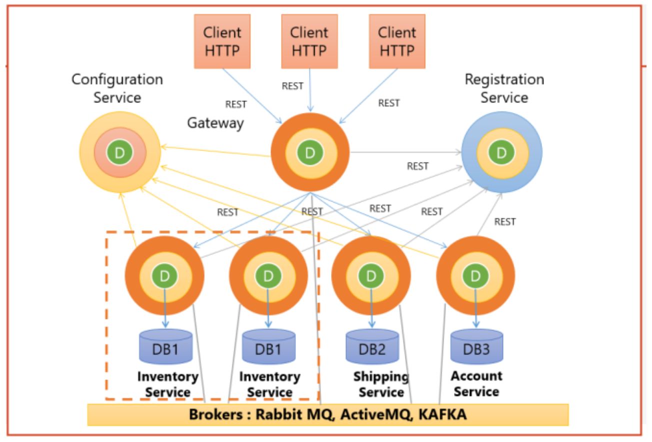
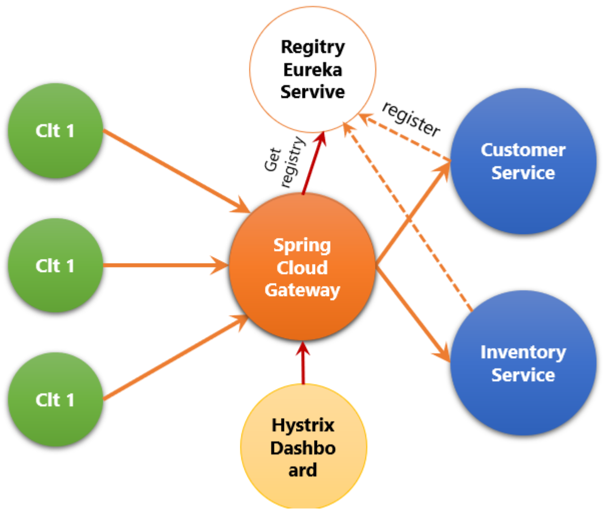
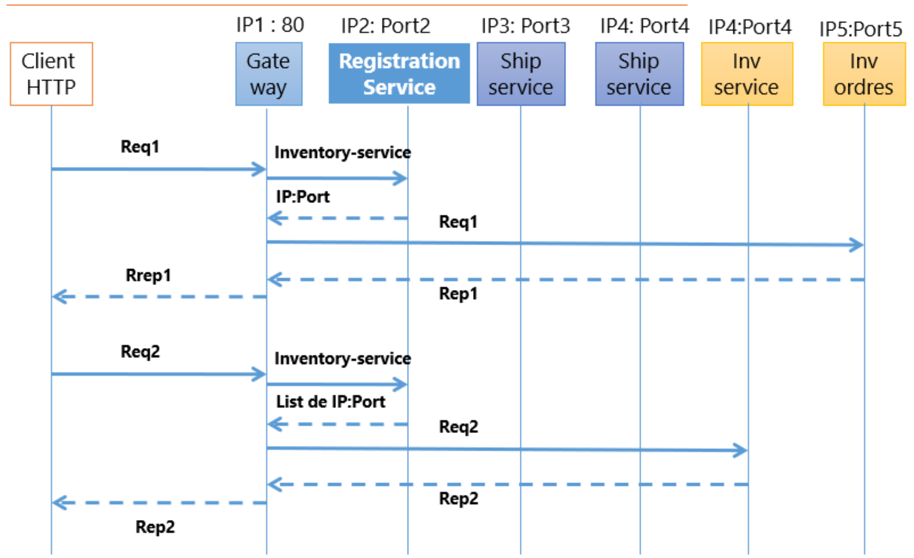
Systèmes Distribués Basés sur les Micro-Services







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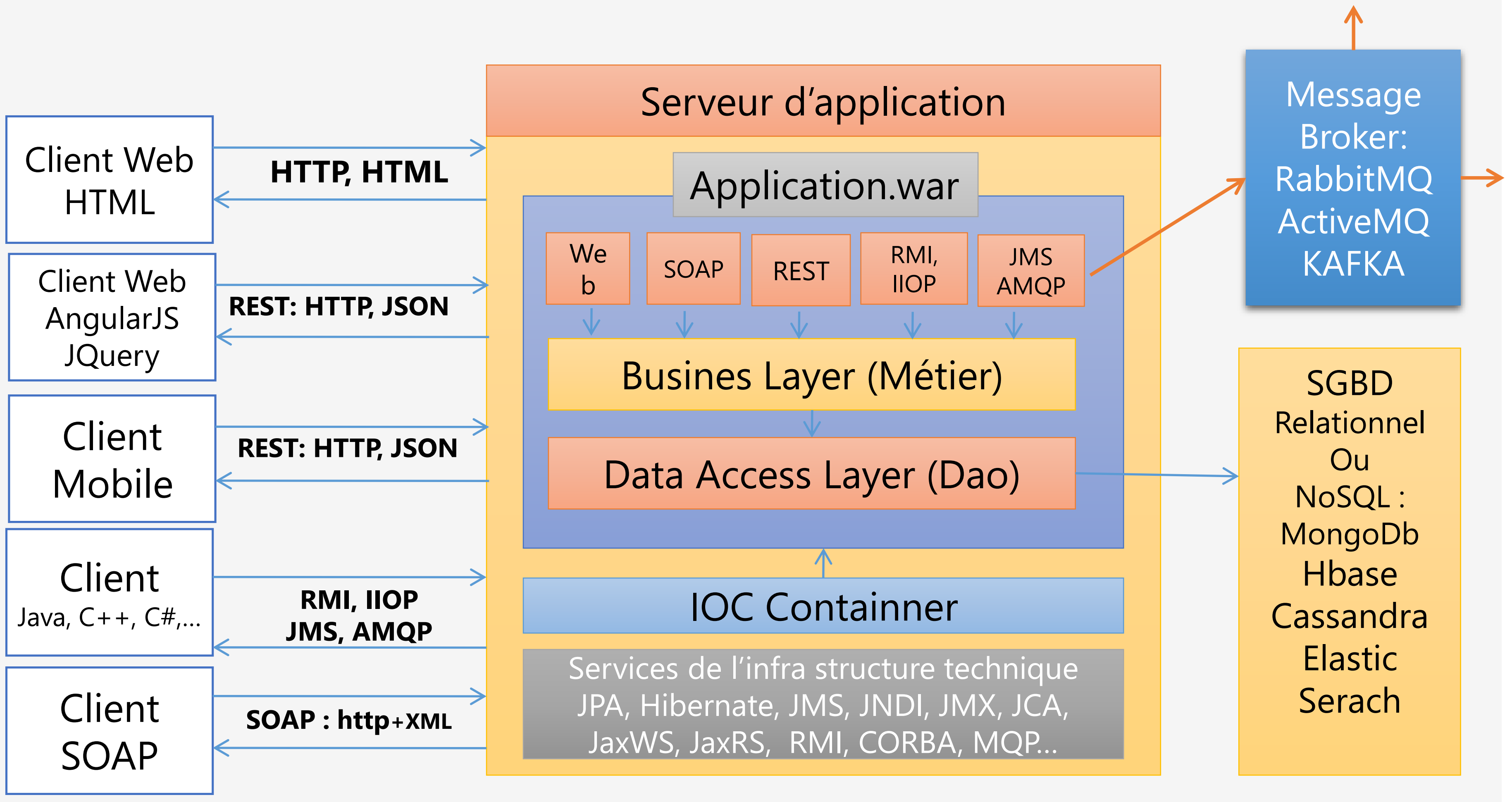
Chaîne vidéo : http://youtube.com/mohamedYoussfi
Recherche : http://www.researchgate.net/profile/Youssfi_Mohamed/publications

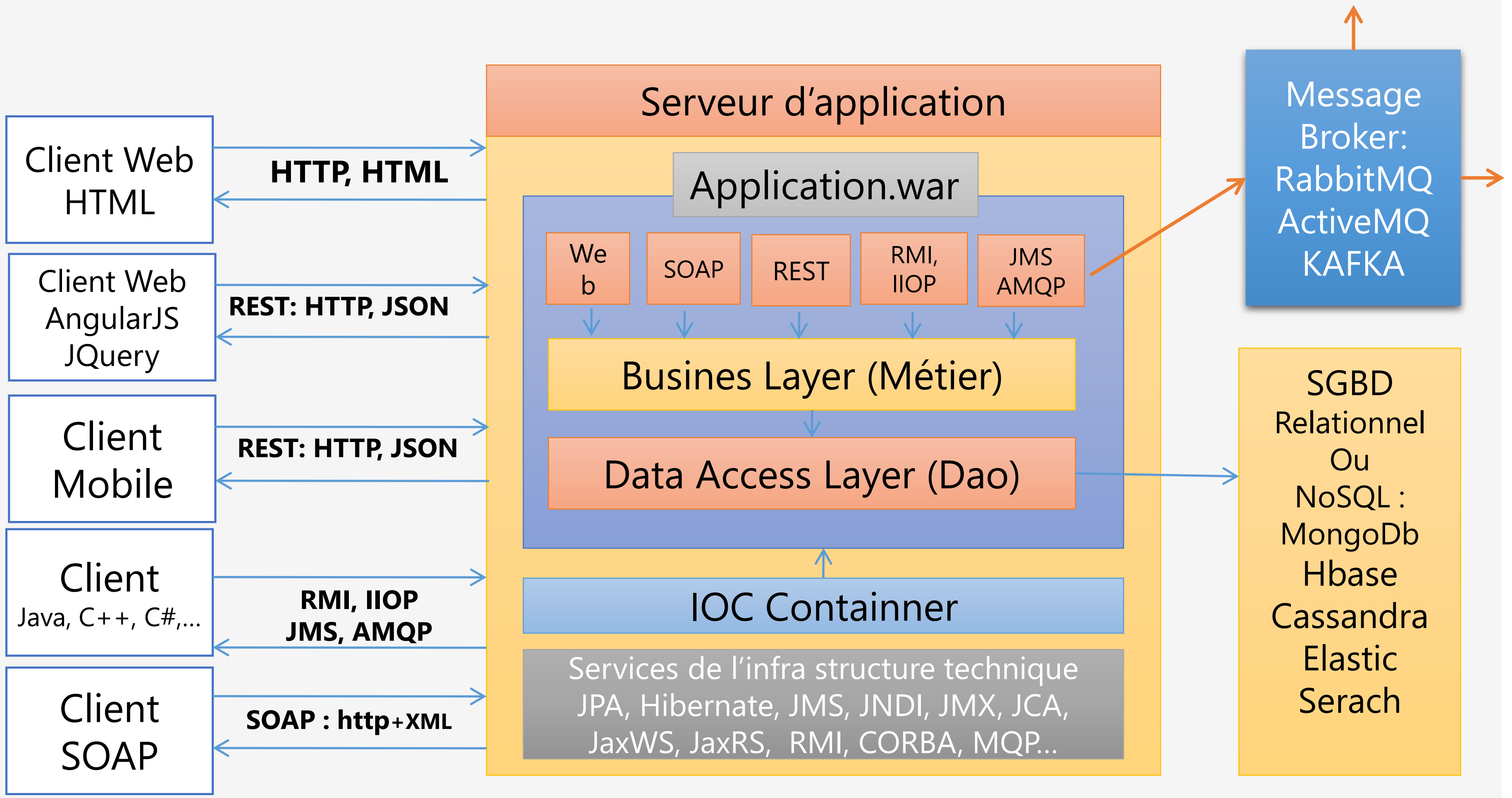
Approche Monolithique Vers Approche Micro-services

Une application monolithique est une application qui est développée en un seul bloc (war, jar, Ear, dll), avec une même technologie et déployée dans un serveur d'application



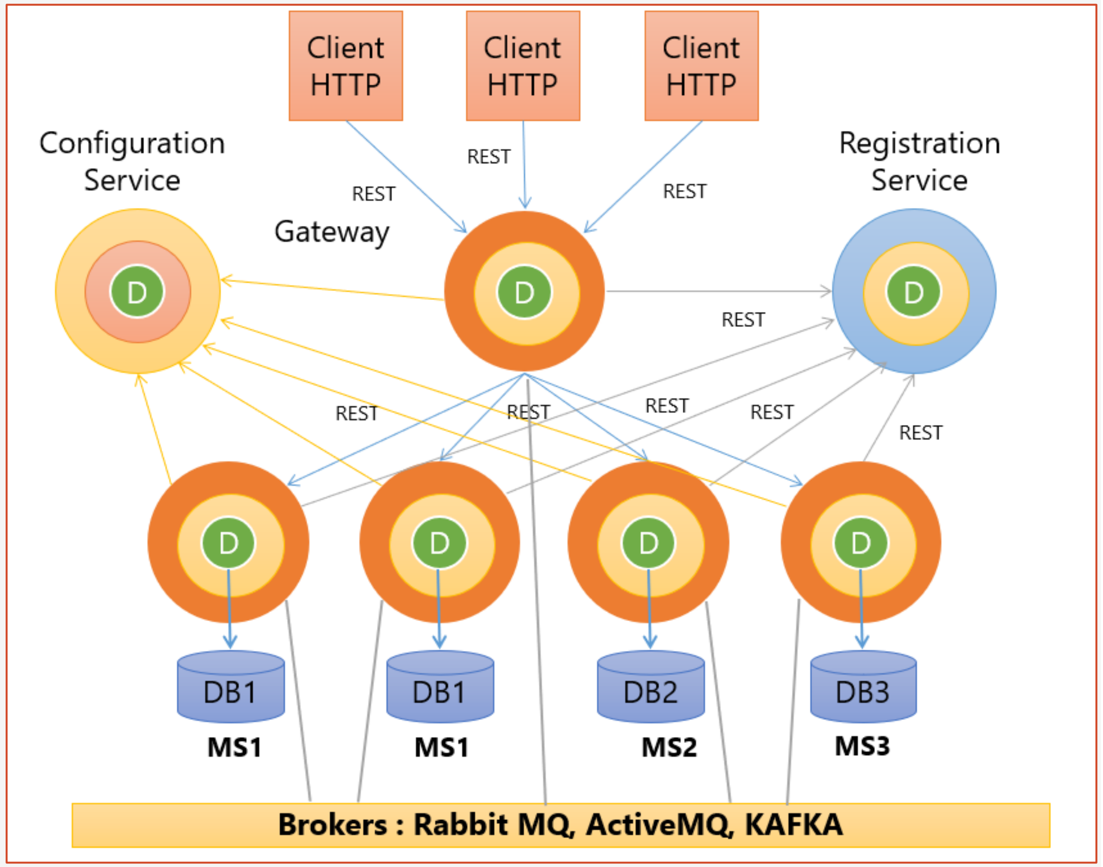
Principaux Problèmes d'une approche monolithique

- Elles centralisent tous les besoins fonctionnels
- Elles sont réalisées dans une seule technologie.
- Chaque modification nécessite de :
- Tester les régressions
- Redéployer toute l'application
- Difficile à faire évoluer au niveau fonctionnel
- Livraison en bloc (Le client attend beaucoup de temps pour commencer à voir les premières versions)



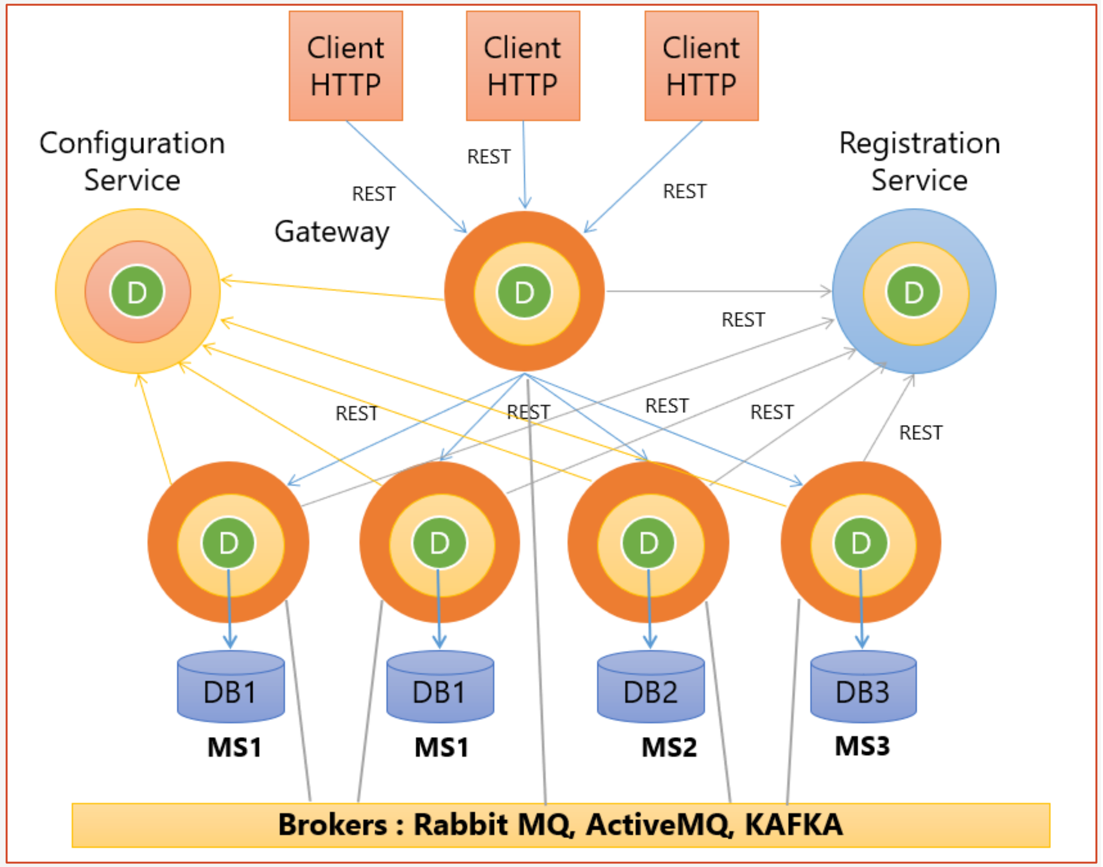
Approche Micro services

- Les micro services sont une approche d'architecture et de développement d'une **application composées de petits services**.
- L'idée étant de découper un grand problème en petites unités implémentée sous forme de micro-services
- Chaque service est responsable d'une fonctionnalité,
- Chaque micro-service est **développé**, **testé** et **déployé séparément** des autres.
- Chaque micro service est développé en utilisant une technologie qui peut être différente des autres. (Java, C++, C#, PHP, NodeJS, Pyton, …)
- Chaque service **tourne dans un processus séparé**.
- Utilisant des mécanismes de communication légers (REST)
- La seule relation entre les différents micro services est l'échange de données effectué à travers les différentes APIs qu'ils exposent. (SOAP, REST, RMI, CORBA, JMS, MQP, …)
- Lorsqu'on **les combinent**, ces micro services peuvent **réaliser des opérations très complexes**.



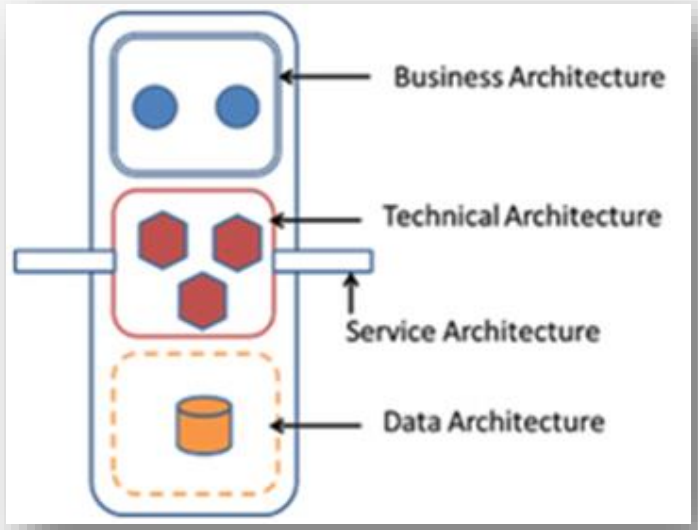
Approche Micro services

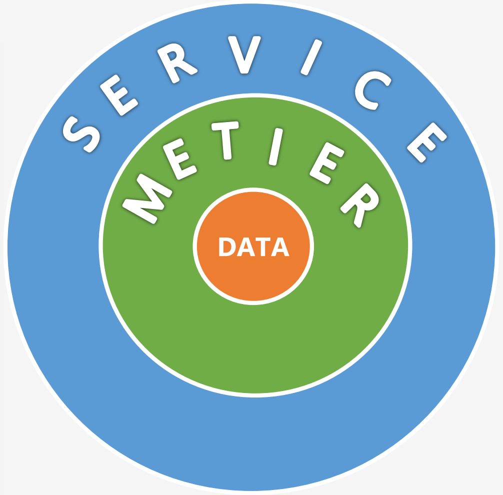
- Ils sont faiblement couplés puisque chaque micro service est physiquement séparé des autres,
- Indépendance relative entre les différentes équipes qui développement les différents micro services.
- Facilité des tests et du déploiement
- Livraison continue.
- S'apprête bien à au processus du GL : **TDD** (Test Driver Développement) et les méthodes agiles

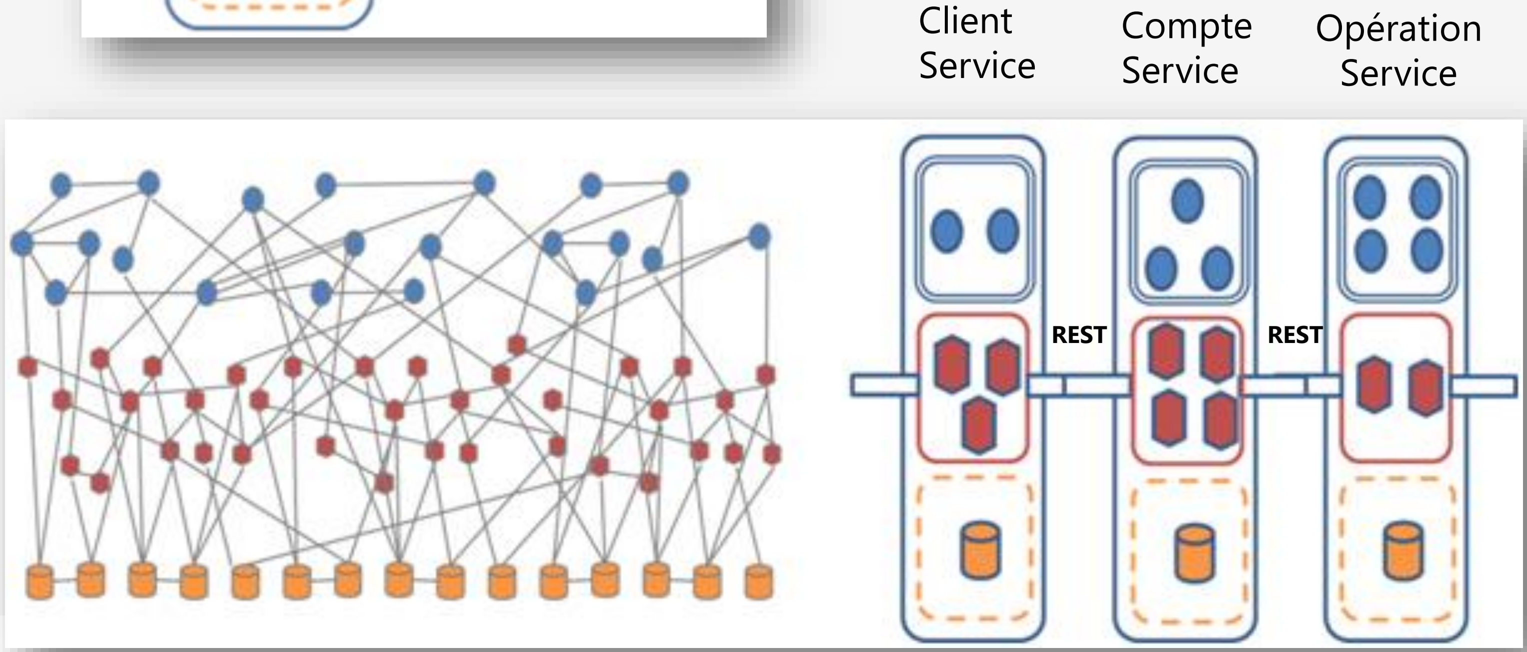


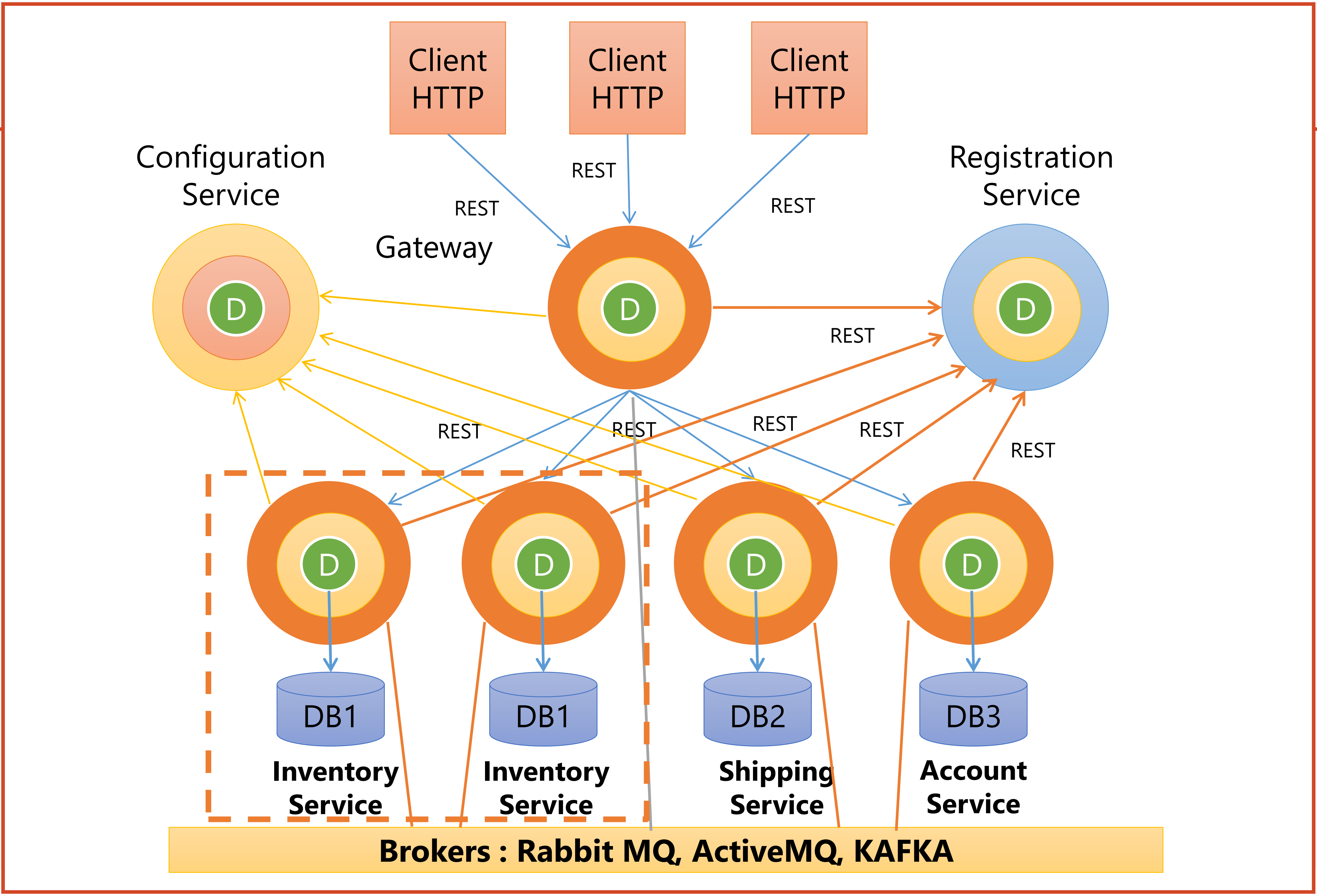
Approche Micro services

- Comme pour le cas d'une application monolithique, un micro service peut être composé de plusieurs très petites couches:
  - Couche DAO
  - Couche Métier,
  - Couches Techniques (REST, SOAP, RMI, JMS, AMQP, Sécurité, etc…)








Client HTTP
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DB1
DB1
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Inventory Service
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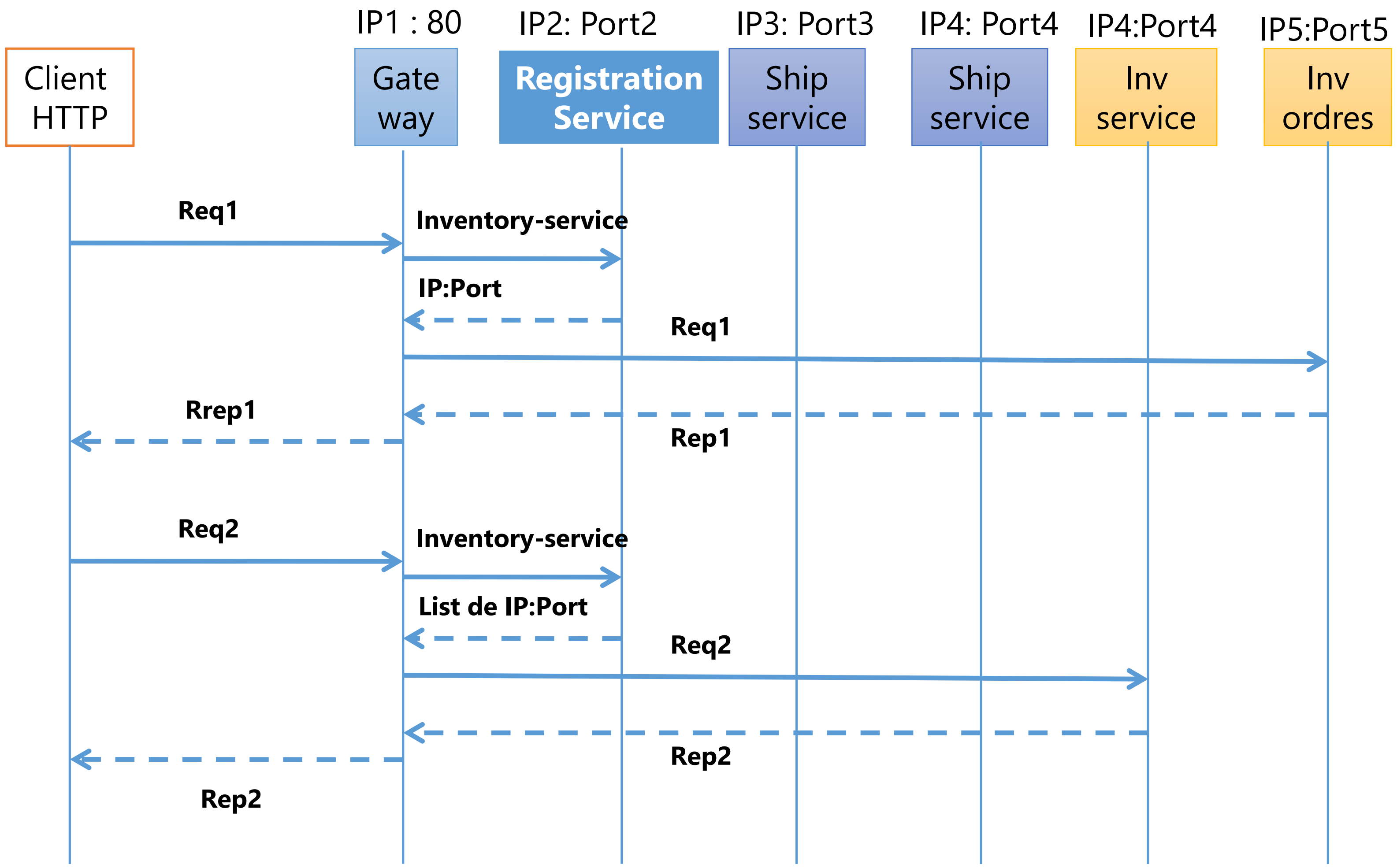
Account Service
Brokers : Rabbit MQ, ActiveMQ, KAFKA

Consulter les services via le service proxy

Req 1 : GET http://gateway/inventory-service/products

Req 2 : GET http://gateway/inventory-service/products



Spring Boot

Spring Boot est un Micro Framework qui permet de créer des applications basées sur des micro services.

