Microservices with Spring Cloud

Leverage the power of Spring to create resilient microservices

About Me

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(@mgrzejszczak)

Spring Cloud developer at VMware.

- Spring Cloud Sleuth
- Spring Cloud Contract
- CI / CD

Course:

https://tinyurl.com/mg-contracts

Blog:

https://toomuchcoding.com

Hands-On Guide to Spring Cloud Contract: Creating Consumer-Driven Contracts to Leverage Contract Tests and Improve Your Code

by Marcin Grzejszczak

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Part 1

What is Spring Cloud and what does Spring Boot have to do with it?

SEGMENT 1

Agenda

12-factor application

Beyond the 12-factor application

What is Spring Boot?

What is Spring Cloud?

12-factor app

https://12factor.net/

Manifesto for cloud native applications from Heroku

Set of rules and guidelines

Declarative format for automation and setup

Beyond the 12factor app

The problem:

- How to build cloud native applications in practice?
- Apps not always running in Cloud
- Rules and guidelines specific for Heroku

Beyond the 12factor app

1. One codebase, one application
2. API first
3. Dependency management
4. Design, build, release, and run
5. Configuration, credentials, and code
6. Logs
7. Disposability
8. Backing services
9. Environment parity
10. Administrative processes
11. Port binding
12. Stateless processes
13. Concurrency
14. Telemetry
15. Authentication and authorization

https://content.pivotal.io/ebooks/beyond-the-12-factor-app

Beyond the 12factor app

1. One codebase, one application

Single codebase for an application

Multiple codebases suggest multiple applications

Difficult to deploy and test

Beyond the 12factor app

2. API first

Define contracts for your API

Define abstractions before implementing the details

Define how your interactions look like

Automate generation of the API documentation

Beyond the 12factor app

3. Dependency management

Cloud native applications bundled with all dependencies

Don’t assume that a dependency will be provided

Beyond the 12factor app

4. Design, build, release, and run

Hours of design can save weeks of coding

Design

- Architecture
- Bundled dependencies

Beyond the 12factor app

5. Configuration, credentials, and code

Store configuration in an environment

What about security?

- Assume externalization as if you pushed it to GitHub
- Have the credentials injected
- Ask for encrypted credentials and decrypt them at runtime

Beyond the 12factor app

6. Logs

Logs as event streams

Logs piped to an output stream

The application not concerned about stream storage

Beyond the 12factor app

7. Disposability

Treat an application as if it was disposable

It can be started or stopped at any time

Treat communication with other services the same way

Beyond the 12factor app

8. Backing services

Filesystem ephemeral

Instead use a backing service

    Caches, messaging systems, databases

Treat filesystem as a backing service

Beyond the 12factor app

9. Environment parity

Only production environment is production

Your application set up as if on production

Each commit a candidate for deployment to production

Beyond the 12factor app

10. Administrative processes

Factor 12 of the original 12 factor app - Run admin/management tasks as one-off processes

Issues with solutions like Cron

- Multiple instances in various zones

Create an application

- That runs batch jobs
- REST endpoints to run administrative jobs

Beyond the 12factor app

11. Port binding

Multiple instances, different ports

Push the problem to the platform

    Manages network, Scaling, Routing etc.

Beyond the 12factor app

12. Stateless processes

State stored in a backing service

State not maintained in your application

Beyond the 12factor app

13. Concurrency

Scale out horizontally

No need to invest in more memory or cpu for your larger process

Multiple instances of your application do more work

Beyond the 12factor app

14. Telemetry

Application treated like a space probe

When in space, can’t interact with it too much

Metrics

Technical (health checks, load) - Application Performance Management

Domain Specific (business domain) - Business Key Performance Indicators (KPI)

Beyond the 12factor app

15. Authentication and authorization

“We’ll talk about security if we don’t run out of time”

Security should be in core of your application’s development

It shouldn’t be added in the post-production phase

What is Spring Boot?

Opinionated view on Spring

Sets up third-party libraries if on classpath

Fully extensible

Takes care of managing versions

Production-ready features e.g. metrics, health-checks

https://spring.io/projects/spring-boot

What is Spring Boot? - Version Management

```xml
<parent>
    <groupId>org.springframework.boot</groupId>
    <artifactId>spring-boot-starter-parent</artifactId>
    <version>2.2.2.RELEASE</version>
    <relativePath/>
    <!-- lookup parent from repository -->
</parent>
```

What is Spring Cloud?

Spring Boot based tools for developers with patterns in distributed systems

- Configuration management, service discovery etc.

Will work in any distributed environment

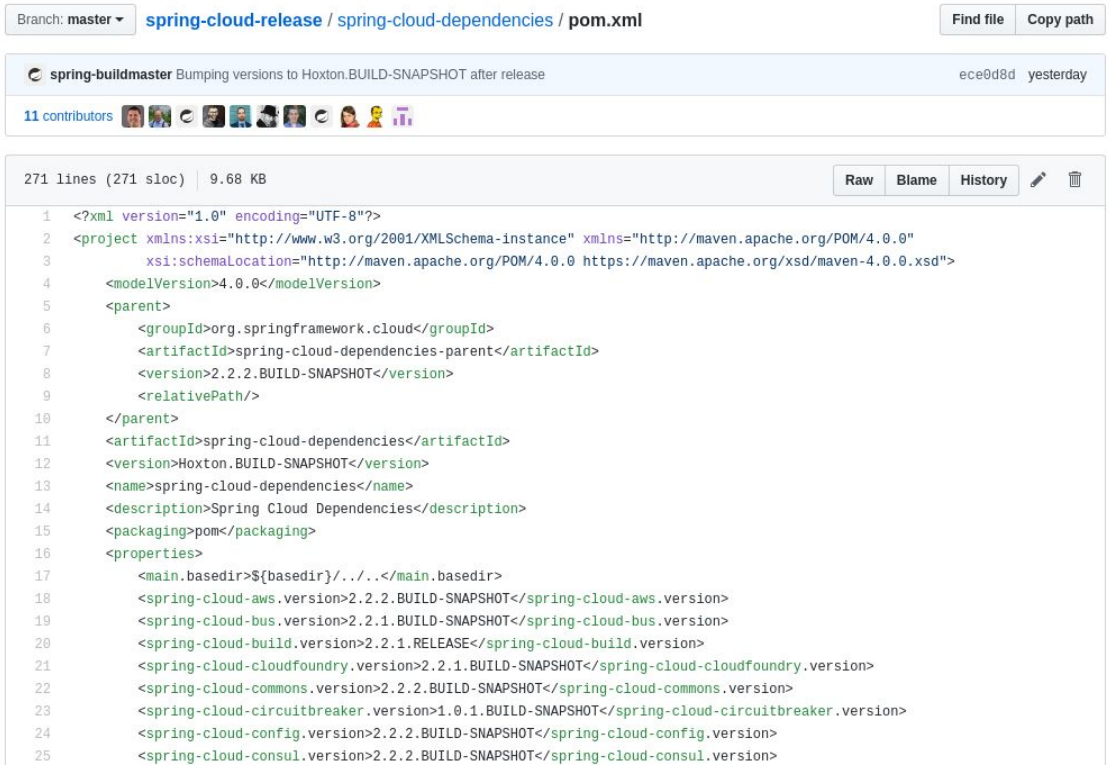
- Developer’s own laptop
- Bare metal data centres
- Managed platforms such as Cloud Foundry or Kubernetes

https://spring.io/projects/spring-cloud

What is Spring Cloud

```xml
<dependencyManagement>
    <dependencies>
        <dependency>
            <groupId>org.springframework.cloud</groupId>
            <artifactId>spring-cloud-dependencies</artifactId>
            <version>${release.train.version}</version>
            <type>pom</type>
            <scope>import</scope>
        </dependency>
    </dependencies>
</dependencyManagement>
<dependency>
    <groupId>org.springframework.cloud</groupId>
    <artifactId>spring-cloud-starter-*</artifactId>
</dependency>
```

HTTPS://GITHUB.COM/SPRING-CLOUD/SPRING-CLOUD-RELEASE/



Branch: master ▾ spring-cloud-release / spring-cloud-dependencies / pom.xml — Find file | Copy path

spring-buildmaster Bumping versions to Hoxton.BUILD-SNAPSHOT after release — ece0d8d — yesterday

11 contributors

271 lines (271 sloc) | 9.68 KB — Raw | Blame | History

```
<?xml version="1.0" encoding="UTF-8"?>
<project xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xmlns="http://maven.apache.org/POM/4.0.0"
         xsi:schemaLocation="http://maven.apache.org/POM/4.0.0 https://maven.apache.org/xsd/maven-4.0.0.xsd">
    <modelVersion>4.0.0</modelVersion>
    <parent>
        <groupId>org.springframework.cloud</groupId>
        <artifactId>spring-cloud-dependencies-parent</artifactId>
        <version>2.2.2.BUILD-SNAPSHOT</version>
        <relativePath/>
    </parent>
    <artifactId>spring-cloud-dependencies</artifactId>
    <version>Hoxton.BUILD-SNAPSHOT</version>
    <name>spring-cloud-dependencies</name>
    <description>Spring Cloud Dependencies</description>
    <packaging>pom</packaging>
    <properties>
        <main.basedir>${basedir}/../..</main.basedir>
        <spring-cloud-aws.version>2.2.2.BUILD-SNAPSHOT</spring-cloud-aws.version>
        <spring-cloud-bus.version>2.2.1.BUILD-SNAPSHOT</spring-cloud-bus.version>
        <spring-cloud-build.version>2.2.1.RELEASE</spring-cloud-build.version>
        <spring-cloud-cloudfoundry.version>2.2.1.BUILD-SNAPSHOT</spring-cloud-cloudfoundry.version>
        <spring-cloud-commons.version>2.2.2.BUILD-SNAPSHOT</spring-cloud-commons.version>
        <spring-cloud-circuitbreaker.version>1.0.1.BUILD-SNAPSHOT</spring-cloud-circuitbreaker.version>
        <spring-cloud-config.version>2.2.2.BUILD-SNAPSHOT</spring-cloud-config.version>
        <spring-cloud-consul.version>2.2.2.BUILD-SNAPSHOT</spring-cloud-consul.version>
```

What is Spring Cloud

Release Trains

Spring Cloud is an umbrella project consisting of independent projects with, in principle, different release cadences. To manage the portfolio a BOM (Bill of Materials) is published with a curated set of dependencies on the individual project (see below). The release trains have names, not versions, to avoid confusion with the sub-projects. The names are an alphabetic sequence (so you can sort them chronologically) with names of London Tube stations ("Angel" is the first release, "Brixton" is the second). When point releases of the individual projects accumulate to a critical mass, or if there is a critical bug in one of them that needs to be available to everyone, the release train will push out "service releases" with names ending ".SRX", where "X" is a number.

Table 1. Release train Spring Boot compatibility

Release Train	Boot Version
Hoxton	2.2.x
Greenwich	2.1.x
Finchley	2.0.x
Edgware	1.5.x
Dalston	1.5.x

SEGMENT 2

Agenda

What is Spring Initlizr?

How to use it?

What problem are we trying to solve?

Manual version setting

Version mismatch

Class / Method not found

Dependency management hell

What is Spring Initializr?

Extensible API to generate JVM-based projects

- Basic language generation for Java, Kotlin and Groovy
- Build system abstraction for Apache Maven and Gradle
- .gitignore support
- Several hook-points for custom resources generations

https://github.com/spring-io/initializr

What is Start Spring IO?

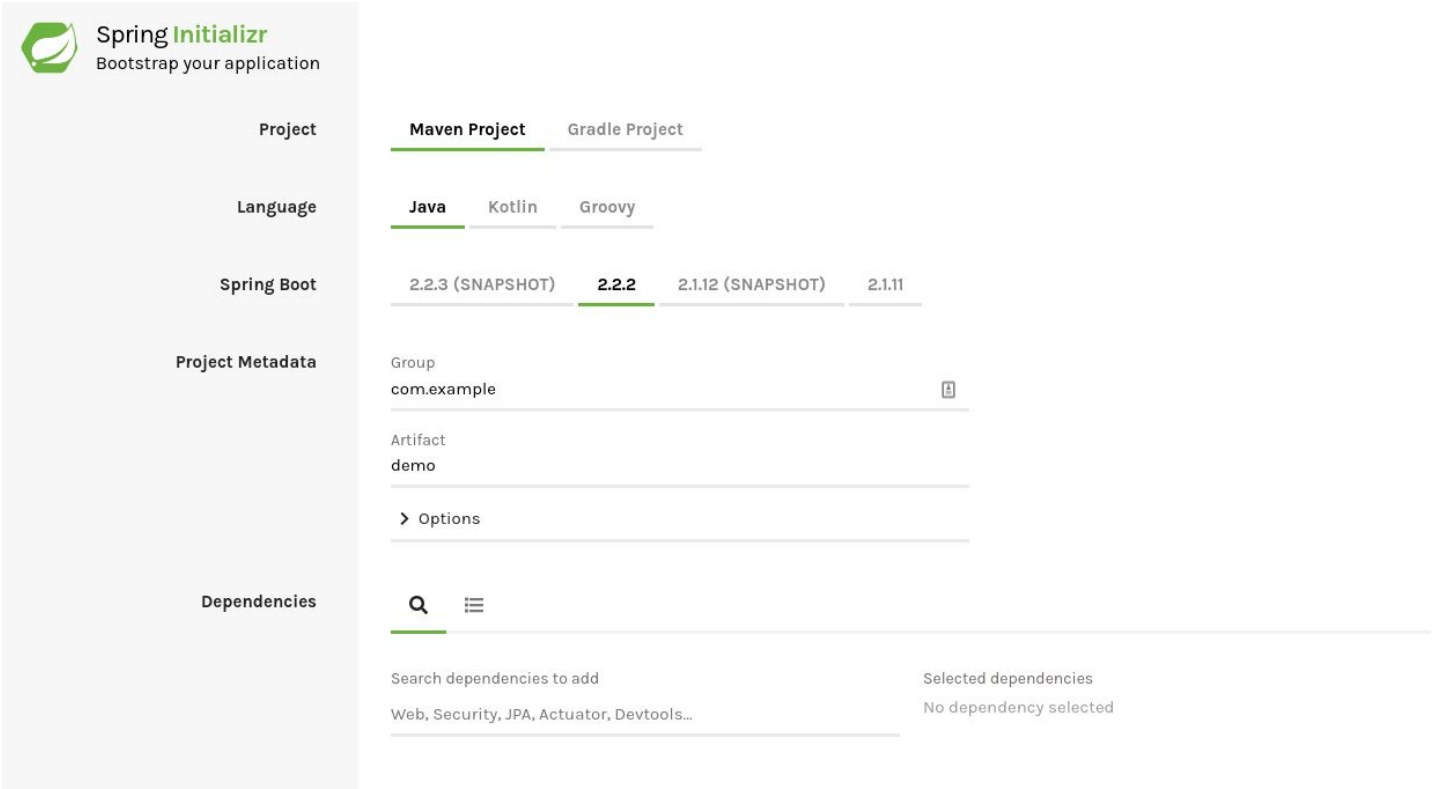
A GitHub project
https://github.com/spring-io/start.spring.io

Set up for the https://start.spring.io site

Configuration
https://github.com/spring-io/start.spring.io/blob/master/start-site/src/main/resources/application.yml

Contains a custom UI

What is Start Spring IO?



How to use Start Spring IO?

Supported interfaces
https://github.com/spring-io/initializr#supported-interfaces

- Command line
- IDE
- Custom Web UI

DEMO

SEGMENT 3

Agenda

Configuration, credentials, and code

What is Spring Cloud Config server?

Spring Cloud Config

GitHub project
https://spring.io/projects/spring-cloud-config

Server and client-side support for externalizing configuration

The default backend implementation is git

Spring Cloud Config Server

Different backends

- Git, File System, Vault, JDBC, Redis, AWS S3, CredHub

Security

- Spring Boot-configured HTTP Basic security with Spring Security
- symmetric (shared) key
- asymmetric (RSA key pair)

Spring Cloud Config Server Security

Encryption

```
$ curl localhost:8888/encrypt -d mysecret
```

Decryption

```
$ curl localhost:8888/decrypt -d
682bc583f4641835fa2db009355293665d2647dade3375c0ee201de2a49f
7bda
```

DEMO

Spring Cloud Config Server

Spring Cloud Config has an HTTP service:

- /{application}/{profile}[/{label}]
- /{application}-{profile}.yml
- /{label}/{application}-{profile}.yml
- /{application}-{profile}.properties
- /{label}/{application}-{profile}.properties

DEMO

Spring Cloud Config Client

Binds to the Config Server (default localhost:8888)

you can override it by bootstrap.properties

Spring Environment with remote property sources

Add the **spring-cloud-starter-config** dependency

You need to refresh the application to see the changed prop

Whitelist the refresh endpoint
management.endpoints.web.exposure.include=*

DEMO

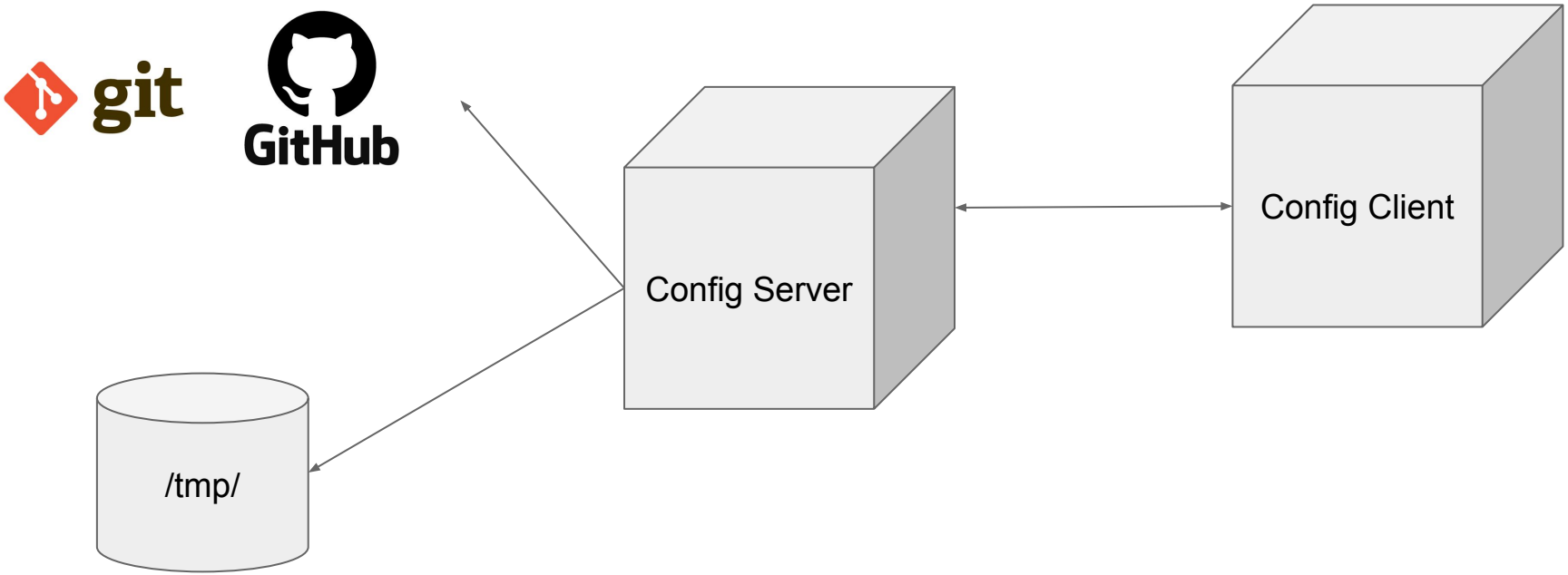
Part 1
Assignment

Part 1 - Assignment

Externalizing configuration via Spring Cloud Config. In this lab, students will use the Project Initializr (start.spring.io) to generate two projects - a Spring Cloud Config server and a Spring Cloud Config client application. Students will fork a simple Git repository where the externalized configuration will be stored. During the exercise students will be able to fetch those properties and refresh them at runtime.

Assignment time (15 min)

Part 1 - Assignment



Part 1 - Assignment

https://tinyurl.com/spring-cloud-workshops-2#assignment-1

https://gist.github.com/marcingrzejszczak/ae5da2606a21dc8144f8e212d786c91e#assignment-1

PART 2

How can microservices communicate and what is service discovery?

SEGMENT 4

Agenda

How can microservices communicate?

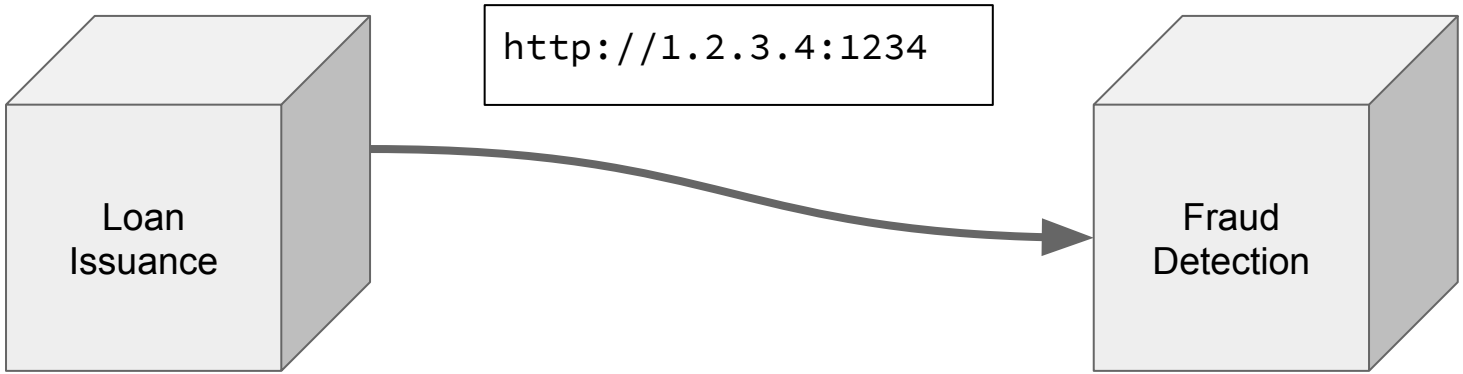
What is service discovery?

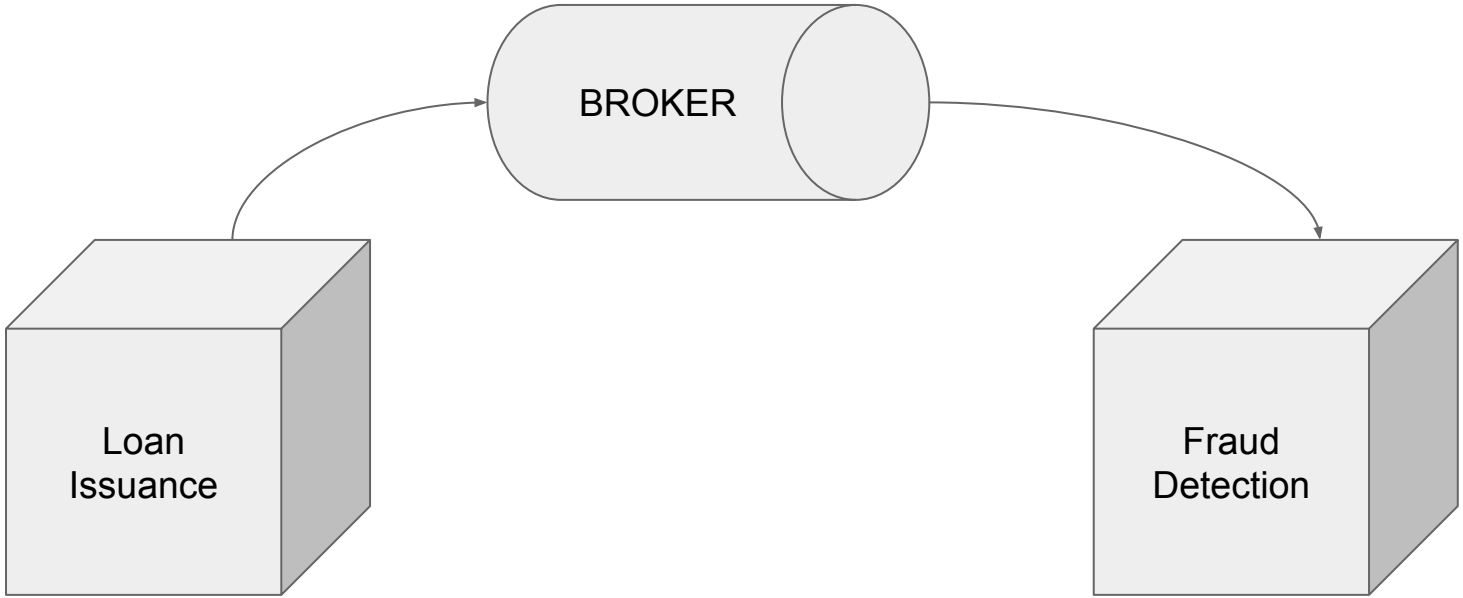
What is Netflix Eureka?

