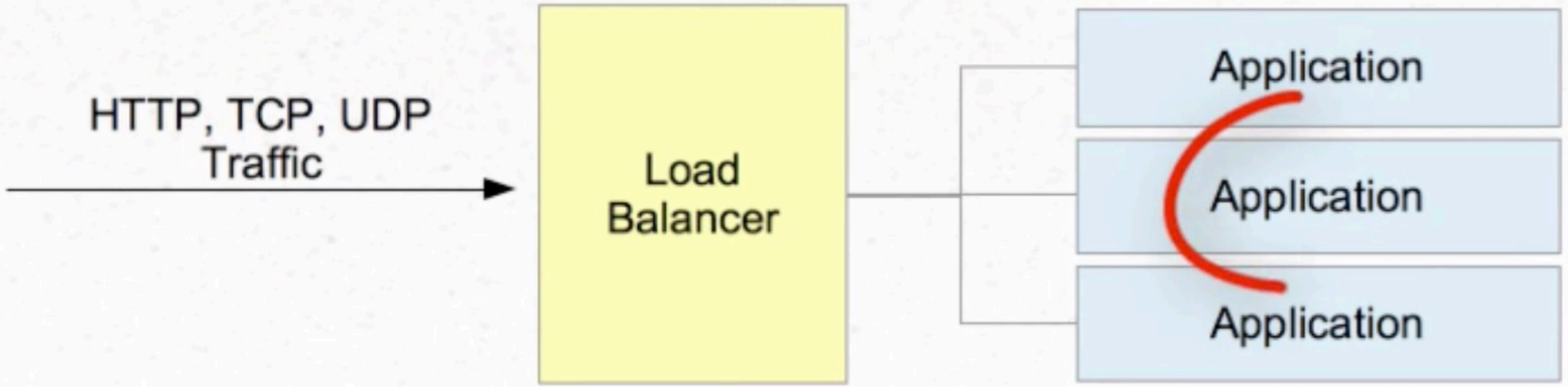
- Implies `spring.cloud.config.uri` configured in each app

Eureka First Bootstrap – Use Eureka to expose location to config server

- Config server is just another client
- Implies `spring.cloud.config.discovery.enabled=true` and `eureka.client.serviceUrl.defaultZone` configured in each app.
- Client makes two network trips to obtain configuration.

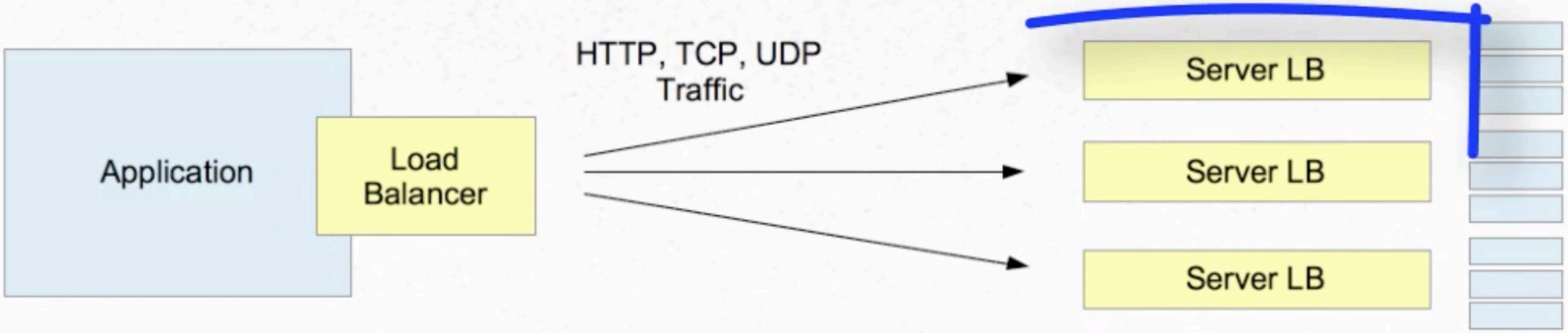
What is a Load Balancer?