Atouts de Spring Boot :

- Faciliter le développement d’applications complexes.
- Faciliter à l’extrême l’injection des dépendances
- Réduire à l’extrême les fichier de configurations
- Faciliter la gestion des dépendances Maven.
- Auto Configuration : la plupart des beans sont créés si le ou les jar(s) adéquats sont dans le classpath.
- Fournir un conteneur de servlet embarqué (Tomcat, Jetty)
- Créer une application autonome (jar ou war)

EXEMPLE DE MICRO SERVICE AVEC SPRING BOOT

https://www.youtube.com/watch?v=zBLXWIhrg7U

Premier Exemple d’application

On souhaite créer une application qui permet de gérer des produits.

Chaque produit est défini par :

- Sa référence de type Long
- Sa désignation de type String
- Son prix

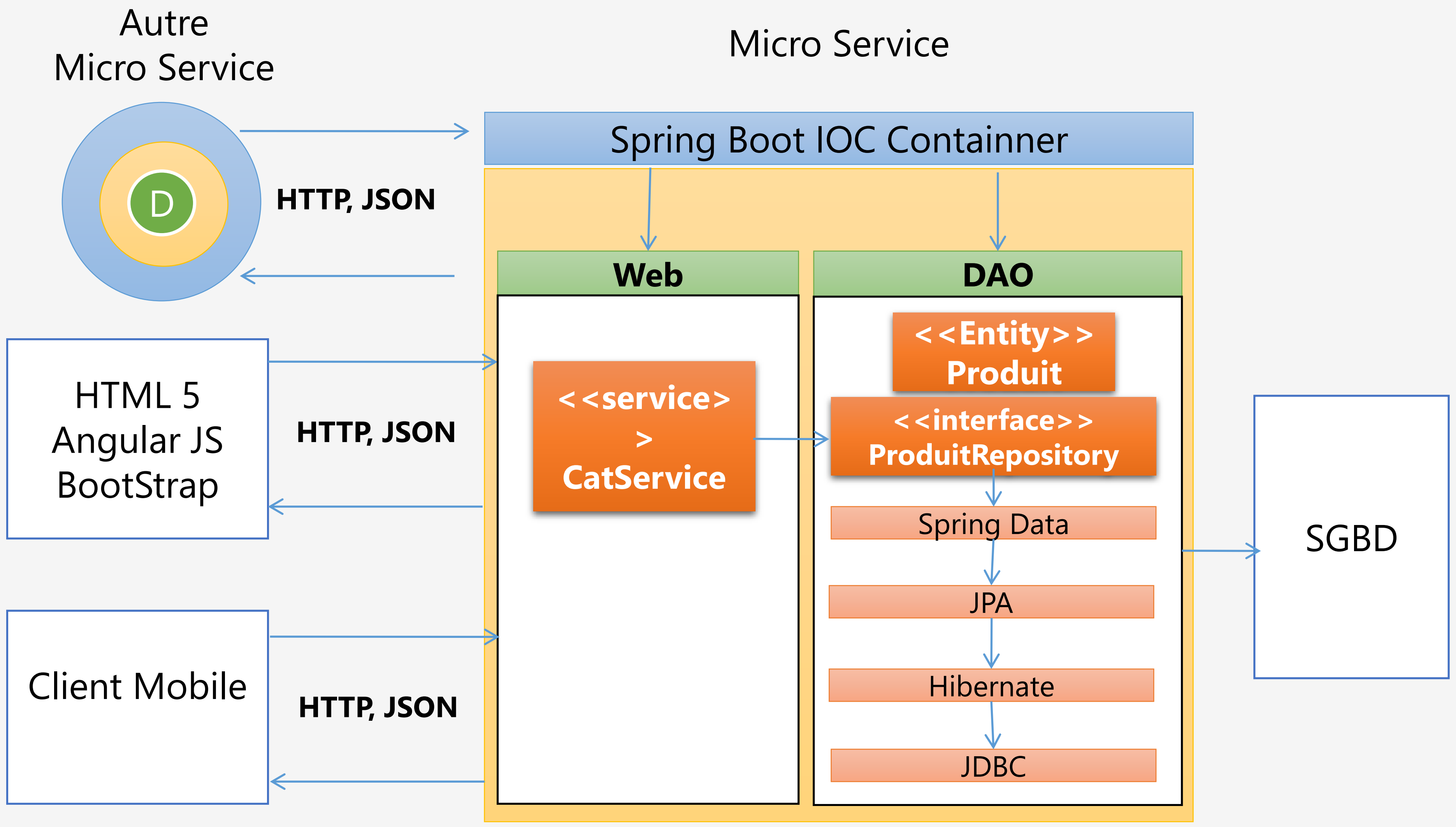
L’applications de permettre de :

- Ajouter des produits
- Chercher les produits par mot clé

Les données sont stockées dans une base de données MySQL

L’application est un micro service Restful basée sur Spring Boot

Architecture



Micro Service : Spring Boot

Service Restful

```
@RestController
public class ProduitRestService {
   @Autowired private ProduitRepository produitRepository;
   @RequestMapping(value="/produits",method=RequestMethod.GET)
   public Lit<Produit> produits(){
    return produitRepository. findAll();
   }
   @RequestMapping(value="/produits",method=RequestMethod.POST)
   public Produit save(@RequestBody Produit p){
         return produitRepository.save(p);
   }
}
```

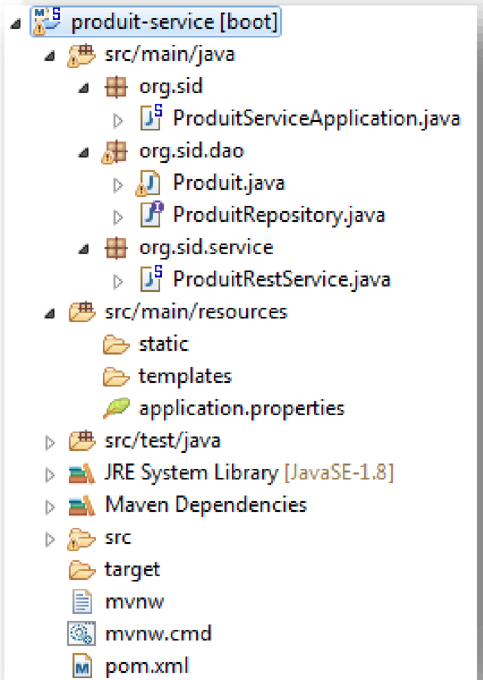
Entité produit

```
@Entity
@Data
public class Produit {
@Id @GeneratedValue
  private Long id;
  private String designation;
  private double prix;

}
```

Interface DAO basée sur Spring data

```
public interface ProduitRepository extends JpaRepository<Produit, Long> {
}
```



```
produit-service [boot]
  src/main/java
    org.sid
      ProduitServiceApplication.java
    org.sid.dao
      Produit.java
      ProduitRepository.java
    org.sid.service
      ProduitRestService.java
  src/main/resources
    static
    templates
    application.properties
  src/test/java
  JRE System Library [JavaSE-1.8]
  Maven Dependencies
  src
  target
  mvnw
  mvnw.cmd
  pom.xml
```

Application Spring Boot

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

Application.properties

```
spring.datasource.url = jdbc:mysql://localhost:3306/prod-services
spring.datasource.username = root
spring.datasource.password =
spring.datasource.driverClassName = com.mysql.jdbc.Driver
spring.jpa.hibernate.ddl-auto = update
spring.jpa.properties.hibernate.dialect = org.hibernate.dialect.MySQL5Dialect
```

Micro Service : Spring Boot

Service Restful

```java
@RestController
public class ProduitRestService {
   @Autowired
   private ProduitRepository produitRepository;
   @RequestMapping(value="/produits",method=RequestMethod.GET)
   public Lit<Produit> produits(){
    return produitRepository. findAll();
   }
   @RequestMapping(value="/produits",method=RequestMethod.POST)
   public Produit save(@RequestBody Produit p){
          return produitRepository.save(p);
   }

}
```

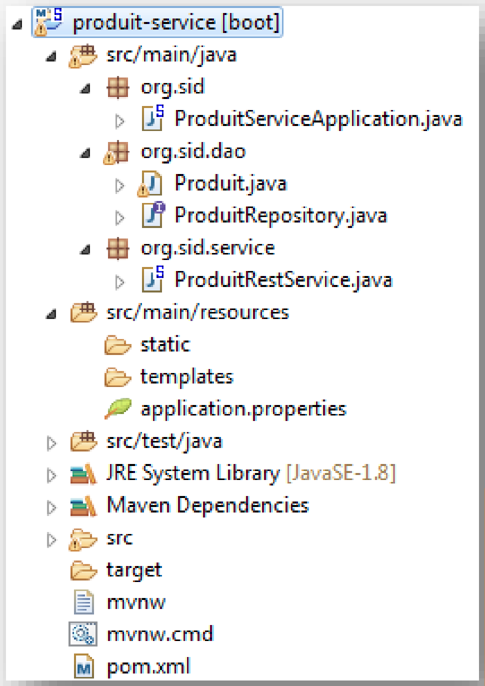
Entité produit

```java
@Entity
public class Produit
implements Serializable {
@Id @GeneratedValue
  private Long id;
  private String designation;
  private double prix;

  // Getters et Setters
}
```

Interface DAO basée sur Spring data

```java
@RepositoryRestResource
public interface ProduitRepository extends JpaRepository<Produit, Long> {
}
```



```
produit-service [boot]
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  JRE System Library [JavaSE-1.8]
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  src
  target
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  mvnw.cmd
  pom.xml
```

Application Spring Boot

```java
@SpringBootApplication
public class ProduitServiceApplication {
    public static void main(String[] args) {
        SpringApplication.run(ProduitServiceApplication.class, args);
    }
}
```

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```
spring.datasource.url = jdbc:mysql://localhost:3306/prod-services
spring.datasource.username = root
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spring.datasource.driverClassName = com.mysql.jdbc.Driver
spring.jpa.hibernate.ddl-auto = update
spring.jpa.properties.hibernate.dialect = org.hibernate.dialect.MySQL5Dialect
```
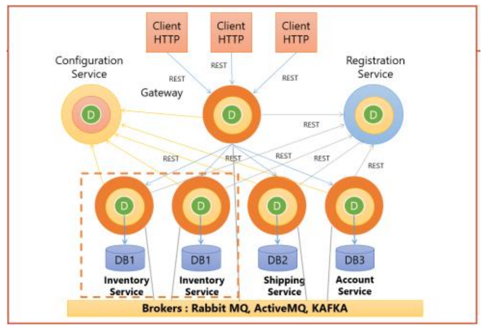
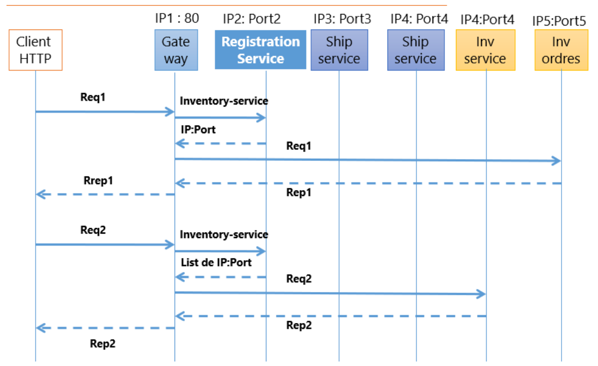
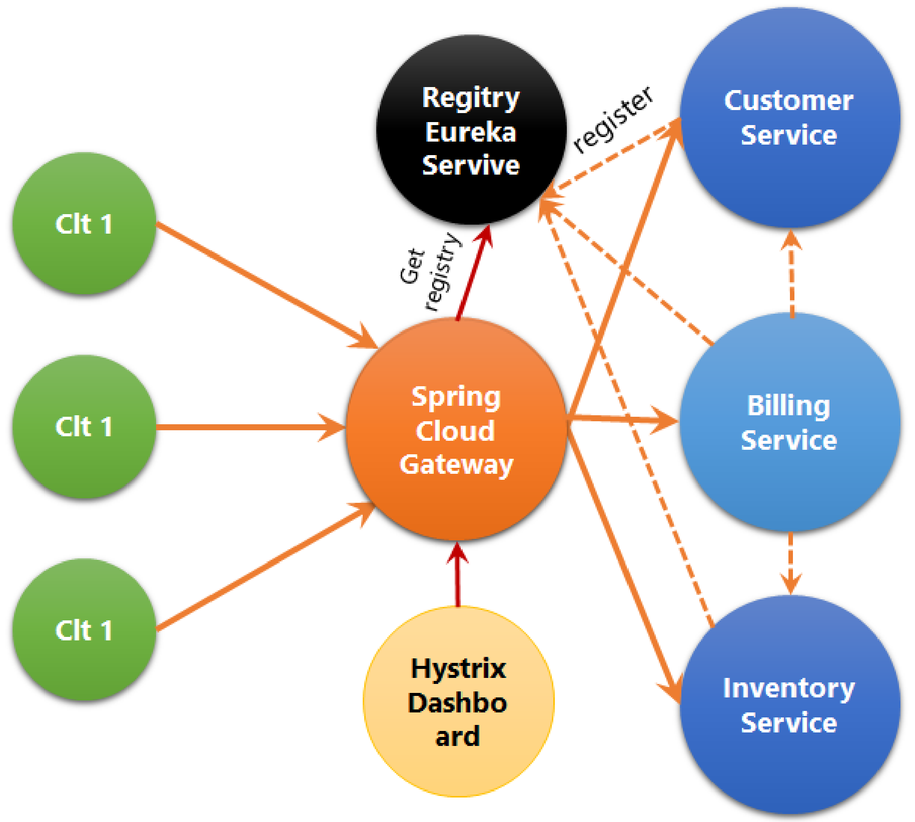

Architectures

Micro Services avec Spring Cloud

- Spring Cloud Gateway
- Eureka Discovery
- Open Feign Rest Client
- Hystrix DashBoard







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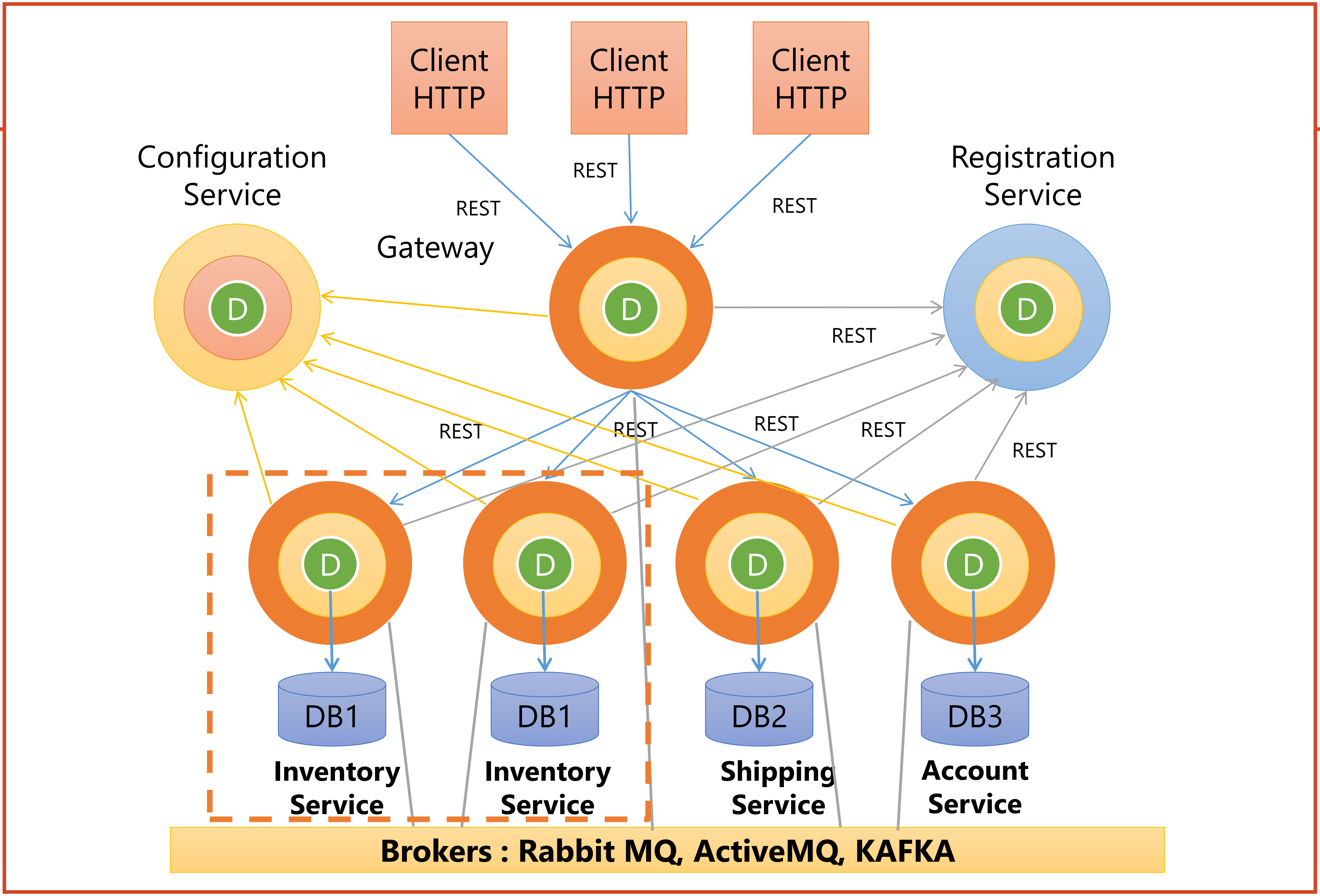
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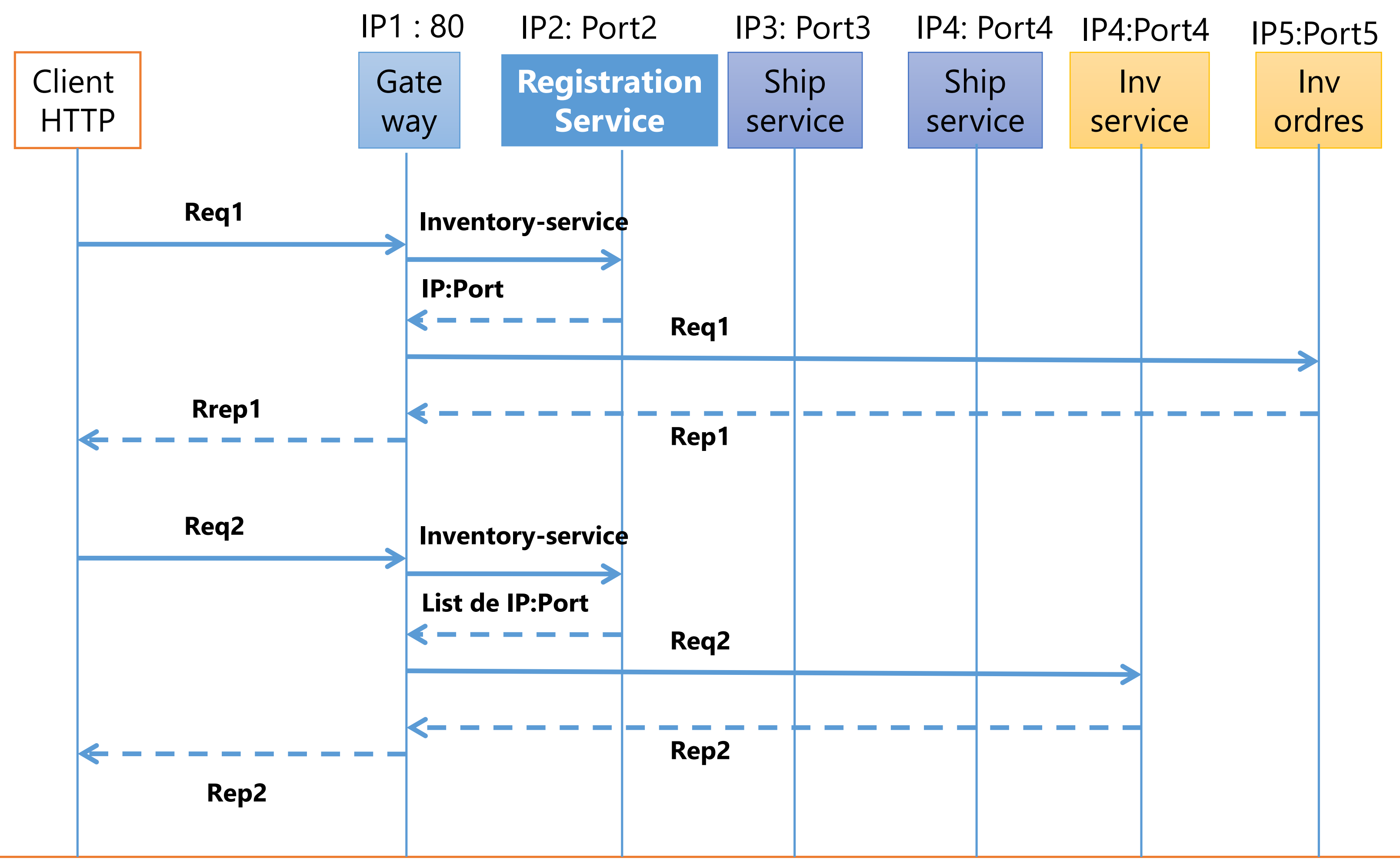
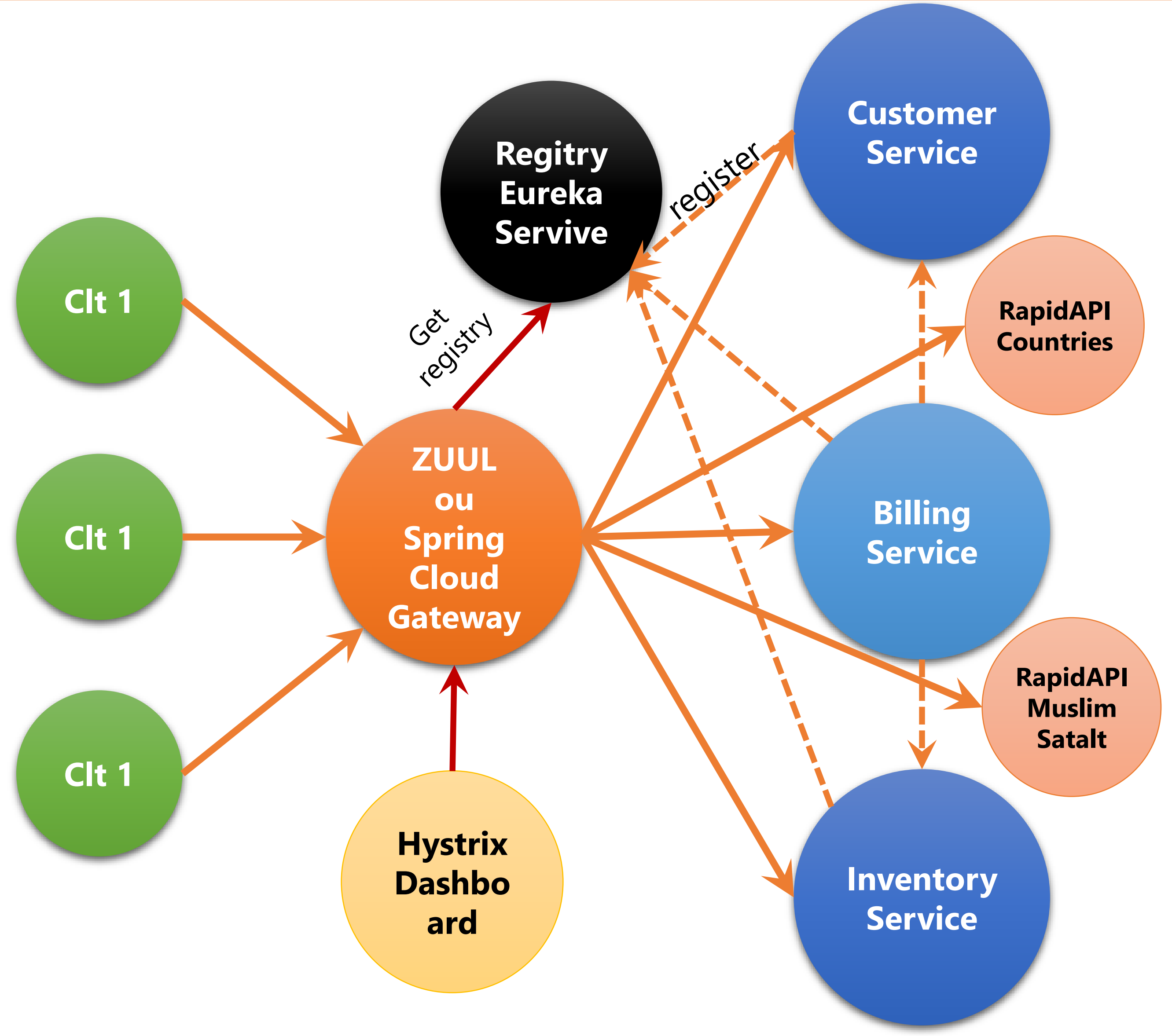


Spring Cloud Gateway

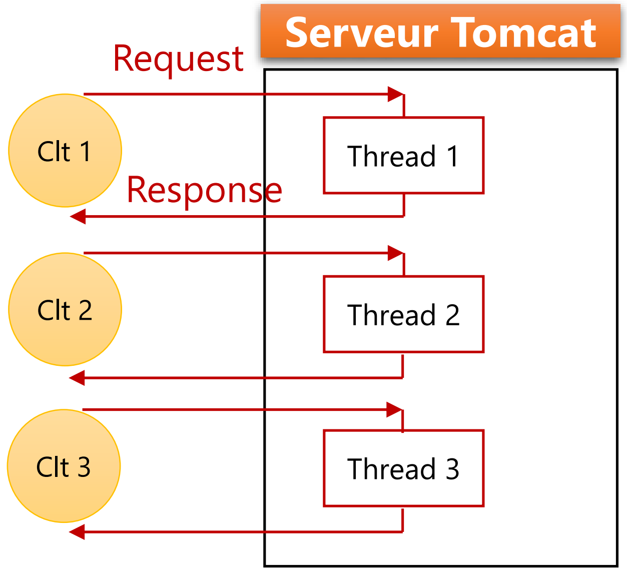
- Gateway API est un reverse proxy amélioré avec des fonctionnalités plus avancées, y compris l'**orchestration** et la **sécurité** et le **monitoring**.
- Quelques implémentations de API Gateway :

  Netflix Zuul Proxy, Amazon Gateway API, et Spring Cloud Gateway
- **Zuul** est un proxy utilisant une API qui utilise des entrées sorties bloquantes.
  - Une api de passerelle bloquante utilise autant de threads que le nombre de requêtes entrantes.
  - Si aucun thread n'est disponible pour traiter la requête entrante, celle-ci doit attendre dans la file d'attente.
- **Spring Cloud Gateway** est un proxy utilisant une API non bloquante.
  - Un thread est toujours disponible pour traiter requête entrante.
  - Ces requêtes sont ensuite traitées de manière asynchrone en arrière-plan et une fois complétées, la réponse est renvoyée.
  - Ainsi, aucune requête entrante n'est jamais bloquée lors de l'utilisation de Spring Cloud Gateway sauf si les ressources CPU et mémoires sont saturées.



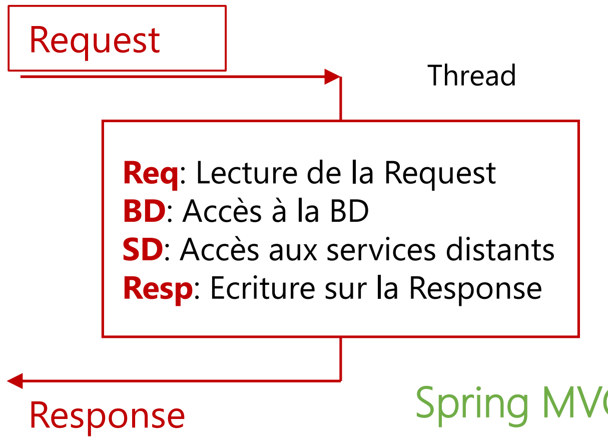
Modèles : Multi Threads avec IO Bloquantes Vs Single Thread avec IO Non Bloquantes

Multi Threads avec IO Bloquantes



Package java.io

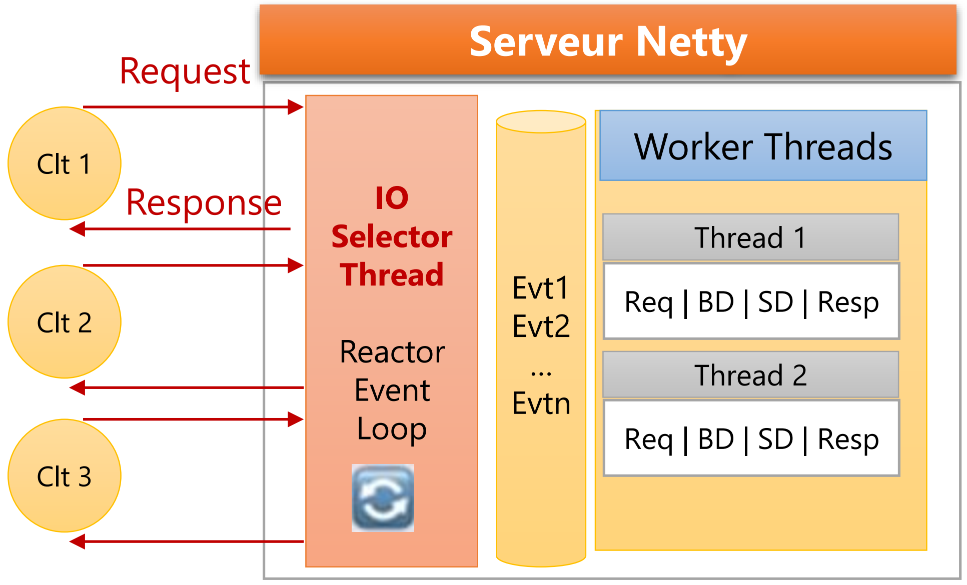
- InputStream
- OutputStream
- Reader
- Writer



Req: Lecture de la Request
BD: Accès à la BD
SD: Accès aux services distants
Resp: Ecriture sur la Response

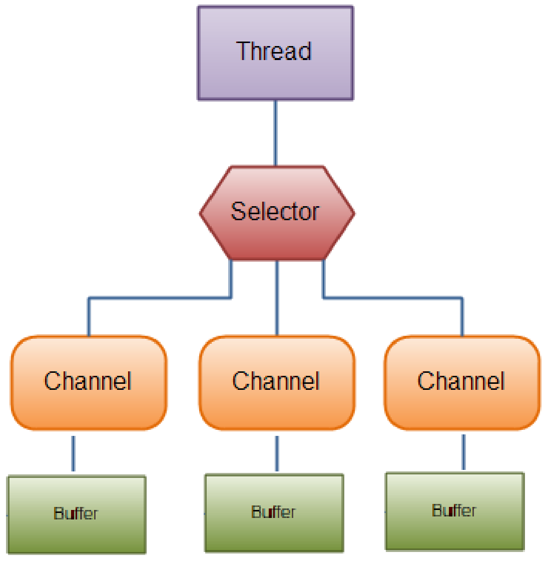
Spring MVC avec Tomcat

Multi Single Thread avec IO Non Bloquantes



Package java.nio

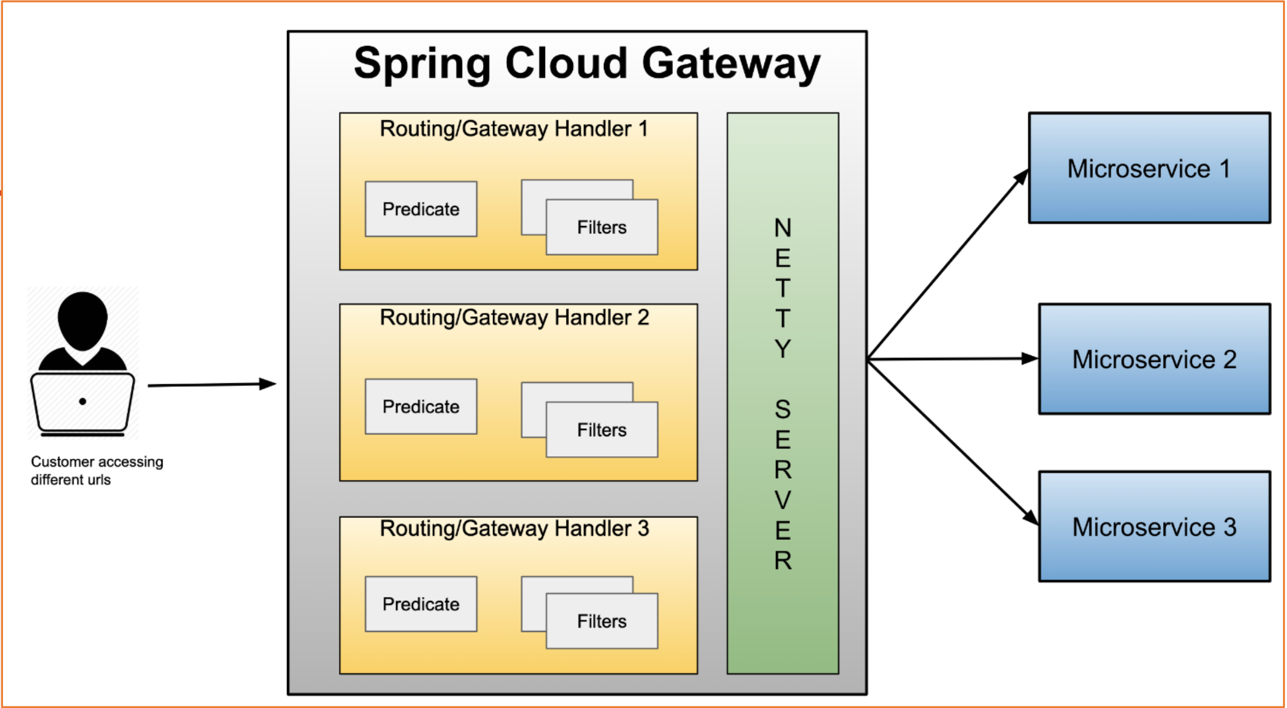
- Channels:
  - SocketChannel,
  - DataGramChannel
- Buffers
- Selector



Réactive Spring ou Spring Web Flux avec Netty

Spring Cloud Gateway

- Route: Destination vers laquelle nous voulons qu'une requête particulière soit acheminée. Une route comprend :
  - l'URI de destination,
  - Predicate : Une condition qui doit satisfaire
  - Filters : Un ou plusieurs filtres qui peuvent intervenir pour apporter des traitement et des modifications des requêtes et des réponses HTTP

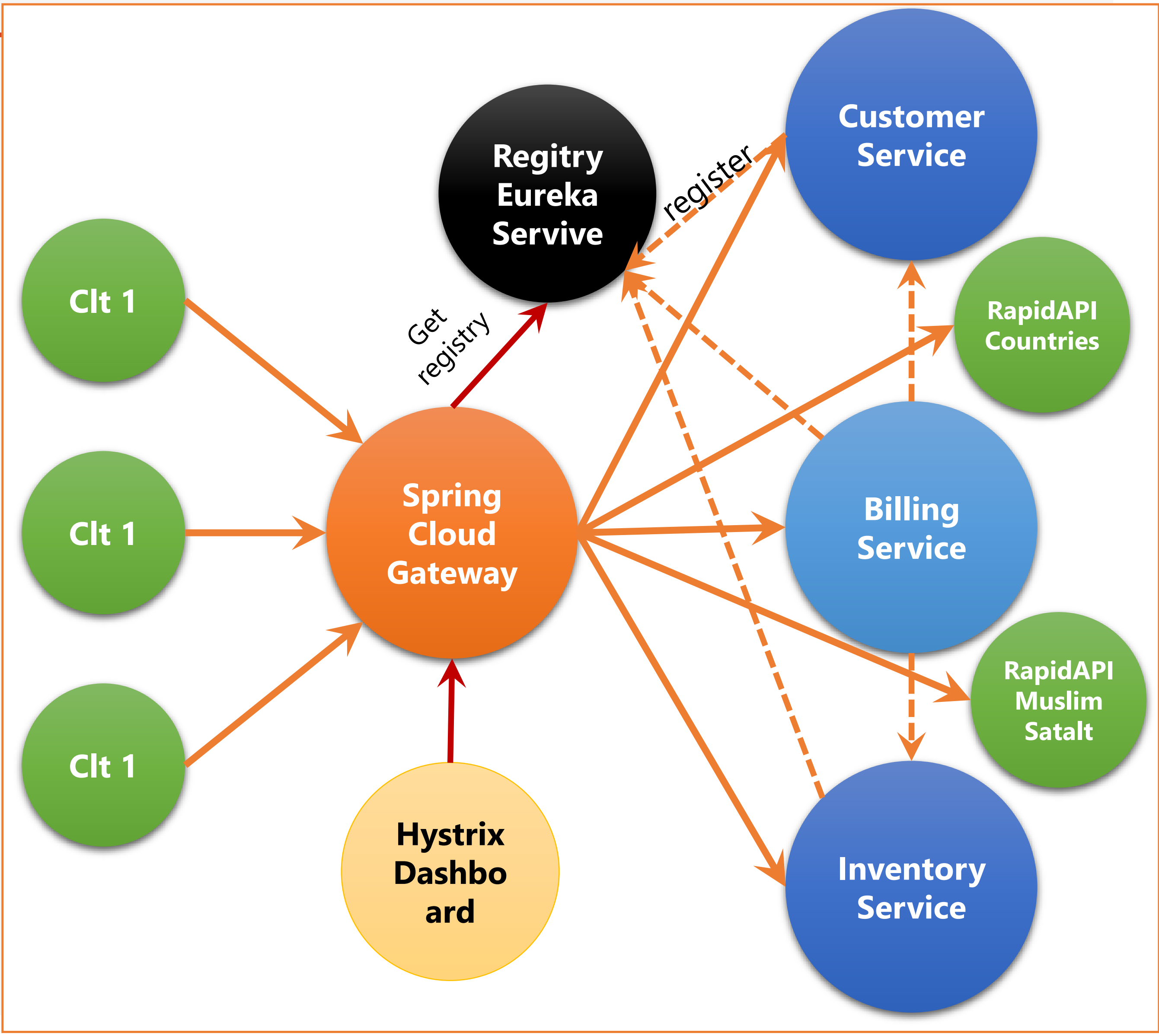


Predicates :
- Host, Path, Method
- After, Before, Between
- Cookie, Header, Query
- RmoteAddr
- Etc …

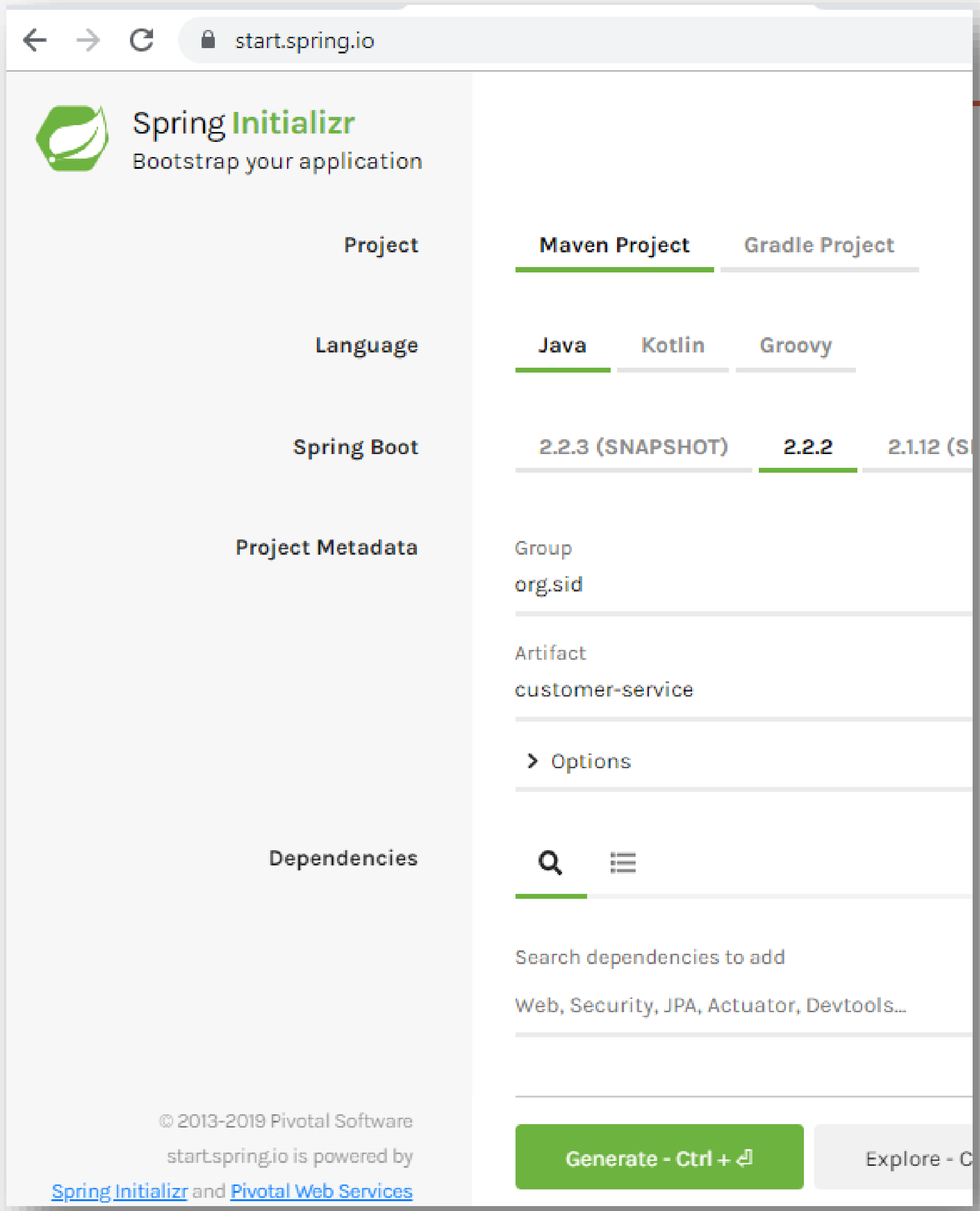
Filters :
- AddRequestHeader
- AddRequestParameter
- AddResponseHeader
- DedupeResponseHeader
- Hystrix
- CircuitBreaker
- RewritePath
- Etc …

Application

- Créer une application basée sur deux services métiers:
  - Service des clients
  - Service d'inventaire
  - Service Facturation
  - Services Externes : RapidAPI
- L'orchestration des services se fait via les services techniques de Spring Cloud :
  - Spring Cloud Gateway Service comme service proxy
  - Registry Eureka Service comme annuaire d'enregistrement et de découverte des services de l'architecture
  - Hystrix Circuit Breaker
  - Hystrix DashBoard



Customer-service



start.spring.io

Spring Initializr
Bootstrap your application

Project: Maven Project | Gradle Project

Language: Java | Kotlin | Groovy

Spring Boot: 2.2.3 (SNAPSHOT) | 2.2.2 | 2.1.12 (S

Project Metadata

Group
org.sid

Artifact
customer-service

> Options

Dependencies

Search dependencies to add
Web, Security, JPA, Actuator, Devtools...

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start.spring.io is powered by
Spring Initializr and Pivotal Web Services

Generate - Ctrl + ⏎ | Explore - C

Selected dependencies

- **Spring Web** : Build web, including RESTful, applications using Spring MVC. Uses Apache Tomcat as the default embedded container.
- **Spring Data JPA** : Persist data in SQL stores with Java Persistence API using Spring Data and Hibernate.
- **H2 Database** : Provides a fast in-memory database that supports JDBC API and R2DBC access, with a small (2mb) footprint. Supports embedded and server modes as well as a browser-based console application.
- **Rest Repositories** : Exposing Spring Data repositories over REST via Spring Data REST.
- **Lombok** : Java annotation library which helps to reduce boilerplate code.
- **Spring Boot DevTools** : Provides fast application restarts, LiveReload, and configurations for enhanced development experience.
- **Eureka Discovery Client** : a REST based service for locating services for the purpose of load balancing and failover of middle-tier servers.
- **Spring Boot Actuator :** Supports built in (or custom) endpoints that let you monitor and manage your application - such as application health, metrics, sessions, etc.

Customer-service : CustomerServiceApplication.java

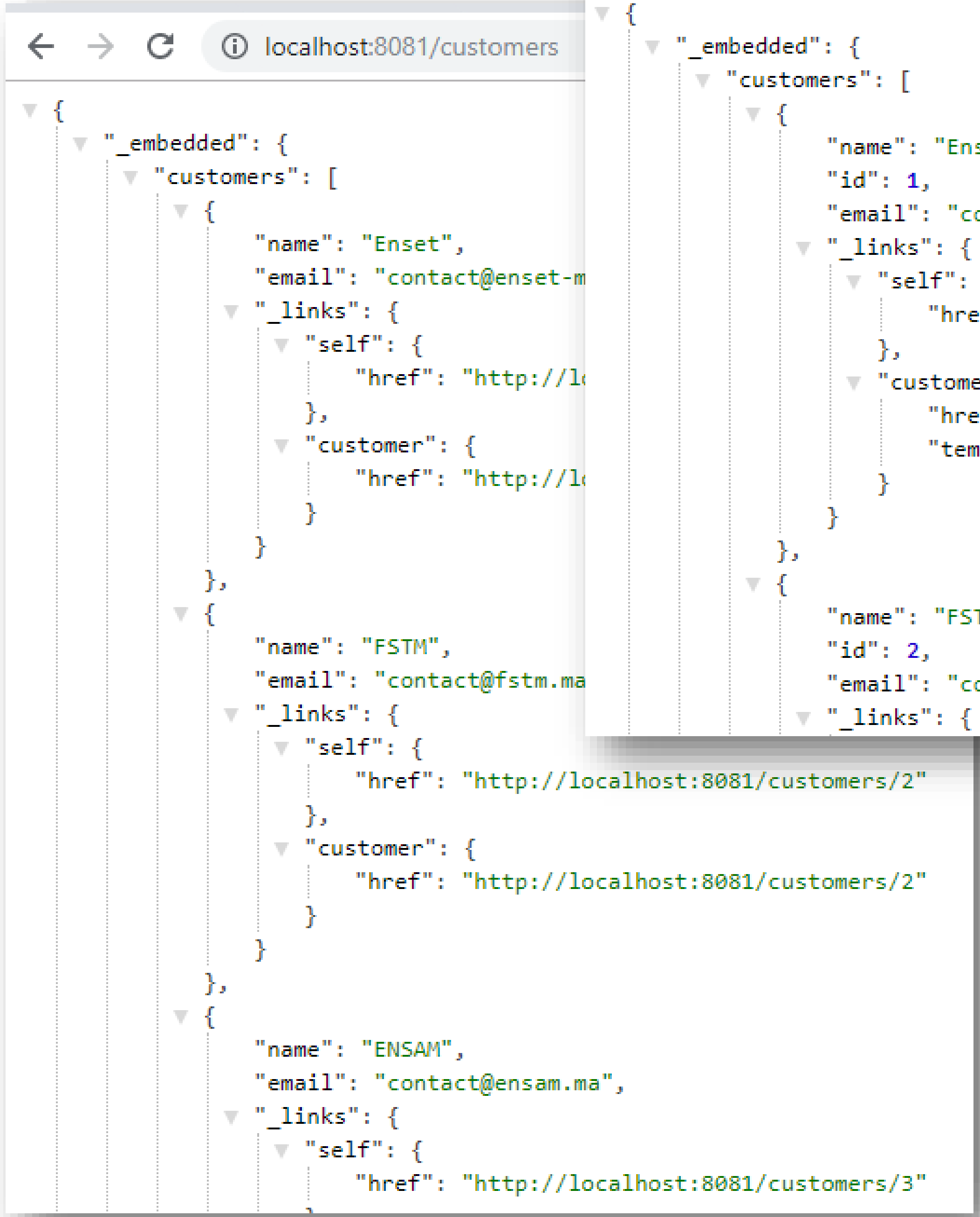
```java
package org.id.customerservice;
import lombok.AllArgsConstructor; import lombok.Data; import lombok.NoArgsConstructor;import lombok.ToString; import org.springframework.boot.CommandLineRunner;
import org.springframework.boot.SpringApplication;import org.springframework.boot.autoconfigure.SpringBootApplication;import org.springframework.context.annotation.Bean;
import org.springframework.data.jpa.repository.JpaRepository;import org.springframework.data.rest.core.annotation.RepositoryRestResource; import javax.persistence.Entity;
import javax.persistence.GeneratedValue;import javax.persistence.GenerationType; import javax.persistence.Id;