How can microservices communicate?

HTTP

Messaging


http://1.2.3.4:1234
Loan
Issuance
Fraud
Detection


BROKER
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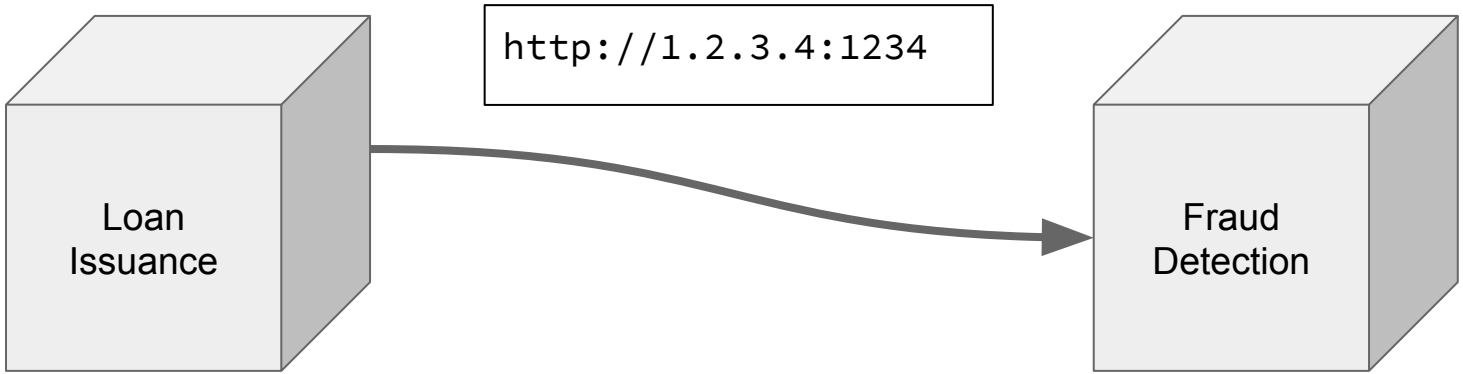
Issuance
Fraud
Detection

Service Discovery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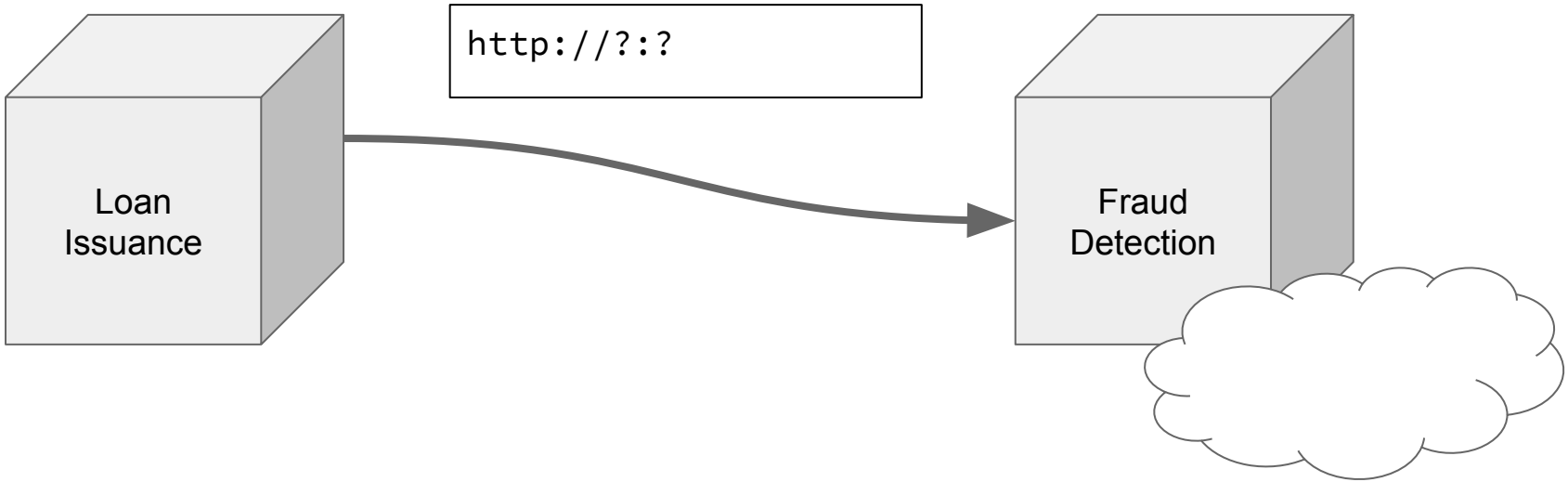
Issuance
Fraud
Detection


http://?:?
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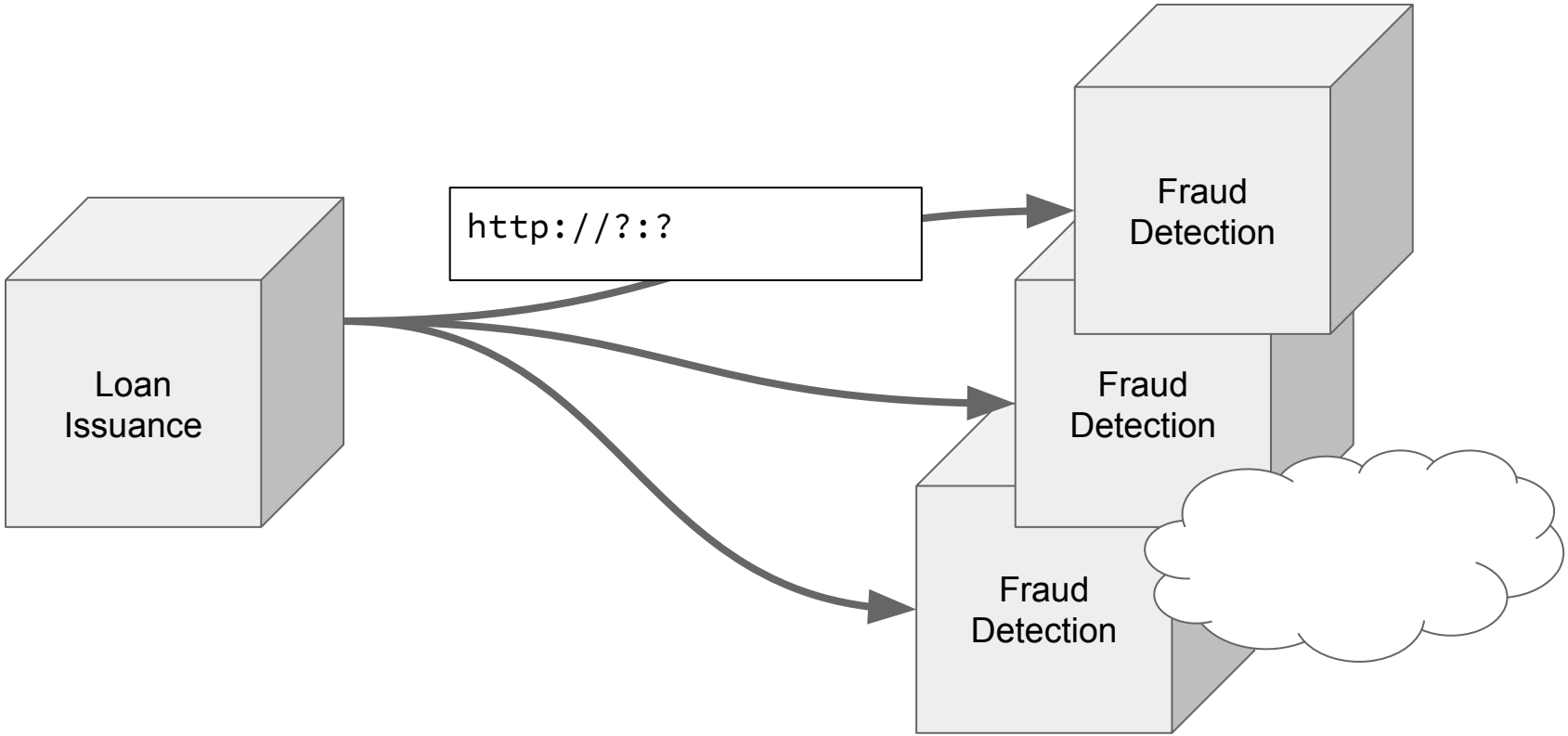
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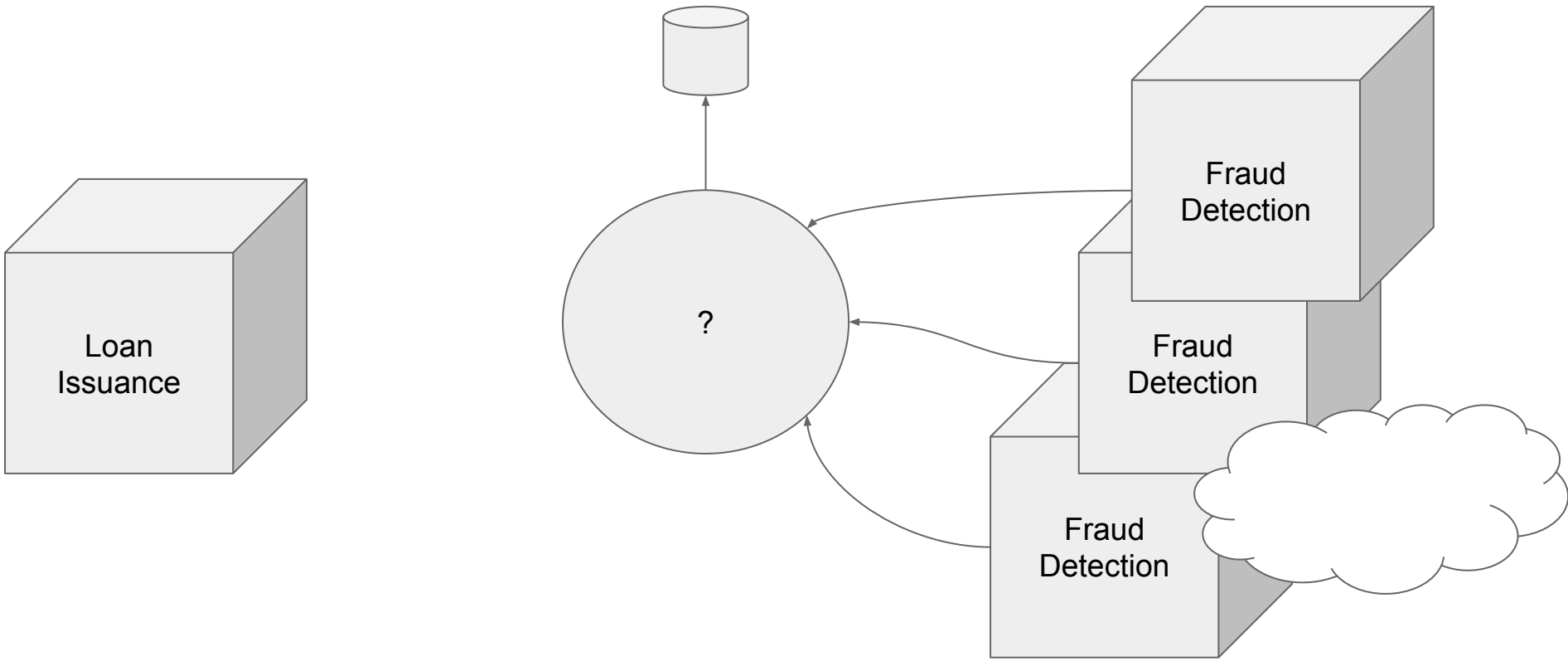
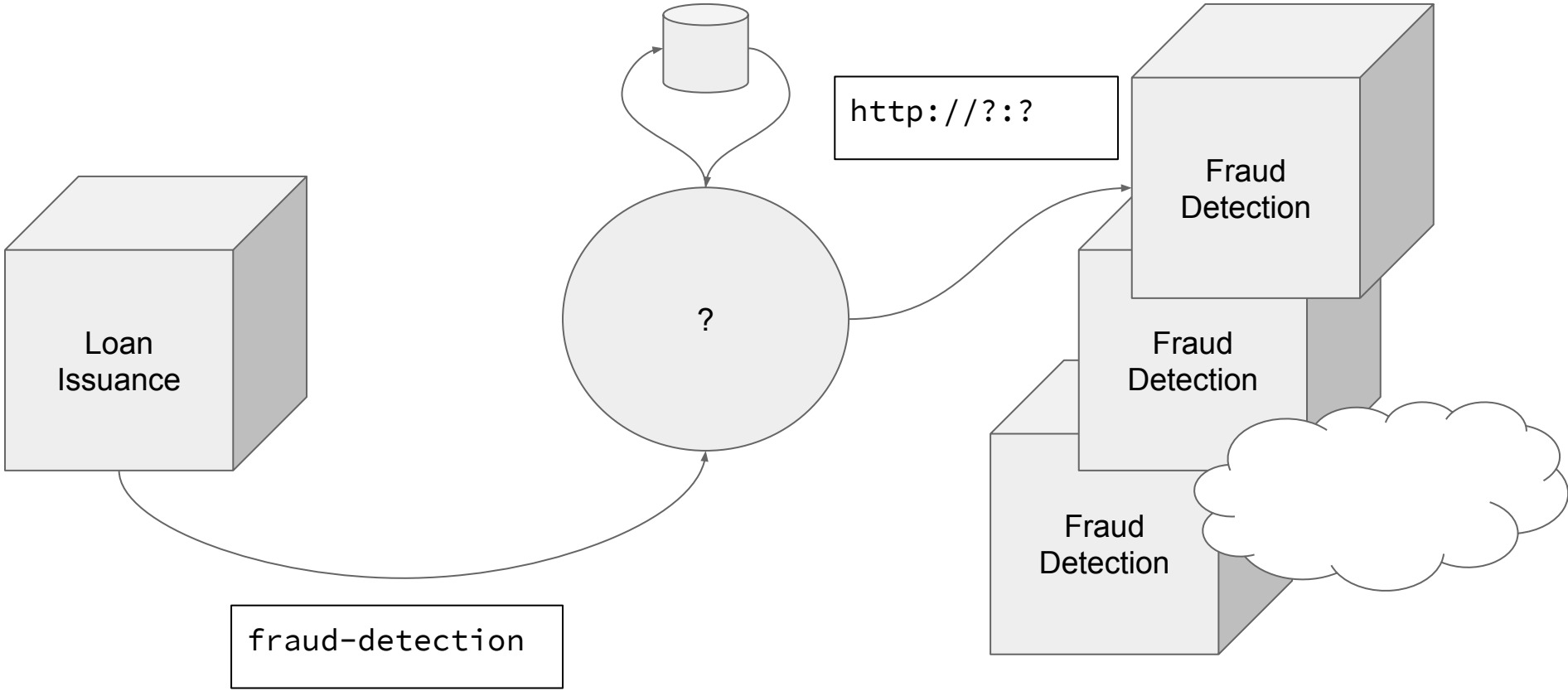
http://?:?
Fraud
Detection
Fraud
Detection
Fraud
Detection


Loan
Issuance
?
Fraud
Detection
Fraud
Detection
Fraud
Detection

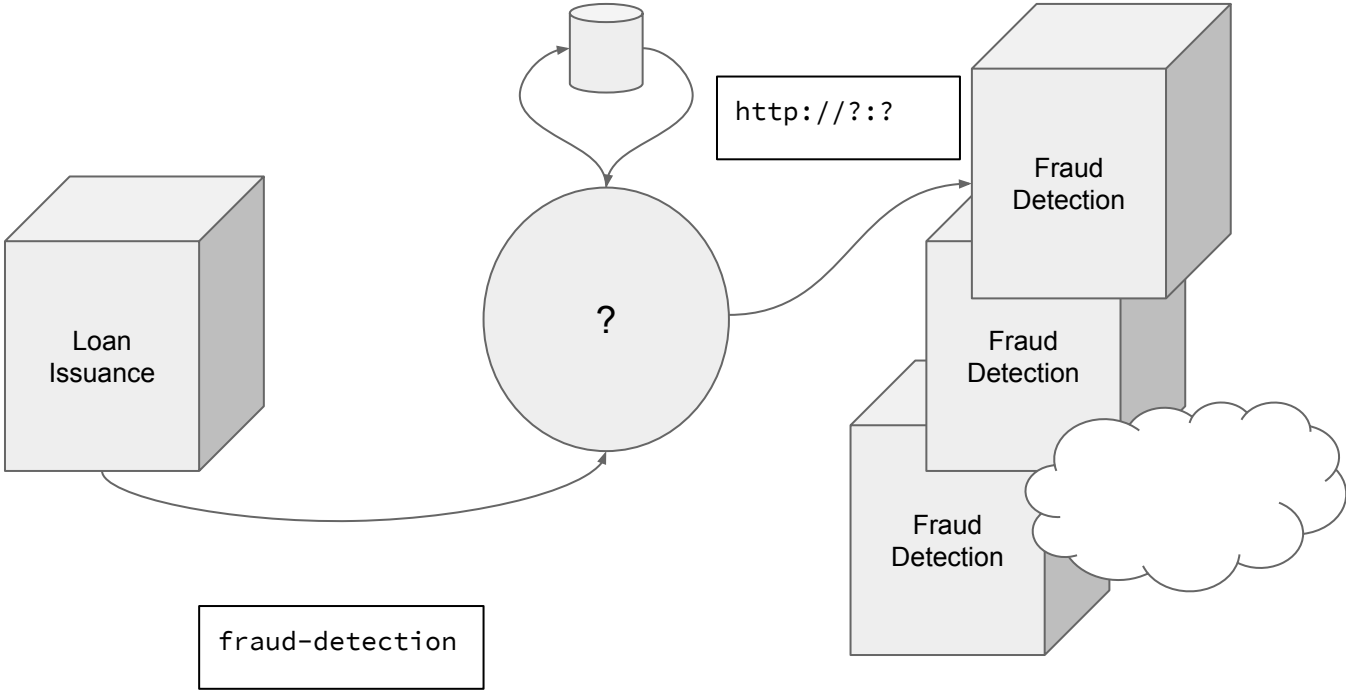

http://?:?
Loan
Issuance
?
Fraud
Detection
Fraud
Detection
Fraud
Detection
fraud-detection