- Traditional load balancers are server-side components
  - Distribute incoming traffic among several servers
  - Software (Apache, Nginx, HA Proxy) or Hardware (F5, NSX, BigIP)



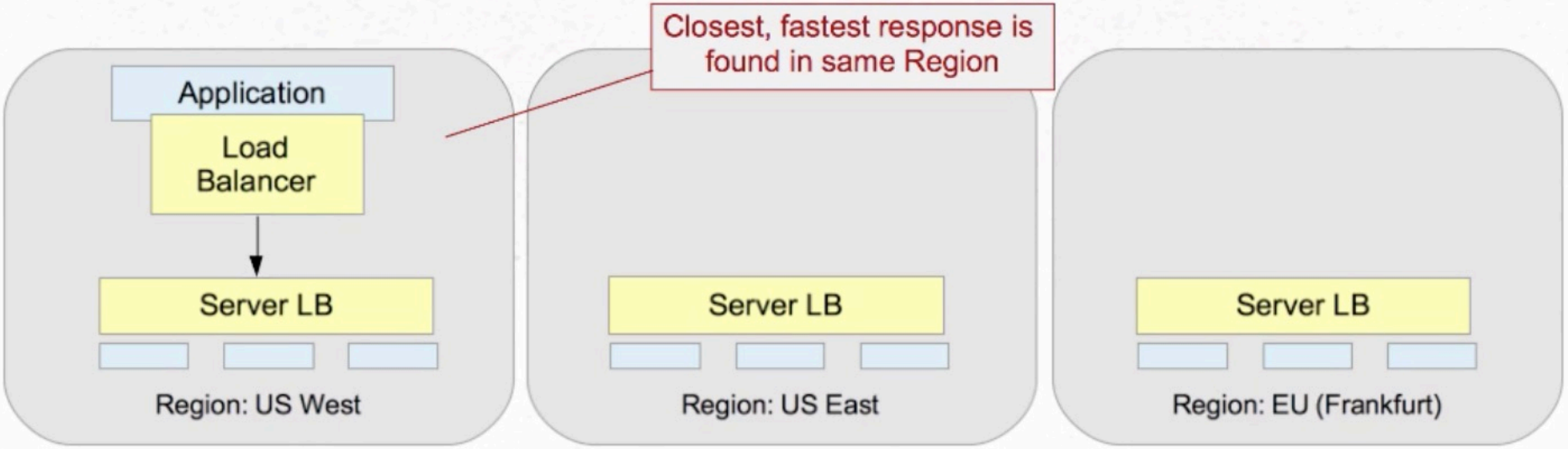
Client-Side Load Balancer

- Client-Side Load Balancer selects which server to call
  - Based on some criteria
  - Part of client software
  - Server can still employ its own load balancer



Why?

- Not all servers are the same
  - Some may be unavailable (faults)
  - Some may be slower than others (performance)
  - Some may be further away than others (regions)



Spring Cloud Netflix Ribbon

- Ribbon – Another part of the Netflix OSS family
  - Client side load balancer
  - Automatically integrates with service discovery (Eureka)
  - Built in failure resiliency (Hystrix)
  - Caching / Batching
  - Multiple protocols (HTTP, TCP, UDP)
- Spring Cloud provides an easy API Wrapper for using Ribbon.

List of Servers

- Determines what the list of possible servers are (for a given service (client))
  - Static – Populated via configuration
  - Dynamic – Populated via Service Discovery (Eureka)
- Spring Cloud default – Use Eureka when present on the classpath.

Example of "Static" server lists

"stores" and "products" - Examples of client-ids

application.yml

```
stores:
  ribbon:
    listOfServers: store1.com,store2.com
products:
  ribbon:
    listOfServers: productServer1.com, productServer2.com
```