@Entity @Data @NoArgsConstructor @AllArgsConstructor @ToString
class Customer{
        @Id @GeneratedValue(strategy = GenerationType.IDENTITY)
        private Long id;   private String name; private String email;
}
@RepositoryRestResource
interface CustomerRepository extends JpaRepository<Customer,Long> { }

@SpringBootApplication
public class CustomerServiceApplication {

public static void main(String[] args) { pringApplication.run(CustomerServiceApplication.class, args);        }
        @Bean
        CommandLineRunner start(CustomerRepository customerRepository){
                return args -> {
                        customerRepository.save(new Customer(null,"Enset","contact@enset-media.ma"));
                        customerRepository.save(new Customer(null,"FSTM","contact@fstm.ma"));
                        customerRepository.save(new Customer(null,"ENSAM","contact@ensam.ma"));
                        customerRepository.findAll().forEach(System.out::println);
                };
        }
}
```

application.properties

```properties
spring.cloud.discovery.enabled=false
server.port=8081
spring.application.name=customer-service
#management.endpoints.web.exposure.include=*
```

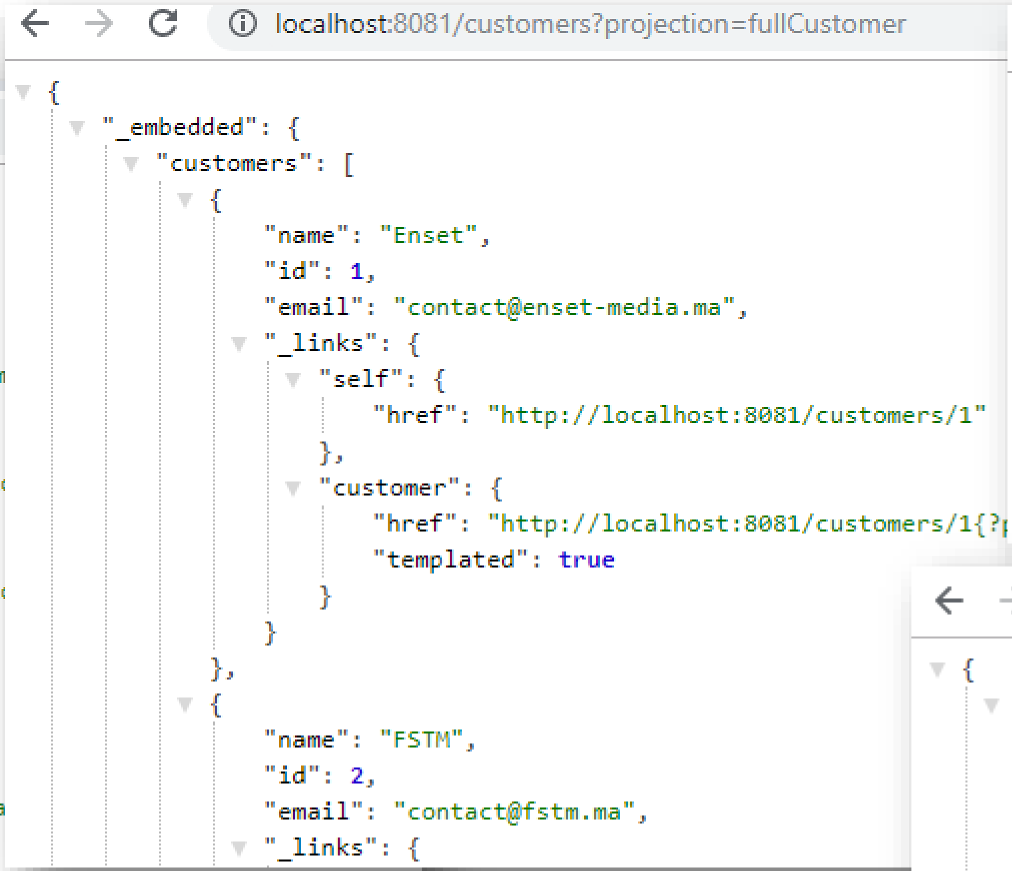
```java
@Projection(name = "fullCustomer",types =
Customer.class)
interface CustomerProjection extends Projection{
        public Long getId();
        public String getName();
        public String getEmail();
}
```

Customer-service



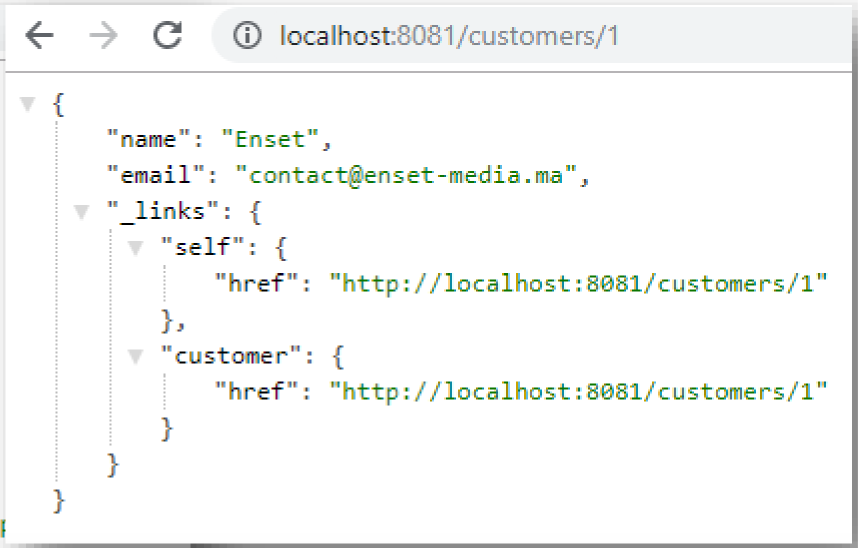
localhost:8081/customers

```
{
  "_embedded": {
    "customers": [
      {
        "name": "Enset",
        "email": "contact@enset-m
        "_links": {
          "self": {
            "href": "http://l
          },
          "customer": {
            "href": "http://l
          }
        }
      },
      {
        "name": "FSTM",
        "email": "contact@fstm.ma
        "_links": {
          "self": {
            "href": "http://localhost:8081/customers/2"
          },
          "customer": {
            "href": "http://localhost:8081/customers/2"
          }
        }
      },
      {
        "name": "ENSAM",
        "email": "contact@ensam.ma",
        "_links": {
          "self": {
            "href": "http://localhost:8081/customers/3"
```



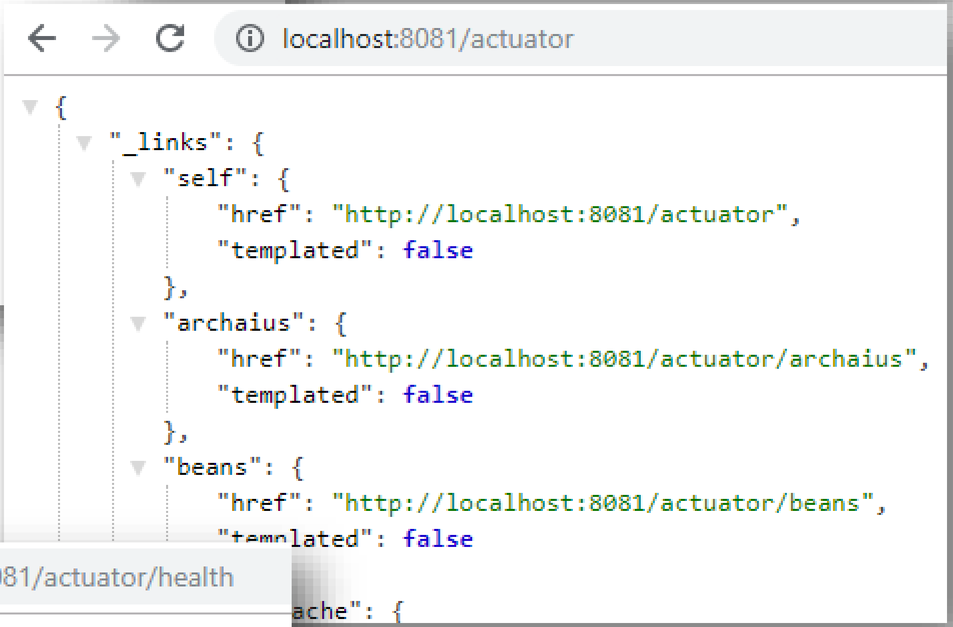
localhost:8081/customers?projection=fullCustomer

```
{
  "_embedded": {
    "customers": [
      {
        "name": "Enset",
        "id": 1,
        "email": "contact@enset-media.ma",
        "_links": {
          "self": {
            "href": "http://localhost:8081/customers/1"
          },
          "customer": {
            "href": "http://localhost:8081/customers/1{?p
            "templated": true
          }
        }
      },
      {
        "name": "FSTM",
        "id": 2,
        "email": "contact@fstm.ma",
        "_links": {
```



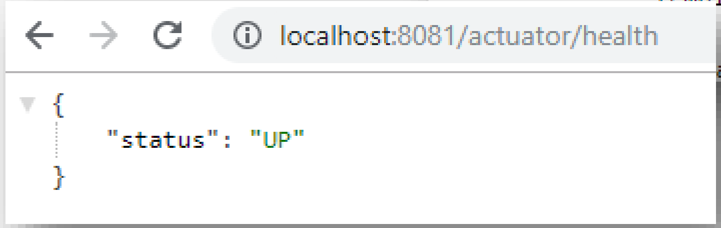
localhost:8081/customers/1

```
{
  "name": "Enset",
  "email": "contact@enset-media.ma",
  "_links": {
    "self": {
      "href": "http://localhost:8081/customers/1"
    },
    "customer": {
      "href": "http://localhost:8081/customers/1"
    }
  }
}
```



localhost:8081/actuator

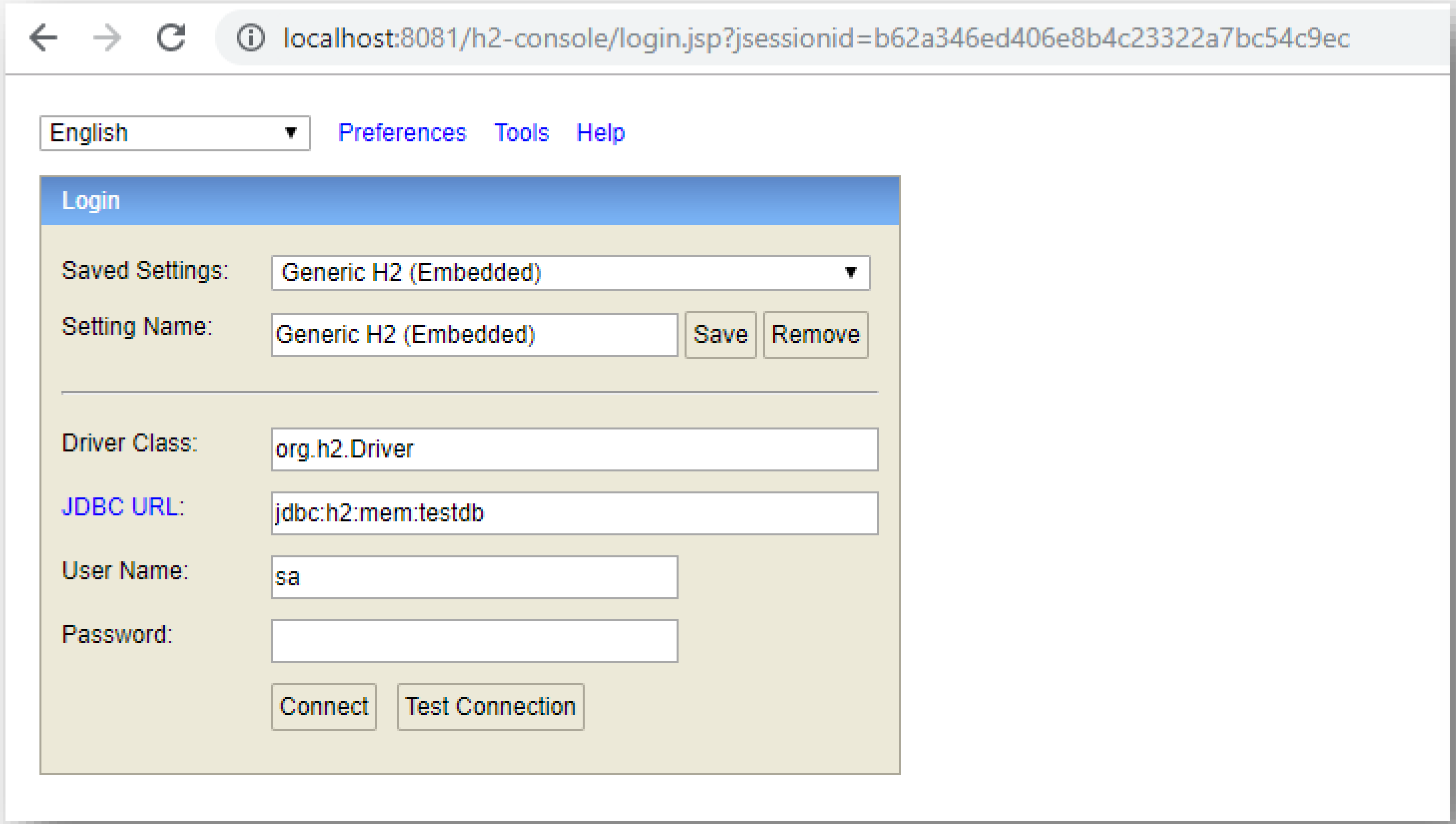
```
{
  "_links": {
    "self": {
      "href": "http://localhost:8081/actuator",
      "templated": false
    },
    "archaius": {
      "href": "http://localhost:8081/actuator/archaius",
      "templated": false
    },
    "beans": {
      "href": "http://localhost:8081/actuator/beans",
      "templated": false
    },
        ache": {
```



localhost:8081/actuator/health