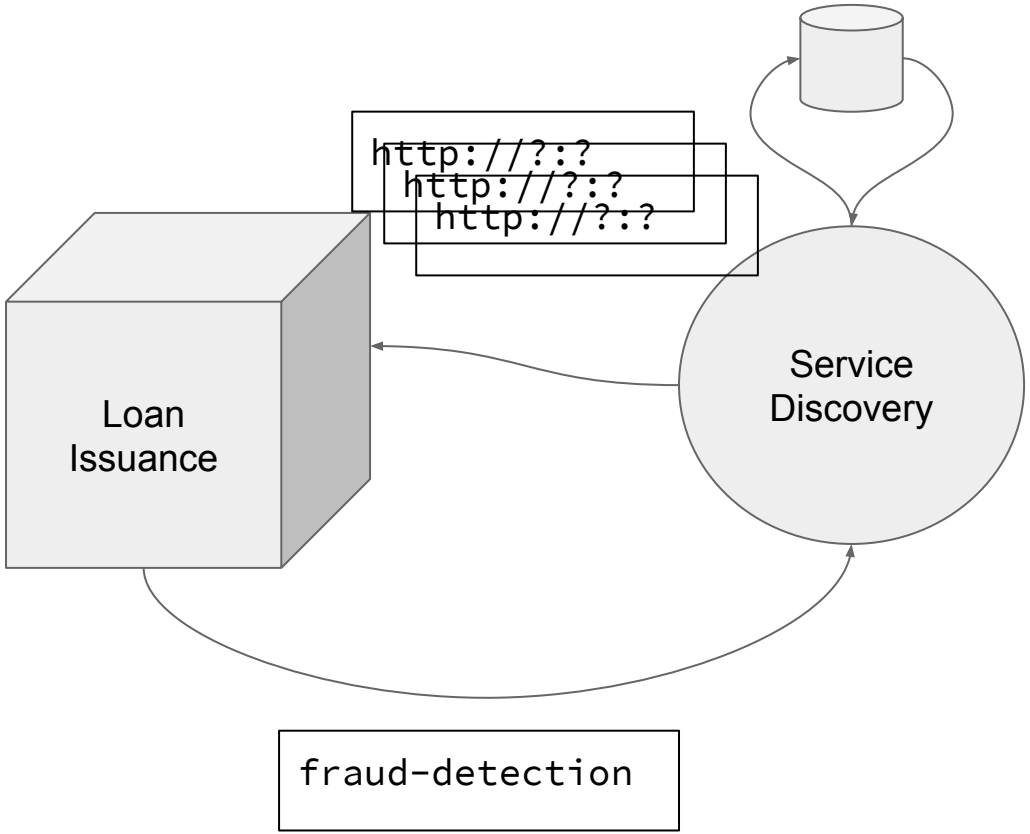
Load Balancing

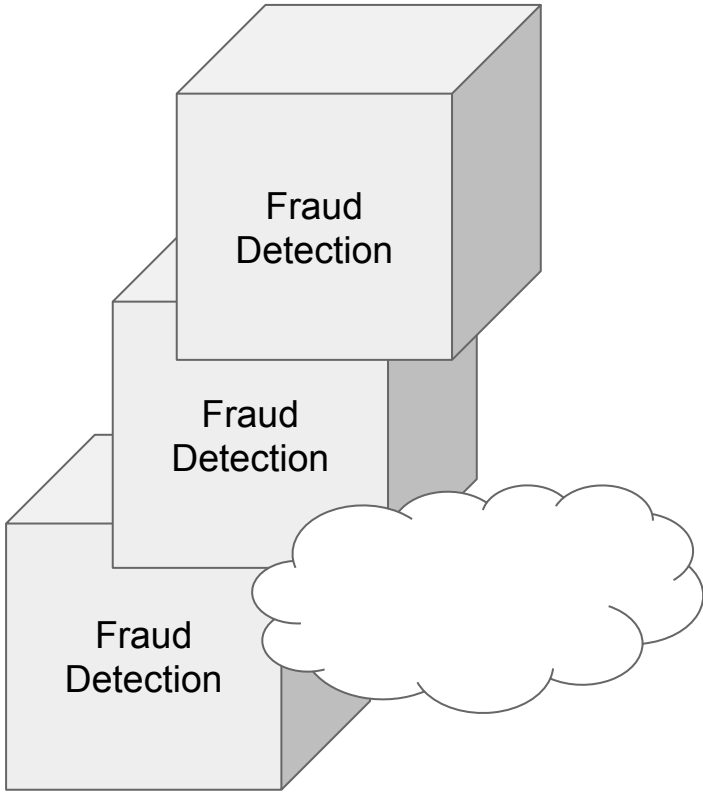
DNS

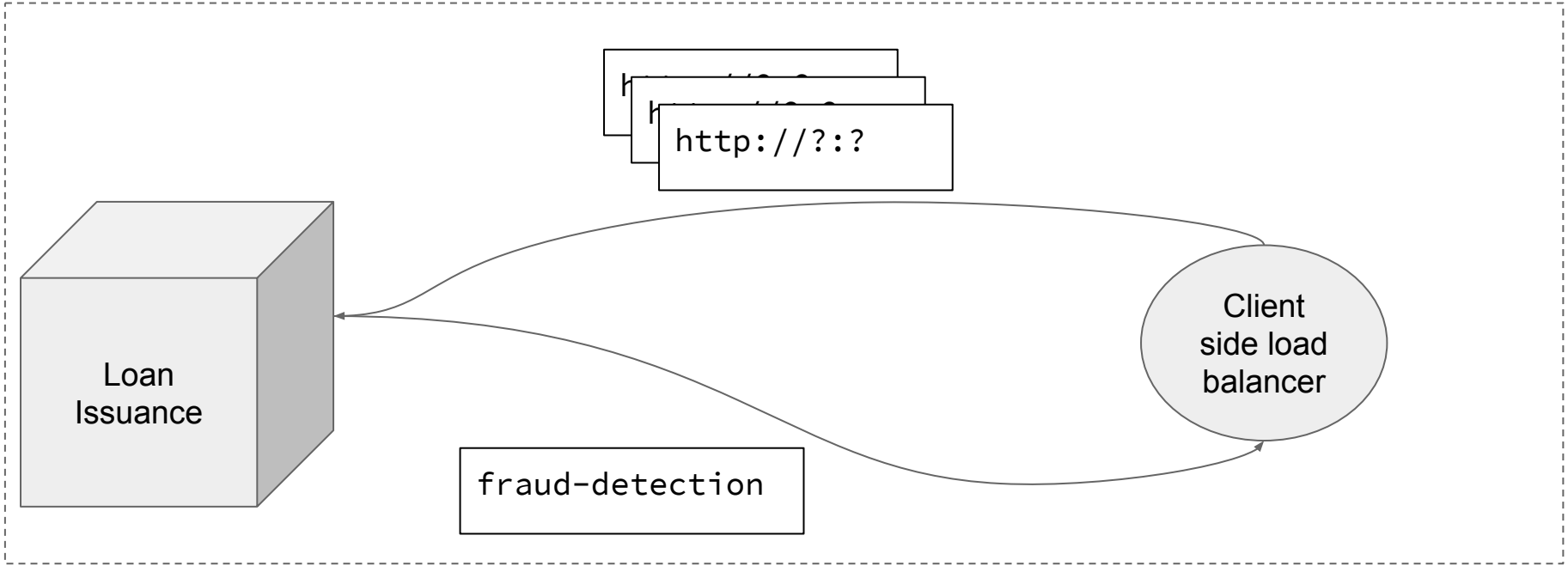
Client side

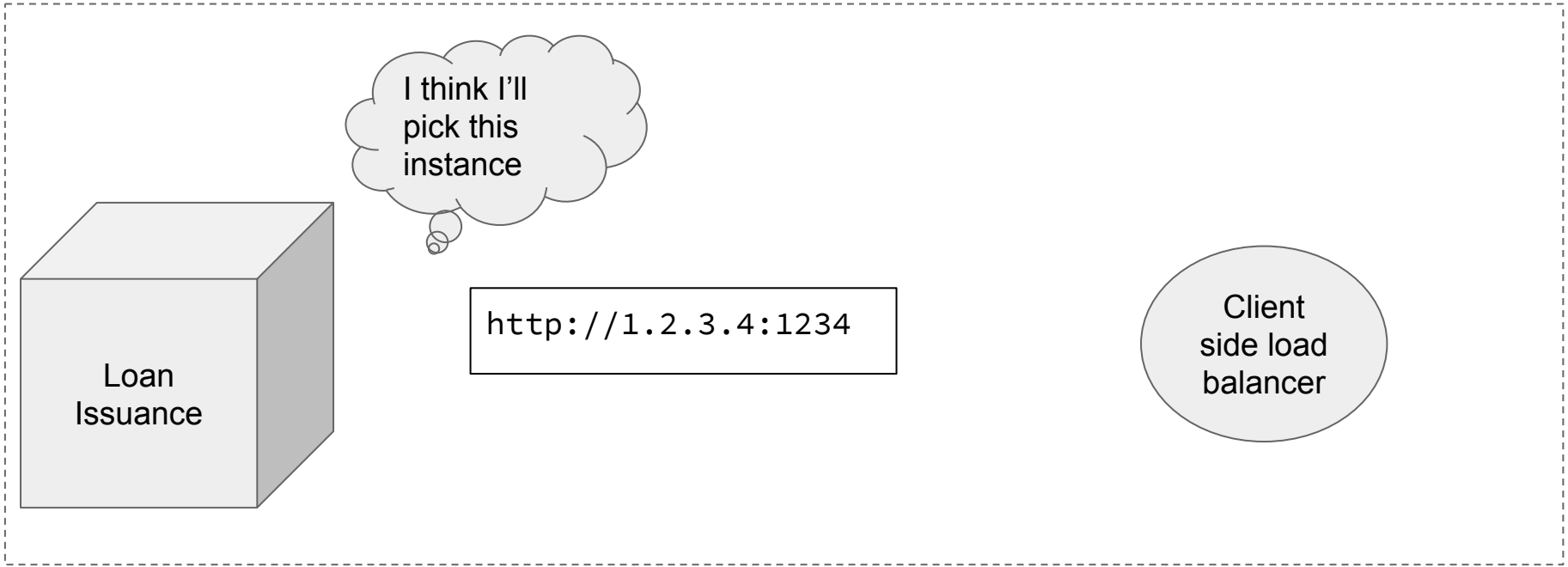
Server side

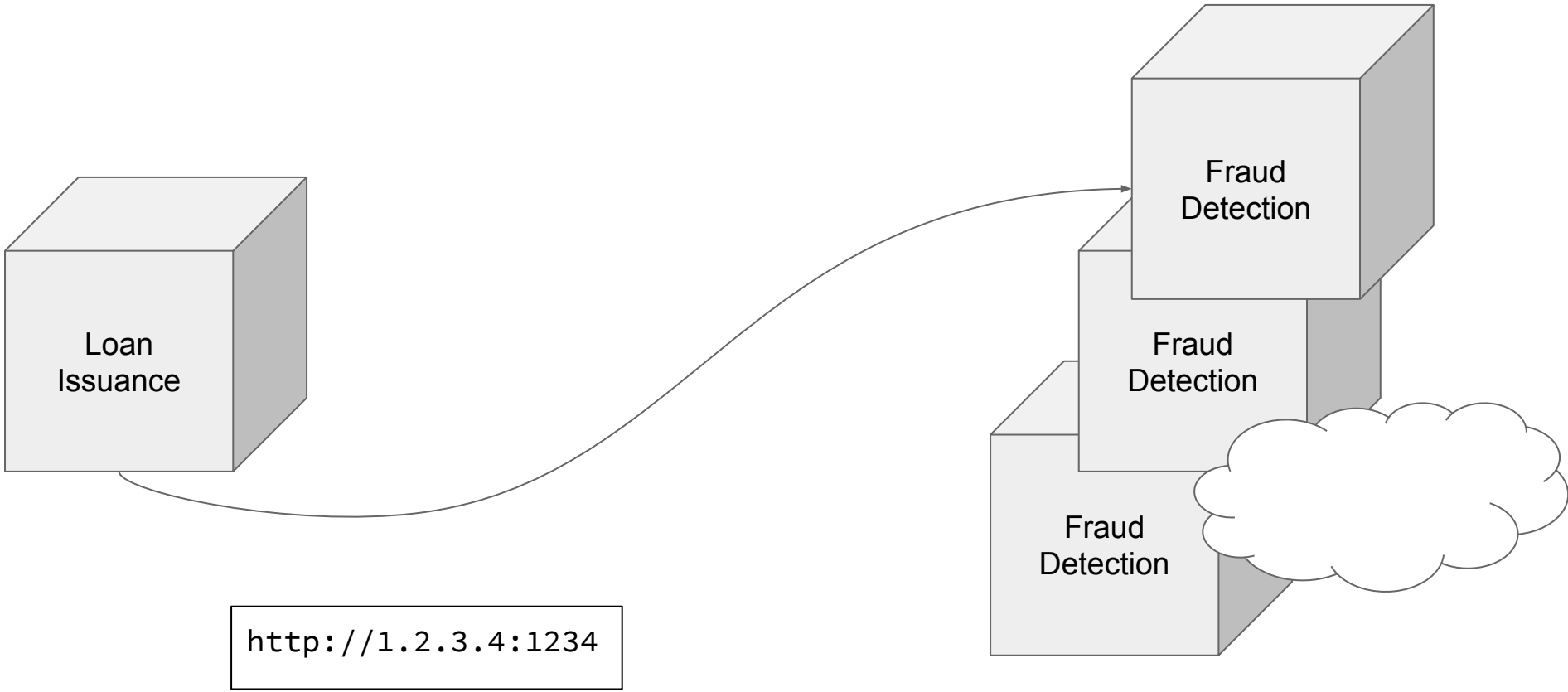



http://?:?
http://?:?
http://?:?
Loan
Issuance
Service
Discovery
fraud-detection


Fraud
Detection
Fraud
Detection
Fraud
Detection


http://?:?
Loan
Issuance
Client
side load
balancer
fraud-detection


I think I'll pick this instance
Loan Issuance
http://1.2.3.4:1234
Client side load balancer


Loan
Issuance
Fraud
Detection
Fraud
Detection
Fraud
Detection
http://1.2.3.4:1234

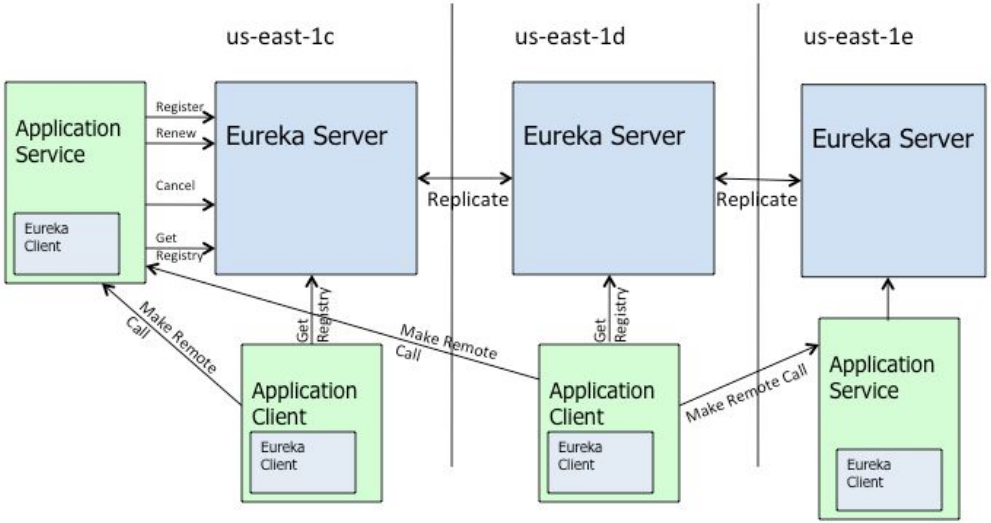
What is Netflix Eureka?

Service discovery from Netflix

Was used for AWS cloud by Netflix

Locating service, load balancing and failover

What is Netflix Eureka?



https://github.com/Netflix/eureka/wiki/Eureka-at-a-glance

What is Netflix Eureka?

Eureka Clients cache state

If server is down you will use the cache

If server down in your zone, failover to another

What is Netflix Eureka?

Eureka Server is a Eureka Client

Replicates data from peers

No peers = plenty of error log messages

SEGMENT 5

Agenda

What is Spring Cloud Netflix?

How to use Spring Cloud Netflix to perform service to service calls?

What is Spring Cloud Netflix?

Netflix OSS integrations for Spring Boot apps

integrates with

- Service Discovery (Eureka)
- Circuit Breaker (Hystrix)
- Intelligent Routing (Zuul)
- Client Side Load Balancing (Ribbon)

Neftlix Oss Deprecations

Ribbon, 2016

Hystrix Dashboard → Atlas

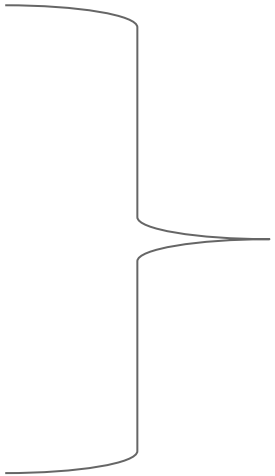
Zuul 1 → backward incompatible Zuul 2

Archaius 1 → backward incompatible Archaius 2

Hystrix, 2018

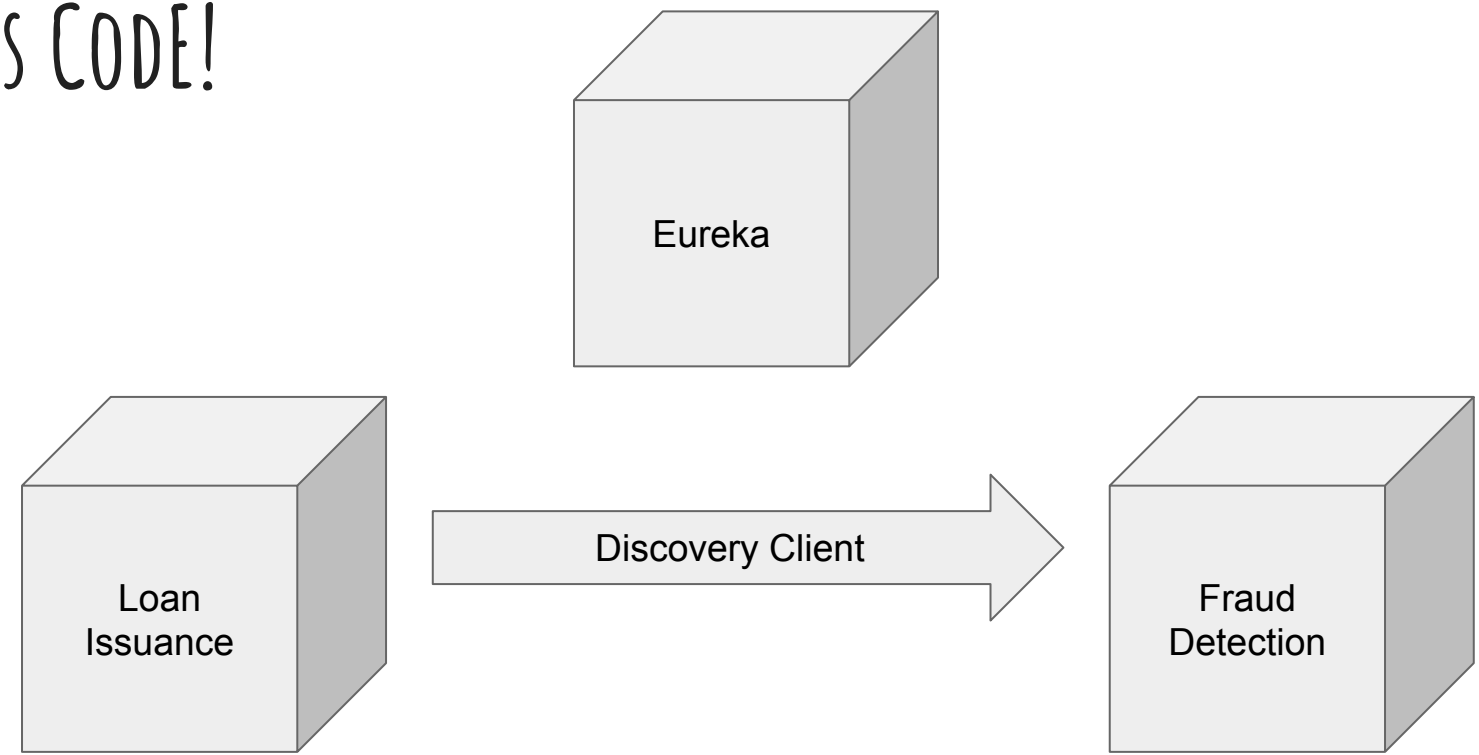
What is Spring Cloud Netflix?

- Spring Cloud Netflix Eureka Client
- Spring Cloud Netflix Eureka Server
- Spring Cloud Netflix Archaius
- Spring Cloud Netflix Ribbon
- Spring Cloud Netflix Zuul
- Spring Cloud Netflix Hystrix
- Spring Cloud Netflix Hystrix Dashboard
- Spring Cloud Netflix Turbine
- Spring Cloud Netflix Hystrix Stream
- Spring Cloud Netflix Turbine Stream



DEPRECATED!

Let's Code!



DEMO

SEGMENT 6

Agenda

What is Spring Cloud LoadBalancer?

What is LoadBalanced RestTemplate?

How to use different RestTemplates at the same time?

What is OpenFeign?

What is Spring Cloud LoadBalancer?

Client-side load-balancer abstraction and implementation

- `ReactiveLoadBalancer` interface
- Default is Round-Robin-based implementation

What is LoadBalanced RestTemplate?

```
new RestTemplate().getForObject(instance.getUri().toString() + "/frauds", List.class);
```

What is LoadBalanced RestTemplate?

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

```
@Autowired
RestTemplate restTemplate;
restTemplate.getForObject(”http://fraud-detection/frauds", List.class);
```

What is OpenFeign?

Feign is a declarative web service client

Create an interface and annotate it

Spring Cloud adds support for Spring MVC annotations

Integrates Spring Cloud LoadBalancer

What is OpenFeign?

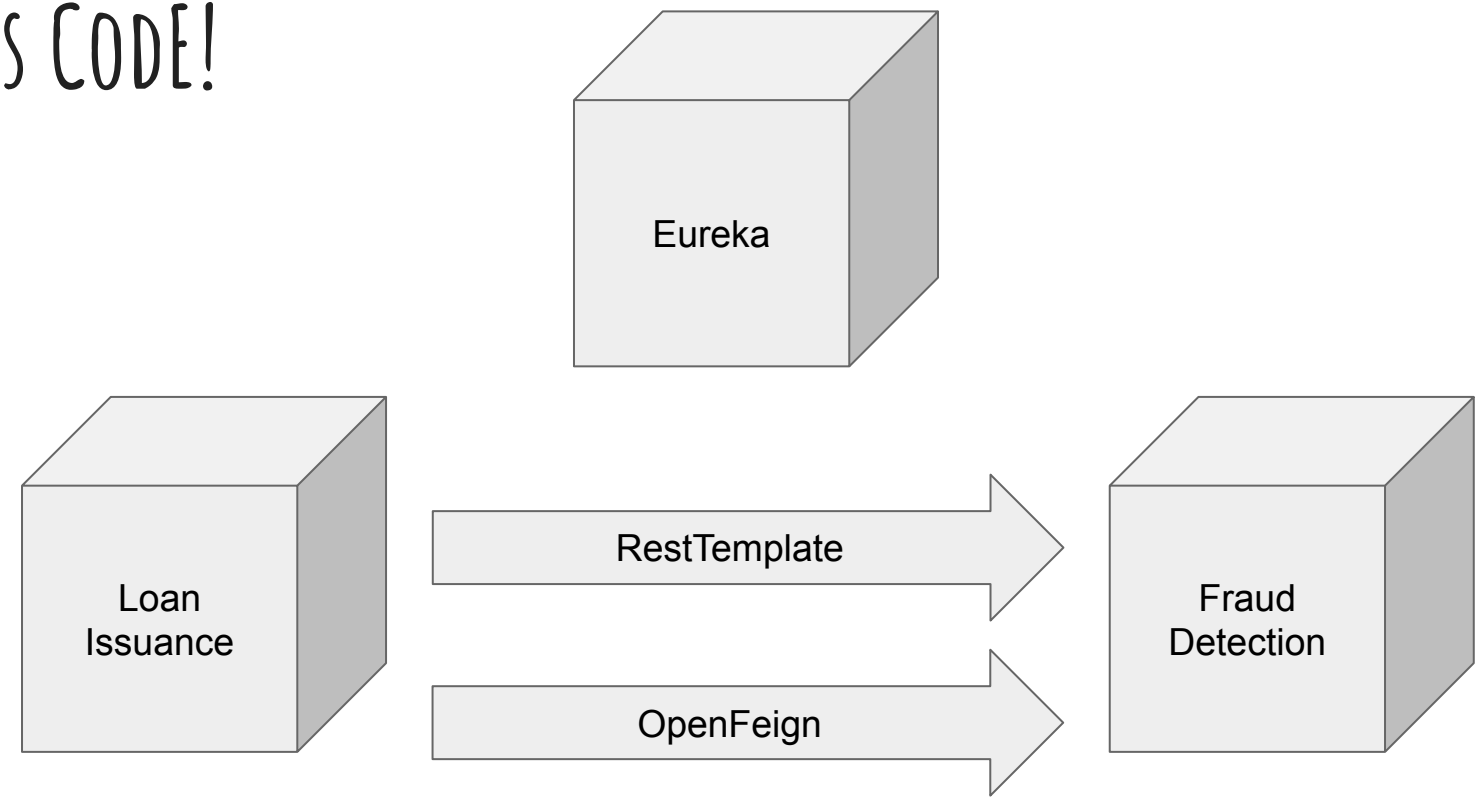
```
@FeignClient("stores")
public interface StoreClient {

    @RequestMapping(method = RequestMethod.GET, value = "/stores")
    List<Store> getStores();

    @RequestMapping(method = RequestMethod.POST,
     value = "/stores/{storeId}", consumes = "application/json")
    Store update(@PathVariable("storeId") Long storeId, Store store);

}
```

Let's Code!



DEMO

Part 2
Assignment

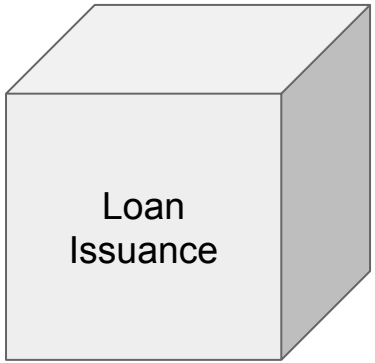
Part 2 - Assignment

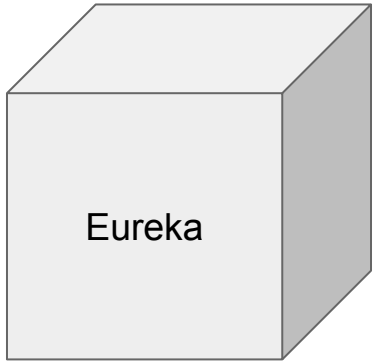
Assignment:

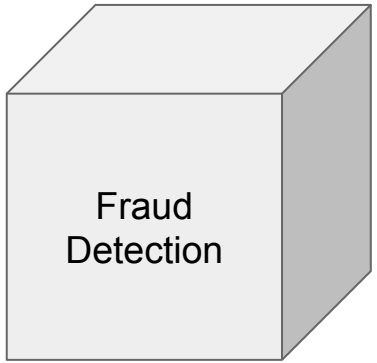
Service to service communication with Spring Cloud. In this lab, students will use the Project Initializr(start.spring.io) to generate a Spring Cloud Eureka server and two client applications. Students will need to implement a REST API, make the applications register in Eureka and make the applications communicate with each other either via

a) RestTemplate
b) Feign.

Assignment time (15 min)


Loan
Issuance


Eureka


Fraud
Detection

Part 2 - Assignment

https://tinyurl.com/spring-cloud-workshops-2#assignment-2

https://gist.github.com/marcingrzejszczak/ae5da2606a21dc8144f8e212d786c91e#assignment-2

PART 3

How can microservices gather metrics? How can microservices not cascade failure?

SEGMENT 7

Agenda

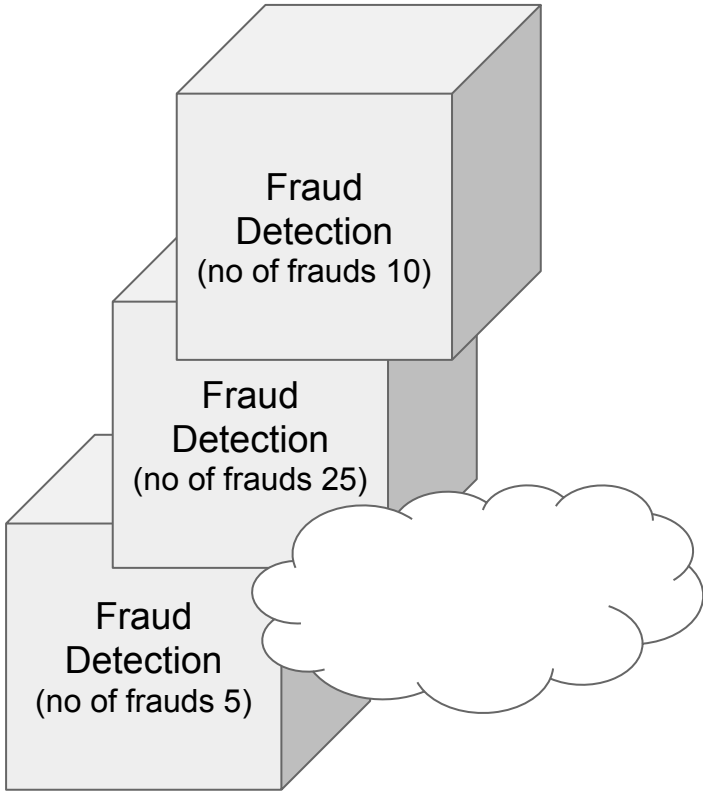
What are the issues related to microservice metrics gathering and aggregation?