```
{
  "status": "UP"
}
```

Customer-service : Base de données H2 (http://localhost:8081/h2-console)

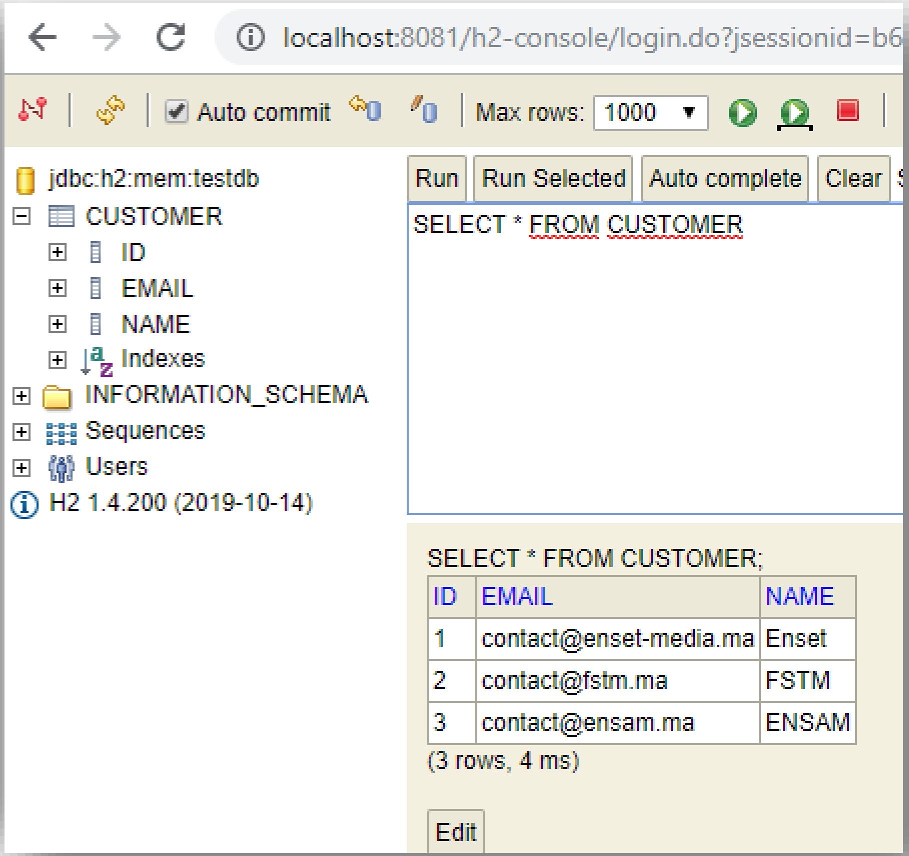


localhost:8081/h2-console/login.jsp?jsessionid=b62a346ed406e8b4c23322a7bc54c9ec

English Preferences Tools Help

Login

Saved Settings:	Generic H2 (Embedded)
Setting Name:	Generic H2 (Embedded)
Driver Class:	org.h2.Driver
JDBC URL:	jdbc:h2:mem:testdb
User Name:	sa
Password:	



localhost:8081/h2-console/login.do?jsessionid=b6

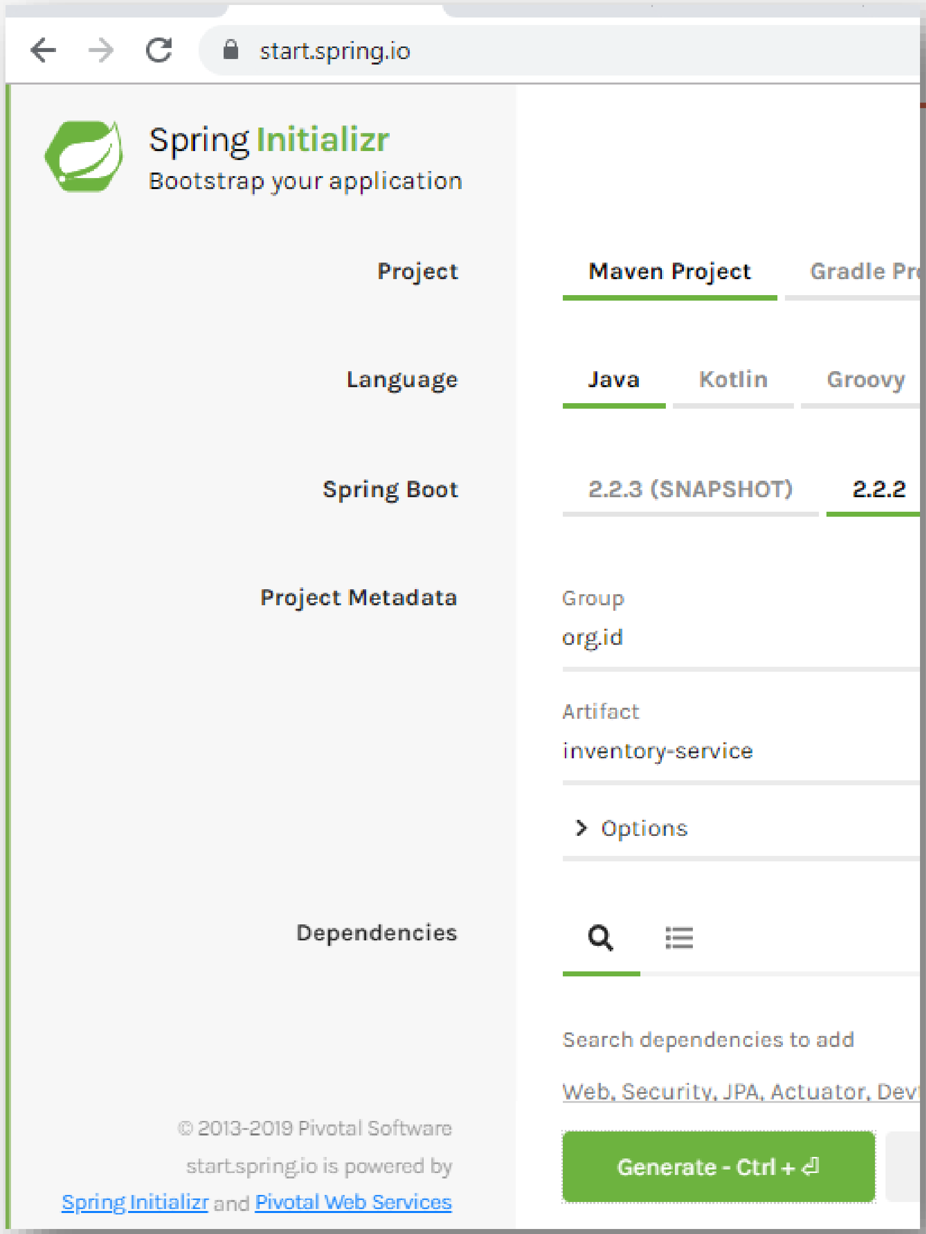
```
SELECT * FROM CUSTOMER
```

SELECT * FROM CUSTOMER;

ID	EMAIL	NAME
1	contact@enset-media.ma	Enset
2	contact@fstm.ma	FSTM
3	contact@ensam.ma	ENSAM

(3 rows, 4 ms)

Inventory-service



start.spring.io

Spring Initializr
Bootstrap your application

Project: Maven Project [✓] | Gradle Pr

Language: Java [✓] | Kotlin | Groovy

Spring Boot: 2.2.3 (SNAPSHOT) | 2.2.2 [✓]

Project Metadata
Group: org.id
Artifact: inventory-service
> Options

Dependencies
Search dependencies to add
Web, Security, JPA, Actuator, Dev

Generate - Ctrl + ⏎

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start.spring.io is powered by
Spring Initializr and Pivotal Web Services

Selected dependencies

- **Spring Web** : Build web, including RESTful, applications using Spring MVC. Uses Apache Tomcat as the default embedded container.
- **Spring Data JPA** : Persist data in SQL stores with Java Persistence API using Spring Data and Hibernate.
- **H2 Database** : Provides a fast in-memory database that supports JDBC API and R2DBC access, with a small (2mb) footprint. Supports embedded and server modes as well as a browser based console application.
- **Rest Repositories** : Exposing Spring Data repositories over REST via Spring Data REST.
- **Lombok** : Java annotation library which helps to reduce boilerplate code.
- **Spring Boot DevTools** : Provides fast application restarts, LiveReload, and configurations for enhanced development experience.
- **Eureka Discovery Client** : a REST based service for locating services for the purpose of load balancing and failover of middle-tier servers.
- **Spring Boot Actuator :** Supports built in (or custom) endpoints that let you monitor and manage your application - such as application health, metrics, sessions, etc.

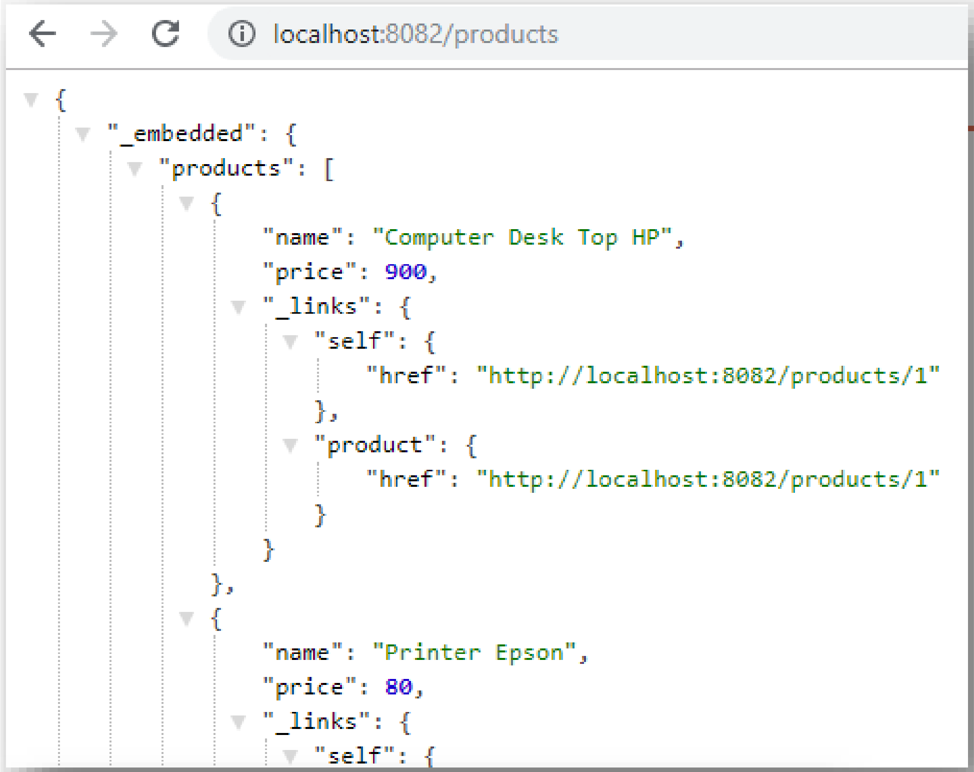
Inventory-service : InventoryServiceApplication.java

```java
package org.id.inventoryservice;

import ...

@Entity @Data @NoArgsConstructor @AllArgsConstructor @ToString
class Product{
         @Id @GeneratedValue(strategy = GenerationType.IDENTITY)
         private Long id; private String name;private double price;
}

@RepositoryRestResource
interface ProductRepository extends JpaRepository<Product,Long> { }

@SpringBootApplication
public class InventoryServiceApplication {
         public static void main(String[] args) { pringApplication.run(InventoryServiceApplication.class, args);;}

         @Bean
         CommandLineRunner start(ProductRepository productRepository){
                  return args -> {
                           productRepository.save(new Product(null,"Computer Desk Top HP",900));
                           productRepository.save(new Product(null,"Printer Epson",80));
                           productRepository.save(new Product(null,"MacBook Pro Lap Top",1800));
                           productRepository.findAll().forEach(System.out::println);
                  };
         }
}
```

application.properties

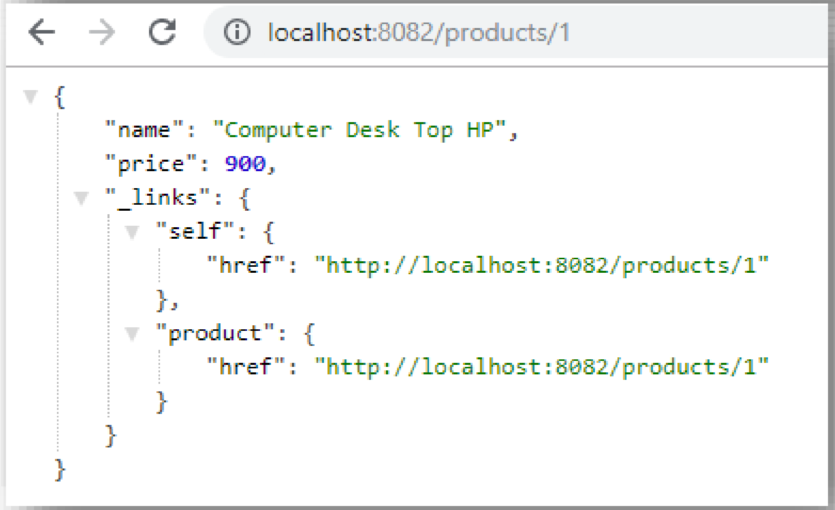
```properties
spring.application.name=inventory-service
spring.cloud.discovery.enabled=false
server.port=8082
```

Inventory-service



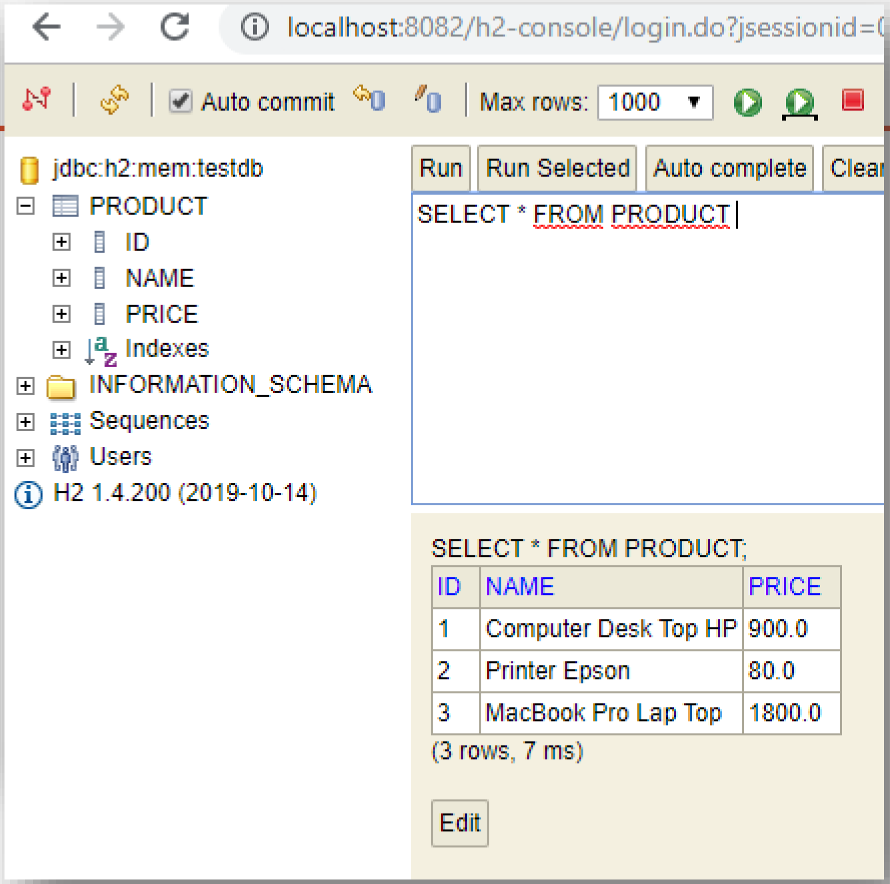
localhost:8082/products

```
{
  "_embedded": {
    "products": [
      {
        "name": "Computer Desk Top HP",
        "price": 900,
        "_links": {
          "self": {
            "href": "http://localhost:8082/products/1"
          },
          "product": {
            "href": "http://localhost:8082/products/1"
          }
        }
      },
      {
        "name": "Printer Epson",
        "price": 80,
        "_links": {
          "self": {
```



localhost:8082/products/1

```
{
  "name": "Computer Desk Top HP",
  "price": 900,
  "_links": {
    "self": {
      "href": "http://localhost:8082/products/1"
    },
    "product": {
      "href": "http://localhost:8082/products/1"
    }
  }
}
```



localhost:8082/h2-console/login.do?jsessionid=(

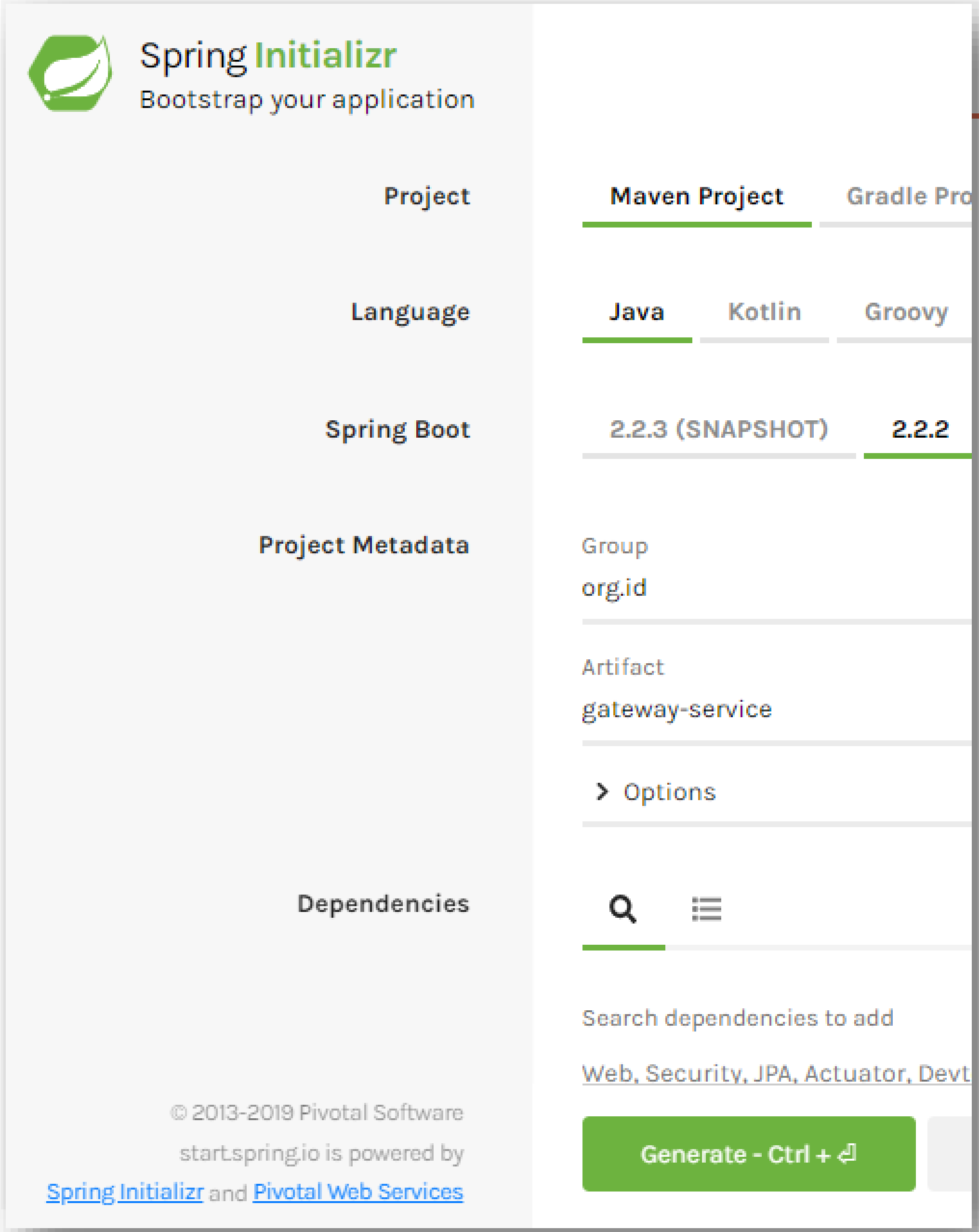
```
SELECT * FROM PRODUCT
```

SELECT * FROM PRODUCT;

ID	NAME	PRICE
1	Computer Desk Top HP	900.0
2	Printer Epson	80.0
3	MacBook Pro Lap Top	1800.0

(3 rows, 7 ms)

Gateway-service


Spring Initializr
Bootstrap your application

Project: Maven Project | Gradle Pro
Language: Java | Kotlin | Groovy
Spring Boot: 2.2.3 (SNAPSHOT) | 2.2.2
Project Metadata
Group: org.id
Artifact: gateway-service
Options
Dependencies
Search dependencies to add
Web, Security, JPA, Actuator, Devt
Generate - Ctrl + ⏎
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Spring Initializr and Pivotal Web Services

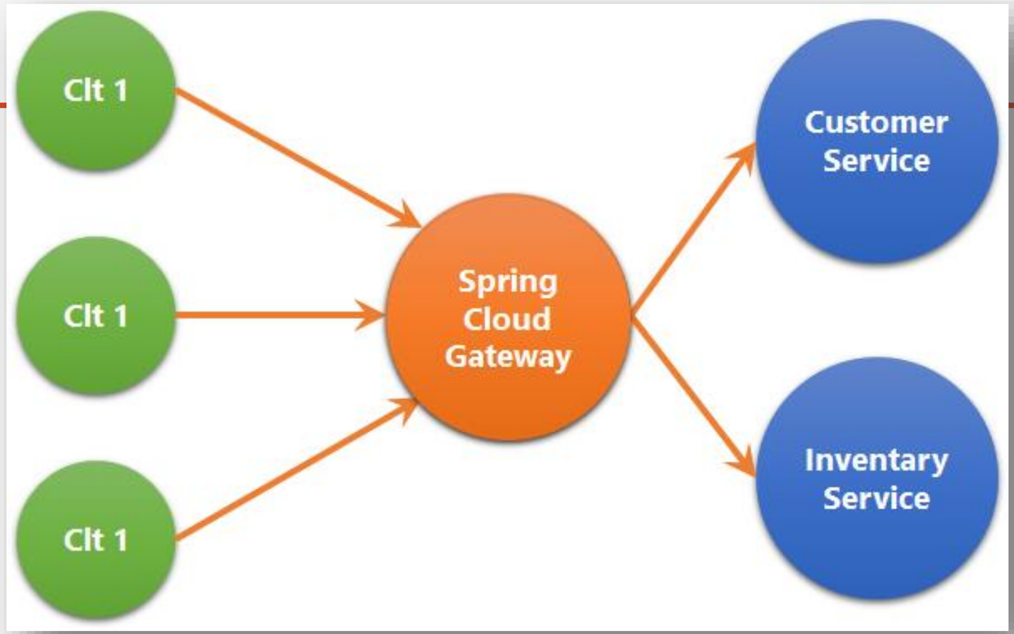
Selected dependencies

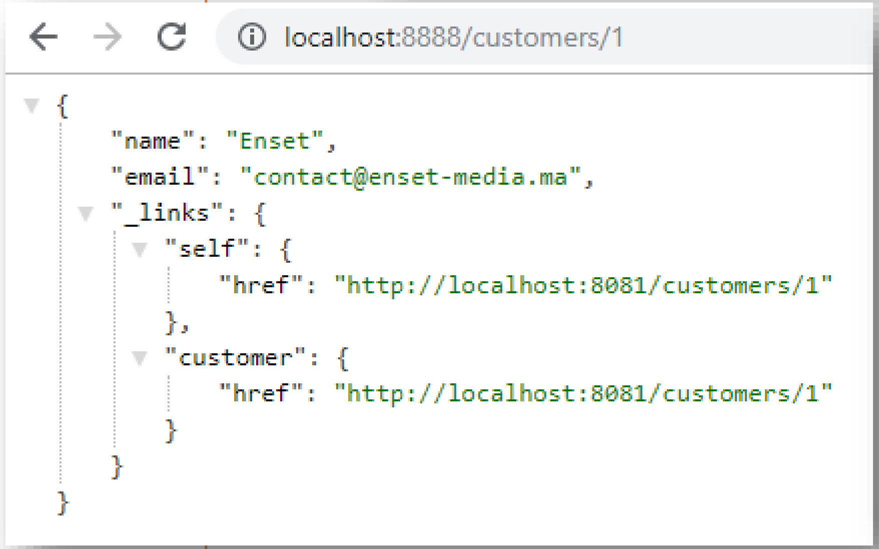
- **Gateway** : Provides a simple, yet effective way to route to APIs and provide cross cutting concerns to them such as security, monitoring/metrics, and resiliency.
- **Spring Boot Actuator** : Supports built in (or custom) endpoints that let you monitor and manage your application - such as application health, metrics, sessions, etc.
- **Hystrix** : Circuit breaker with Spring Cloud Netflix Hystrix.
- **Eureka Discovery Client** : a REST based service for locating services for the purpose of load balancing and failover of middle-tier servers.

Static routes configuration: application.yml

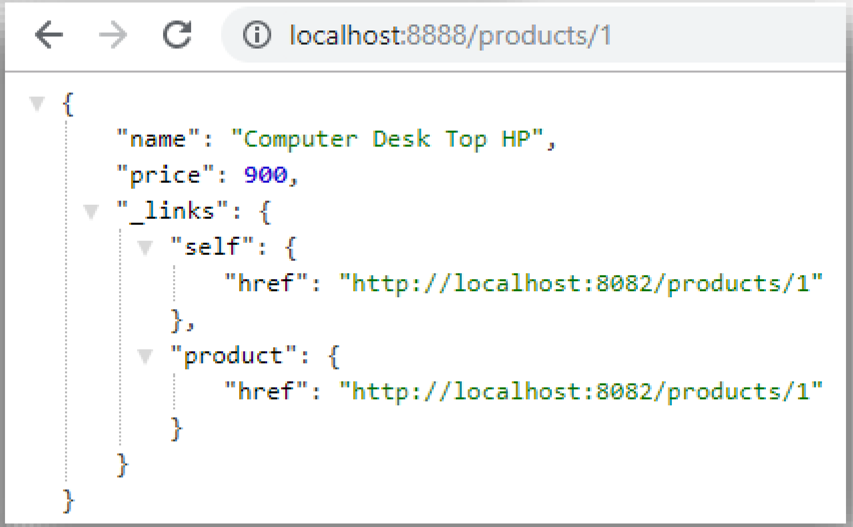
application.yml

```yaml
spring:
  cloud:
    gateway:
      routes:
        - id : r1
          uri : http://localhost:8081/
          predicates :
            - Path= /customers/**
        - id : r2
          uri : http://localhost:8082/
          predicates :
            - Path= /products/**
    discovery:
      enabled: false
server:
  port: 8888
```





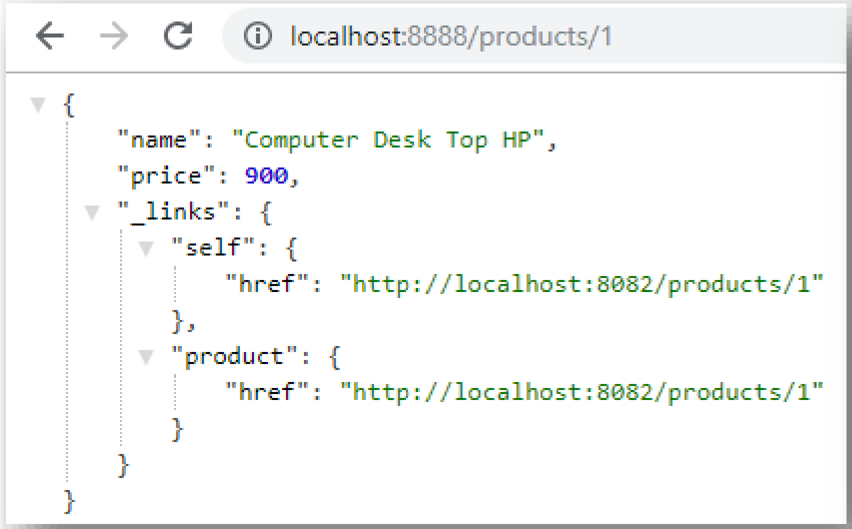
```
{
  "name": "Enset",
  "email": "contact@enset-media.ma",
  "_links": {
    "self": {
      "href": "http://localhost:8081/customers/1"
    },
    "customer": {
      "href": "http://localhost:8081/customers/1"
    }
  }
}
```



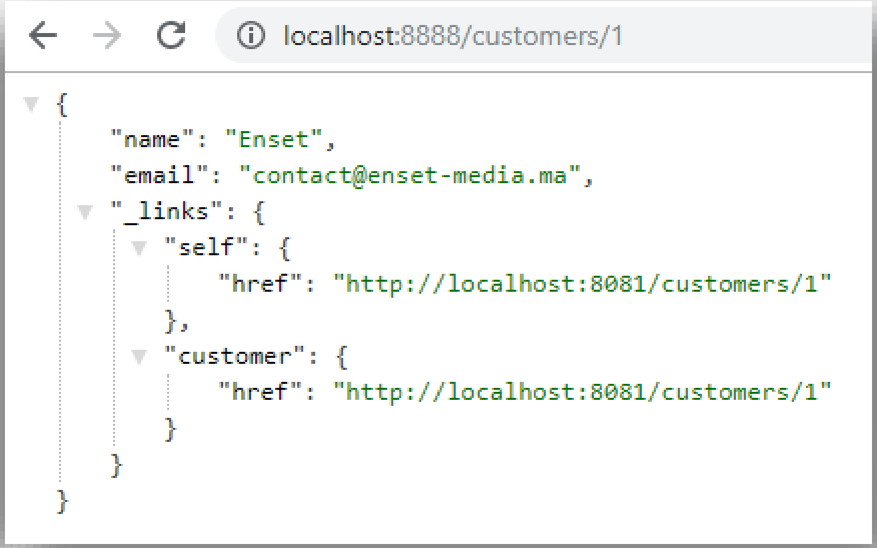
```
{
  "name": "Computer Desk Top HP",
  "price": 900,
  "_links": {
    "self": {
      "href": "http://localhost:8082/products/1"
    },
    "product": {
      "href": "http://localhost:8082/products/1"
    }
  }
}
```

Static routes configuration: Java Config Class

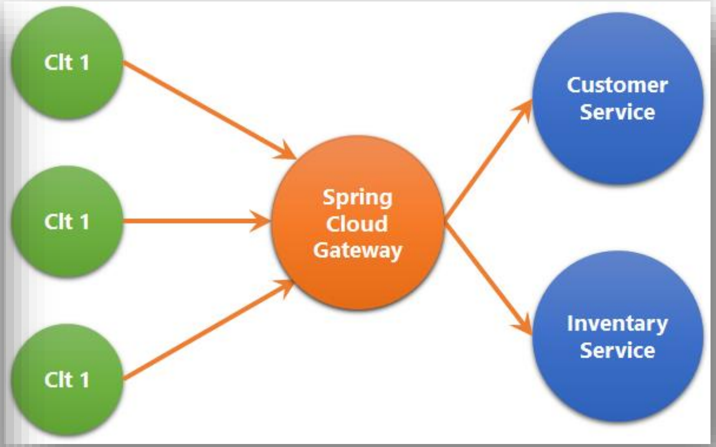
```java
@Bean
RouteLocator gatewayRoutes(RouteLocatorBuilder builder){
        return builder.routes()
                        .route(r->r.path("/customers/**").uri("http://localhost:8081/").id("r1"))
                        .route(r->r.path("/products/**").uri("http://localhost:8082/").id("r2"))
                        .build();
}
```


localhost:8888/products/1

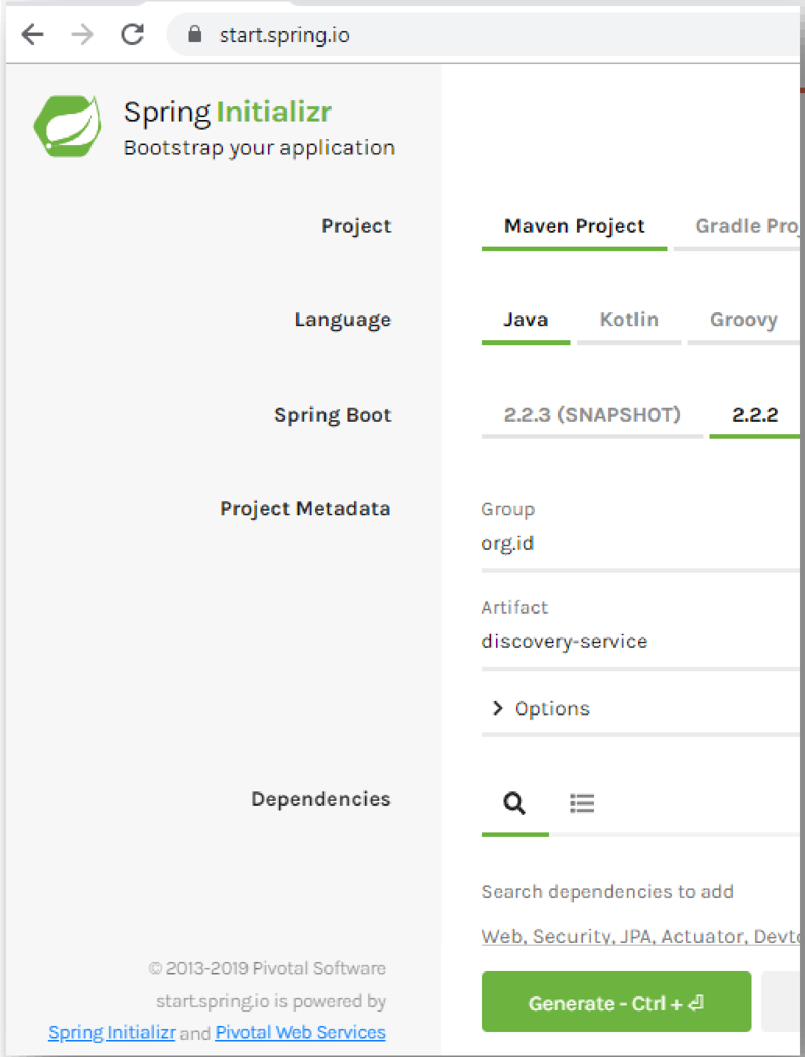
```
{
    "name": "Computer Desk Top HP",
    "price": 900,
    "_links": {
        "self": {
            "href": "http://localhost:8082/products/1"
        },
        "product": {
            "href": "http://localhost:8082/products/1"
        }
    }
}
```


localhost:8888/customers/1