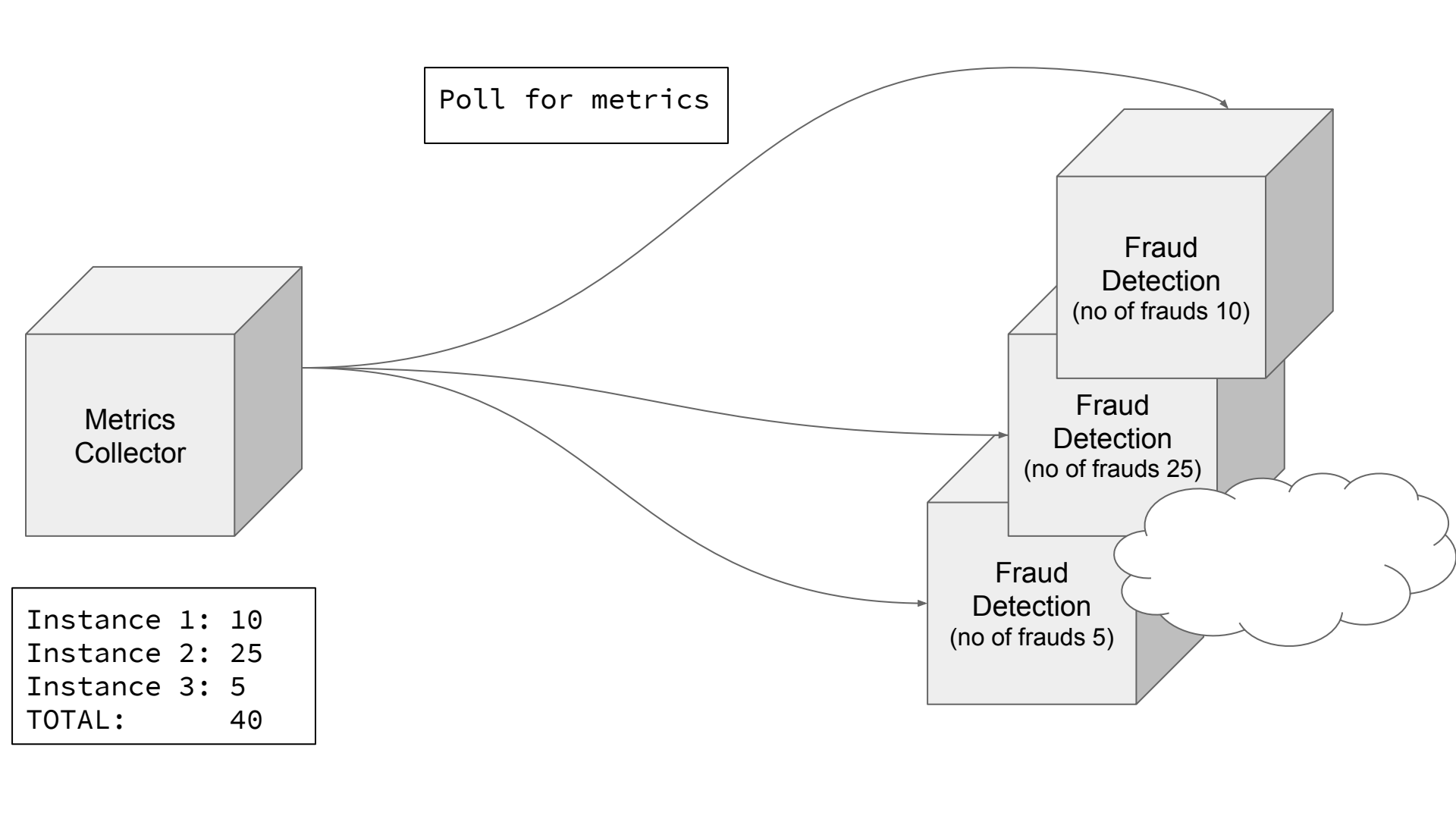
How does Actuator help in that?

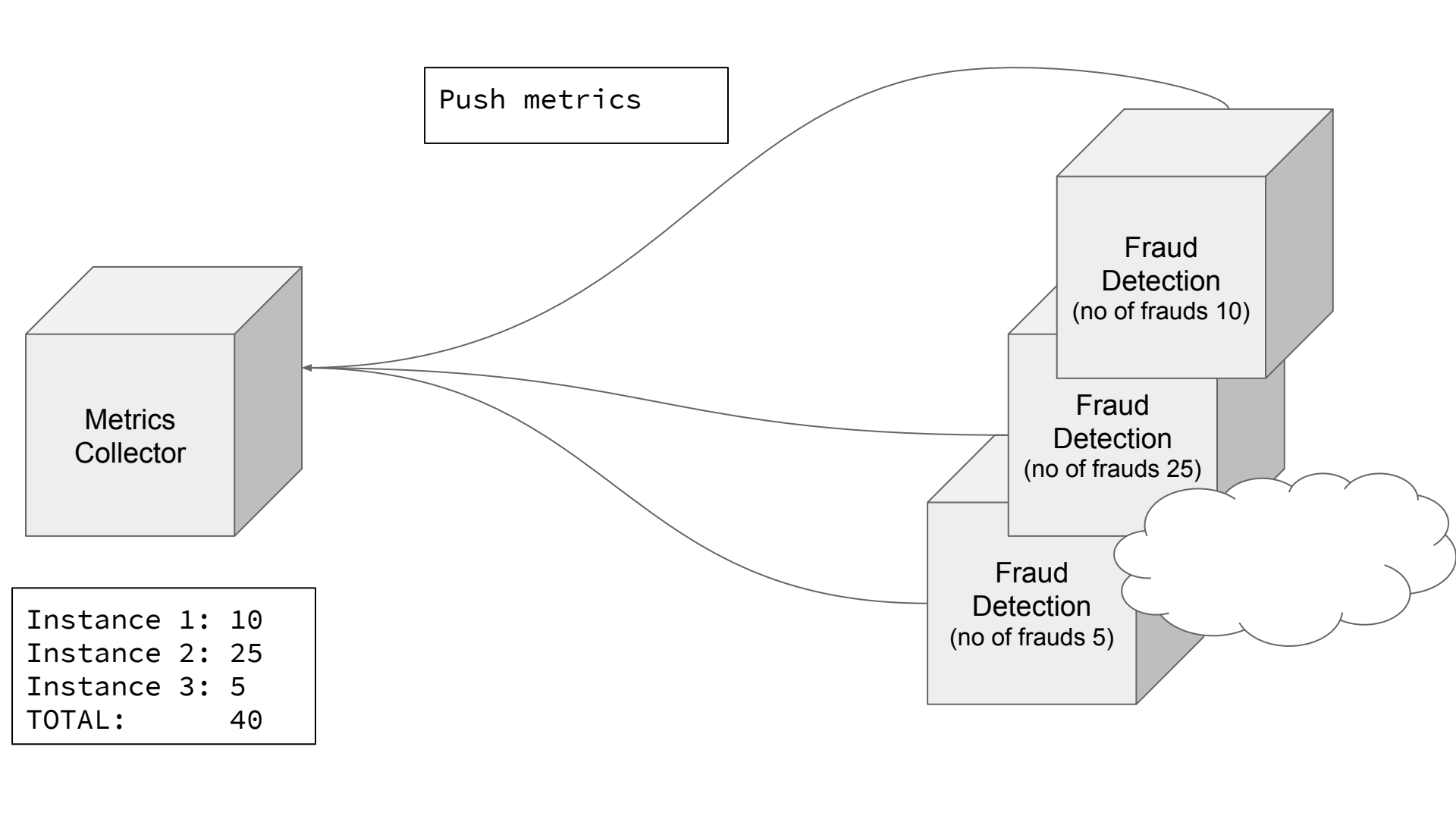
What is project Micrometer?

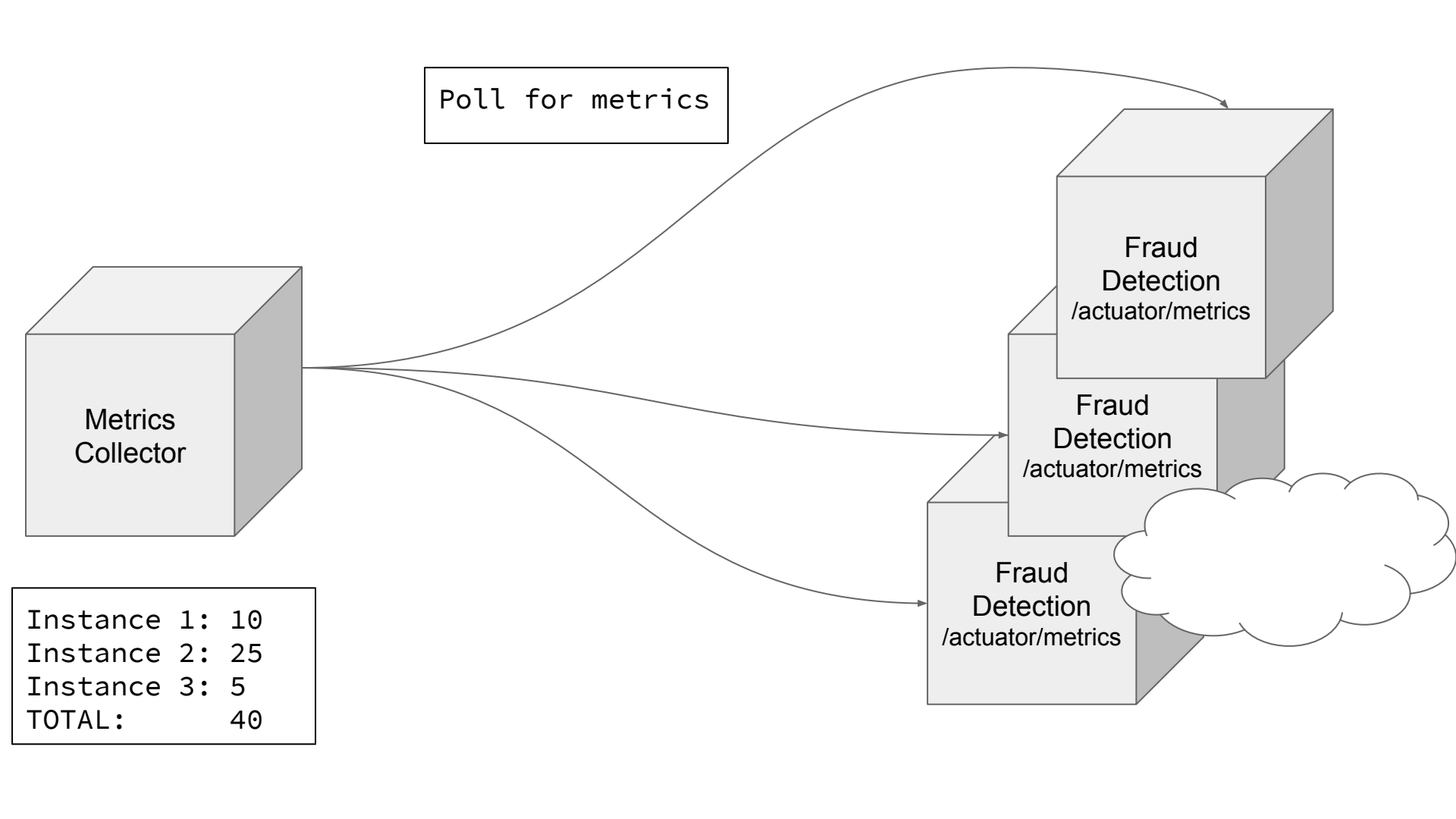
What is Prometheus and Grafana?

```
Total: 40
```


Fraud
Detection
(no of frauds 10)
Fraud
Detection
(no of frauds 25)
Fraud
Detection
(no of frauds 5)


Poll for metrics
Metrics Collector
Fraud Detection (no of frauds 10)
Fraud Detection (no of frauds 25)
Fraud Detection (no of frauds 5)
Instance 1: 10
Instance 2: 25
Instance 3: 5
TOTAL: 40


Push metrics
Metrics Collector
Fraud Detection (no of frauds 10)
Fraud Detection (no of frauds 25)
Fraud Detection (no of frauds 5)
Instance 1: 10
Instance 2: 25
Instance 3: 5
TOTAL: 40


Poll for metrics
Metrics Collector
Fraud Detection /actuator/metrics
Fraud Detection /actuator/metrics
Fraud Detection /actuator/metrics
Instance 1: 10
Instance 2: 25
Instance 3: 5
TOTAL: 40

What is Spring Boot Actuator?

Beyond 12 factor app: 14. Telemetry - Application treated like a space probe

Monitor and manage your application when you push it to production

- HTTP endpoints
- JMX

Auditing, health, and metrics

What is Spring Boot Actuator?

Metrics endpoint

- Not available by default
- Must be exposed
  - **management.endpoints.web.exposure.include=metrics**

/actuator/metrics

- List of available meter names
- **/actuator/metrics/{metric-name}** e.g. jvm.memory.max

Integrates with Micrometer

What is Micrometer?

Vendor-neutral application metrics facade

Instrument your app without vendor lock-in

Micrometer as an API over your monitoring system

What is Micrometer?

Brings dimensional metrics

Basing on the classpath ships metrics to a given backend

Support for AppOptics, Netflix Atlas, Prometheus...

What is Prometheus?

Open-source systems monitoring and alerting toolkit

Originally built at SoundCloud

What is Grafana?

The open observability platform

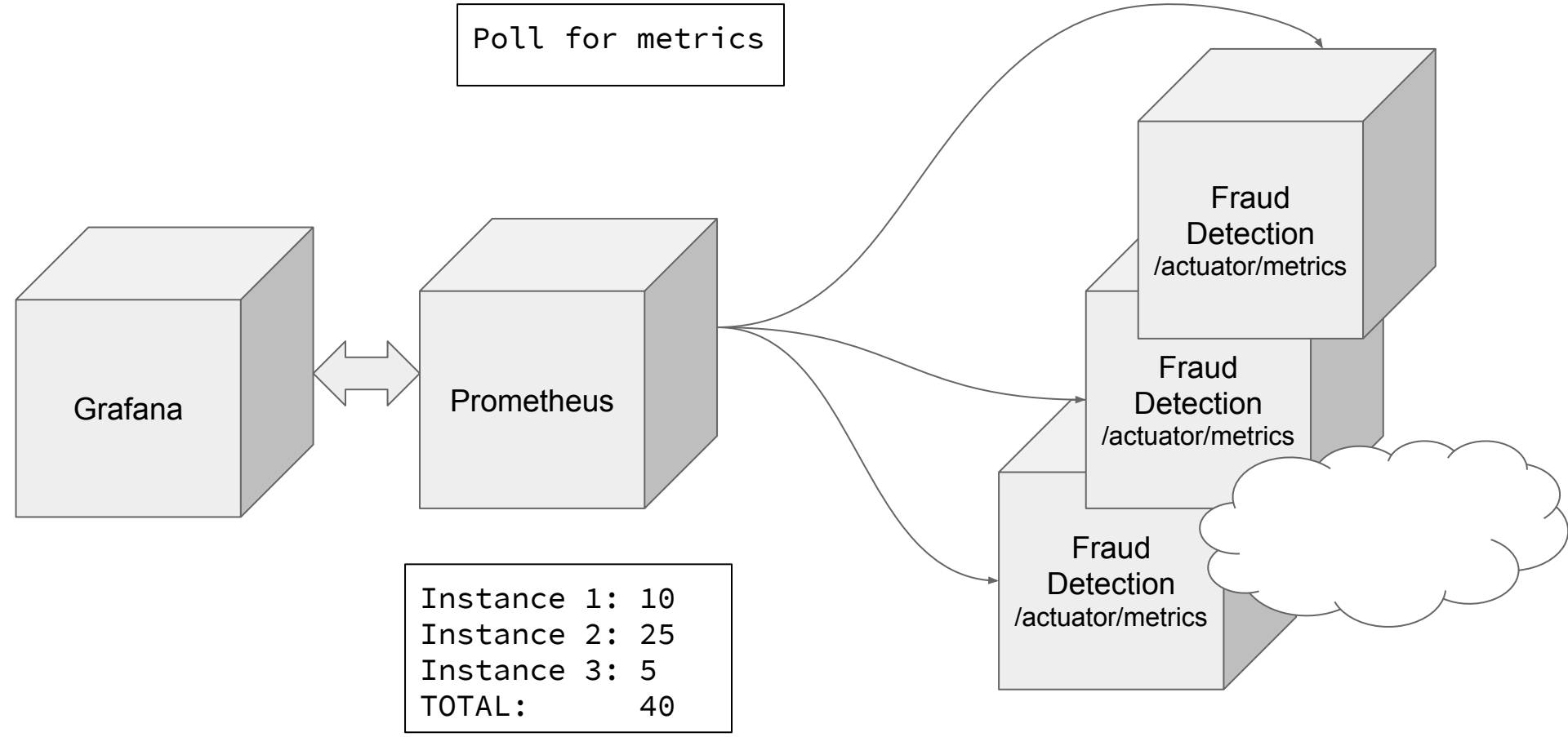
Query, visualize, alert on and understand your metrics

Consumes metrics from various databases

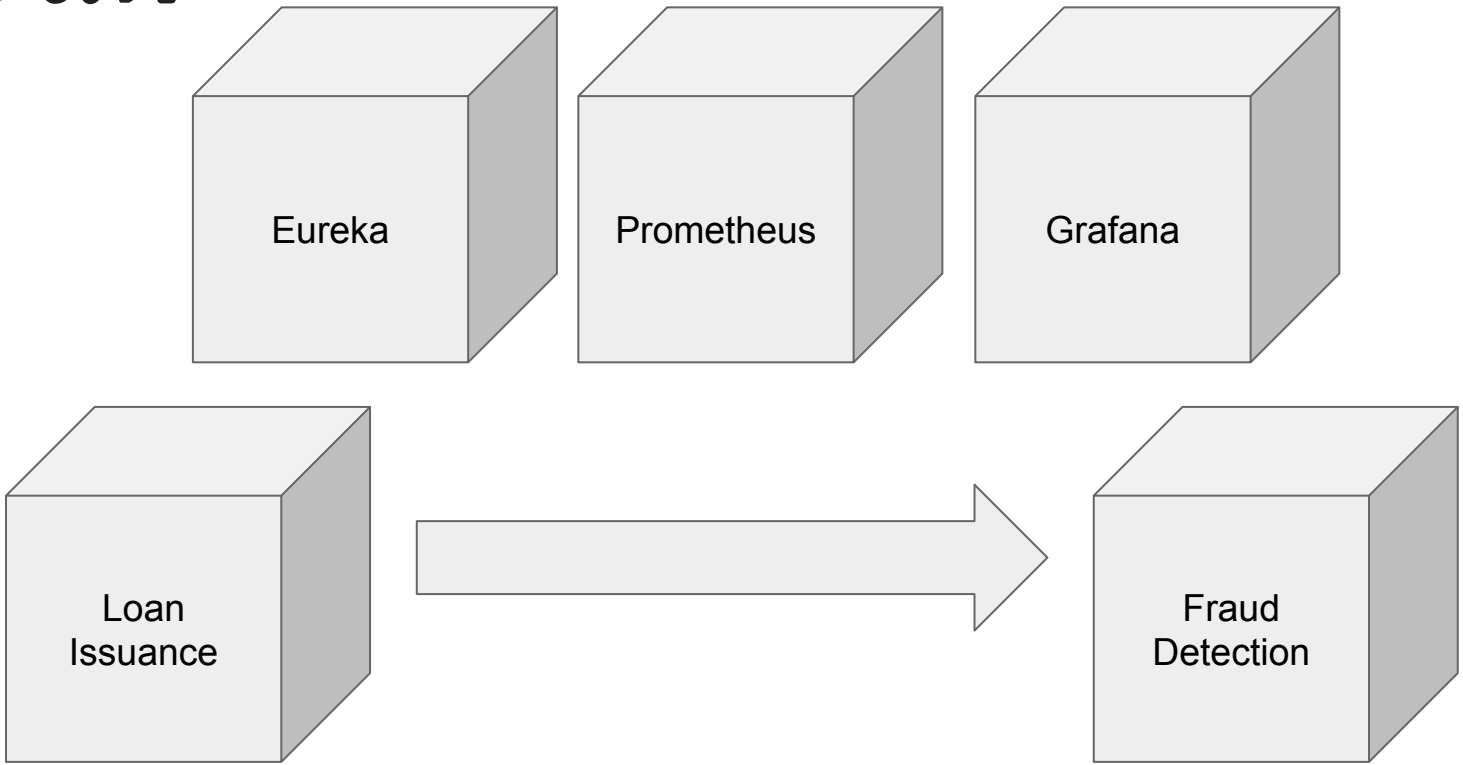
Allows to create, explore, and share dashboards

Micrometer & Prometheus & Grafana

```
<dependency>
    <groupId>io.micrometer</groupId>
    <artifactId>micrometer-registry-prometheus</artifactId>
 </dependency>
```


Poll for metrics
Grafana
Prometheus
Fraud Detection /actuator/metrics
Fraud Detection /actuator/metrics
Fraud Detection /actuator/metrics
Instance 1: 10
Instance 2: 25
Instance 3: 5
TOTAL: 40

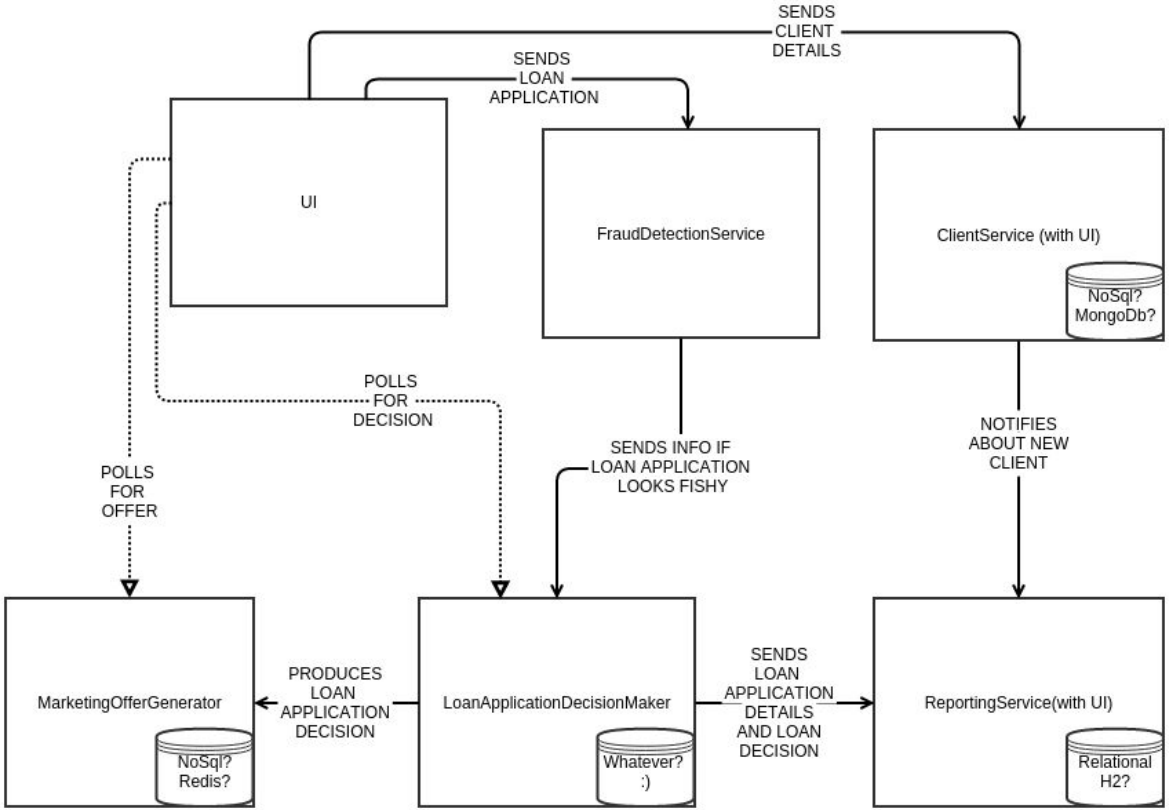
Let's Code



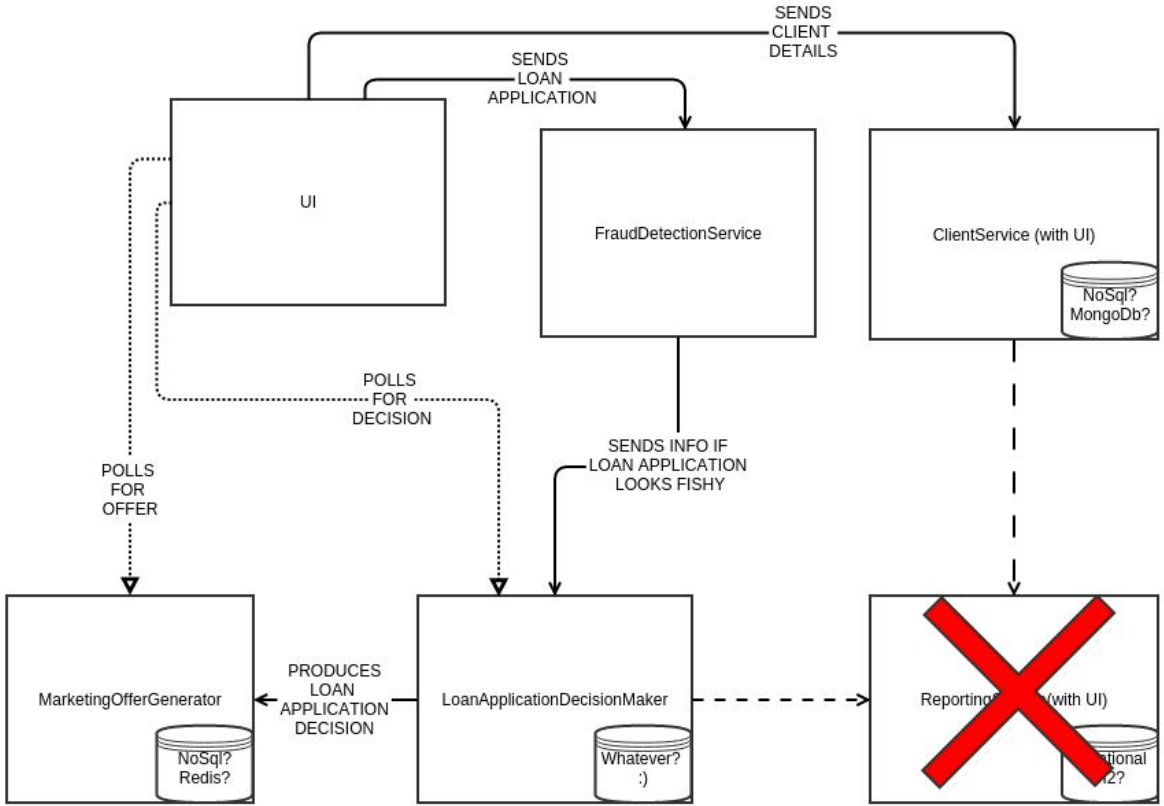
DEMO

SEGMENT 8

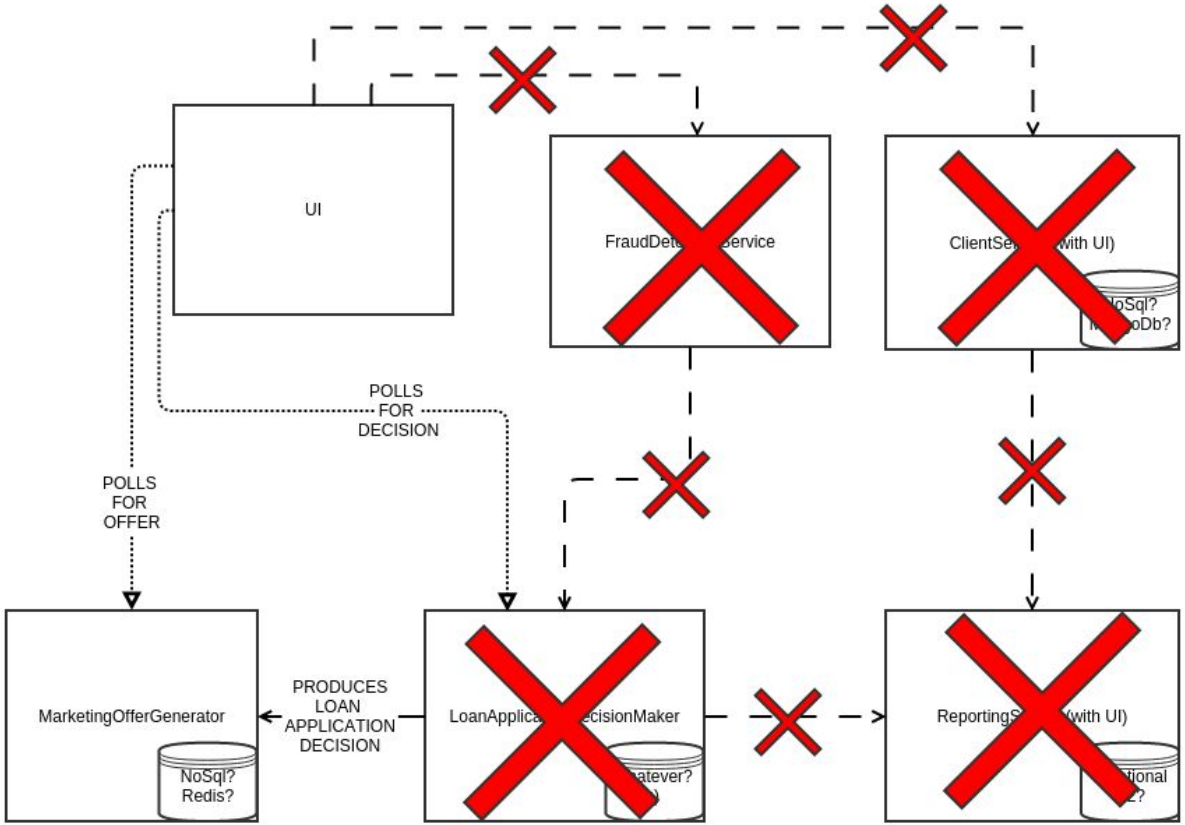
How can microservices not cascade failure?



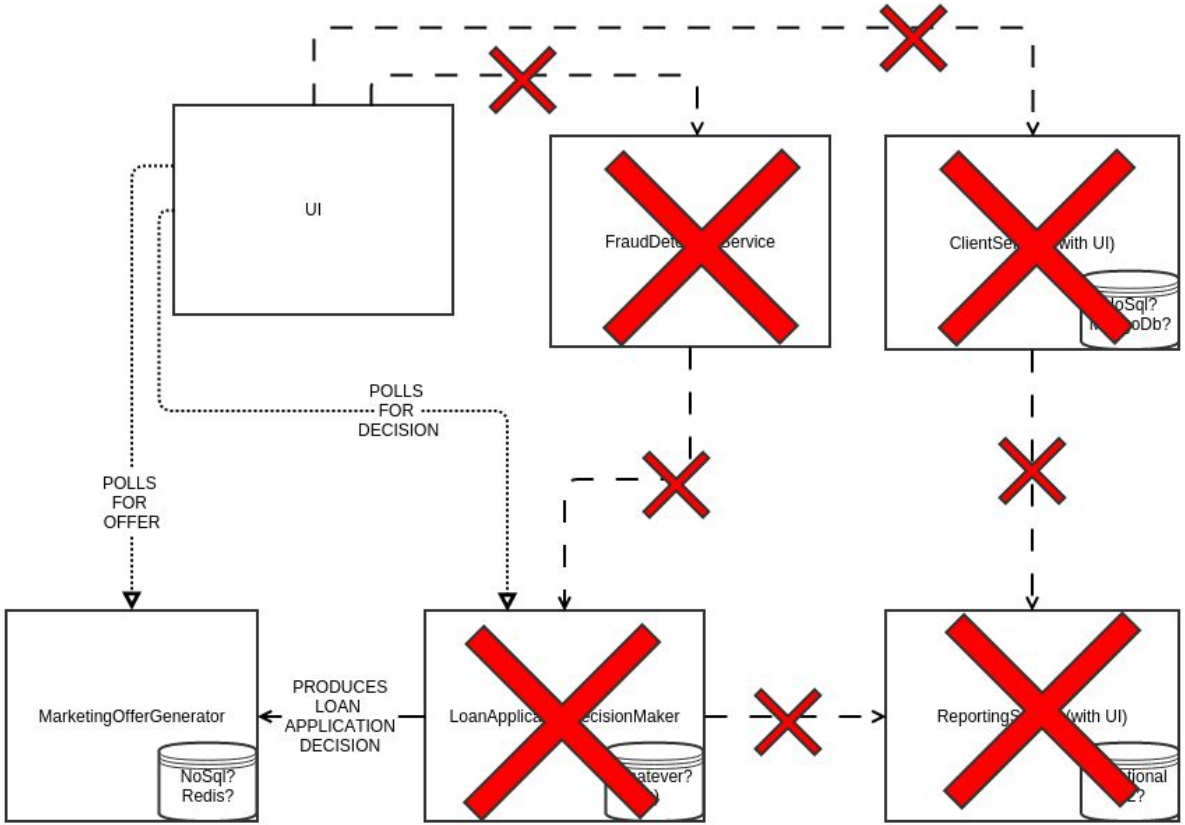
How can microservices not cascade failure?



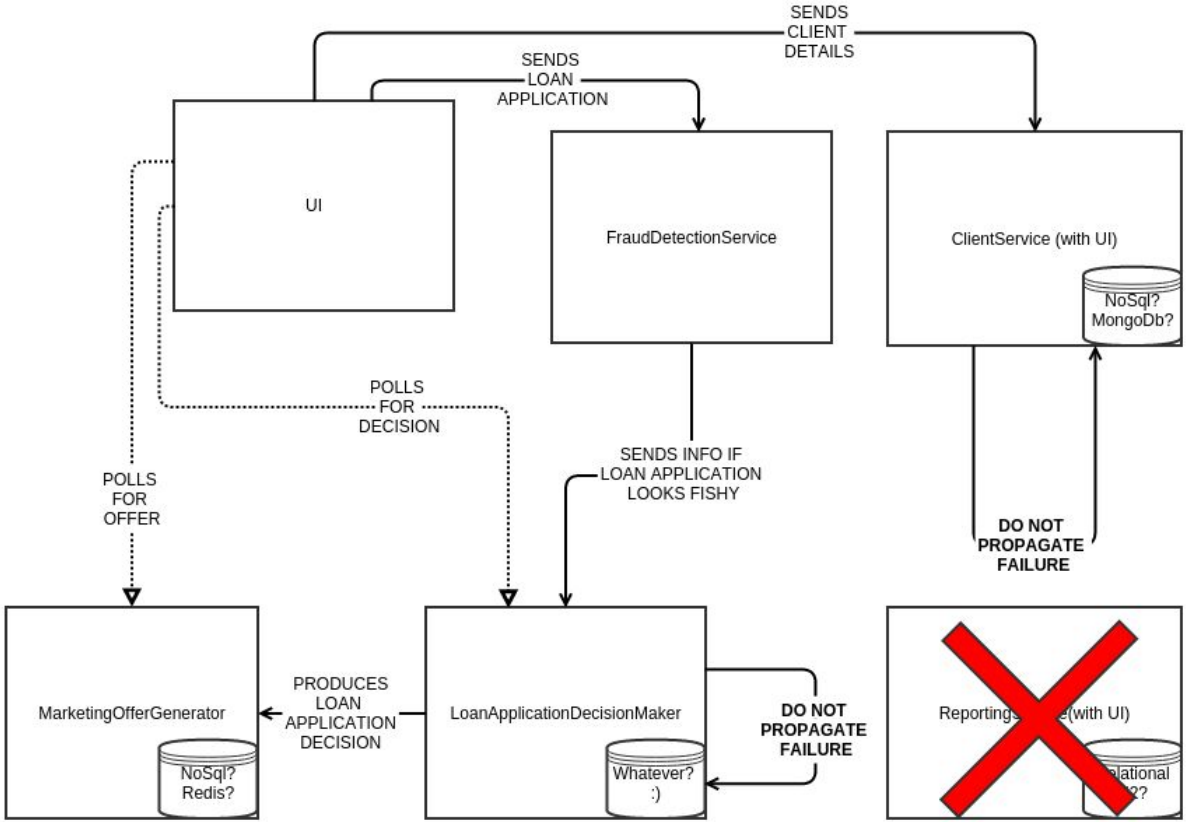
How can microservices not cascade failure?



How can microservices not cascade failure?



How can microservices not cascade failure?



What is a Circuit Breaker?

Design pattern

Detect failures

Prevent a failure from constantly recurring

What is a Circuit Breaker?

Implementations

- Netflix Hystrix (maintenance mode)
- Resilience4J

Abstractions

- Spring Cloud CircuitBreaker

What is Netflix Hystrix?

Initial work began in 2011 in one of Netflix teams

In 2012 Netflix adopted it internally

In 2018 Hystrix put in maintenance mode

Resilience4j

Lightweight fault tolerance library inspired by Hystrix

- Designed for Java 8 and functional programming

Uses Vavr as the only dependency

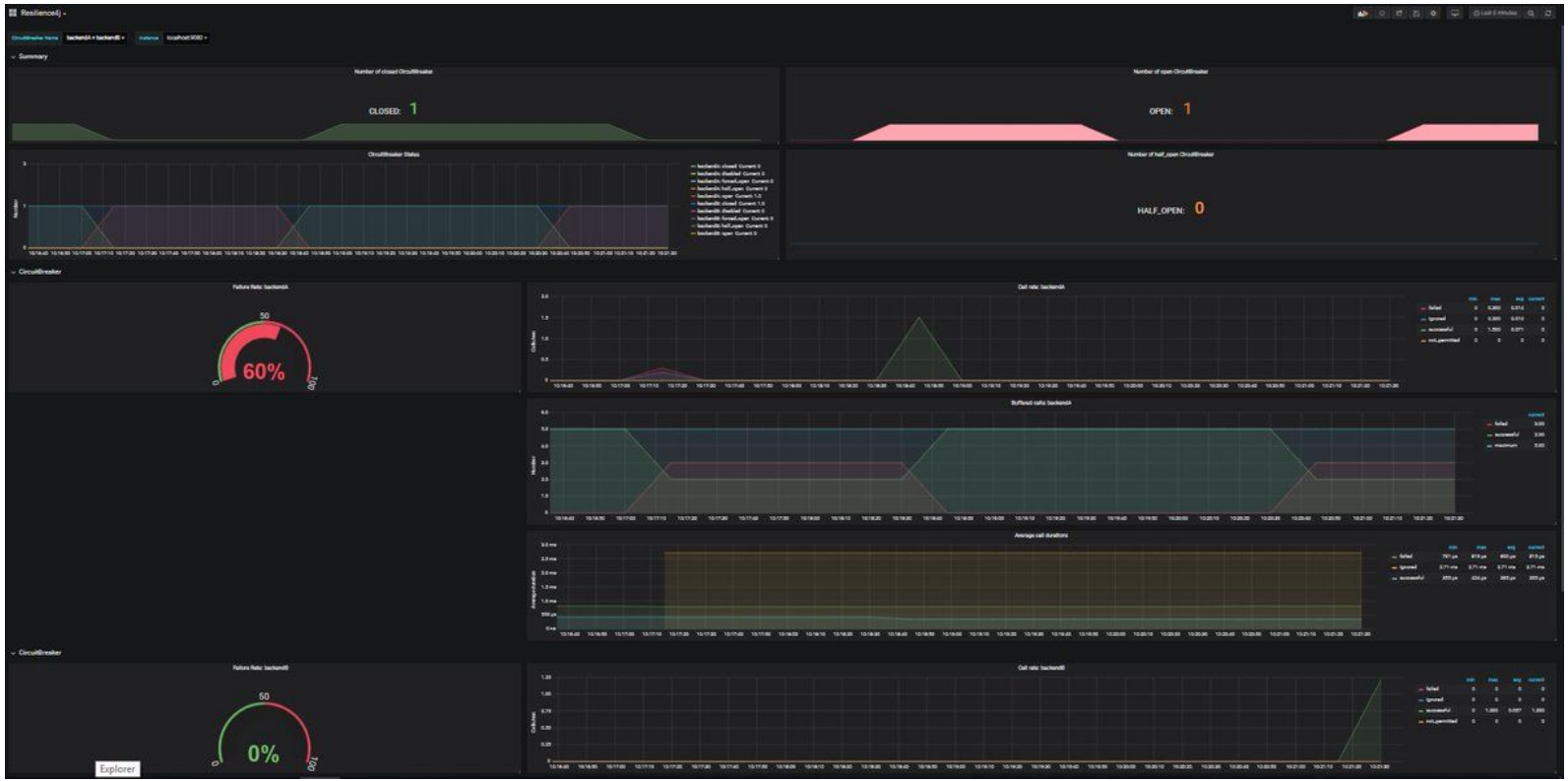
Resilience4j provides

- Circuit Breaker
- Rate Limiter
- Retry
- Bulkhead

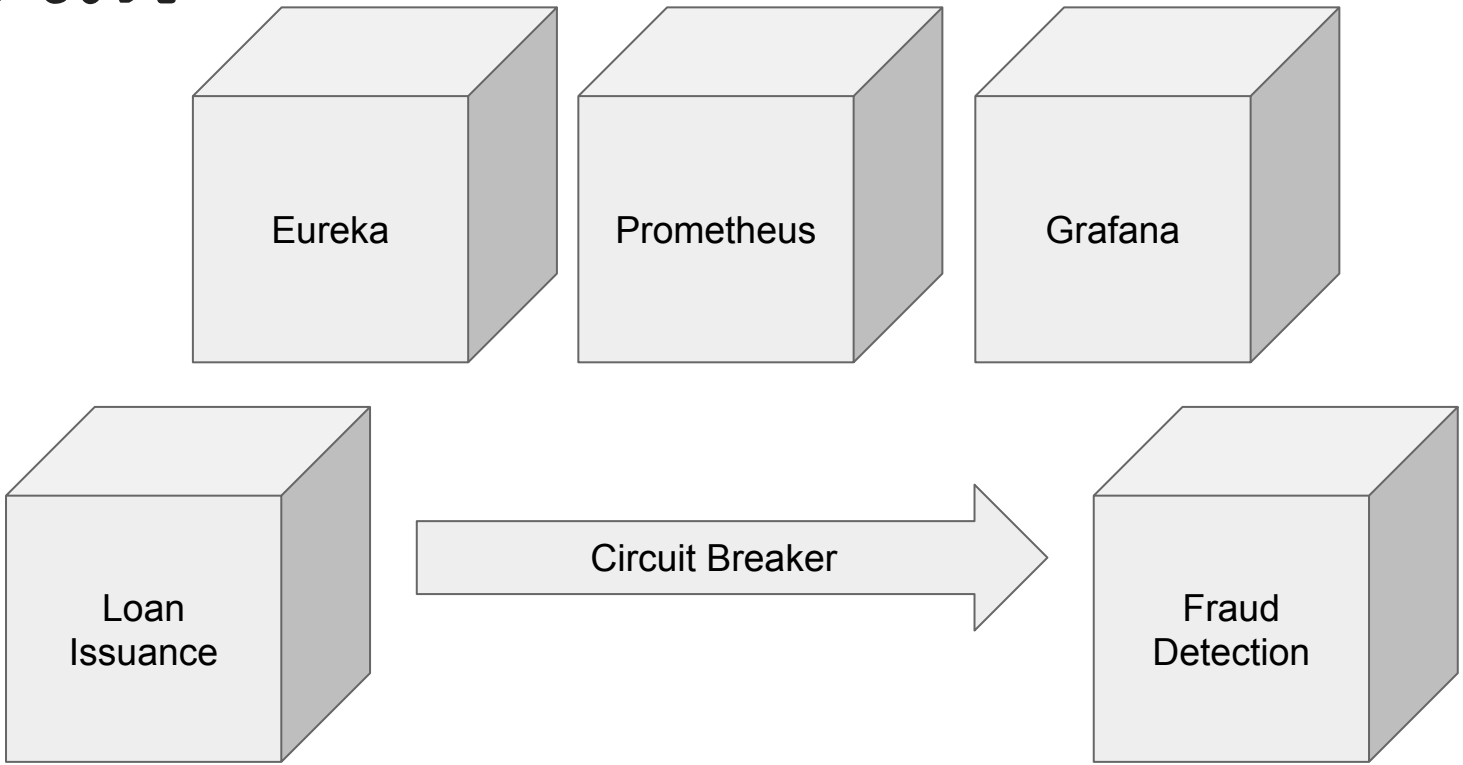
Resilience4j-Micrometer & Prometheus & Grafana

```
<dependency>
    <groupId>io.micrometer</groupId>
    <artifactId>micrometer-registry-prometheus</artifactId>
</dependency>
<dependency>
    <groupId>io.github.resilience4j</groupId>
    <artifactId>resilience4j-micrometer</artifactId>
</dependency>
```

Resilience4J-Micrometer & Prometheus & Grafana



Let's Code



DEMO

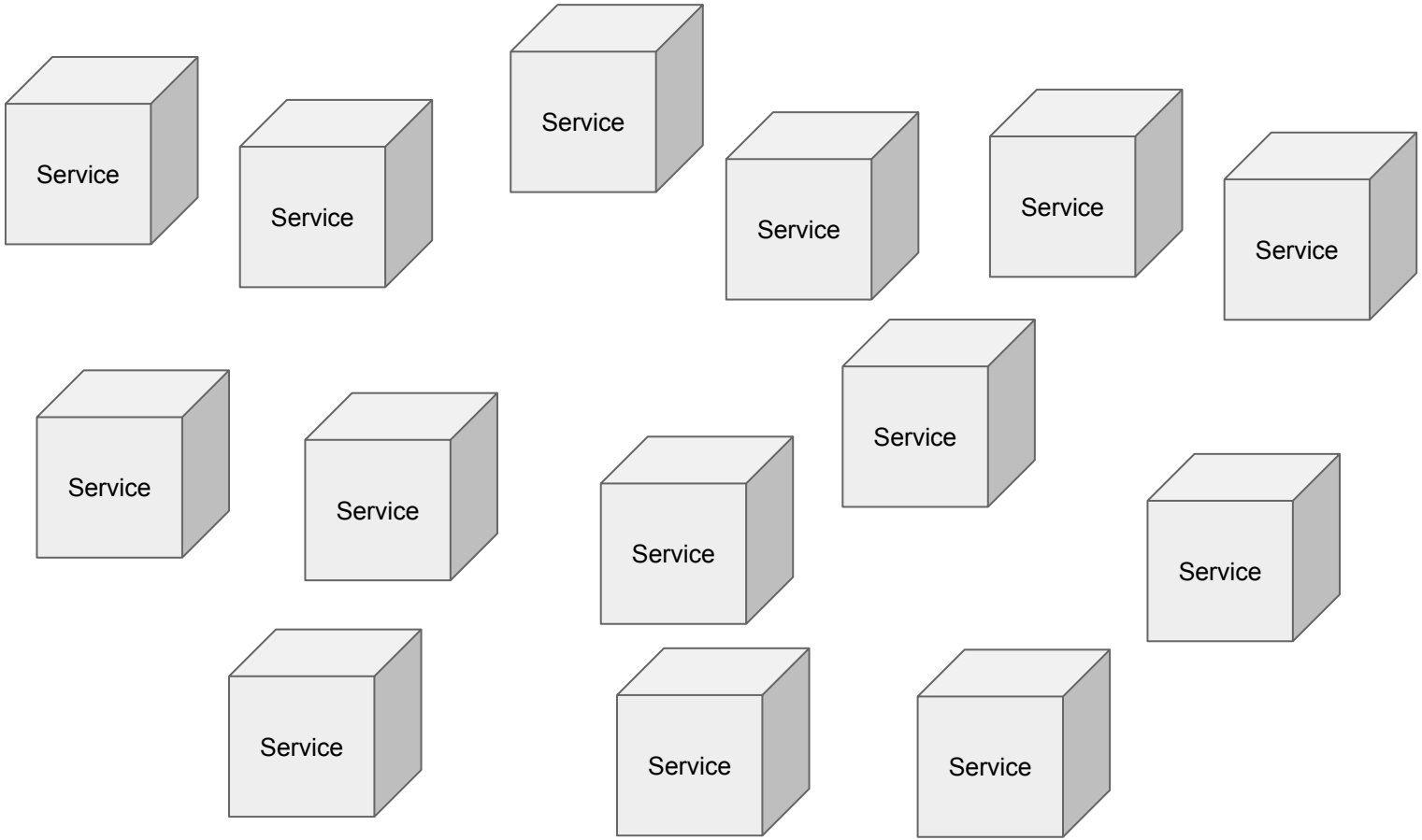
SEGMENT 9

How can microservices Be Traced?

What is distributed tracing?

What is Spring Cloud Sleuth?

What is project Zipkin?