```
{
    "name": "Enset",
    "email": "contact@enset-media.ma",
    "_links": {
        "self": {
            "href": "http://localhost:8081/customers/1"
        },
        "customer": {
            "href": "http://localhost:8081/customers/1"
        }
    }
}
```



Eureka Discovery Service : Dynamic Routing



start.spring.io

Spring Initializr
Bootstrap your application

Project	[✓ Maven Project] Gradle Pro
Language	[✓ Java] Kotlin Groovy
Spring Boot	2.2.3 (SNAPSHOT) [✓ 2.2.2]
Project Metadata	Group: org.id Artifact: discovery-service Options
Dependencies	Search dependencies to add Web, Security, JPA, Actuator, Devt

Generate - Ctrl + ⏎
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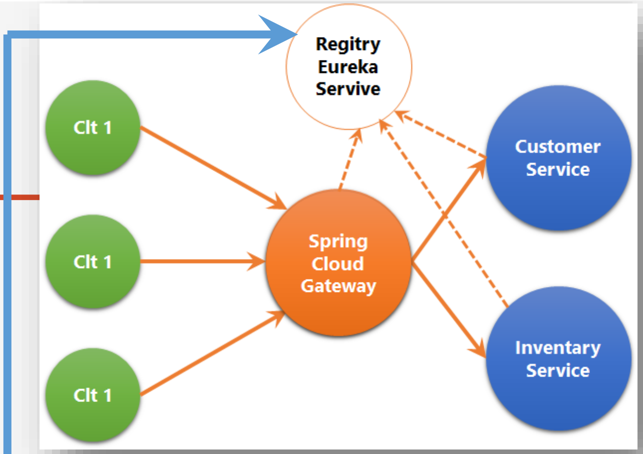
Spring Initializr and Pivotal Web Services



Selected dependencies

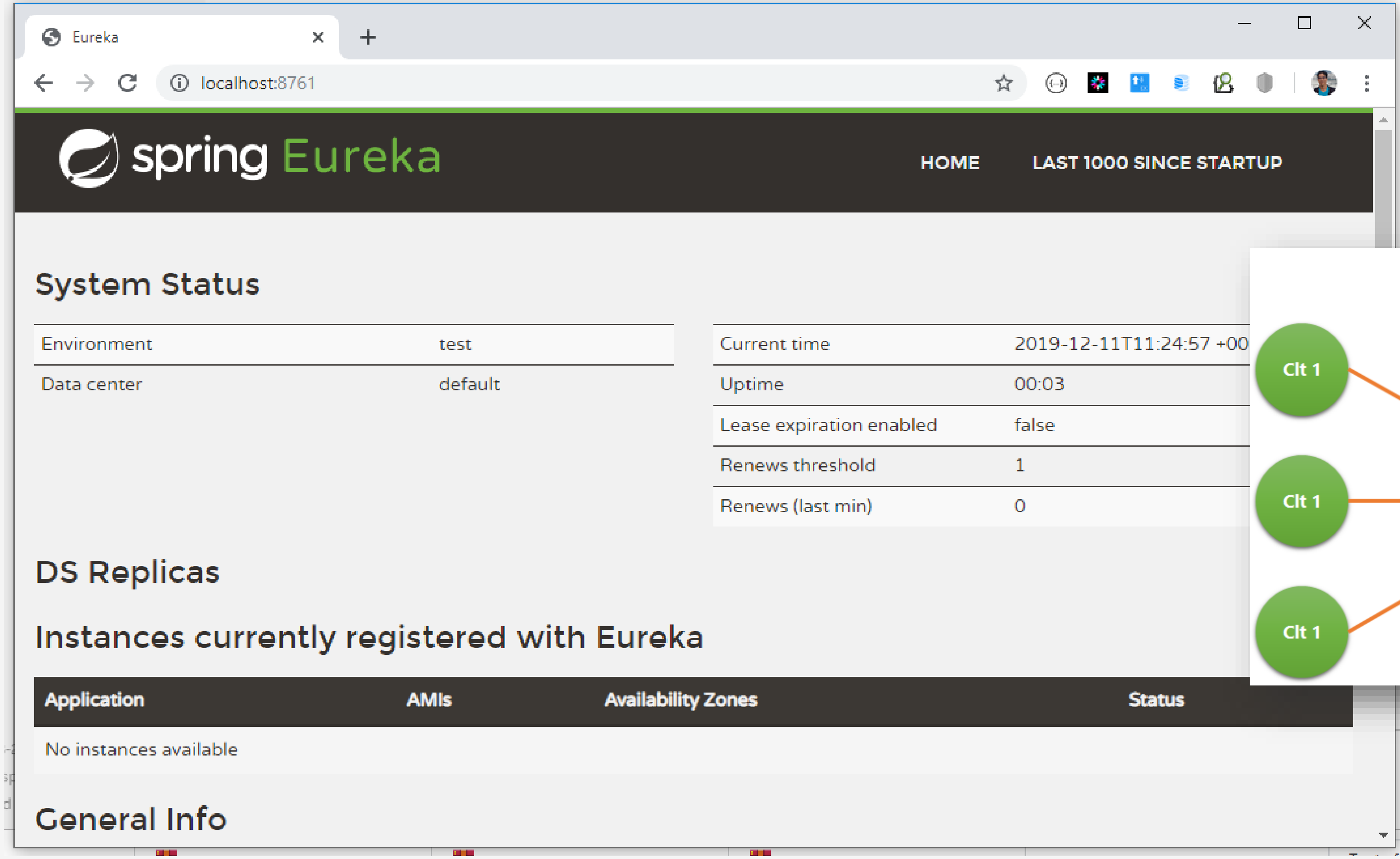
- **Eureka Server** : spring-cloud-netflix Eureka Server.

```
package org.id.discoveryservice; import org.springframework.boot.SpringApplication;
import org.springframework.boot.autoconfigure.SpringBootApplication;
import org.springframework.cloud.netflix.eureka.server.EnableEurekaServer;
@SpringBootApplication
@EnableEurekaServer
public class DiscoveryServiceApplication {
 public static void main(String[] args) {
  SpringApplication.run(DiscoveryServiceApplication.class, args);
 }
}
```

application.properties

```
server.port=8761
eureka.client.fetch-registry=false
eureka.client.register-with-eureka=false
```

Eureka Discovery Service : Dynamic Routing



System Status

Environment	test
Data center	default

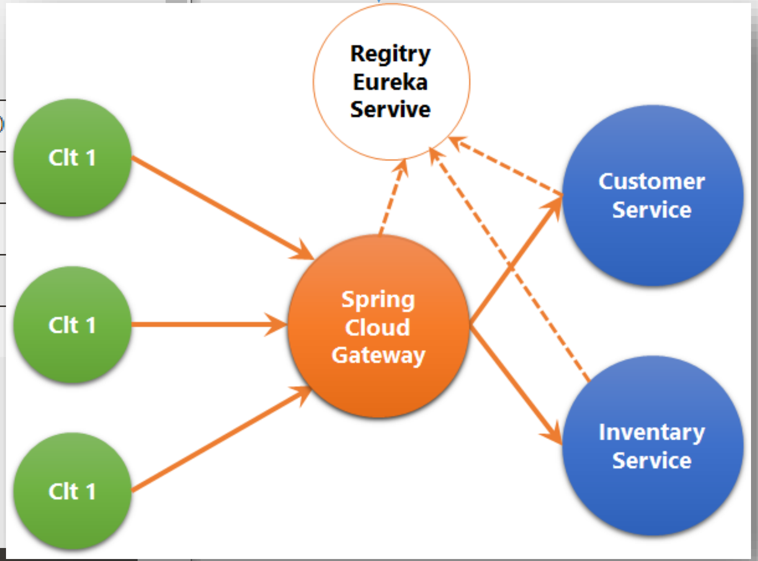
Current time	2019-12-11T11:24:57 +00
Uptime	00:03
Lease expiration enabled	false
Renews threshold	1
Renews (last min)	0

DS Replicas

Instances currently registered with Eureka

Application	AMIs	Availability Zones	Status
No instances available			

General Info



Permettre à Customer-service et Invotory-service de s'enregistrer chez Eureka server

Customer-service

application.properties

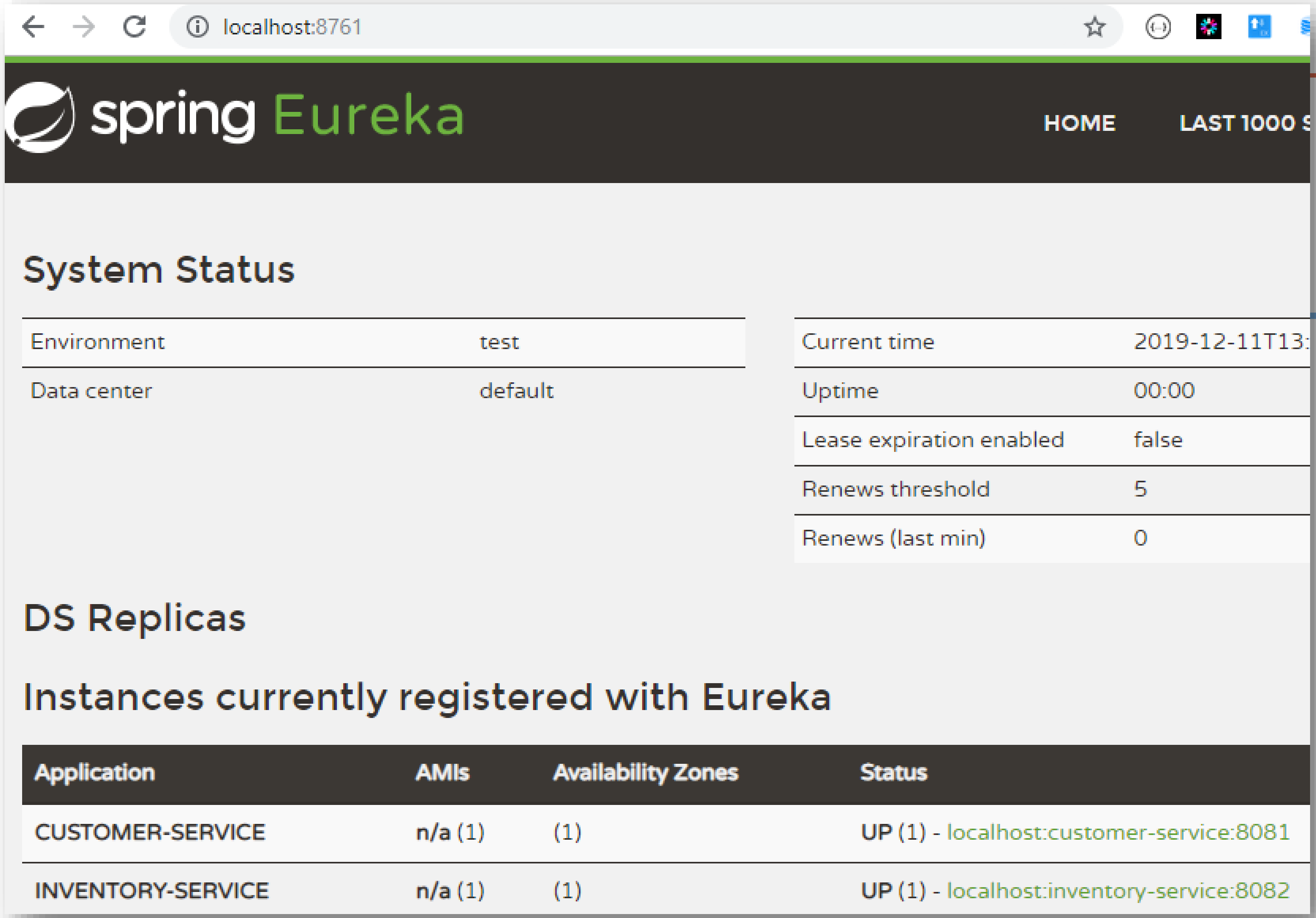
```
spring.cloud.discovery.enabled=true
server.port=8081
spring.application.name=customer-service
management.endpoints.web.exposure.include=*
eureka.client.service-url.defaultZone=http://localhost:8761/eureka
```

Inventory-service

application.properties

```
spring.cloud.discovery.enabled=true
server.port=8082
spring.application.name=inventory-service
eureka.client.service-url.defaultZone=http://localhost:8761/eureka
```

Eureka Discovery Service : Dynamic Routing



localhost:8761

spring Eureka

HOME LAST 1000 S

System Status

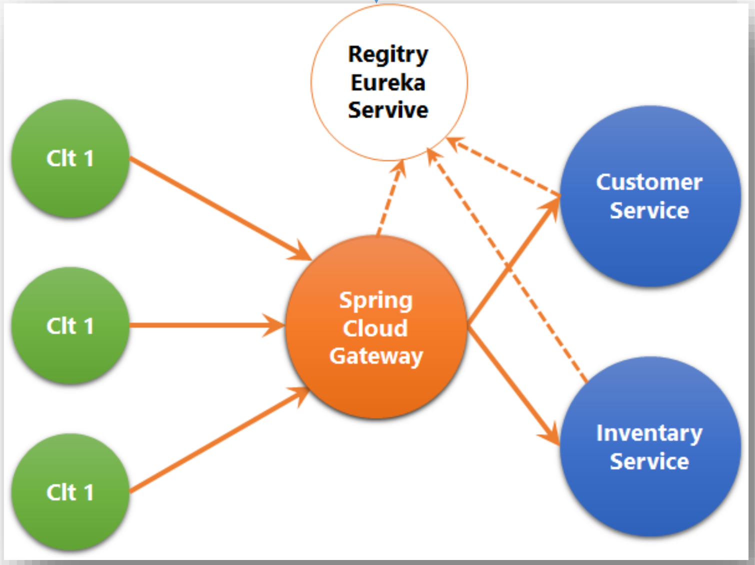
Environment	test
Data center	default

Current time	2019-12-11T13:
Uptime	00:00
Lease expiration enabled	false
Renews threshold	5
Renews (last min)	0

DS Replicas

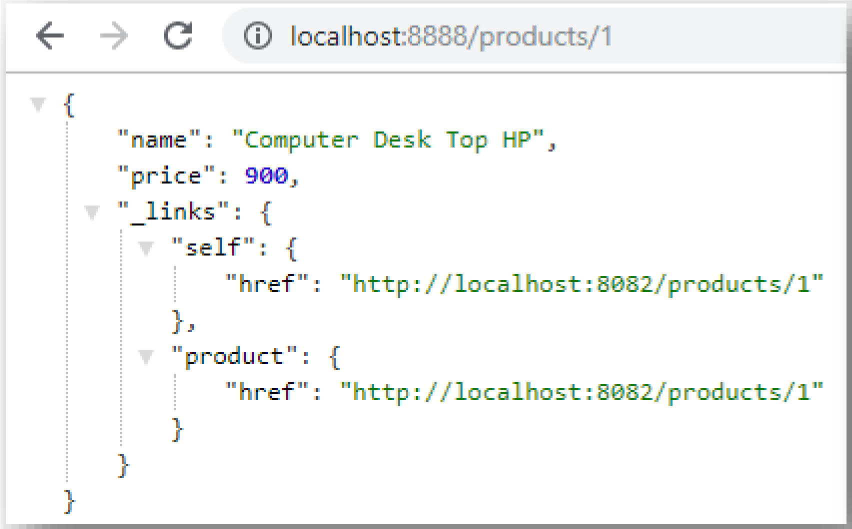
Instances currently registered with Eureka

Application	AMIs	Availability Zones	Status
CUSTOMER-SERVICE	n/a (1)	(1)	UP (1) - localhost:customer-service:8081
INVENTORY-SERVICE	n/a (1)	(1)	UP (1) - localhost:inventory-service:8082



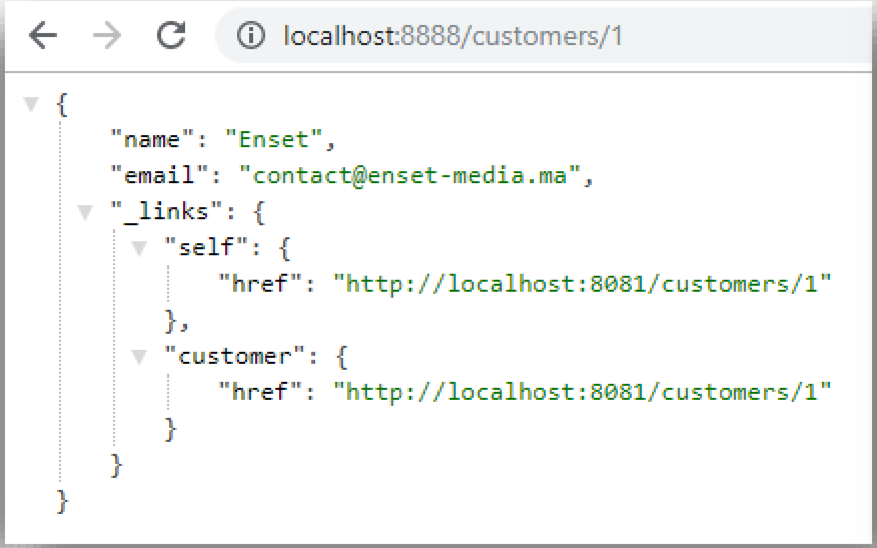
Static routes configuration with Discovery Service

```
@Bean
RouteLocator gatewayRoutes(RouteLocatorBuilder builder){
        return builder.routes()
                        .route(r->r.path("/customers/**").uri("lb://CUSTOMER-SERVICE")  .id("r1"))
                         .route(r->r.path("/products/**").uri("lb://INVENTORY-SERVICE") .id("r2"))
                        .build();
}
```



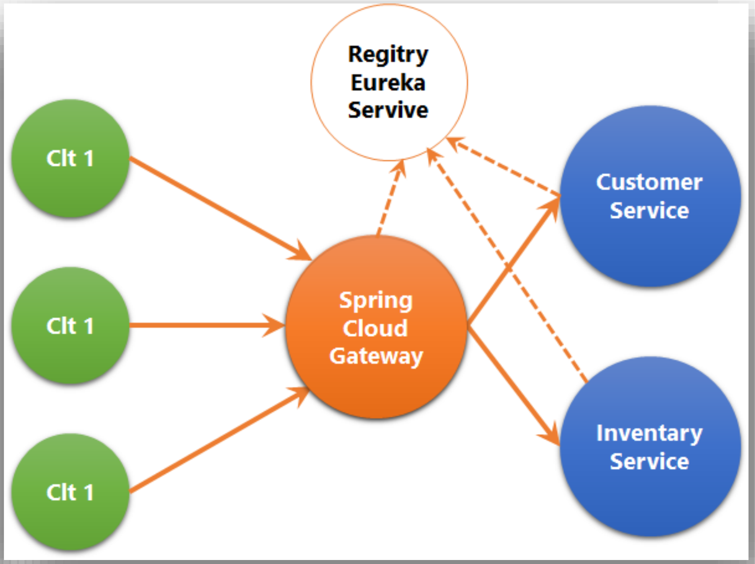
localhost:8888/products/1

```
{
    "name": "Computer Desk Top HP",
    "price": 900,
    "_links": {
        "self": {
            "href": "http://localhost:8082/products/1"
        },
        "product": {
            "href": "http://localhost:8082/products/1"
        }
    }
}
```



localhost:8888/customers/1

```
{
    "name": "Enset",
    "email": "contact@enset-media.ma",
    "_links": {
        "self": {
            "href": "http://localhost:8081/customers/1"
        },
        "customer": {
            "href": "http://localhost:8081/customers/1"
        }
    }
}
```

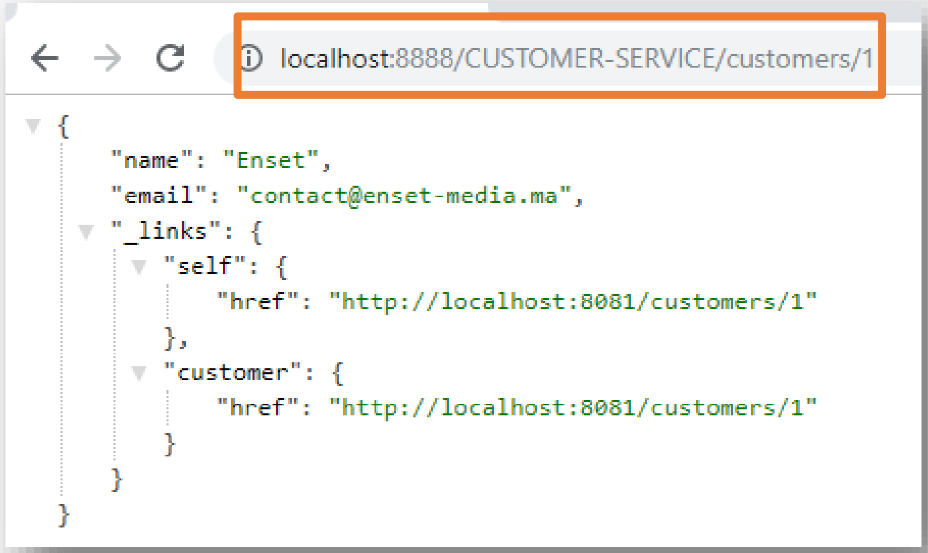


Dynamic routes configuration with Discovery Service

application.properties

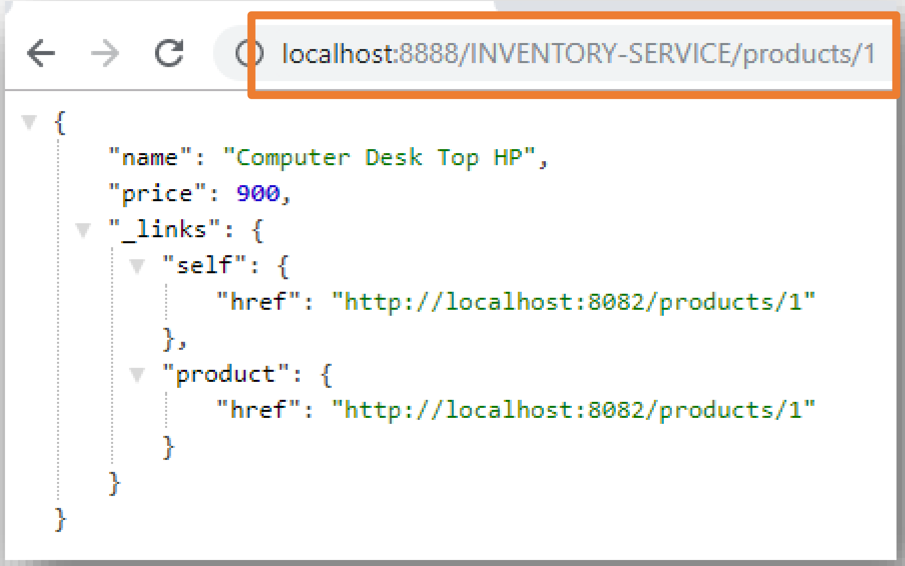
```
spring.application.name=gateway-service
spring.cloud.discovery.enabled=true
server.port=8888
```

```
@Bean
DiscoveryClientRouteDefinitionLocator dynamicRoutes(ReactiveDiscoveryClient rdc,
DiscoveryLocatorProperties dlp){
        return new DiscoveryClientRouteDefinitionLocator(rdc,dlp);
}
```



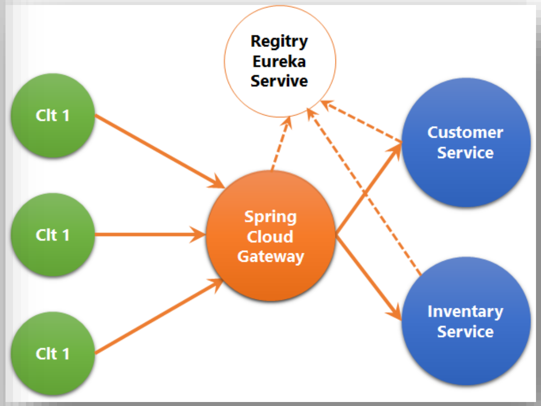
localhost:8888/CUSTOMER-SERVICE/customers/1