Service
Service
Service
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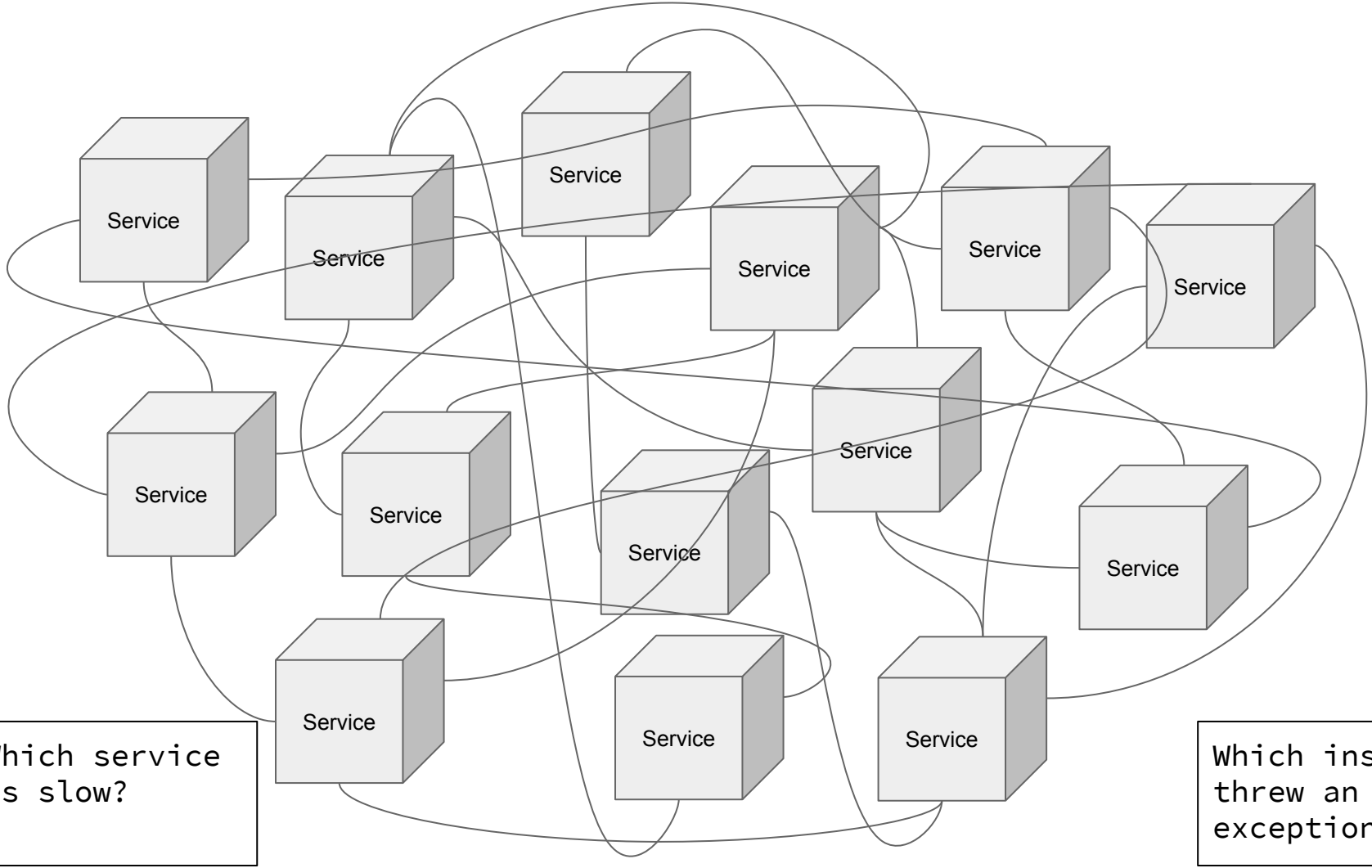
Service
Service
Service
Service
Service


Service
Service
Service
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Service
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Service
Service
Service
Service
Service
Service
Service
Service
Service
Which service is slow?
Which instance threw an exception?

What is a Span?

The basic unit of work (e.g. sending RPC)

They keep track of their timing information

Once you create a span, you must stop it at some point in the future

Has a parent and can have multiple children

All spans have unique span ids

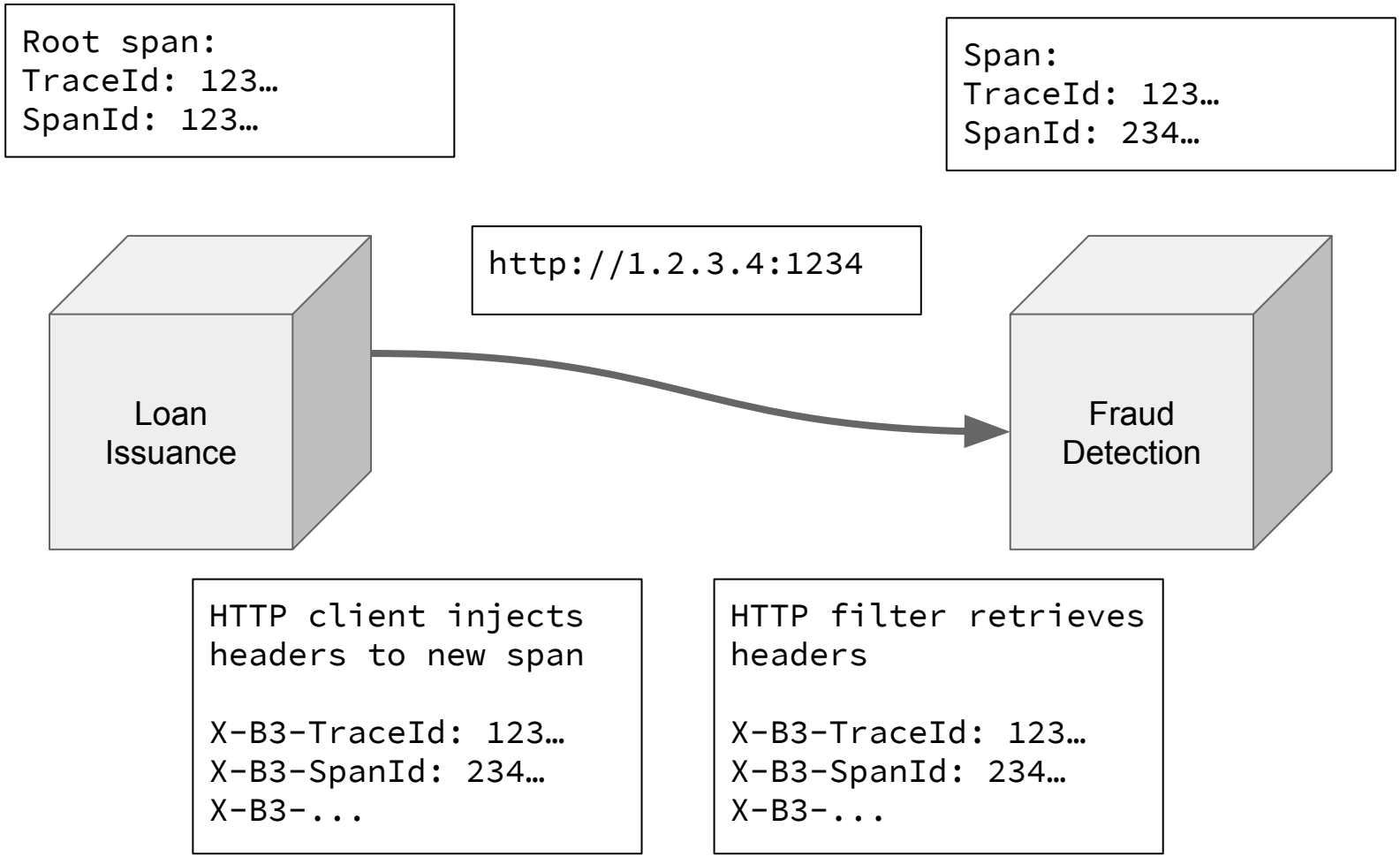
Spans in a single hierarchy share a trace id

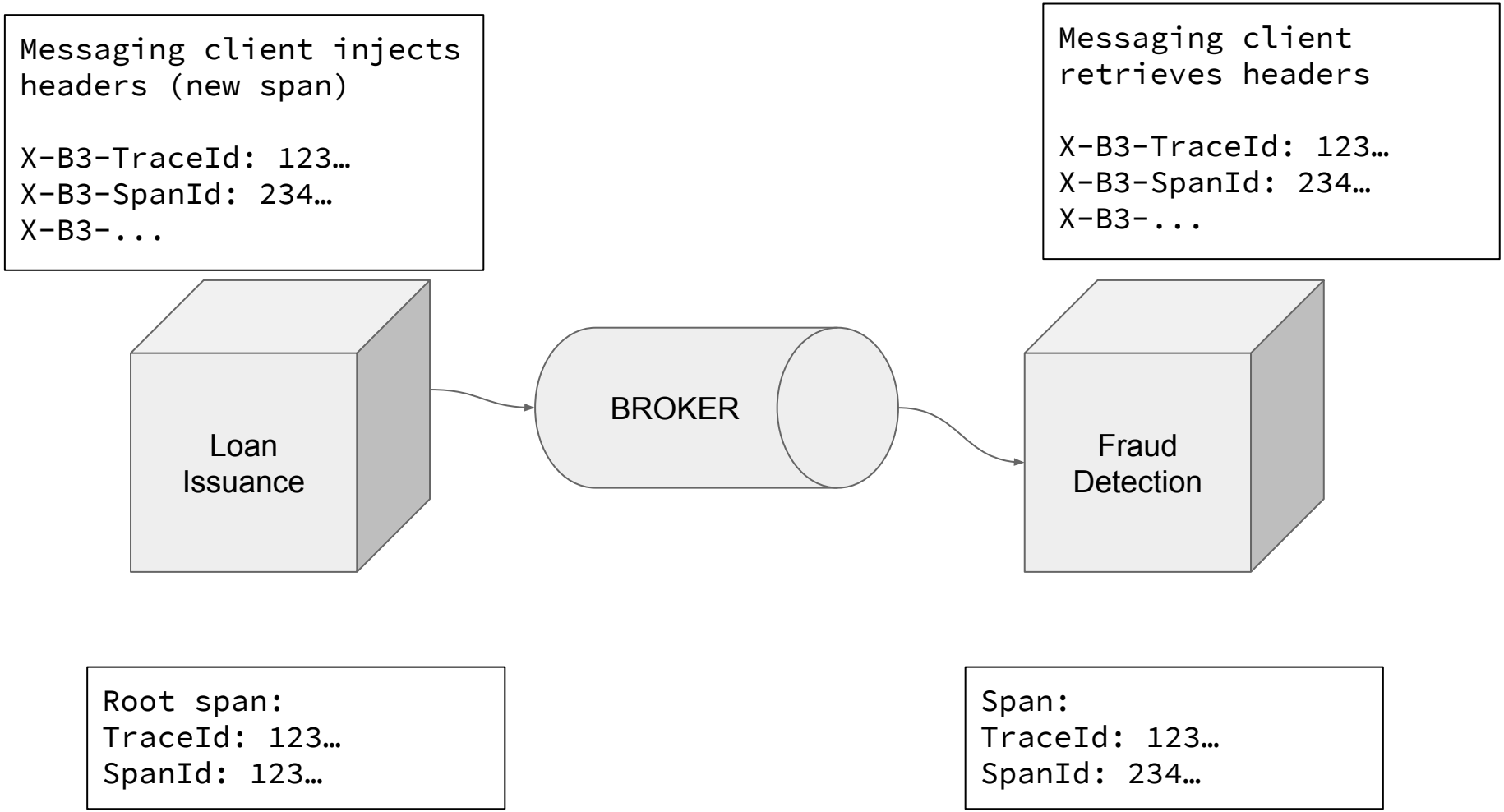
What is a Trace?

A set of spans forming a tree-like structure.

For example, if you are running a bookstore then

- Trace could be retrieving a list of available books
- Assuming that to retrieve the books you have to
  - Send 3 requests to 3 services
  - You could have at least 3 spans (1 for each hop)
  - Forming 1 trace


Root span:
TraceId: 123…
SpanId: 123…
Span:
TraceId: 123…
SpanId: 234…
http://1.2.3.4:1234
Loan
Issuance
Fraud
Detection
HTTP client injects
headers to new span
X-B3-TraceId: 123…
X-B3-SpanId: 234…
X-B3-...
HTTP filter retrieves
headers
X-B3-TraceId: 123…
X-B3-SpanId: 234…
X-B3-...


Messaging client injects headers (new span)
X-B3-TraceId: 123…
X-B3-SpanId: 234…
X-B3-...
Messaging client retrieves headers
X-B3-TraceId: 123…
X-B3-SpanId: 234…
X-B3-...
Loan Issuance
BROKER
Fraud Detection
Root span:
TraceId: 123…
SpanId: 123…
Span:
TraceId: 123…
SpanId: 234…

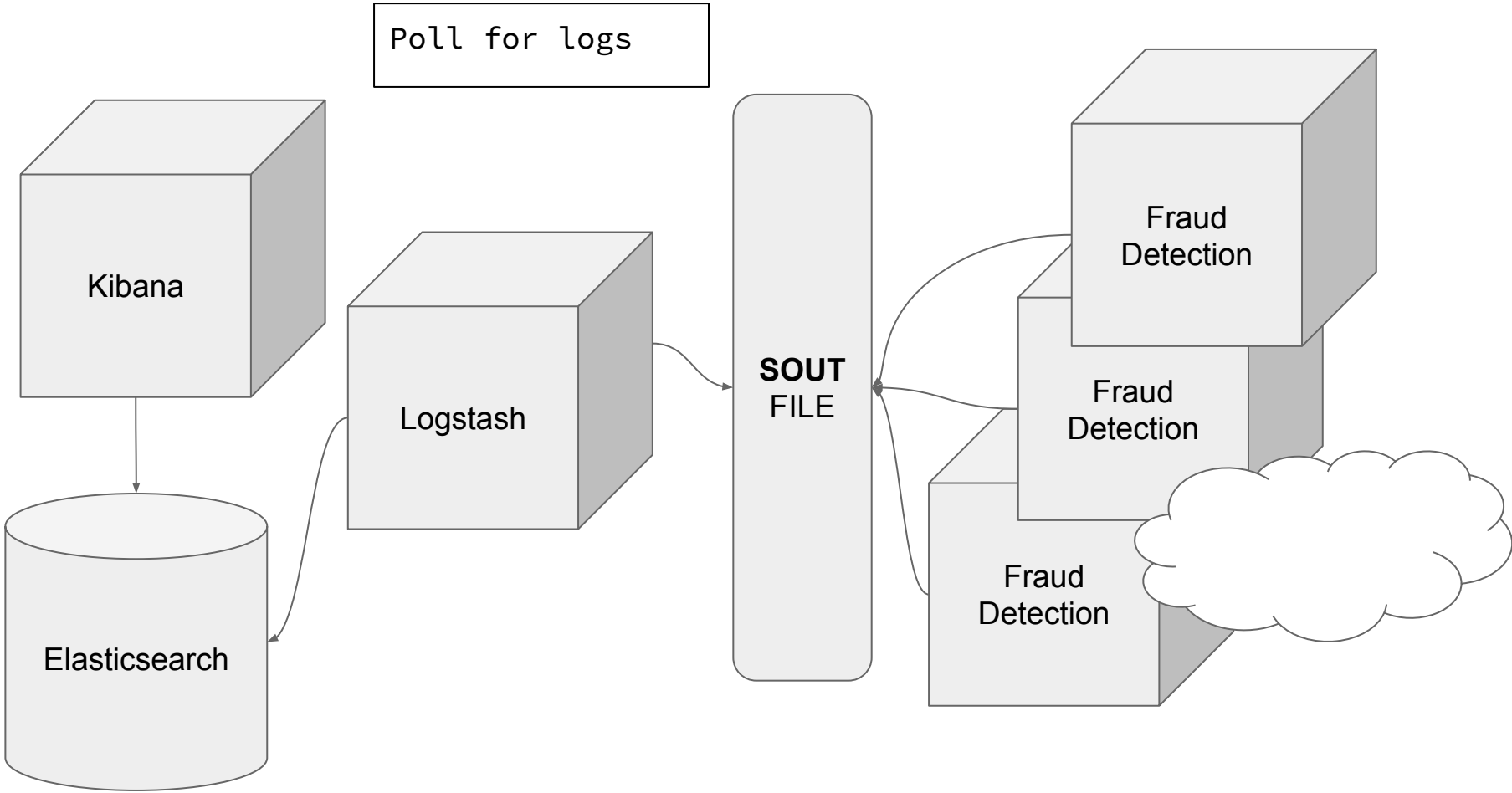
How can microservices Be Traced?

Spring Cloud Sleuth

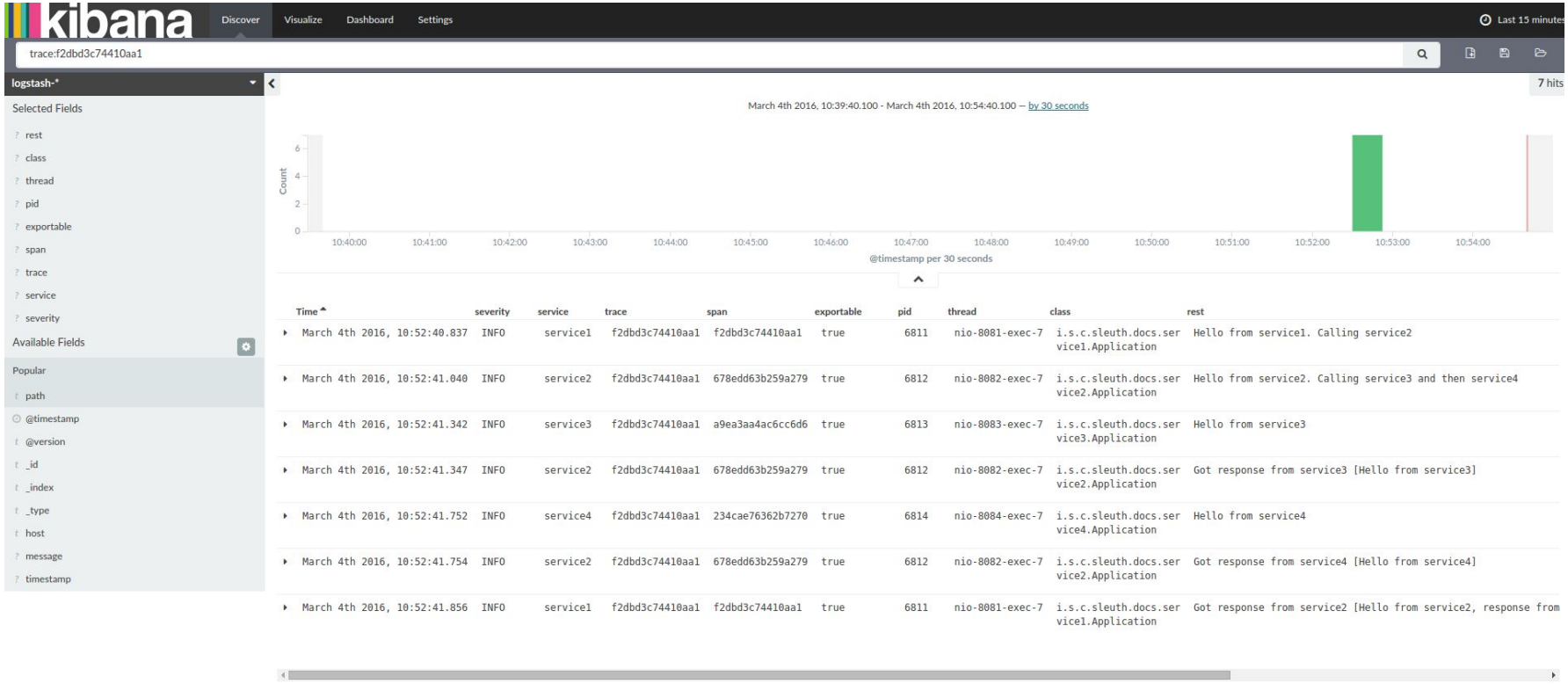
- Log correlation

Project Zipkin

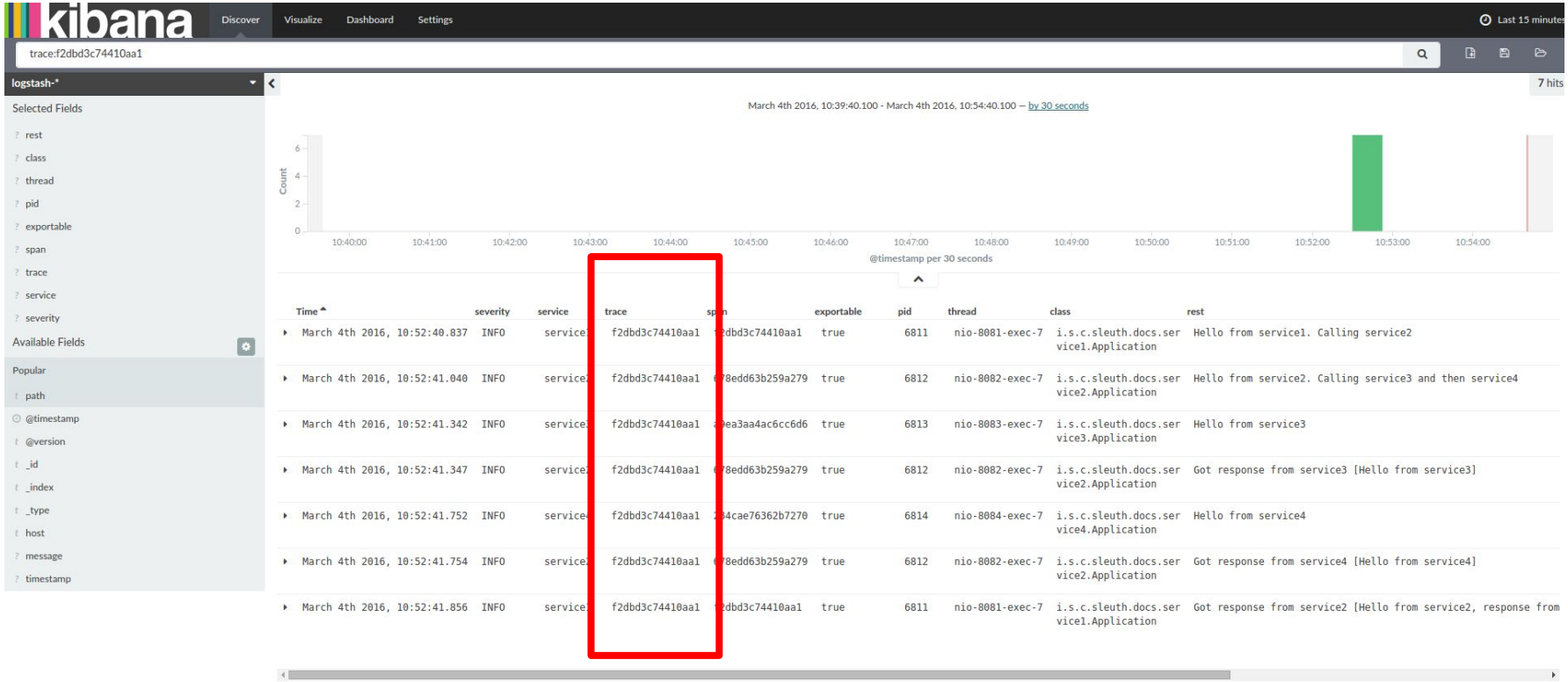
- Latency analysis

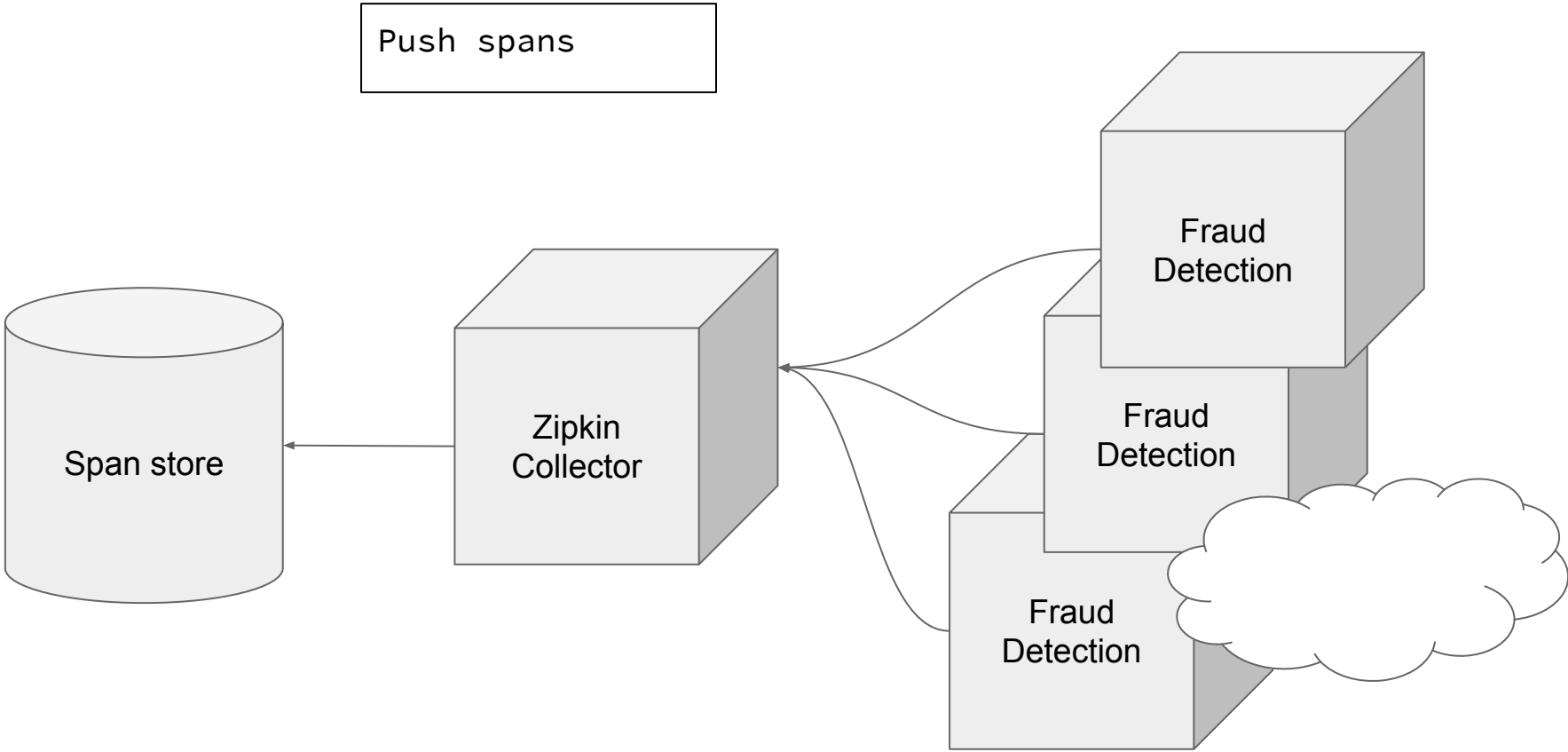

Poll for logs
Kibana
Logstash
SOUT
FILE
Fraud
Detection
Fraud
Detection
Fraud
Detection
Elasticsearch

How can microservices Be Traced?

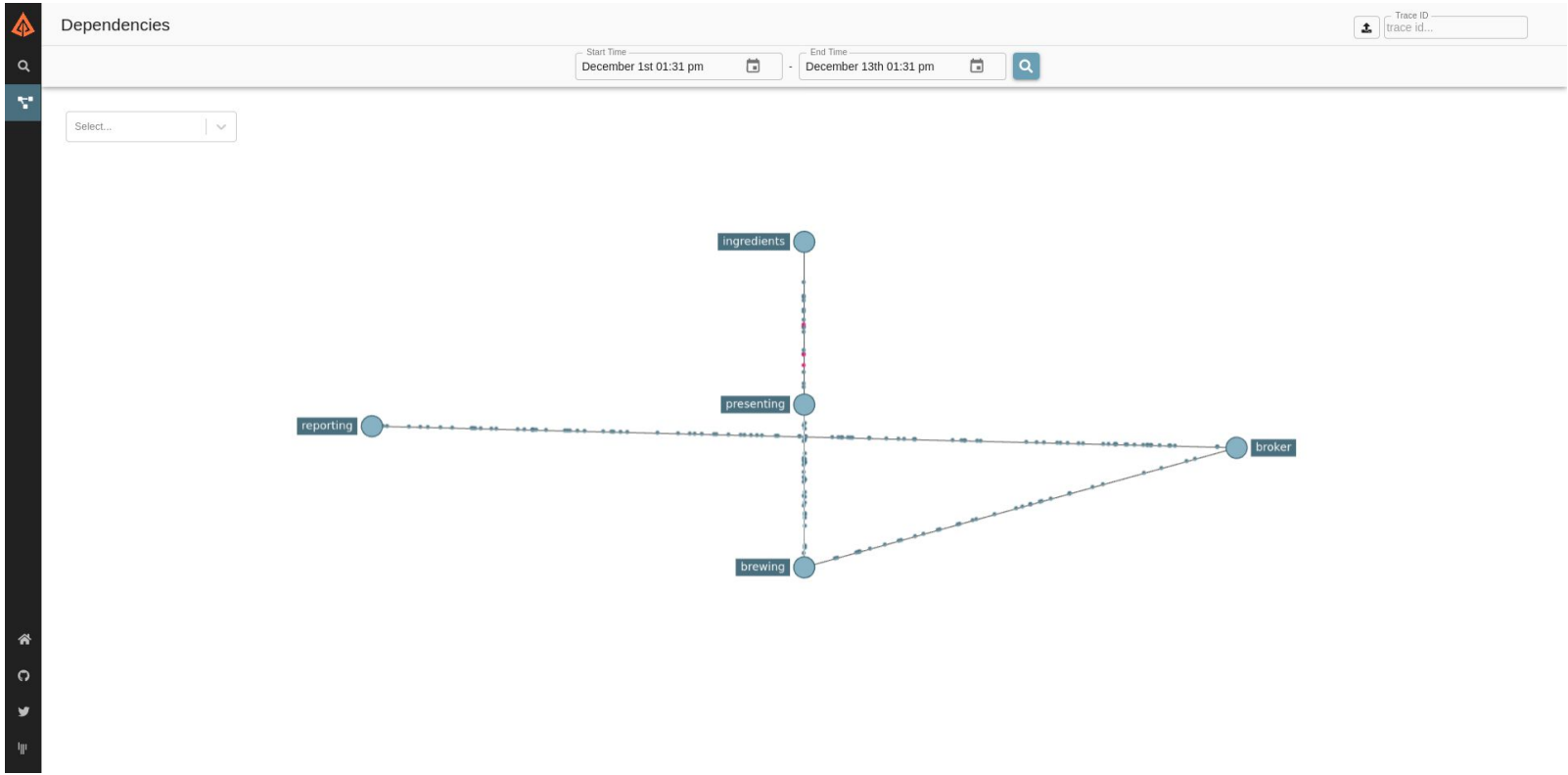


How can microservices Be Traced?

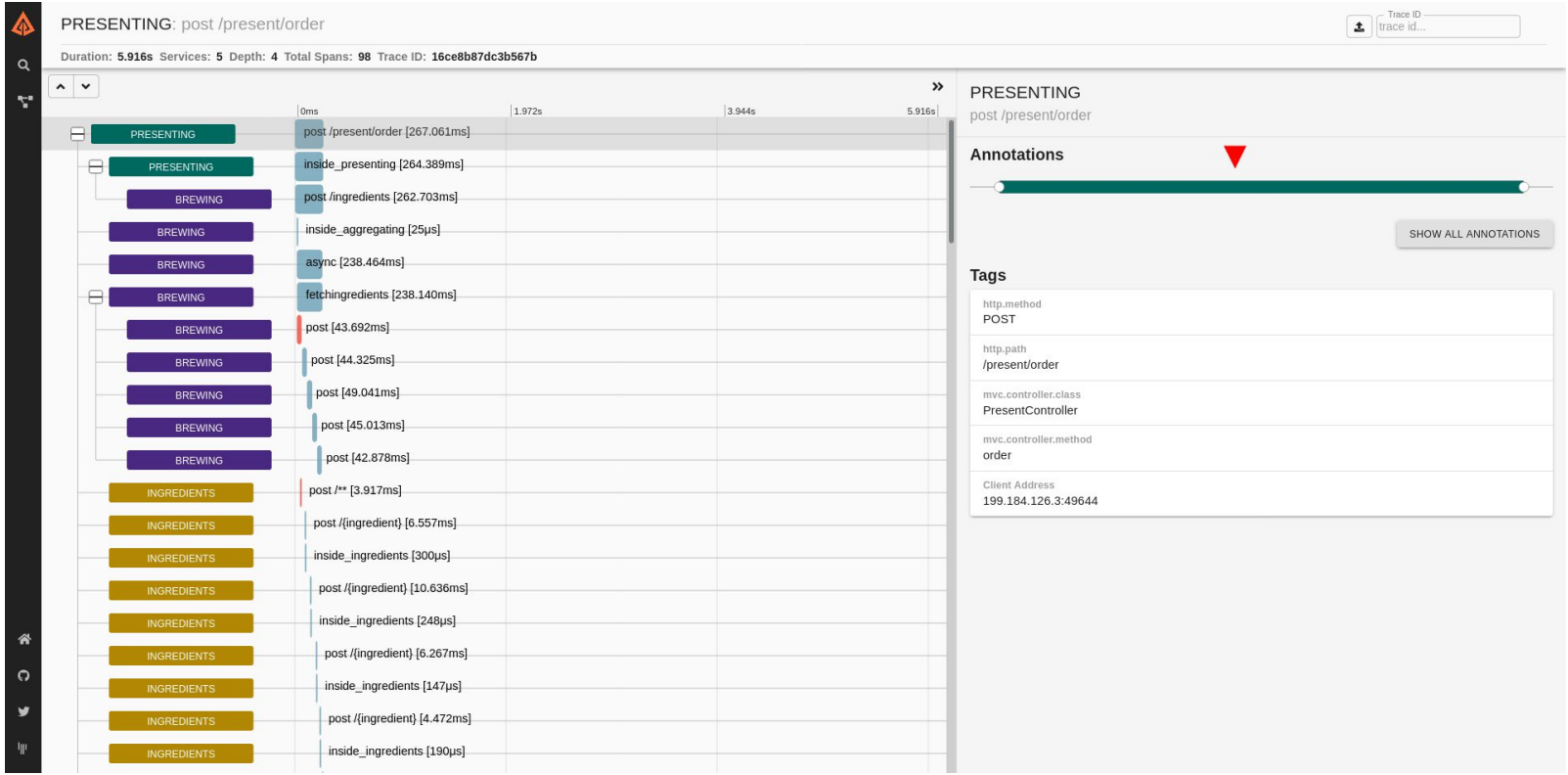



Push spans
Fraud Detection
Fraud Detection
Fraud Detection
Zipkin Collector
Span store

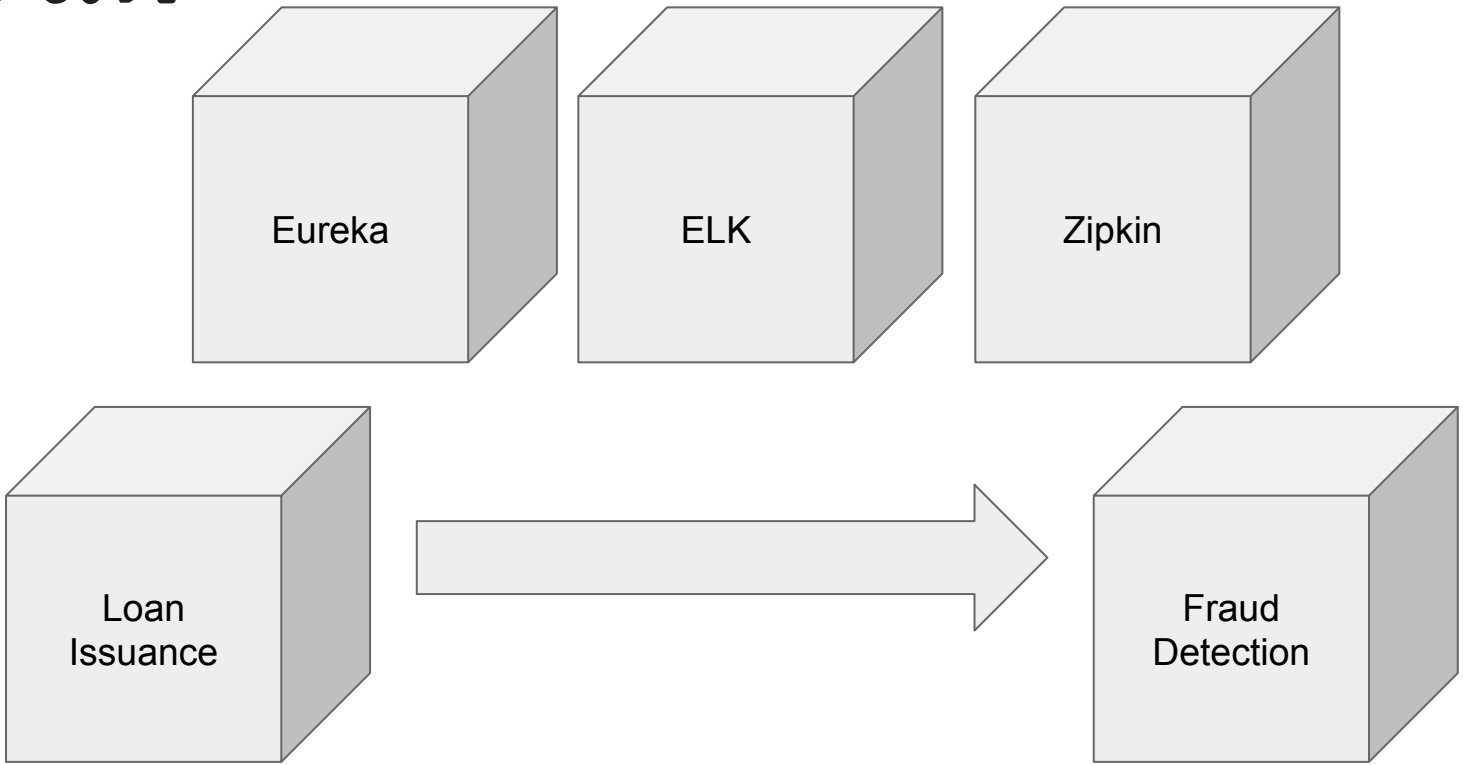
Zipkin with Lens UI



Zipkin with Lens UI



Let's Code



DEMO

Part 3 - Assignment

Assignment:

In this lab, students will either

a) Use the Micrometer project to create custom metrics in their Spring Cloud based applications, generated via Spring Initialzr.

b) Use Spring Cloud Circuit Breaker to wrap the calls from one application to another.

c) Add Spring Cloud Sleuth to the classpath to see the latency analysis in the Zipkin project.

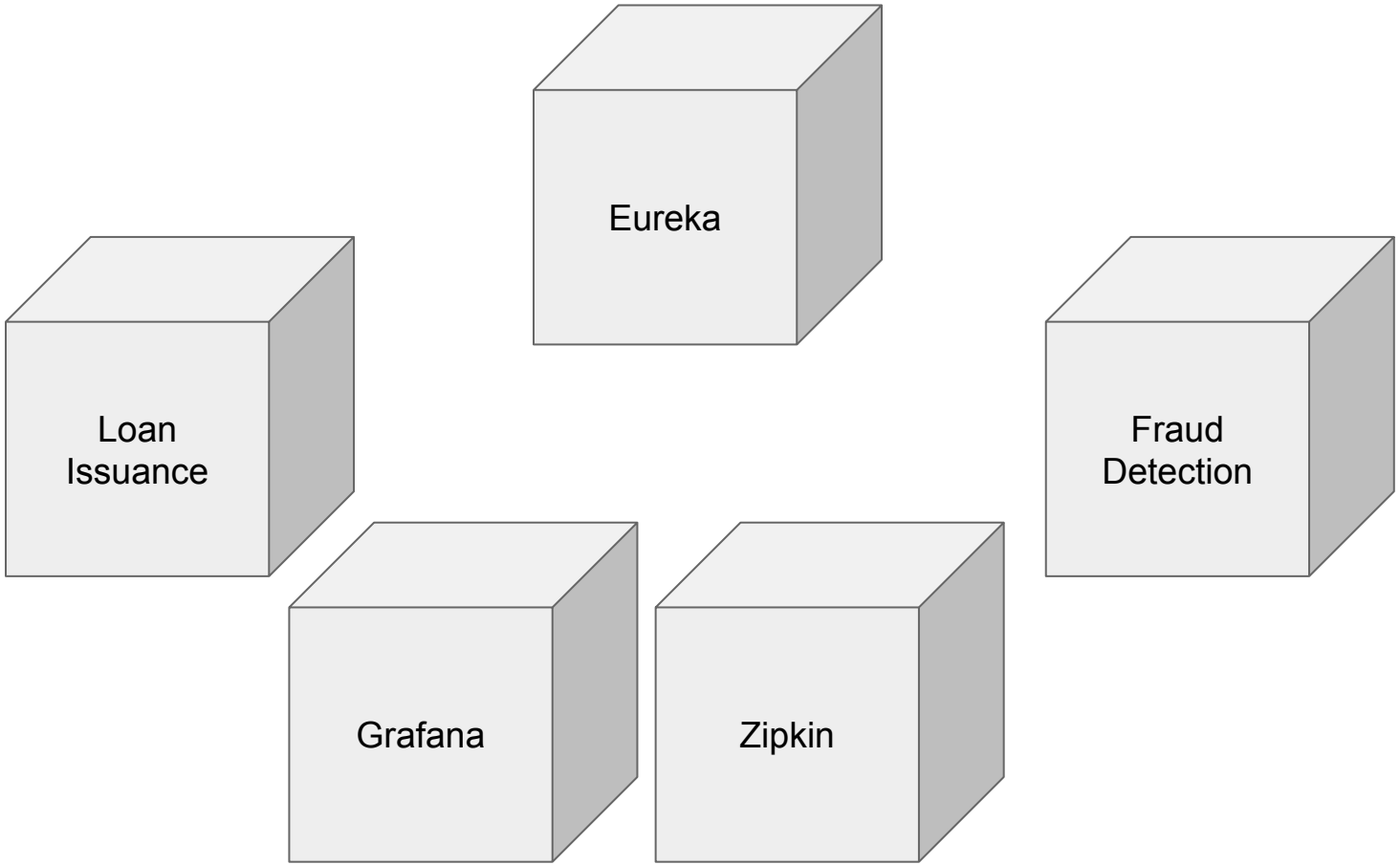
Part 3 - Assignment

Bonus:

a) Via Resilience4j and Micrometer Prometheus integration we will be able to gather metrics in Prometheus and display them in Grafana

b) Perform all three subsections

Assignment time (15 min)


Eureka
Loan
Issuance
Fraud
Detection
Grafana
Zipkin

Part 3 - Assignment

https://tinyurl.com/spring-cloud-workshops-2#assignment-3

https://gist.github.com/marcingrzejszczak/ae5da2606a21dc8144f8e212d786c91e#assignment-3

PART 4

How can we implement an API gateway in a distributed system?

How can we work with messaging when dealing with microservices?

SEGMENT 10

How can we implement an API gateway in a distributed system?

What is an API Gateway?

What is Spring Cloud Gateway?

API Gateway - the benefits

Separation of system clients from

- Services API
- Services location

Might lower the communication chattiness (lower number of calls)

Moves the API complexity from the client to the gateway

Abstracts the internal protocols by using a common API

API Gateway - the drawbacks

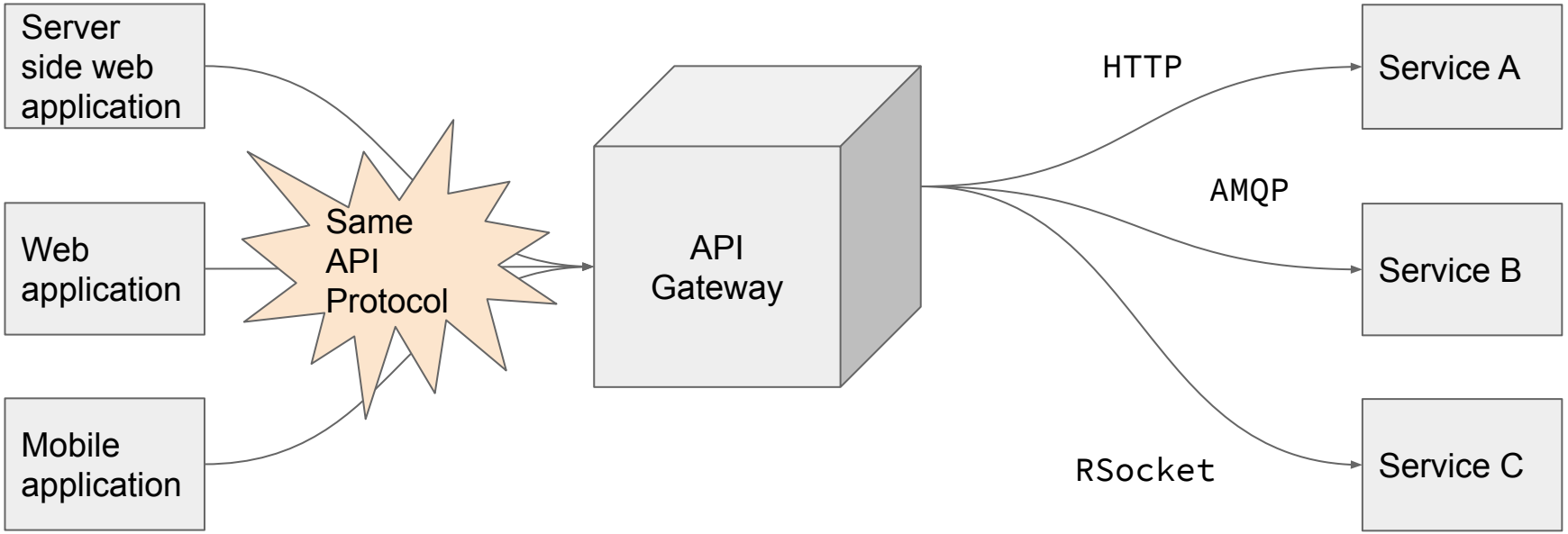
Complexity

The gateway has to be deployed and managed

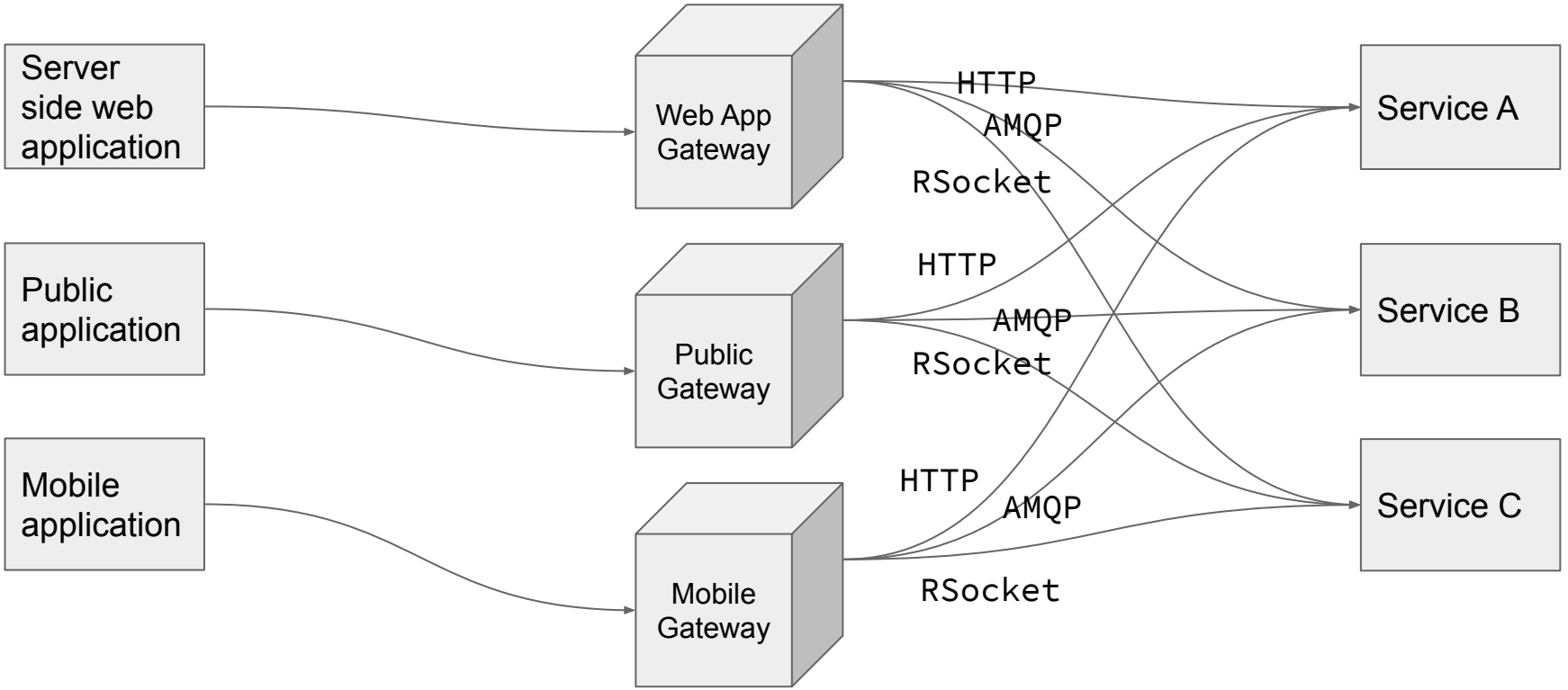
Latency

Additional hop to perform a business request

What is an API Gateway?



What is Backend for Frontend?