```
{
    "name": "Enset",
    "email": "contact@enset-media.ma",
    "_links": {
      "self": {
          "href": "http://localhost:8081/customers/1"
      },
      "customer": {
          "href": "http://localhost:8081/customers/1"
      }
    }
}
```



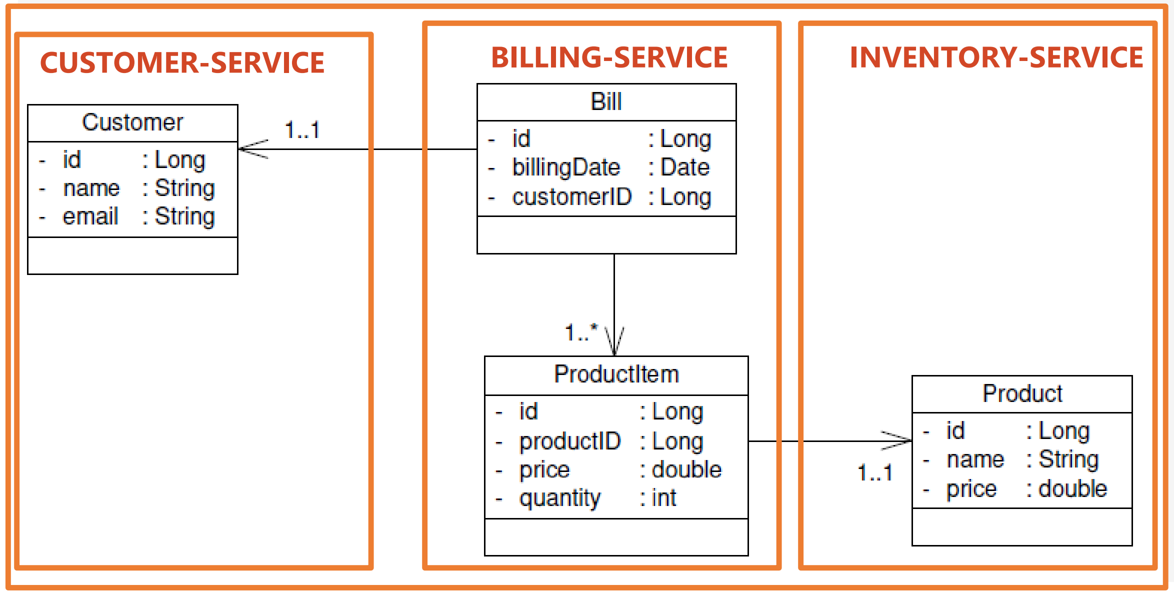
localhost:8888/INVENTORY-SERVICE/products/1

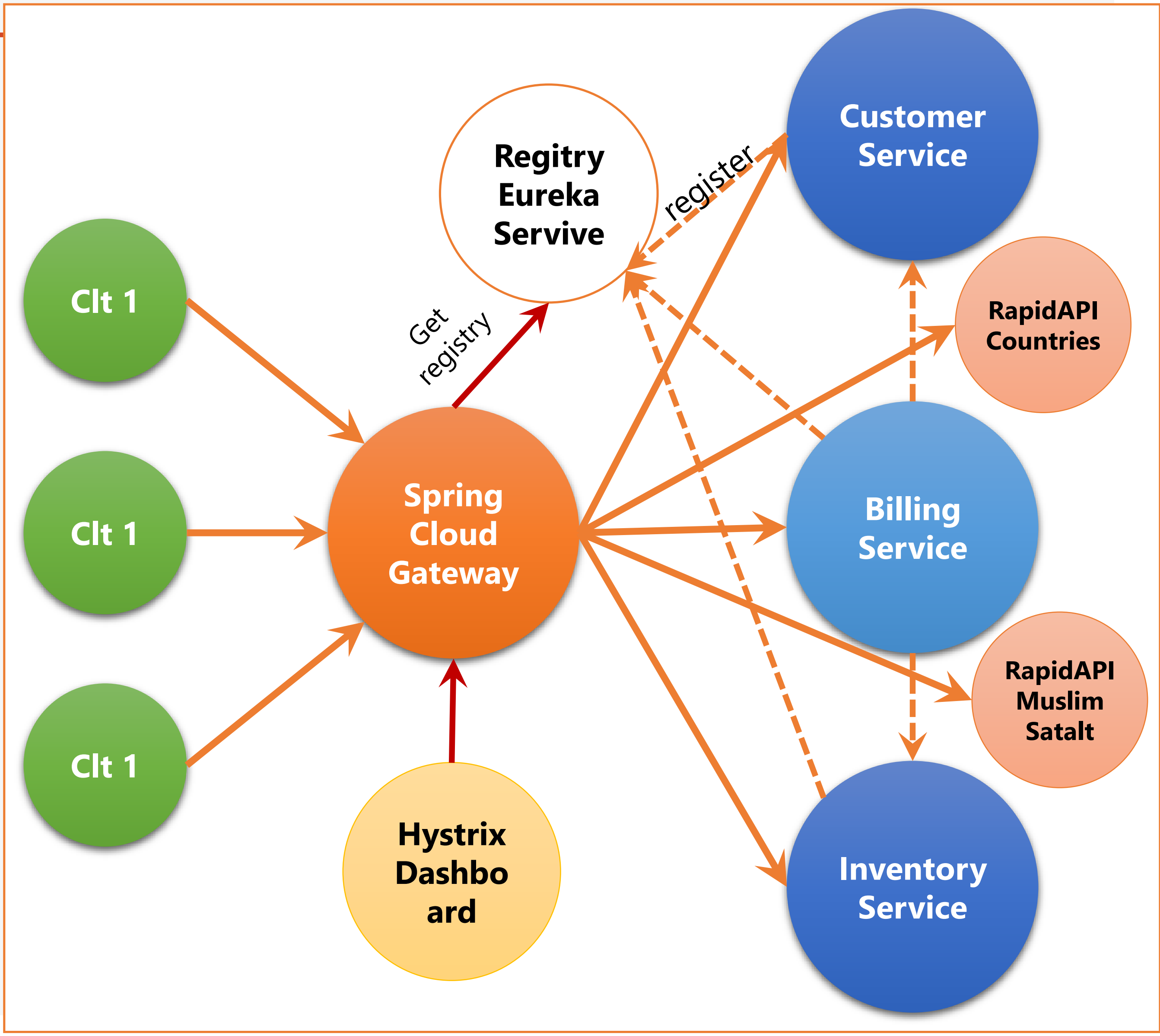
```
{
    "name": "Computer Desk Top HP",
    "price": 900,
    "_links": {
      "self": {
          "href": "http://localhost:8082/products/1"
      },
      "product": {
          "href": "http://localhost:8082/products/1"
      }
    }
}
```



Autres services à ajouter

1. Accès aux services externes en utilisant des filtres au niveau du gateway service :
   - RapidAPI Countries
   - Rapid API Mulsim Salat
2. Utilisation de Circuit Breaker avec Hystrix
3. Utilisation de Hystrix Dashboard pour surveiller l'état du trafic au niveau du service Gateway
4. Ajouter un service de facturation (Billing Service), qui communique avec les services Clients et Inventaire en utilisant Spring cloud OpenFeign Rest Client

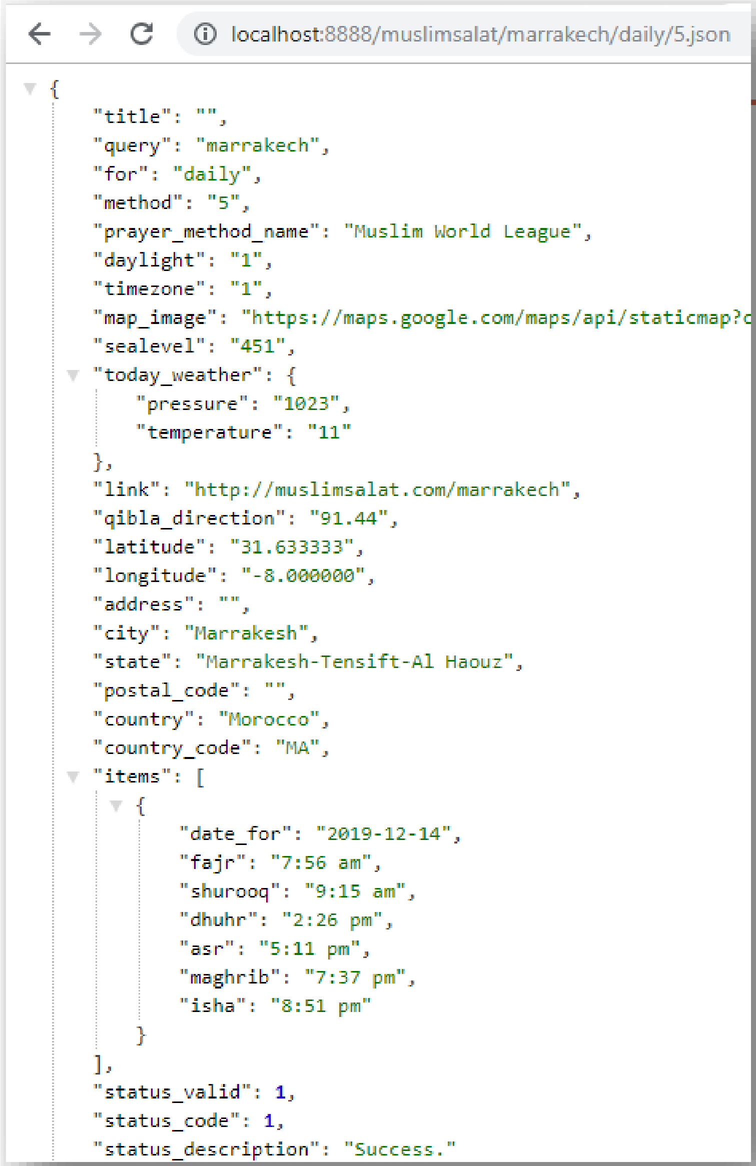




Exemple de : Routes Filters

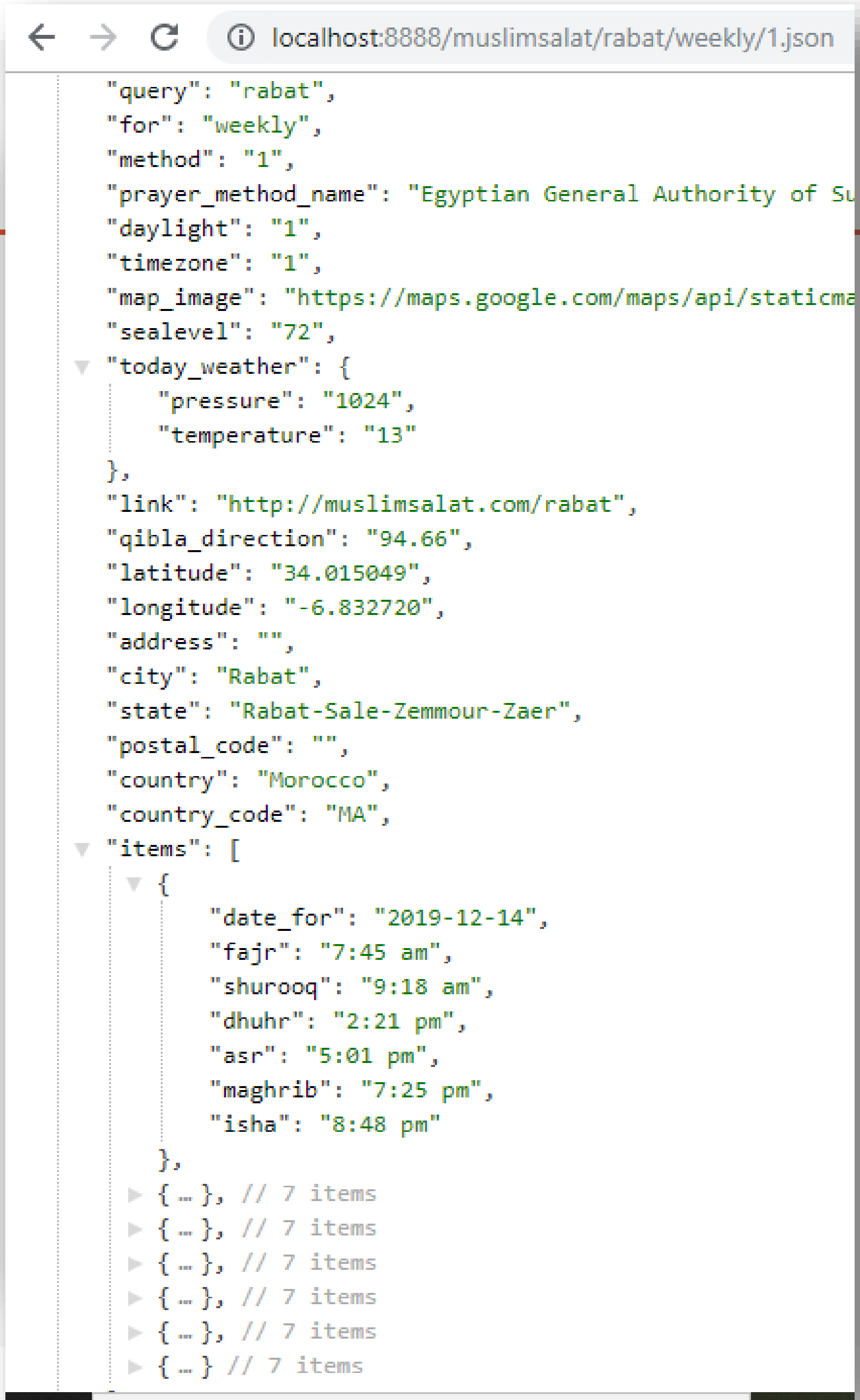
```
@Bean
RouteLocator gatewayRoutes(RouteLocatorBuilder builder){
         return builder.routes()
           .route(r->r.path("/restcountries/**")
            .filters(f->f
             .addRequestHeader("x-rapidapi-host","restcountries-v1.p.rapidapi.com")
             .addRequestHeader("x-rapidapi-key", "fe5e774996msh4eb6e863d457420p1d2ffbjsnee0617ac5078")
             .rewritePath("/restcountries/(?<segment>.*)","/${segment}")

           )
            .uri("https://restcountries-v1.p.rapidapi.com").id("countries")
          )
         .route(r->r.path("/muslimsalat/**")
           .filters(f->f
             .addRequestHeader("x-rapidapi-host","muslimsalat.p.rapidapi.com")
             .addRequestHeader("x-rapidapi-key", "fe5e774996msh4eb6e863d457420p1d2ffbjsnee0617ac5078")
             .rewritePath("/muslimsalat/(?<segment>.*)","/${segment}")
            )
           .uri("https://muslimsalat.p.rapidapi.com")
           .id("countries")
          )
         .build();
}
```

Static Routes with Filters



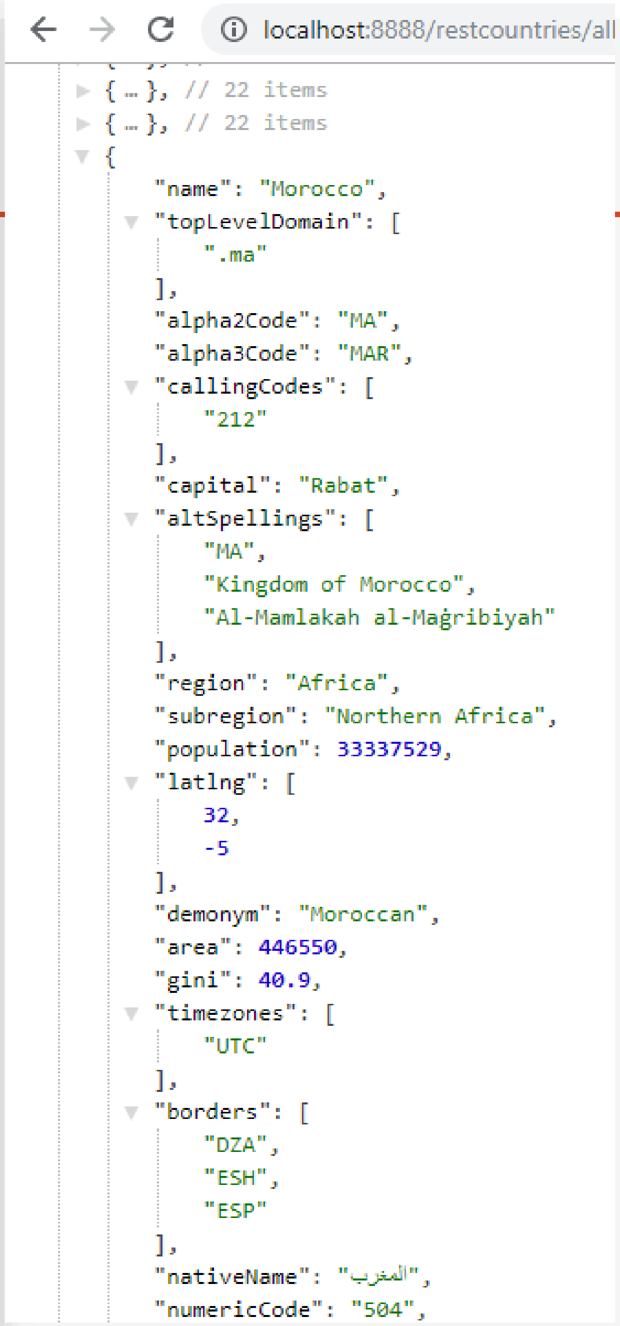
localhost:8888/muslimsalat/marrakech/daily/5.json

```
{
    "title": "",
    "query": "marrakech",
    "for": "daily",
    "method": "5",
    "prayer_method_name": "Muslim World League",
    "daylight": "1",
    "timezone": "1",
    "map_image": "https://maps.google.com/maps/api/staticmap?c
    "sealevel": "451",
    "today_weather": {
        "pressure": "1023",
        "temperature": "11"
    },
    "link": "http://muslimsalat.com/marrakech",
    "qibla_direction": "91.44",
    "latitude": "31.633333",
    "longitude": "-8.000000",
    "address": "",
    "city": "Marrakesh",
    "state": "Marrakesh-Tensift-Al Haouz",
    "postal_code": "",
    "country": "Morocco",
    "country_code": "MA",
    "items": [
        {
            "date_for": "2019-12-14",
            "fajr": "7:56 am",
            "shurooq": "9:15 am",
            "dhuhr": "2:26 pm",
            "asr": "5:11 pm",
            "maghrib": "7:37 pm",
            "isha": "8:51 pm"
        }
    ],
    "status_valid": 1,
    "status_code": 1,
    "status_description": "Success."
```



localhost:8888/muslimsalat/rabat/weekly/1.json

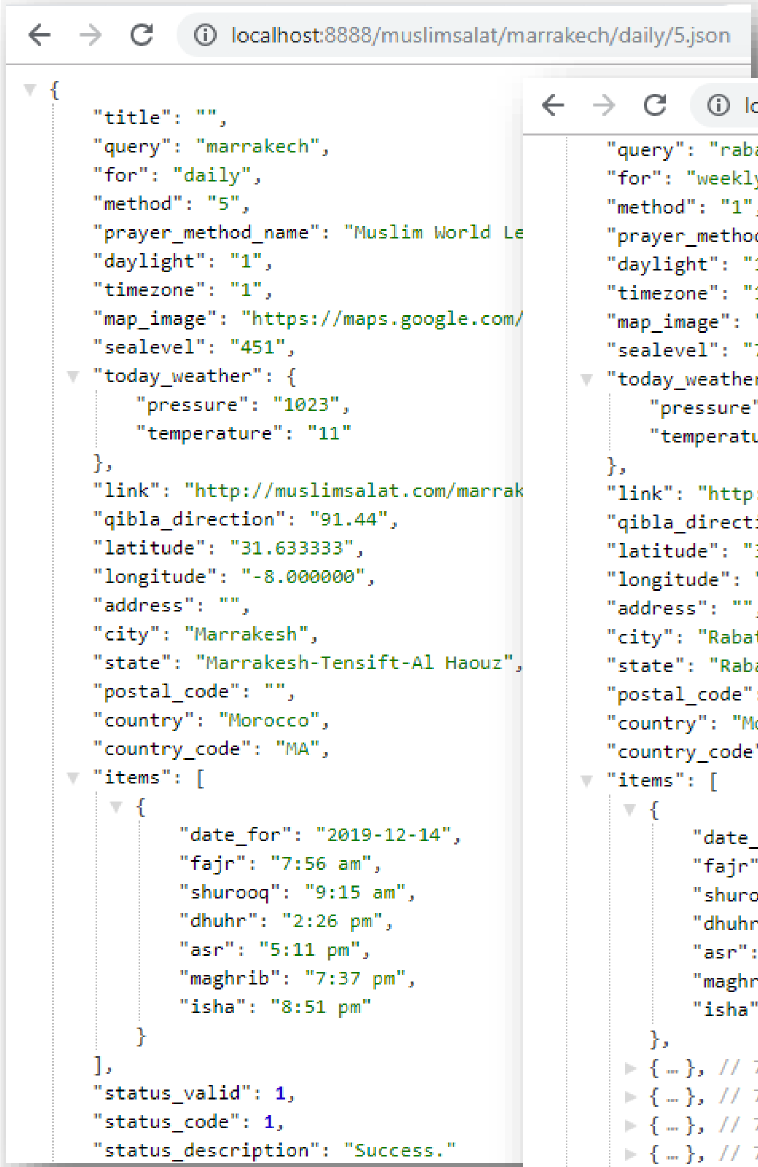
```
    "query": "rabat",
    "for": "weekly",
    "method": "1",
    "prayer_method_name": "Egyptian General Authority of Su
    "daylight": "1",
    "timezone": "1",
    "map_image": "https://maps.google.com/maps/api/staticma
    "sealevel": "72",
    "today_weather": {
        "pressure": "1024",
        "temperature": "13"
    },
    "link": "http://muslimsalat.com/rabat",
    "qibla_direction": "94.66",
    "latitude": "34.015049",
    "longitude": "-6.832720",
    "address": "",
    "city": "Rabat",
    "state": "Rabat-Sale-Zemmour-Zaer",
    "postal_code": "",
    "country": "Morocco",
    "country_code": "MA",
    "items": [
        {
            "date_for": "2019-12-14",
            "fajr": "7:45 am",
            "shurooq": "9:18 am",
            "dhuhr": "2:21 pm",
            "asr": "5:01 pm",
            "maghrib": "7:25 pm",
            "isha": "8:48 pm"
        },
        { … }, // 7 items
        { … }, // 7 items
        { … }, // 7 items
        { … }, // 7 items
        { … }, // 7 items
        { … } // 7 items
```



localhost:8888/restcountries/all

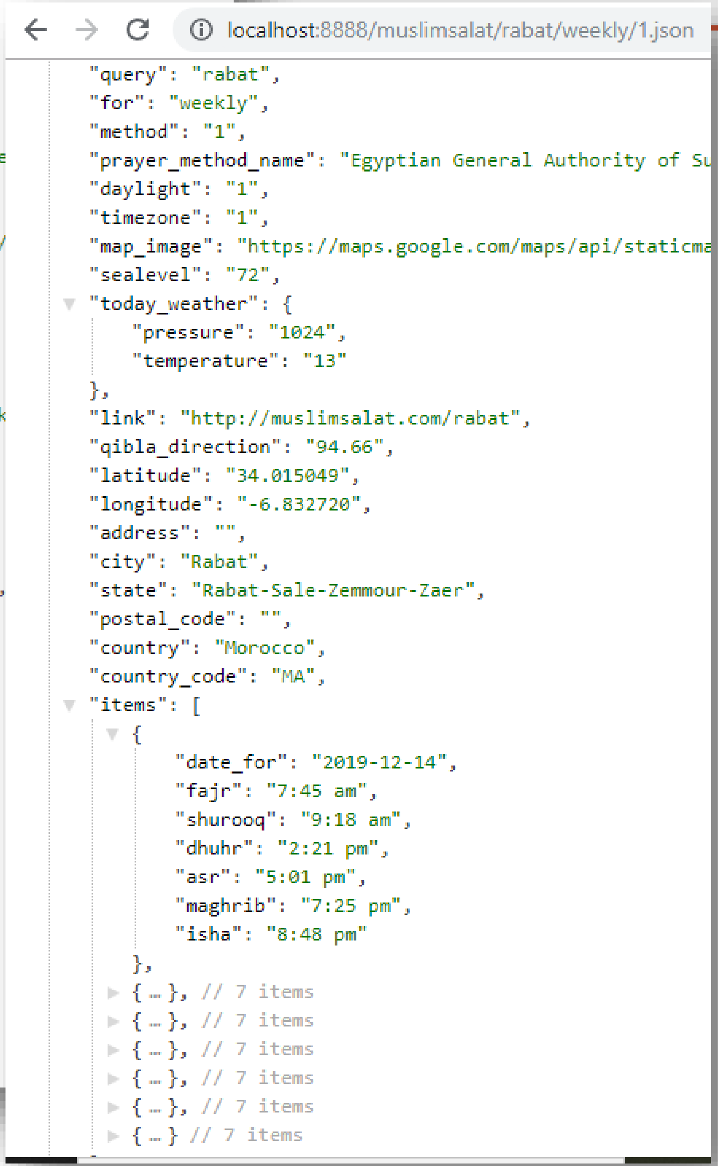
```
    { … }, // 22 items
    { … }, // 22 items
    {
        "name": "Morocco",
        "topLevelDomain": [
            ".ma"
        ],
        "alpha2Code": "MA",
        "alpha3Code": "MAR",
        "callingCodes": [
            "212"
        ],
        "capital": "Rabat",
        "altSpellings": [
            "MA",
            "Kingdom of Morocco",
            "Al-Mamlakah al-Maġribiyah"
        ],
        "region": "Africa",
        "subregion": "Northern Africa",
        "population": 33337529,
        "latlng": [
            32,
            -5
        ],
        "demonym": "Moroccan",
        "area": 446550,
        "gini": 40.9,
        "timezones": [
            "UTC"
        ],
        "borders": [
            "DZA",
            "ESH",
            "ESP"
        ],
        "nativeName": "المغرب",
        "numericCode": "504",
```

Static Routes with Filters



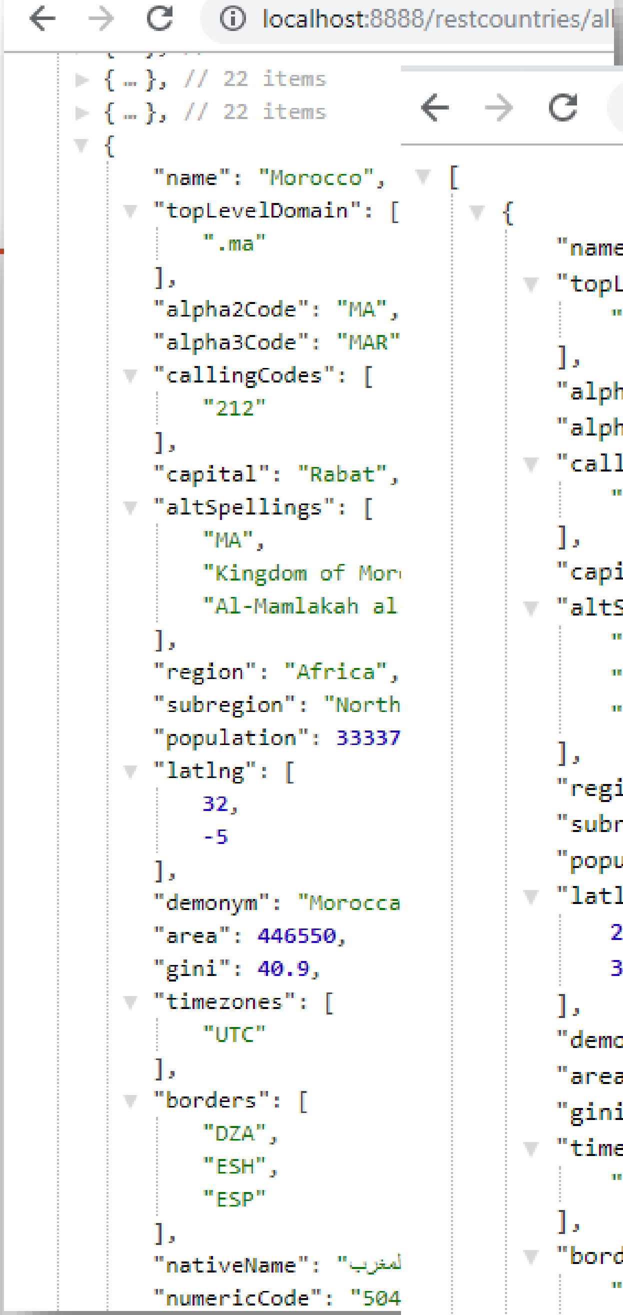
localhost:8888/muslimsalat/marrakech/daily/5.json

```
{
    "title": "",
    "query": "marrakech",
    "for": "daily",
    "method": "5",
    "prayer_method_name": "Muslim World Le
    "daylight": "1",
    "timezone": "1",
    "map_image": "https://maps.google.com/
    "sealevel": "451",
    "today_weather": {
        "pressure": "1023",
        "temperature": "11"
    },
    "link": "http://muslimsalat.com/marrak
    "qibla_direction": "91.44",
    "latitude": "31.633333",
    "longitude": "-8.000000",
    "address": "",
    "city": "Marrakesh",
    "state": "Marrakesh-Tensift-Al Haouz",
    "postal_code": "",
    "country": "Morocco",
    "country_code": "MA",
    "items": [
        {
            "date_for": "2019-12-14",
            "fajr": "7:56 am",
            "shurooq": "9:15 am",
            "dhuhr": "2:26 pm",
            "asr": "5:11 pm",
            "maghrib": "7:37 pm",
            "isha": "8:51 pm"
        }
    ],
    "status_valid": 1,
    "status_code": 1,
    "status_description": "Success."
```



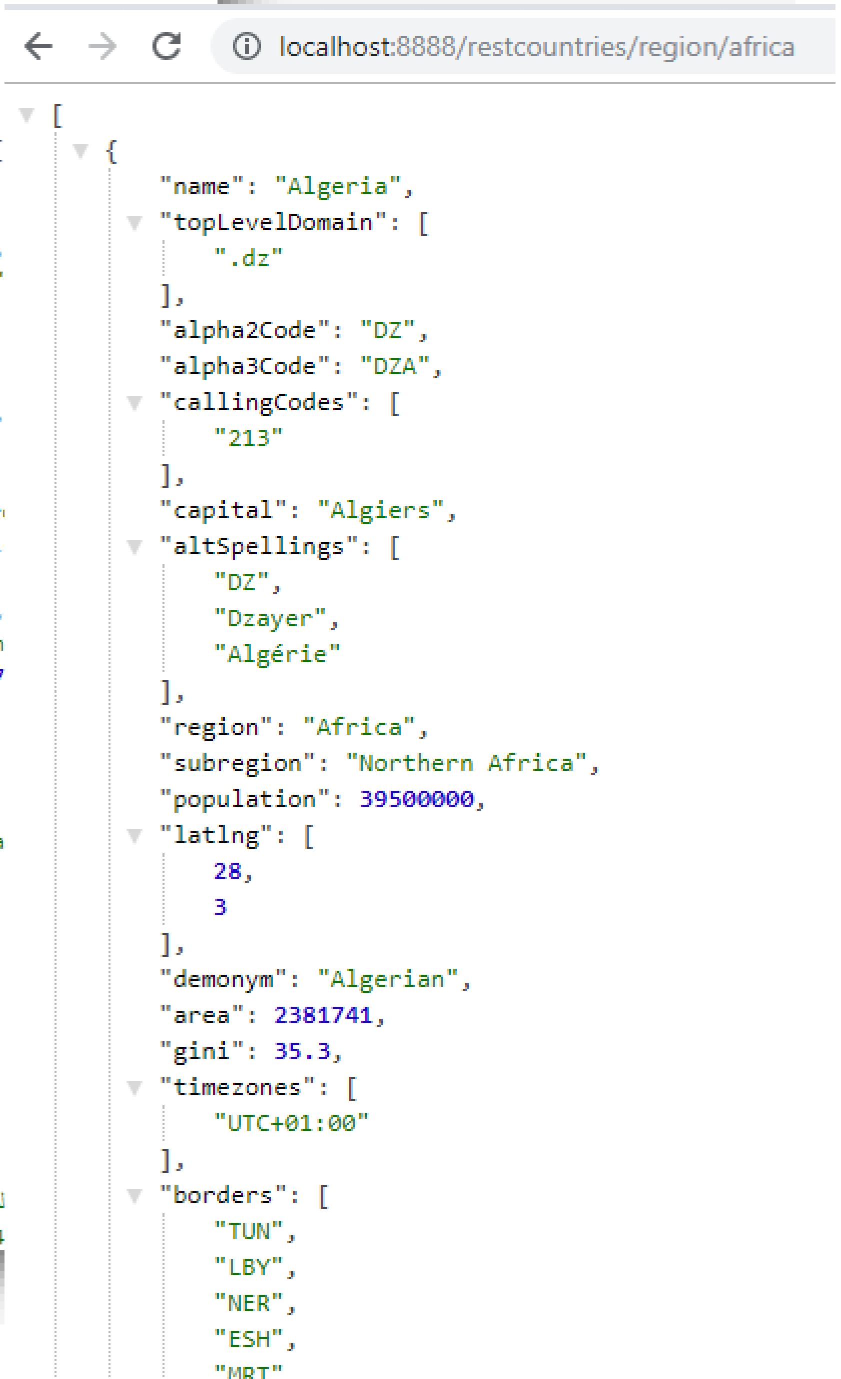
localhost:8888/muslimsalat/rabat/weekly/1.json

```
    "query": "rabat",
    "for": "weekly",
    "method": "1",
    "prayer_method_name": "Egyptian General Authority of Su
    "daylight": "1",
    "timezone": "1",
    "map_image": "https://maps.google.com/maps/api/staticma
    "sealevel": "72",
    "today_weather": {
        "pressure": "1024",
        "temperature": "13"
    },
    "link": "http://muslimsalat.com/rabat",
    "qibla_direction": "94.66",
    "latitude": "34.015049",
    "longitude": "-6.832720",
    "address": "",
    "city": "Rabat",
    "state": "Rabat-Sale-Zemmour-Zaer",
    "postal_code": "",
    "country": "Morocco",
    "country_code": "MA",
    "items": [
        {
            "date_for": "2019-12-14",
            "fajr": "7:45 am",
            "shurooq": "9:18 am",
            "dhuhr": "2:21 pm",
            "asr": "5:01 pm",
            "maghrib": "7:25 pm",
            "isha": "8:48 pm"
        },
        { … }, // 7 items
        { … }, // 7 items
        { … }, // 7 items
        { … }, // 7 items
        { … }, // 7 items
        { … } // 7 items
```



localhost:8888/restcountries/all

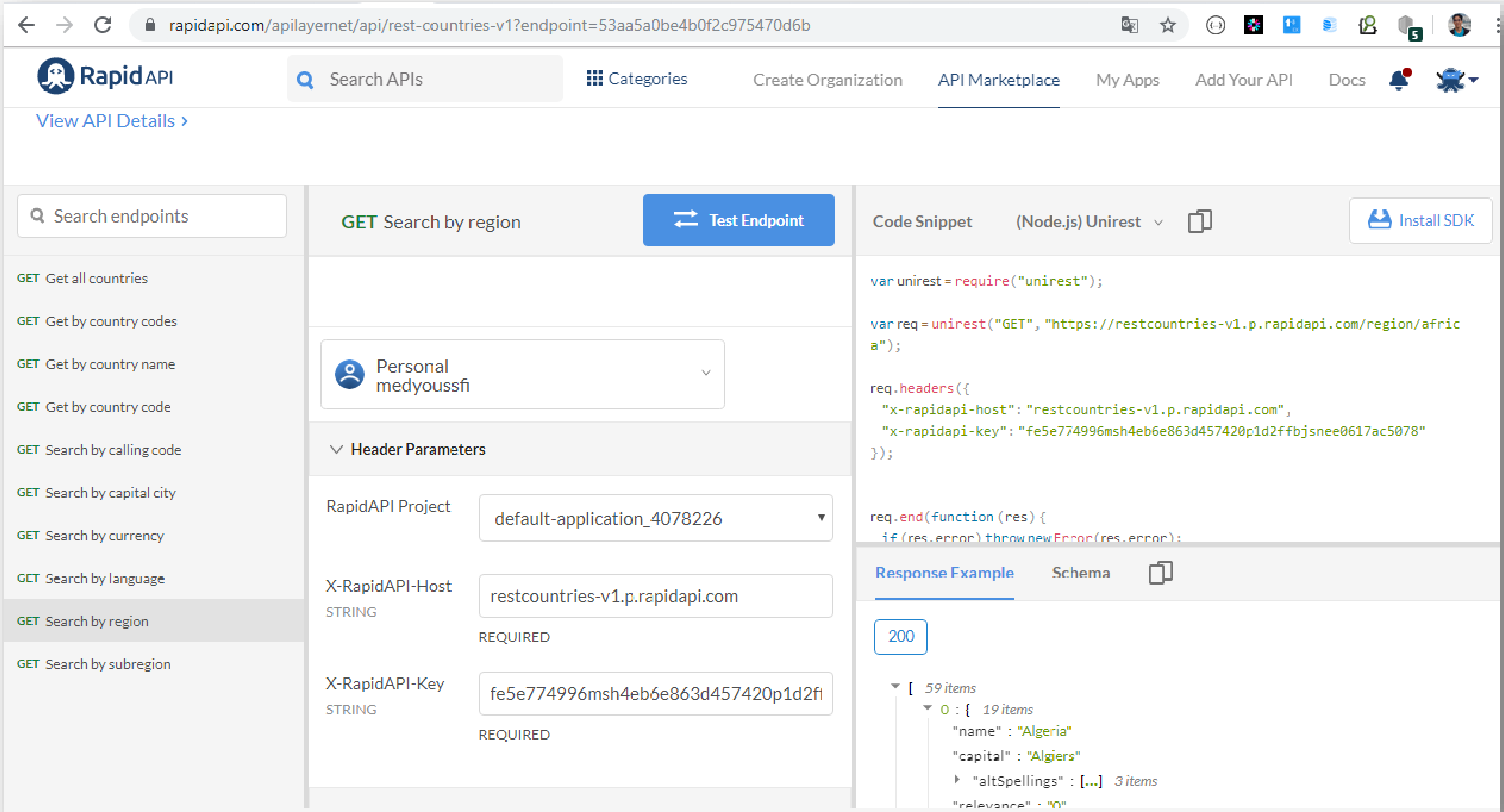
```
    { … }, // 22 items
    { … }, // 22 items
    {
        "name": "Morocco",
        "topLevelDomain": [
            ".ma"
        ],
        "alpha2Code": "MA",
        "alpha3Code": "MAR"
        "callingCodes": [
            "212"
        ],
        "capital": "Rabat",
        "altSpellings": [
            "MA",
            "Kingdom of Mor
            "Al-Mamlakah al
        ],
        "region": "Africa",
        "subregion": "North
        "population": 33337
        "latlng": [
            32,
            -5
        ],
        "demonym": "Morocca
        "area": 446550,
        "gini": 40.9,
        "timezones": [
            "UTC"
        ],
        "borders": [
            "DZA",
            "ESH",
            "ESP"
        ],
        "nativeName": "المغرب
        "numericCode": "504
```



localhost:8888/restcountries/region/africa