What is Spring Cloud Gateway

Built on top of Spring 5, Spring Boot 2 and Project Reactor

Route to APIs

Provide cross cutting concerns

- Security
- Monitoring/metrics
- Resiliency

What is Spring Cloud Gateway

Route

- ID
- Destination URI
- Predicates
- Filters

Route matched if the aggregate predicate is true

What is Spring Cloud Gateway

Predicate

- Java 8 Function `Predicate`
- Input type is a Spring Framework `ServerWebExchange`
- Match on anything from the HTTP request

What is Spring Cloud Gateway

Filter

- Spring Framework `GatewayFilter`
- Constructed with a specific factory
- You can modify requests and responses
  - Before sending the downstream request
  - After sending the downstream request

What is Spring Cloud Gateway

The After Route Predicate Factory

```yaml
spring:
  cloud:
    gateway:
      routes:
      - id: after_route
        uri: https://example.org
        predicates:
        - After=2017-01-20T17:42:47.789-07:00[America/Denver]
```

[1] - https://cloud.spring.io/spring-cloud-gateway/reference/html/

What is Spring Cloud Gateway

The AddRequestHeader GatewayFilter Factory

```yaml
spring:
  cloud:
    gateway:
      routes:
      - id: add_request_header_route
        uri: https://example.org
        filters:
        - AddRequestHeader=X-Request-red, blue
```

[1] - https://cloud.spring.io/spring-cloud-gateway/reference/html/

What is Spring Cloud Gateway

4. Route Predicate Factories
   - **4.1. The After Route Predicate Factory**
   - 4.2. The Before Route Predicate Factory
   - 4.3. The Between Route Predicate Factory
   - 4.4. The Cookie Route Predicate Factory
   - 4.5. The Header Route Predicate Factory
   - 4.6. The Host Route Predicate Factory
   - 4.7. The Method Route Predicate Factory
   - 4.8. The Path Route Predicate Factory
   - 4.9. The Query Route Predicate Factory
   - 4.10. The RemoteAddr Route Predicate Factory
   - 4.11. The Weight Route Predicate Factory

5. GatewayFilter Factories
- 5.1. The AddRequestHeader GatewayFilter Factory
- 5.2. The AddRequestParameter GatewayFilter Factory
- 5.3. The AddResponseHeader GatewayFilter Factory
- 5.4. The DedupeResponseHeader GatewayFilter Factory
- 5.5. The Hystrix GatewayFilter Factory
- 5.6. Spring Cloud CircuitBreaker GatewayFilter Factory
- 5.7. The FallbackHeaders GatewayFilter Factory
- 5.8. The MapRequestHeader GatewayFilter Factory
- 5.9. The PrefixPath GatewayFilter Factory
- 5.10. The PreserveHostHeader GatewayFilter Factory
- 5.11. The RequestRateLimiter GatewayFilter Factory
- 5.12. The RedirectTo GatewayFilter Factory
- 5.13. The RemoveHopByHopHeadersFilter GatewayFilter Factory
- 5.14. The RemoveRequestHeader GatewayFilter Factory
- 5.15. RemoveResponseHeader GatewayFilter Factory
- 5.16. The RemoveRequestParameter GatewayFilter Factory
- 5.17. The RewritePath GatewayFilter Factory
- 5.18. RewriteLocationResponseHeader GatewayFilter Factory
- 5.19. The RewriteResponseHeader GatewayFilter Factory
- 5.20. The SaveSession GatewayFilter

6. Global Filters
- 6.1. Combined Global Filter and GatewayFilter Ordering
- 6.2. Forward Routing Filter
- 6.3. The LoadBalancerClient Filter
- 6.4. The ReactiveLoadBalancerClientFilter
- 6.5. The Netty Routing Filter
- 6.6. The Netty Write Response Filter
- 6.7. The RouteToRequestUrl Filter
- 6.8. The Websocket Routing Filter
- 6.9. The Gateway Metrics Filter
- 6.10. Marking An Exchange As Routed

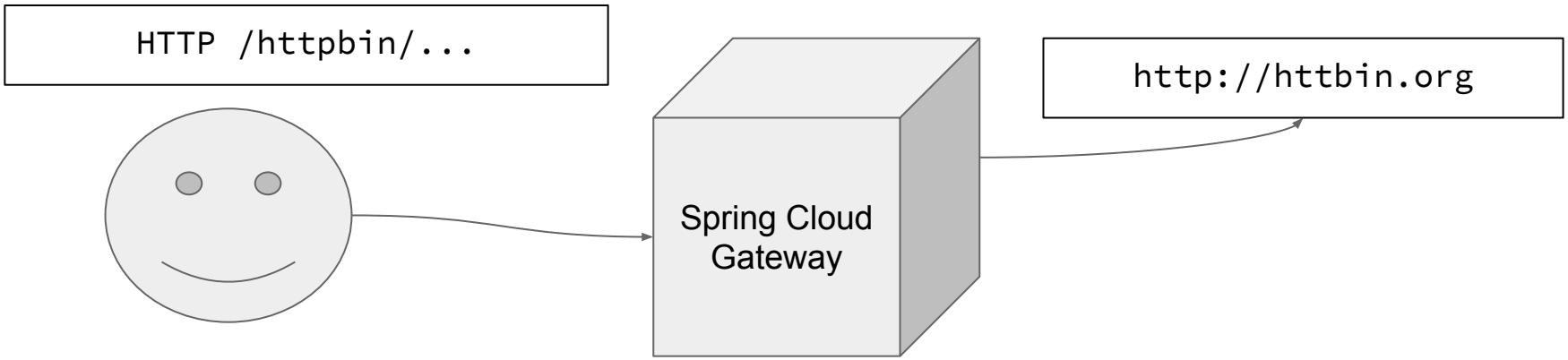
[1] - https://cloud.spring.io/spring-cloud-gateway/reference/html/

What is Spring Cloud Gateway

```java
// static imports from GatewayFilters and RoutePredicates
@Bean
public RouteLocator customRouteLocator(RouteLocatorBuilder builder, ThrottleGatewayFilterFactory throttle) {
    return builder.routes()
            .route(r -> r.host("**.abc.org").and().path("/image/png")
                .filters(f ->
                        f.addResponseHeader("X-TestHeader", "foobar"))
                .uri("http://httpbin.org:80")
            )
            .route(r -> r.path("/image/webp")
                .filters(f ->
                        f.addResponseHeader("X-AnotherHeader", "baz"))
                .uri("http://httpbin.org:80")
                .metadata("key", "value")
            )
            .route(r -> r.order(-1)
                .host("**.throttle.org").and().path("/get")
                .filters(f -> f.filter(throttle.apply(1,
                        1,
                        10,
                        TimeUnit.SECONDS)))
                .uri("http://httpbin.org:80")
                .metadata("key", "value")
            )
            .build();
}
```

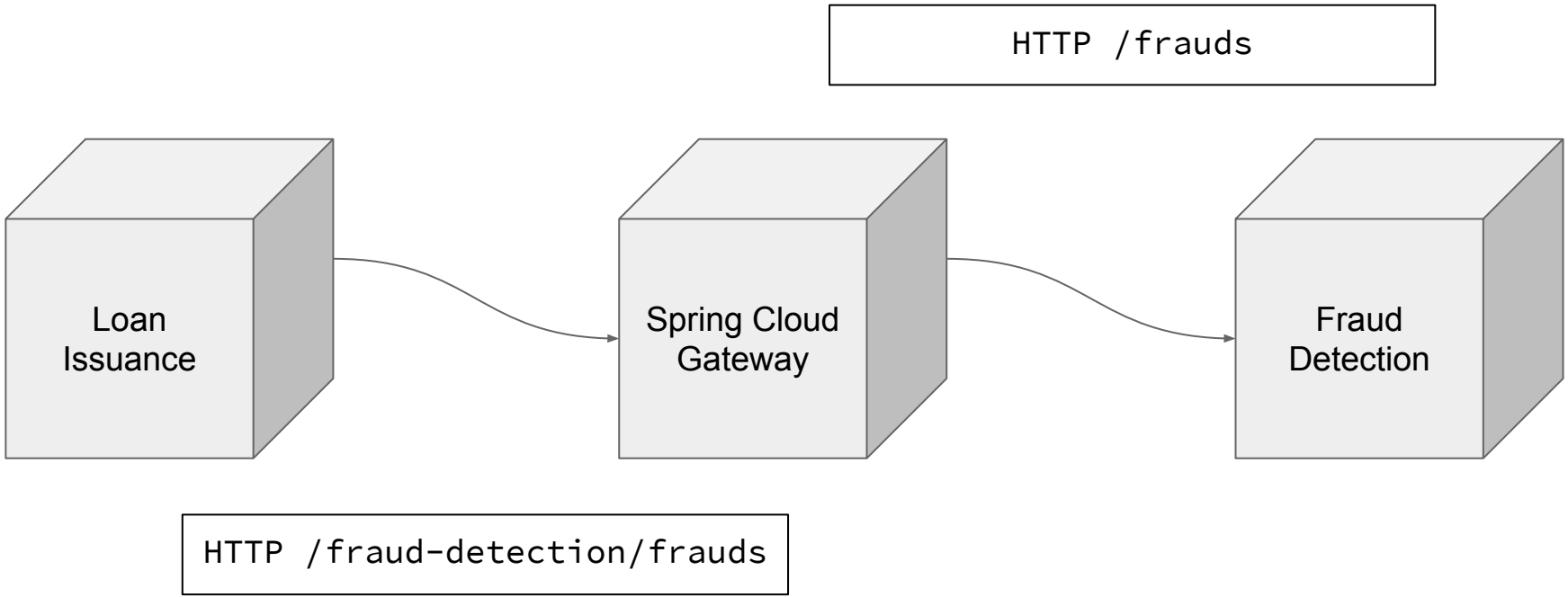
[1] - https://cloud.spring.io/spring-cloud-gateway/reference/html/

Let's Code



DEMO

Let's Code



DEMO

SEGMENT 11

How can microservices talk to each other over messaging?

Why should you consider using messaging in microservice environment?

What is Spring Cloud Stream?

Why should you consider using messaging in microservice environment?

Microservice = individual, separately deployed application

Immediate reply required = request-response

Events and asynchronous messaging

- Follow real life cases
- Scalability
- Resiliency
- Loose physical coupling

What is Spring Cloud Stream?

Framework for message-driven microservice applications

Build on top of Spring Boot and Spring Integration

Provides

- Abstraction over message brokers
- Opinionated configuration for middleware

Setup depending on classpath

Functional requirement based on `java.util.function` package

What is Spring Cloud Stream?

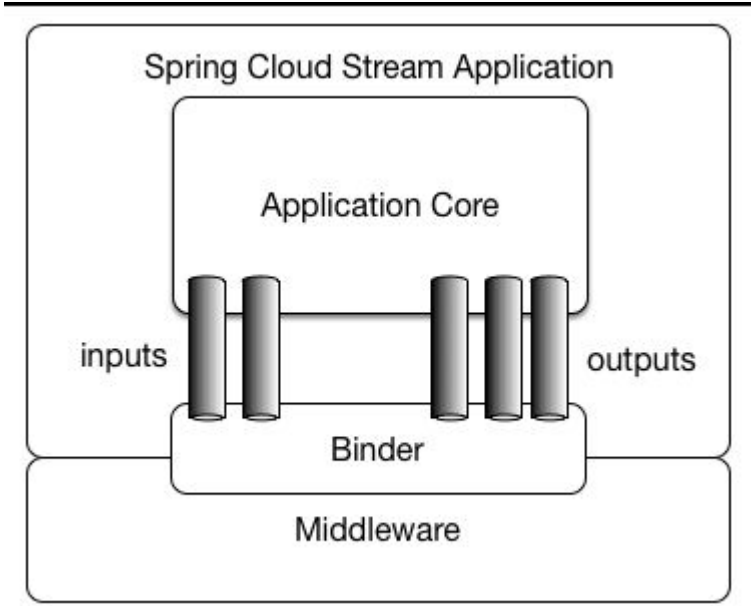
Treat data-centric applications as microservices

    Independently built, tested and deployed

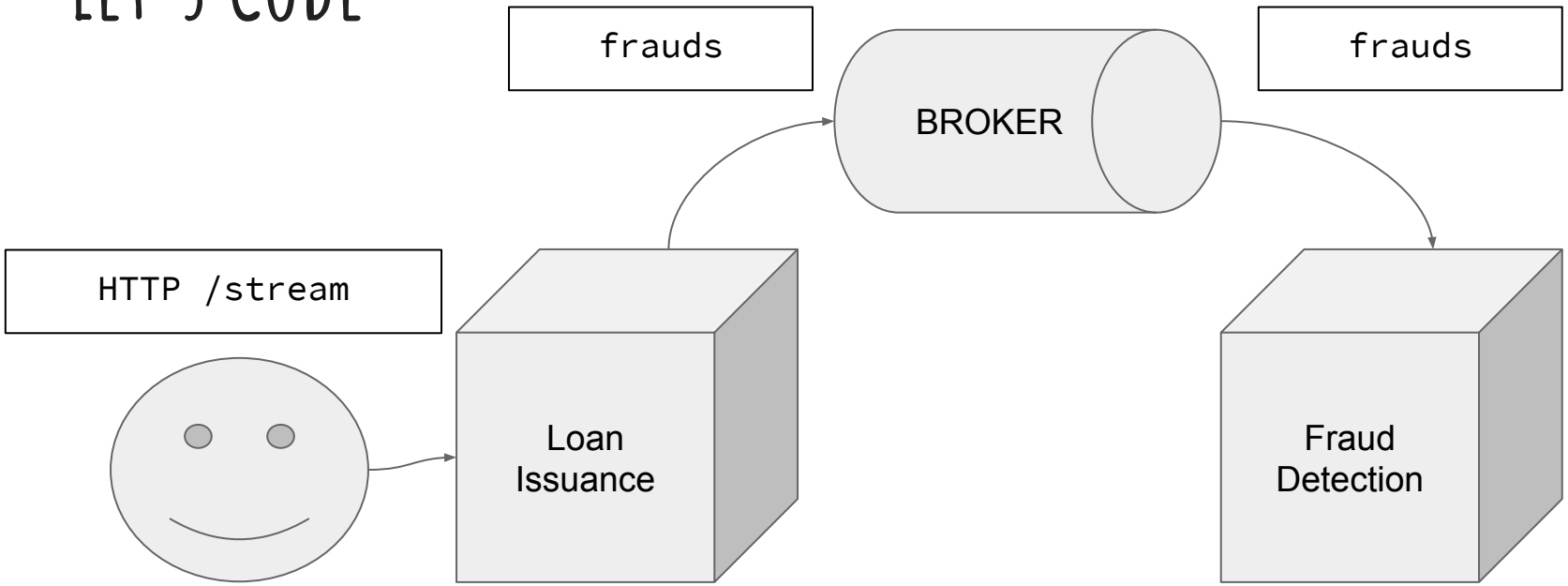
Map business to events on top of message brokers

Push the configuration and content type resolution to the framework

What is Spring Cloud Stream?



Let's Code



DEMO

Part 4 - Assignment

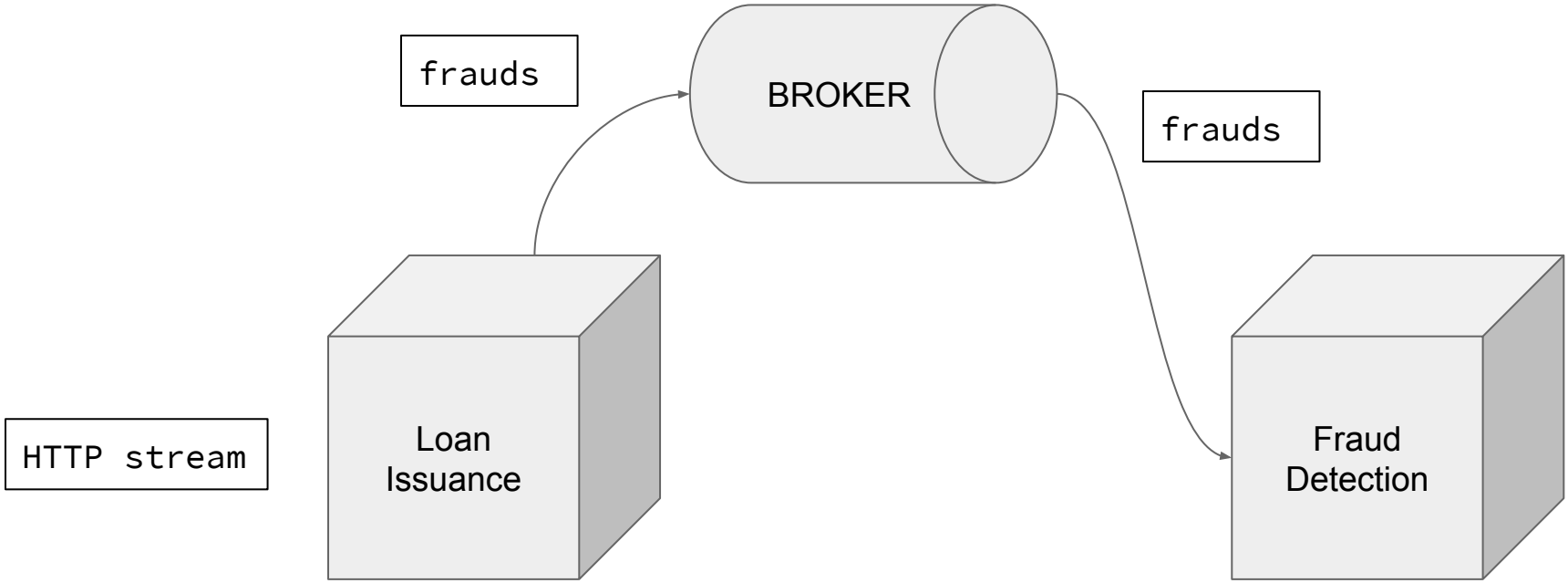
Assignment:

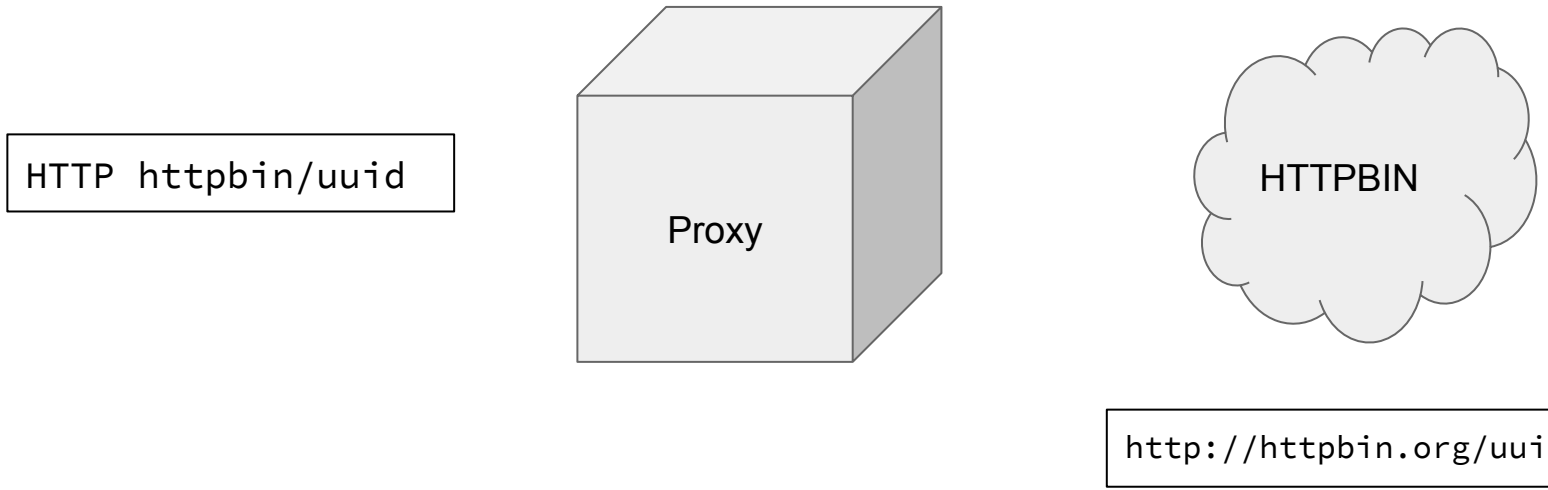
API gateway and messaging. In this lab, students will either

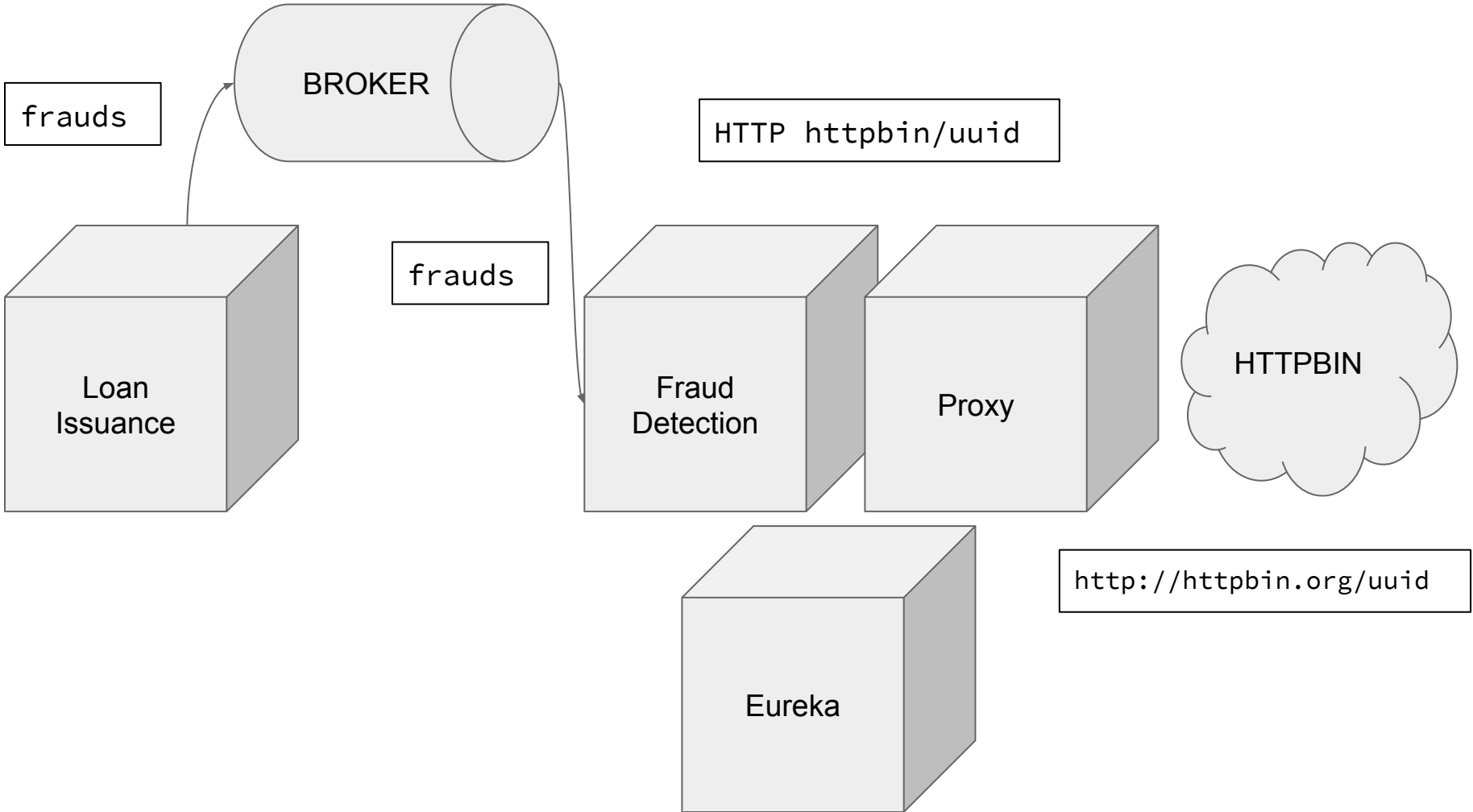
Generate two Spring Cloud Stream applications that will talk to each other over Spring Cloud Stream with RabbitMQ. The first one will also have an HTTP API to trigger it via the command line.

Create a Spring Cloud Gateway application to route the traffic to an external website.

Assignment time (20 min)


frauds
BROKER
frauds
HTTP stream
Loan
Issuance
Fraud
Detection


HTTP httpbin/uuid
Proxy
HTTPBIN
http://httpbin.org/uuid


frauds
BROKER
HTTP httpbin/uuid
frauds
Loan
Issuance
Fraud
Detection
Proxy
HTTPBIN
http://httpbin.org/uuid
Eureka

Part 4 - Assignment

https://tinyurl.com/spring-cloud-workshops-2#assignment-4

https://gist.github.com/marcingrzejszczak/ae5da2606a21dc8144f8e212d786c91e#assignment-4