```
[
    {
        "name": "Algeria",
        "topLevelDomain": [
            ".dz"
        ],
        "alpha2Code": "DZ",
        "alpha3Code": "DZA",
        "callingCodes": [
            "213"
        ],
        "capital": "Algiers",
        "altSpellings": [
            "DZ",
            "Dzayer",
            "Algérie"
        ],
        "region": "Africa",
        "subregion": "Northern Africa",
        "population": 39500000,
        "latlng": [
            28,
            3
        ],
        "demonym": "Algerian",
        "area": 2381741,
        "gini": 35.3,
        "timezones": [
            "UTC+01:00"
        ],
        "borders": [
            "TUN",
            "LBY",
            "NER",
            "ESH",
            "MRT"
```

Static Routes with Filters



rapidapi.com/apilayernet/api/rest-countries-v1?endpoint=53aa5a0be4b0f2c975470d6b

- GET Get all countries
- GET Get by country codes
- GET Get by country name
- GET Get by country code
- GET Search by calling code
- GET Search by capital city
- GET Search by currency
- GET Search by language
- GET Search by region
- GET Search by subregion

GET Search by region

Personal medyoussfi

Header Parameters

RapidAPI Project	default-application_4078226
X-RapidAPI-Host STRING	restcountries-v1.p.rapidapi.com REQUIRED
X-RapidAPI-Key STRING	fe5e774996msh4eb6e863d457420p1d2ff REQUIRED

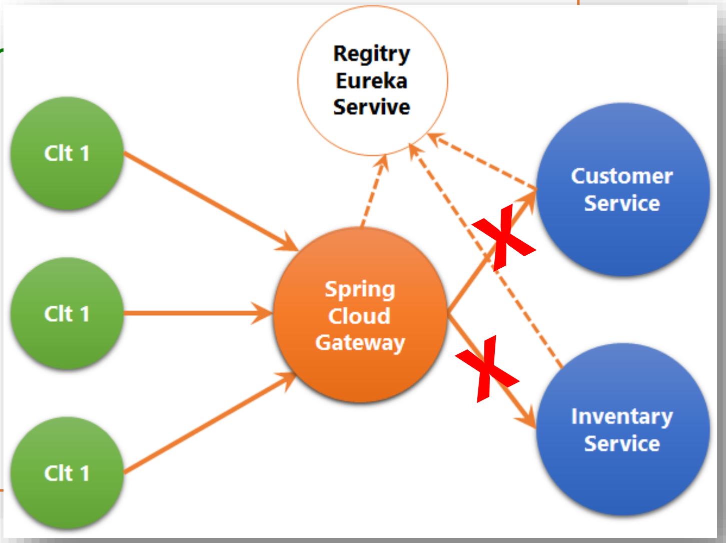
```
var unirest = require("unirest");

var req = unirest("GET", "https://restcountries-v1.p.rapidapi.com/region/afric
a");

req.headers({
  "x-rapidapi-host": "restcountries-v1.p.rapidapi.com",
  "x-rapidapi-key": "fe5e774996msh4eb6e863d457420p1d2ffbjsnee0617ac5078"
});


req.end(function (res) {
  if (res.error) throw new Error(res.error);
```

200

```
[ 59 items
  0 : { 19 items
    "name" : "Algeria"
    "capital" : "Algiers"
    "altSpellings" : [...] 3 items
    "relevance" : "0"
```

Circuit Breaker avec Hystrix

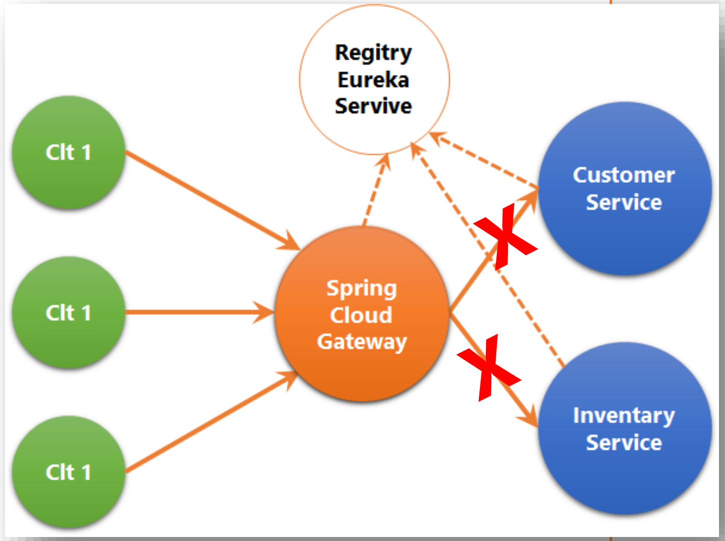
```
@Bean
RouteLocator gatewayRoutes(RouteLocatorBuilder builder){
          return builder.routes()
          .route(r->r.path("/restcountries/**")
            .filters(f->f
            .addRequestHeader("x-rapidapi-host","restcountries-v1.p.rapidapi.com")
            .addRequestHeader("x-rapidapi-key", "fe5e774996msh4eb6e863d457420p1d2ffbjsnee0617ac5078")
            .rewritePath("/restcountries/(?<segment>.*)","/${segment}")
            .hystrix(h->h.setName("rest-countries")
             .setFallbackUri("forward:/restCountriesFallback"))

          )
          .uri("https://restcountries-v1.p.rapidapi.com").id("countries")
          .route(r->r.path("/muslimsalat/**")
            .filters(f->f
              .addRequestHeader("x-rapidapi-host","muslimsalat.p.rapidapi.com")
              .addRequestHeader("x-rapidapi-key", "fe5e774996msh4eb6e863d457420p1d2ffbjsr
              .rewritePath("/muslimsalat/(?<segment>.*)","/${segment}")
              .hystrix(h->h.setName("muslimsalat")
                .setFallbackUri("forward:/muslimsalatFallback"))
          )
           .uri("https://muslimsalat.p.rapidapi.com").id("countries")
          )
      .build();
}
```



Circuit Breaker avec Hystrix

```
@SpringBootApplication
@EnableHystrix
public class CloudGatewayApplication {
```

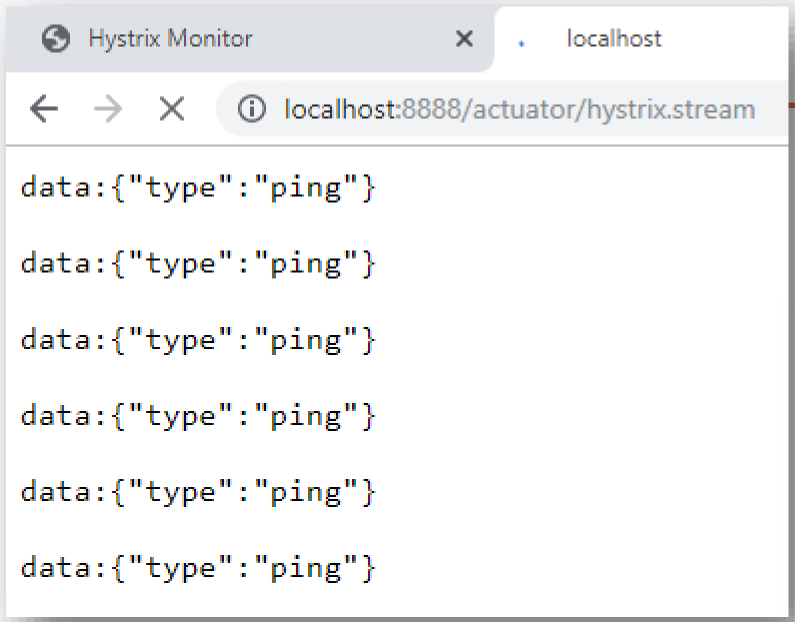
```
@RestController
class FallBackRestController{
	@GetMapping("/restCountriesFallback")
	public Map<String,String> restCountriesFallback(){
		Map<String,String> map=new HashMap<>();
		map.put("message","Default Rest Countries Fallback service");
		map.put("countries","Algeria, Morocco");
		return map;
	}
	@GetMapping("/muslimsalatFallback")
	public Map<String,String> muslimsalatback(){
		Map<String,String> map=new HashMap<>();
		map.put("message","Default Muslim Fallback service");
		map.put("Fajr","07:00");
		map.put("DOHR","14:00");
		return map;
	}
}
```



application.properties

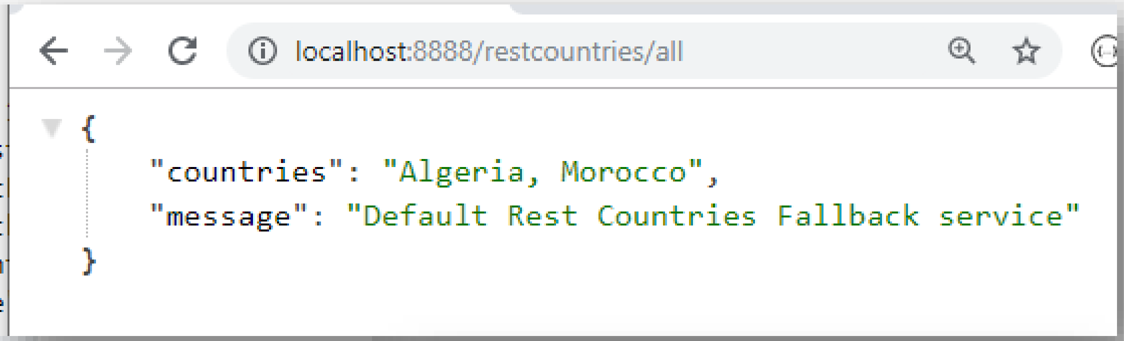
```
management.endpoints.web.exposure.include=hystrix.stream
hystrix.command.default.execution.isolation.thread.timeoutInMilliseconds=1000
```

Circuit Breaker With Hystrix



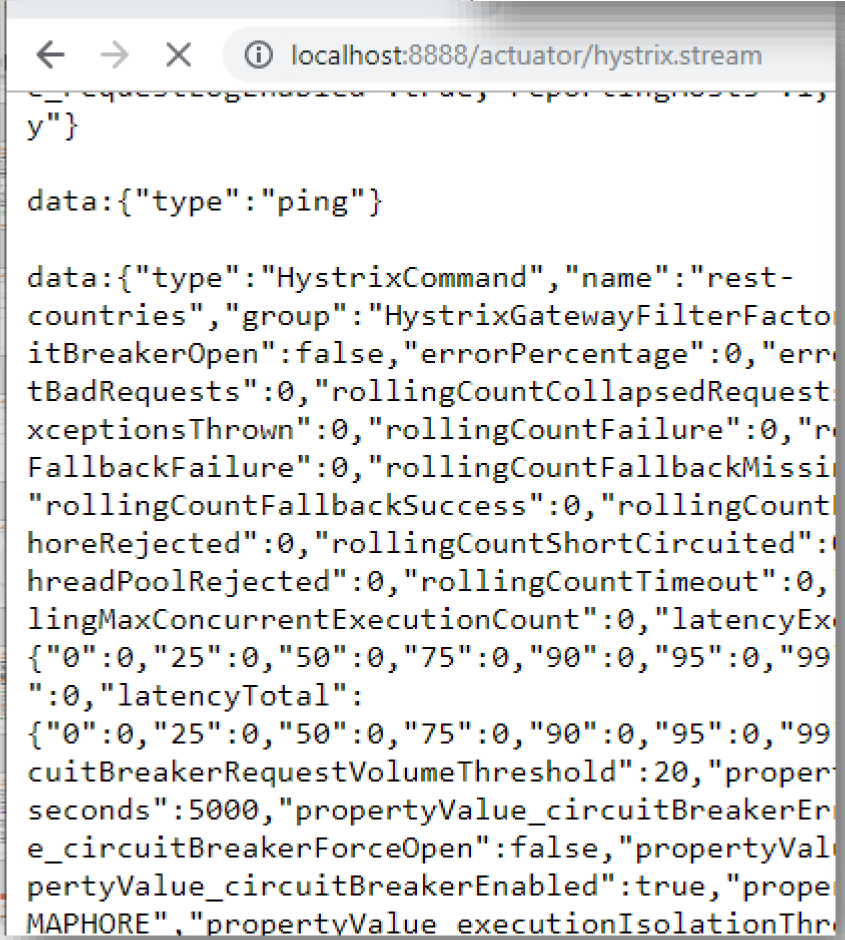
localhost:8888/actuator/hystrix.stream

```
data:{"type":"ping"}

data:{"type":"ping"}

data:{"type":"ping"}

data:{"type":"ping"}

data:{"type":"ping"}

data:{"type":"ping"}
```



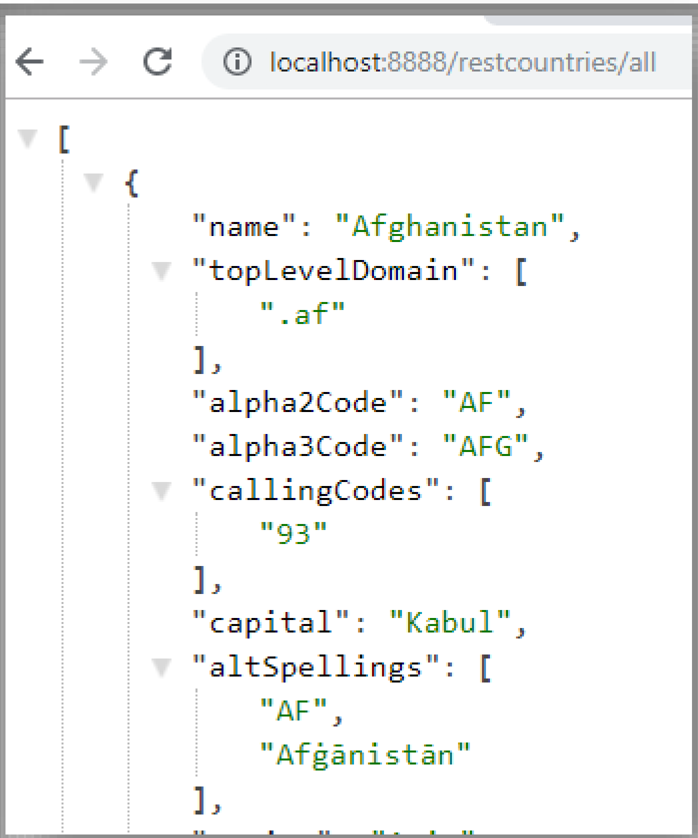
localhost:8888/restcountries/all

```
{
    "countries": "Algeria, Morocco",
    "message": "Default Rest Countries Fallback service"
}
```



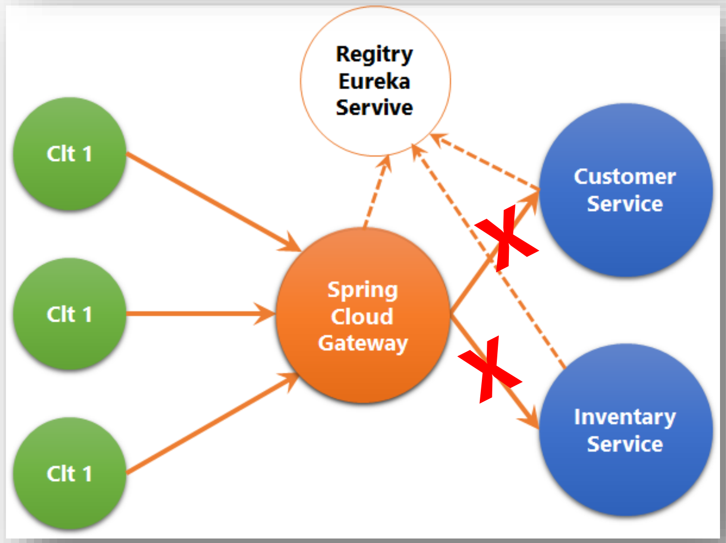
localhost:8888/actuator/hystrix.stream

```
y"}

data:{"type":"ping"}

data:{"type":"HystrixCommand","name":"rest-
countries","group":"HystrixGatewayFilterFacto
itBreakerOpen":false,"errorPercentage":0,"err
tBadRequests":0,"rollingCountCollapsedRequest
xceptionsThrown":0,"rollingCountFailure":0,"r
FallbackFailure":0,"rollingCountFallbackMissi
"rollingCountFallbackSuccess":0,"rollingCount
horeRejected":0,"rollingCountShortCircuited":
hreadPoolRejected":0,"rollingCountTimeout":0,
lingMaxConcurrentExecutionCount":0,"latencyEx
{"0":0,"25":0,"50":0,"75":0,"90":0,"95":0,"99
":0,"latencyTotal":
{"0":0,"25":0,"50":0,"75":0,"90":0,"95":0,"99
cuitBreakerRequestVolumeThreshold":20,"proper
seconds":5000,"propertyValue_circuitBreakerEr
e_circuitBreakerForceOpen":false,"propertyVal
pertyValue_circuitBreakerEnabled":true,"prope
MAPHORE","propertyValue_executionIsolationThr
```

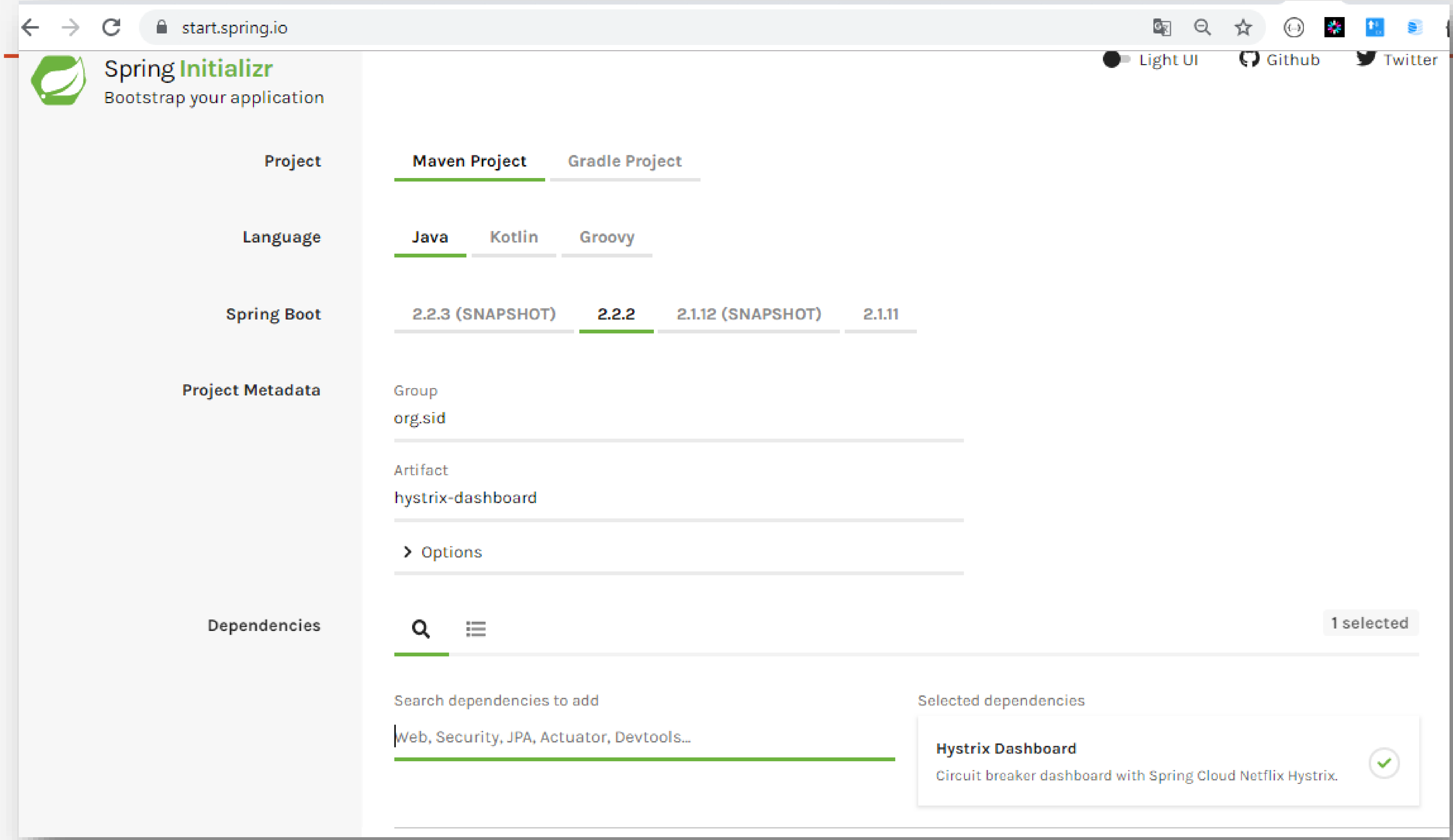


localhost:8888/restcountries/all

```
[
  {
      "name": "Afghanistan",
      "topLevelDomain": [
          ".af"
      ],
      "alpha2Code": "AF",
      "alpha3Code": "AFG",
      "callingCodes": [
          "93"
      ],
      "capital": "Kabul",
      "altSpellings": [
          "AF",
          "Afġānistān"
      ],
```



Hystrix Dashboard



start.spring.io

Spring Initializr
Bootstrap your application

Project: [✓ Maven Project] Gradle Project

Language: [✓ Java] Kotlin Groovy

Spring Boot: 2.2.3 (SNAPSHOT) [✓ 2.2.2] 2.1.12 (SNAPSHOT) 2.1.11

Project Metadata

Group
org.sid

Artifact
hystrix-dashboard

> Options

Dependencies

1 selected

Search dependencies to add
Web, Security, JPA, Actuator, Devtools...

Selected dependencies

Hystrix Dashboard
Circuit breaker dashboard with Spring Cloud Netflix Hystrix.

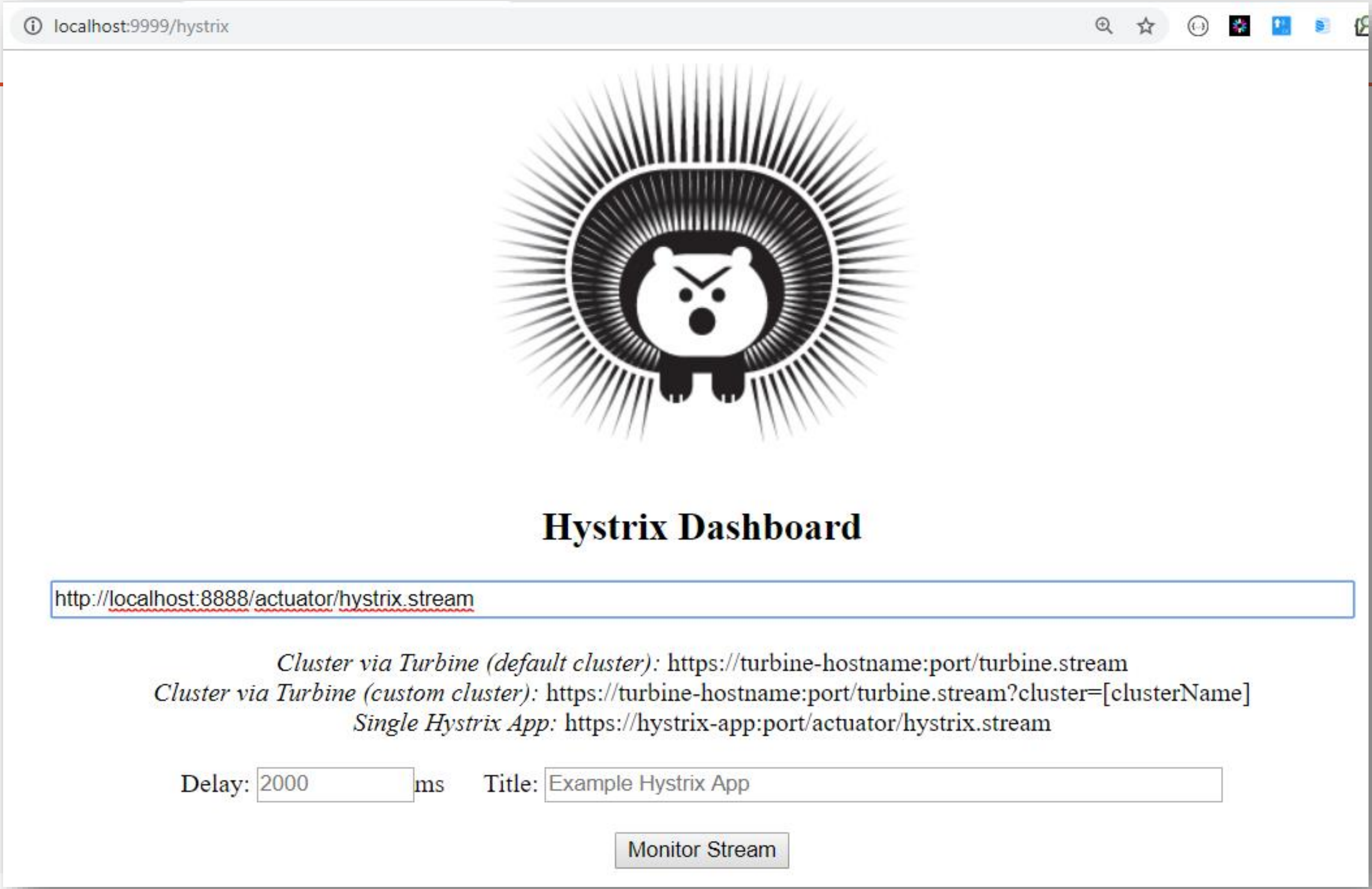
Circuit Breaker avec Hystrix

```java
package org.sid.hystrixdashboard;

import org.springframework.boot.SpringApplication;
import org.springframework.boot.autoconfigure.SpringBootApplication;
import org.springframework.cloud.netflix.hystrix.dashboard.EnableHystrixDashboard;

@SpringBootApplication
@EnableHystrixDashboard
public class HystrixDashboardApplication {

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

}
```

application.properties

```
server.port=9999
```

Circuit Breaker avec Hystrix



localhost:9999/hystrix

Hystrix Dashboard

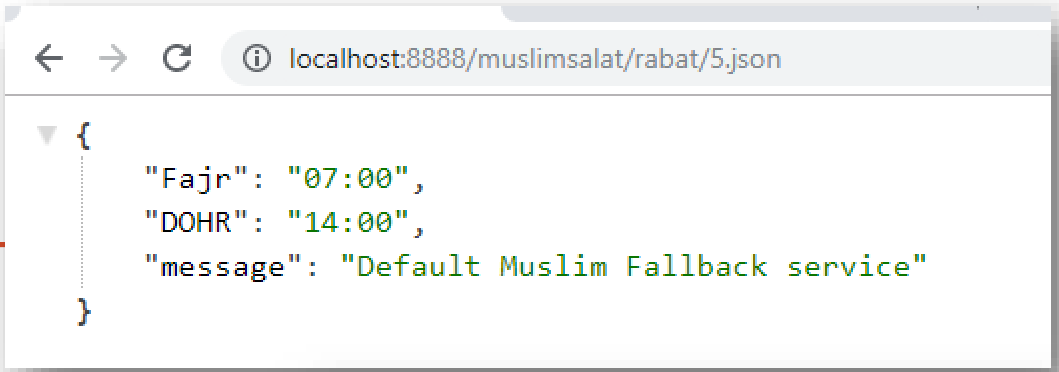
http://localhost:8888/actuator/hystrix.stream

Cluster via Turbine (default cluster): https://turbine-hostname:port/turbine.stream
Cluster via Turbine (custom cluster): https://turbine-hostname:port/turbine.stream?cluster=[clusterName]
Single Hystrix App: https://hystrix-app:port/actuator/hystrix.stream

Delay: 2000 ms Title: Example Hystrix App

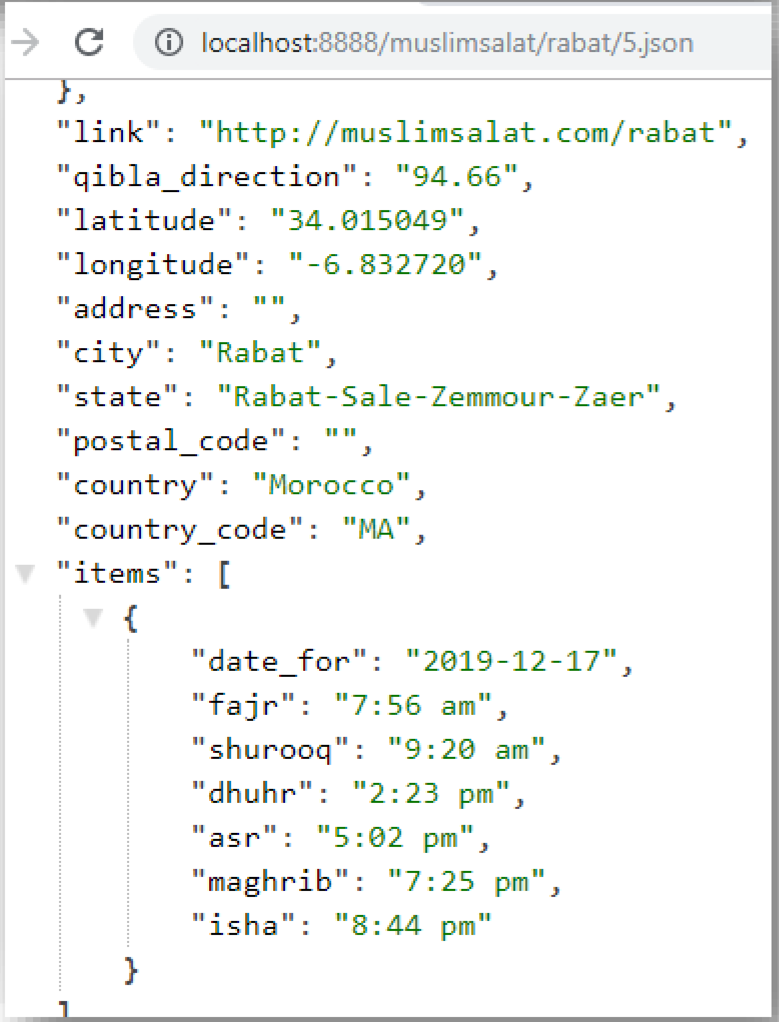
Monitor Stream

Circuit Breaker avec Hystrix



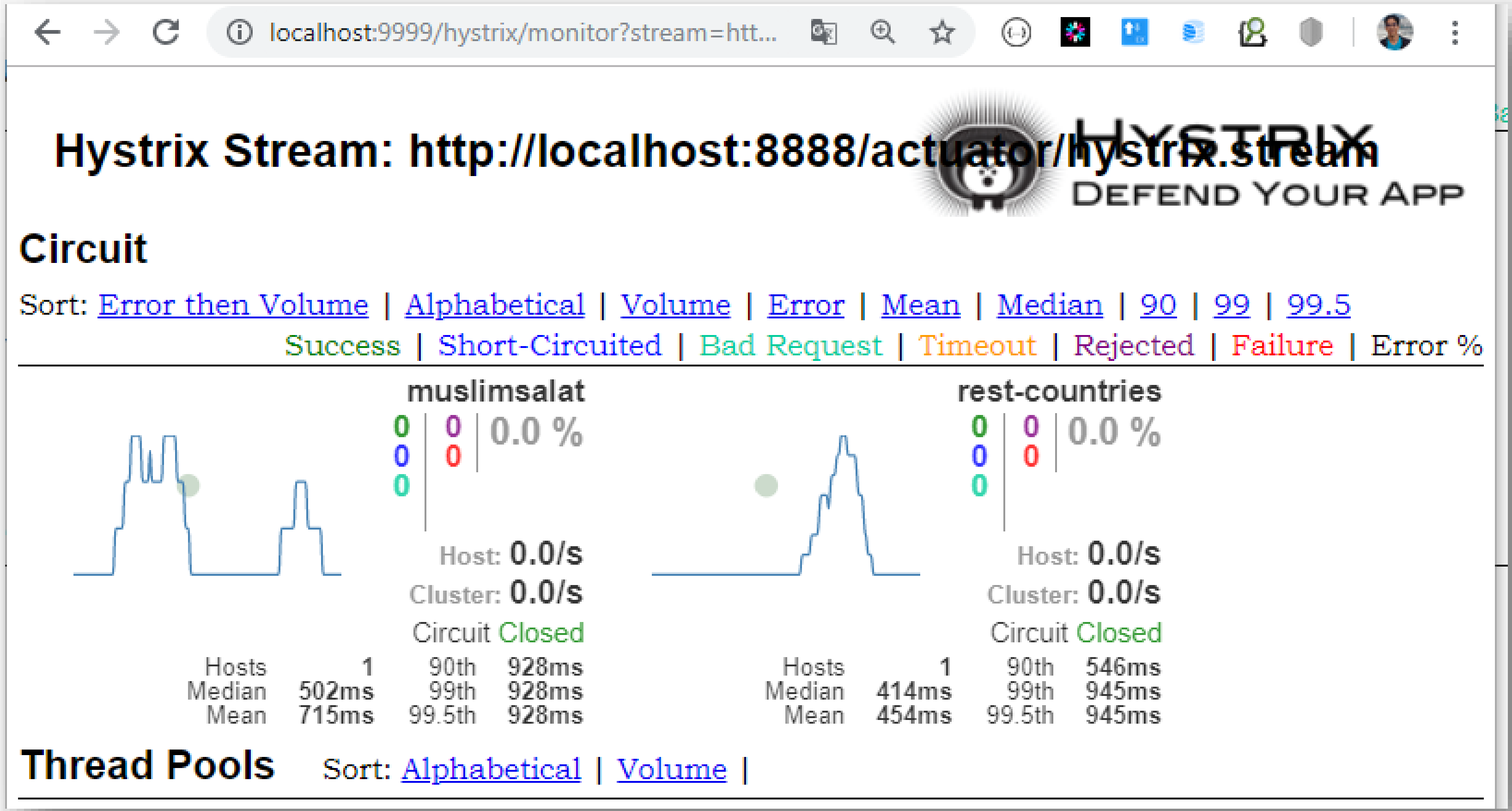
localhost:8888/muslimsalat/rabat/5.json

```
{
    "Fajr": "07:00",
    "DOHR": "14:00",
    "message": "Default Muslim Fallback service"
}
```



localhost:8888/muslimsalat/rabat/5.json

```
},
"link": "http://muslimsalat.com/rabat",
"qibla_direction": "94.66",
"latitude": "34.015049",
"longitude": "-6.832720",
"address": "",
"city": "Rabat",
"state": "Rabat-Sale-Zemmour-Zaer",
"postal_code": "",
"country": "Morocco",
"country_code": "MA",
"items": [
  {
    "date_for": "2019-12-17",
    "fajr": "7:56 am",
    "shurooq": "9:20 am",
    "dhuhr": "2:23 pm",
    "asr": "5:02 pm",
    "maghrib": "7:25 pm",
    "isha": "8:44 pm"
  }
]
```



localhost:9999/hystrix/monitor?stream=htt...

Hystrix Stream: http://localhost:8888/actuator/hystrix.stream

Circuit

Sort: Error then Volume | Alphabetical | Volume | Error | Mean | Median | 90 | 99 | 99.5

Success | Short-Circuited | Bad Request | Timeout | Rejected | Failure | Error %

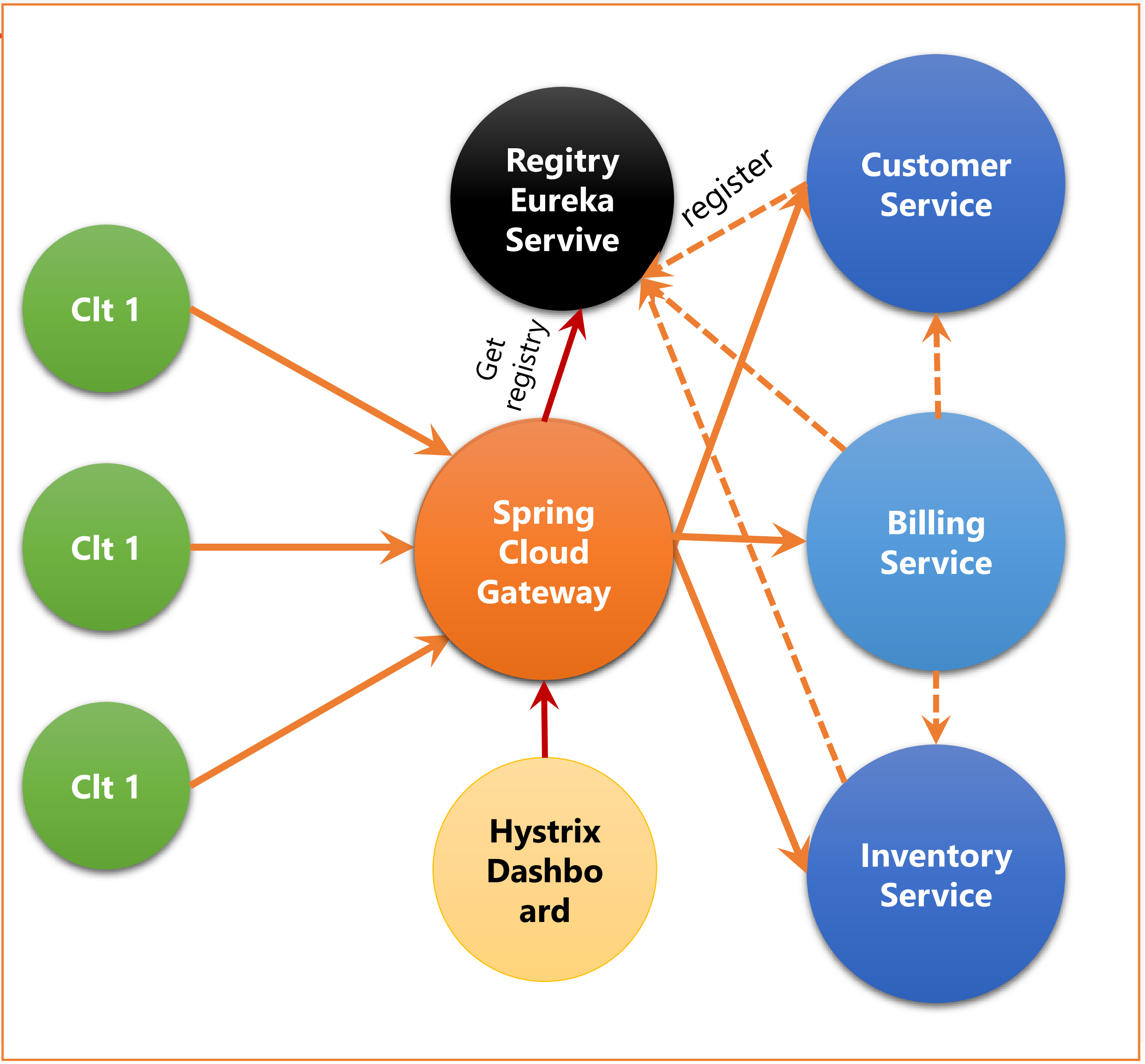
```
muslimsalat
0 | 0 | 0.0 %
0 | 0
0

Host: 0.0/s
Cluster: 0.0/s
Circuit Closed

  Hosts      1    90th   928ms
  Median 502ms    99th   928ms
  Mean   715ms  99.5th   928ms
```

```
rest-countries
0 | 0 | 0.0 %
0 | 0
0

Host: 0.0/s
Cluster: 0.0/s
Circuit Closed

  Hosts      1    90th   546ms
  Median 414ms    99th   945ms
  Mean   454ms  99.5th   945ms
```

Thread Pools Sort: Alphabetical | Volume |

Communication REST entre les micro-services : Declarative Rest Client avec Spring Cloud Feign

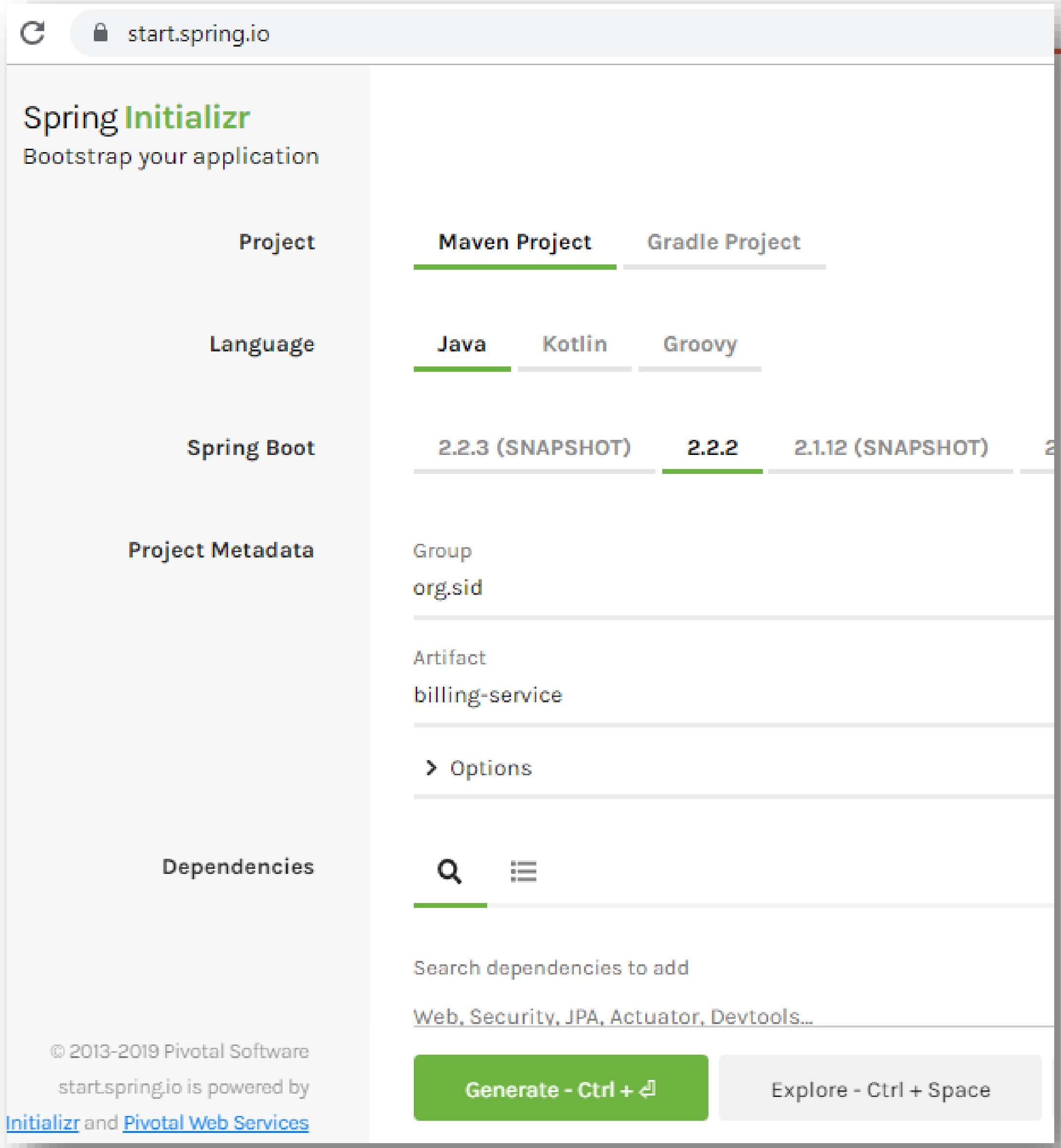
- Feign est un Framework, introduite dans Spring cloud, qui permet de créer facilement un Client REST d'une manière déclarative.
- Feign peut être utilisée à la place de RestTemplate pour intéragir avec d'autres services distants via des API Restful.
- Dans Notre cas, nous allons ajouter un autre service de facturation qui a besoin de communiquer avec els services d'inventaires et le service client pour récupérer les informations sur le client et les produits d'une facture



Billing-service

```java
@SpringBootApplication
@EnableFeignClients
public class BillingServiceApplication {
    public static void main(String[] args) {SpringApplication.run(BillingServiceApplication.class, args); }
         @Bean
         CommandLineRunner start(BillRepository billRepository, ProductItemRepository productItemRepository,
         InventoryServiceClient inventoryServiceClient, CustomerServiceClient customerServiceClient){
                  return args -> {
                           Bill bill=new Bill();
                           bill.setBillingDate(new Date());
                           Customer customer=customerServiceClient.findCustomerById(1L);
                           bill.setCustomerID(customer.getId());
                           billRepository.save(bill);
                           inventoryServiceClient.findAll().getContent().forEach(p->{
productItemRepository.save(new ProductItem(null,null,p.getId(),p.getPrice(),(int)(1+Math.random()*1000),bill));
                           });
                  };
         }}
```

Billing-service


start.spring.io

Spring Initializr
Bootstrap your application

Project: [✓ Maven Project] Gradle Project

Language: [✓ Java] Kotlin Groovy

Spring Boot: 2.2.3 (SNAPSHOT) [✓ 2.2.2] 2.1.12 (SNAPSHOT)

Project Metadata

Group: org.sid

Artifact: billing-service

Options

Dependencies

Search dependencies to add

Web, Security, JPA, Actuator, Devtools...

Selected dependencies

- **Spring Web** : Build web, including RESTful, applications using Spring MVC. Uses Apache Tomcat as the default embedded container.
- **Spring Data JPA** : Persist data in SQL stores with Java Persistence API using Spring Data and Hibernate.
- **H2 Database** : Provides a fast in-memory database that supports JDBC API and R2DBC access, with a small (2mb) footprint. Supports embedded and server modes as well as a browser based console application.
- **Rest Repositories** : Exposing Spring Data repositories over REST via Spring Data REST.
- **Lombok** : Java annotation library which helps to reduce boilerplate code.
- **Spring Boot DevTools** : Provides fast application restarts, LiveReload, and configurations for enhanced development experience.
- **Eureka Discovery Client** : a REST based service for locating services for the purpose of load balancing and failover of middle-tier servers.
- **OpenFeign** : Declarative REST Client. OpenFeign creates a dynamic implementation of an interface decorated with JAX-RS or Spring MVC annotations.
- **Spring HATEOAS** : Eases the creation of RESTful APIs that follow the HATEOAS principle when working with Spring / Spring MVC.

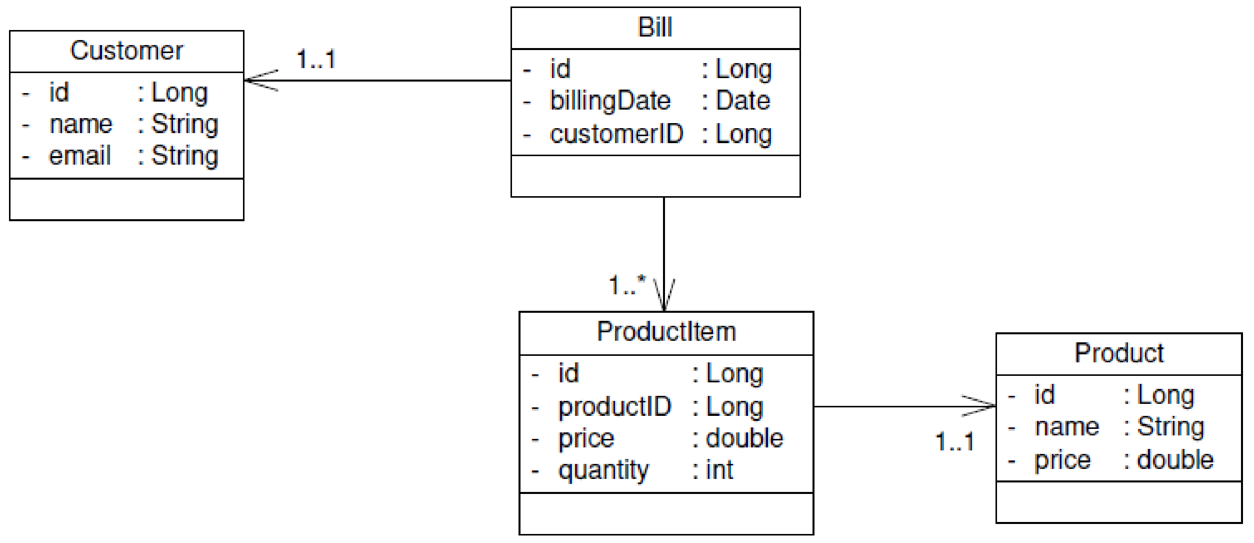
Billing-service

```java
package org.sid.billingservice;
import com.fasterxml.jackson.annotation.JsonProperty;
import lombok.AllArgsConstructor;import lombok.Data; import lombok.NoArgsConstructor;
import org.springframework.beans.factory.annotation.Autowired;
import org.springframework.boot.CommandLineRunner;
import org.springframework.boot.SpringApplication;
import org.springframework.boot.autoconfigure.SpringBootApplication;
import org.springframework.cloud.openfeign.EnableFeignClients;
import org.springframework.cloud.openfeign.FeignClient;
import org.springframework.context.annotation.Bean;
import org.springframework.data.jpa.repository.JpaRepository;
import org.springframework.data.rest.core.annotation.RepositoryRestResource;
import org.springframework.hateoas.PagedModel;
import org.springframework.web.bind.annotation.GetMapping;
import org.springframework.web.bind.annotation.PathVariable;
import org.springframework.web.bind.annotation.RestController;
import javax.persistence.*;import java.util.Collection; import java.util.Date;import java.util.List;
```

Billing-service

```java
@Entity @Data @NoArgsConstructor @AllArgsConstructor
class Bill{
 @Id  @GeneratedValue(strategy = GenerationType.IDENTITY)
 private Long id; private Date billingDate;
 @Transient  @OneToMany(mappedBy = "bill")
 private Collection<ProductItem> productItems;
 @Transient private Customer customer;
private long customerID;
}
@RepositoryRestResource
interface BillRepository extends JpaRepository<Bill,Long>{}
```

```java
@Entity @Data @NoArgsConstructor @AllArgsConstructor
class ProductItem{
 @Id @GeneratedValue(strategy = GenerationType.IDENTITY)
 private Long id;
 @Transient
 private Product product; private long productID;
 private double price; private double quantity;
 @ManyToOne
 @JsonProperty(access = JsonProperty.Access.WRITE_ONLY)
 private Bill bill;
}
@RepositoryRestResource
interface ProductItemRepository extends
JpaRepository<ProductItem,Long>{
         List<ProductItem> findByBillId(Long billID);
}
```



Billing-service

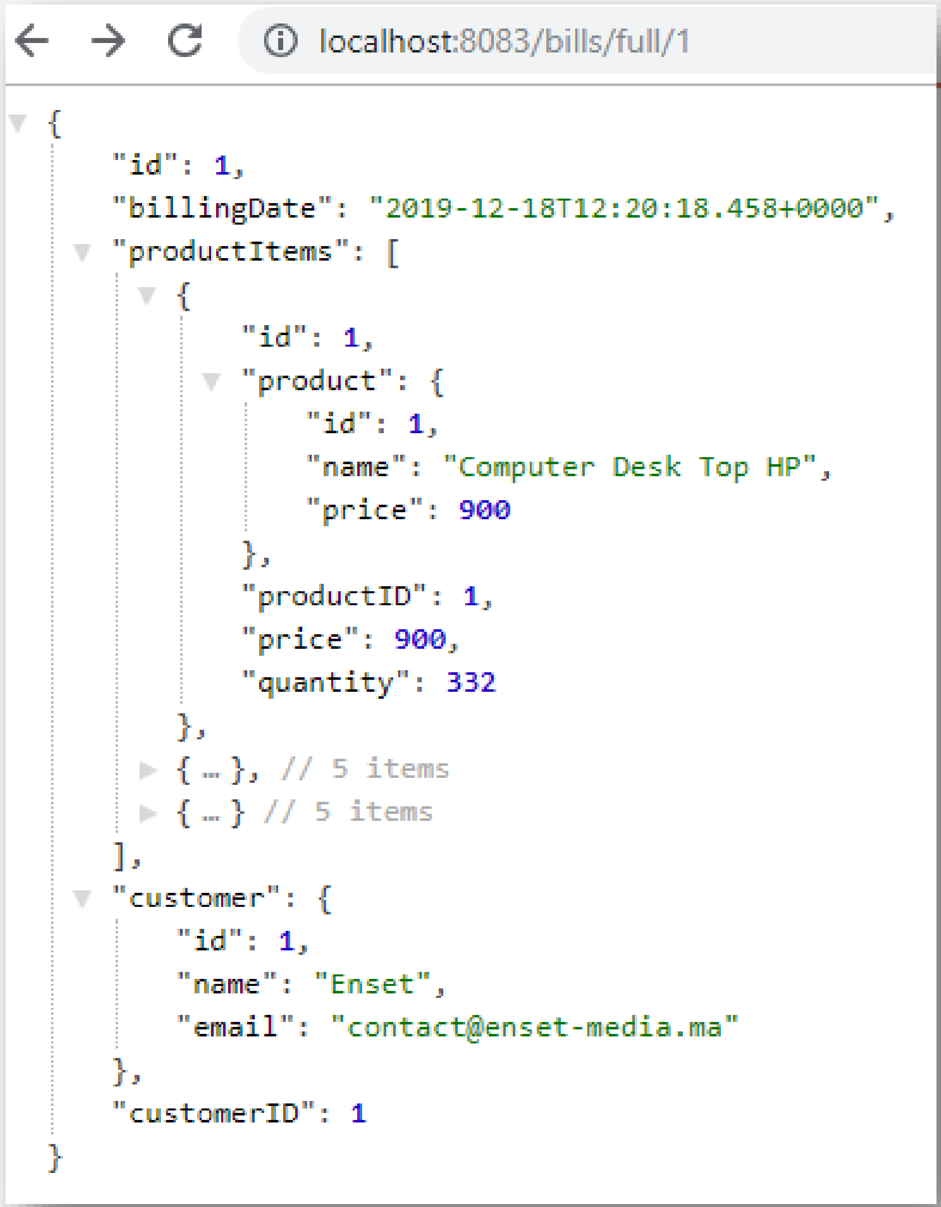
```java
@Data
class Product{
        private Long id;
        private String name;
        private double price;
}
@Data
class Customer{
        private Long id;
        private String name;
        private String email;
}
```

```java
@FeignClient(name="customer-service")
interface CustomerServiceClient{
    @GetMapping("/customers/{id}?projection=fullCustomer")
    Customer findCustomerById(@PathVariable("id") Long id);
}
@FeignClient(name="inventory-service")
interface InventoryServiceClient{
  @GetMapping("/products/{id}?projection=fullProduct")
  Product findProductById(@PathVariable("id") Long id);
  @GetMapping("/products?projection=fullProduct")
  PagedModel<Product> findAll();
}
```

Billing-service

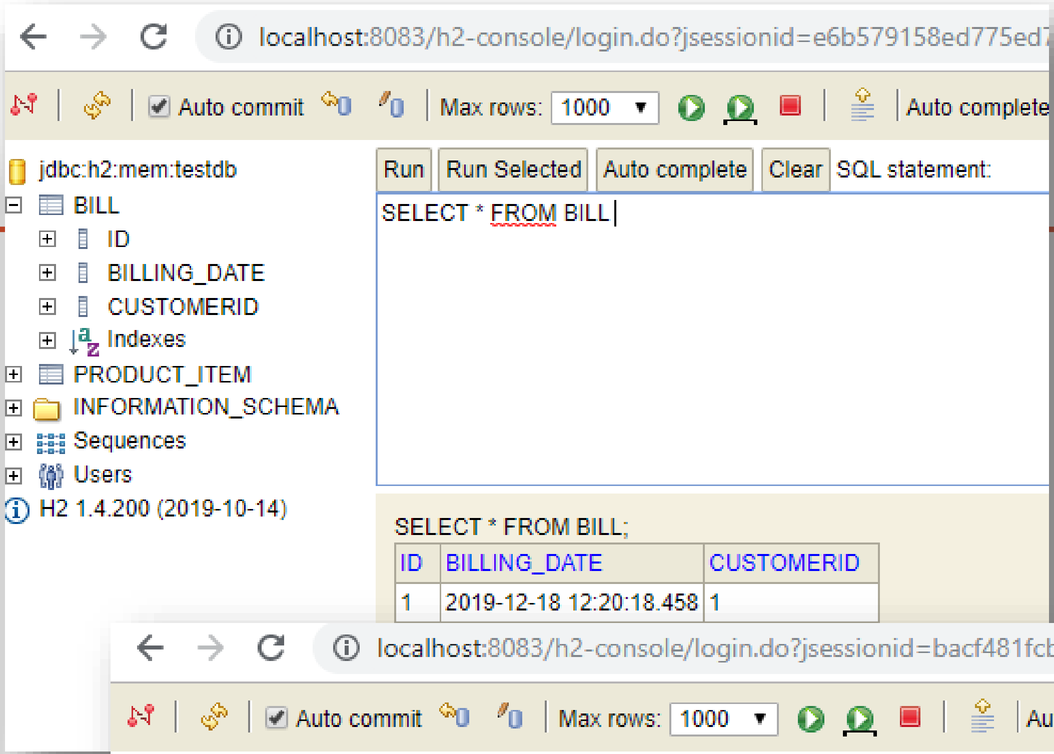
```
@RestController
class BillRestController{
        @Autowired private BillRepository billRepository;
        @Autowired private ProductItemRepository productItemRepository;
        @Autowired private CustomerServiceClient customerServiceClient;
        @Autowired private InventoryServiceClient inventoryServiceClient;
        @GetMapping("/bills/full/{id}")
        Bill getBill(@PathVariable(name="id") Long id){
            Bill bill=billRepository.findById(id).get();
            bill.setCustomer(customerServiceClient.findCustomerById(bill.getCustomerID()));
            bill.setProductItems(productItemRepository.findByBillId(id));
            bill.getProductItems().forEach(pi->{
                pi.setProduct(inventoryServiceClient.findProductById(pi.getProductID()));
                });
        return bill; }
}
```

Billing-service



localhost:8083/bills/full/1

```
{
    "id": 1,
    "billingDate": "2019-12-18T12:20:18.458+0000",
    "productItems": [
        {
            "id": 1,
            "product": {
                "id": 1,
                "name": "Computer Desk Top HP",
                "price": 900
            },
            "productID": 1,
            "price": 900,
            "quantity": 332
        },
        { … }, // 5 items
        { … } // 5 items
    ],
    "customer": {
        "id": 1,
        "name": "Enset",
        "email": "contact@enset-media.ma"
    },
    "customerID": 1
}
```

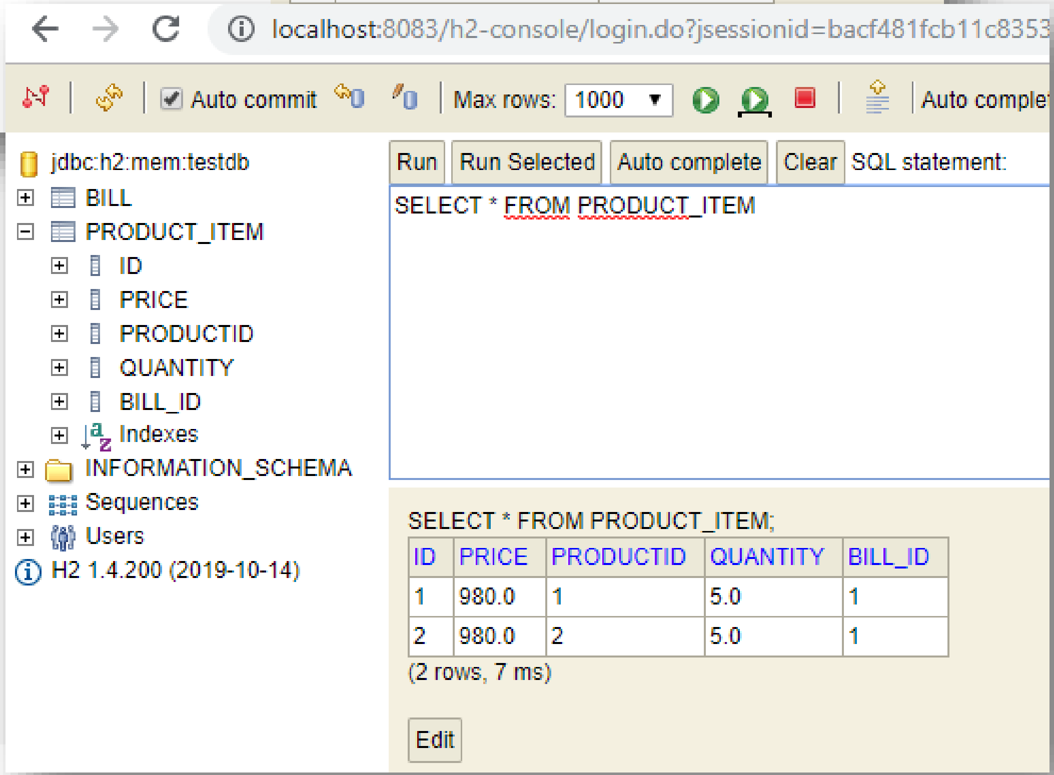


localhost:8083/h2-console/login.do?jsessionid=e6b579158ed775ed7

```
SELECT * FROM BILL
```

SELECT * FROM BILL;

ID	BILLING_DATE	CUSTOMERID
1	2019-12-18 12:20:18.458	1



localhost:8083/h2-console/login.do?jsessionid=bacf481fcb11c8353

```
SELECT * FROM PRODUCT_ITEM
```

SELECT * FROM PRODUCT_ITEM;

ID	PRICE	PRODUCTID	QUANTITY	BILL_ID
1	980.0	1	5.0	1
2	980.0	2	5.0	1

(2 rows, 7 ms)