



# **Develop cloud-native microservices with Apache Camel on Spring Boot and Kubernetes**

Claus Ibsen  
Senior Principal Software Engineer, Red Hat

# About me

- Senior Principal Software Engineer at Red Hat
- 10 years as Apache Camel committer
- Author of Camel in Action books
- Based in Denmark



Blog: <http://www.davsclaus.com>  
Twitter: @davsclaus  
Linkedin: davsclaus

# System Integration



**Figure 1.1** Camel is the glue between disparate systems.

# Integration Framework





APACHE®  
Camel

# PATTERN BASED INTEGRATION

Apache Camel, a powerful pattern-based integration engine with a comprehensive set of connectors and data formats to tackle any integration problem.



## ENTERPRISE INTEGRATION PATTERNS

Build integrations using enterprise best practices.



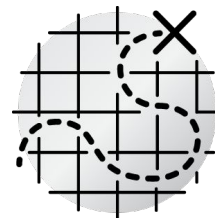
## 200+ COMPONENTS

Batch, messaging, web services, cloud, APIs, and more ...



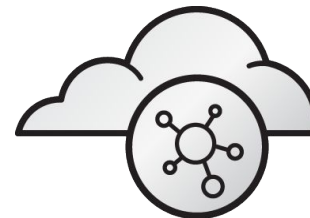
## BUILT-IN DATA TRANSFORMATION

JSON, XML, HL7, YAML, SOAP, Java, CSV, and more ...



## INTUITIVE ROUTING

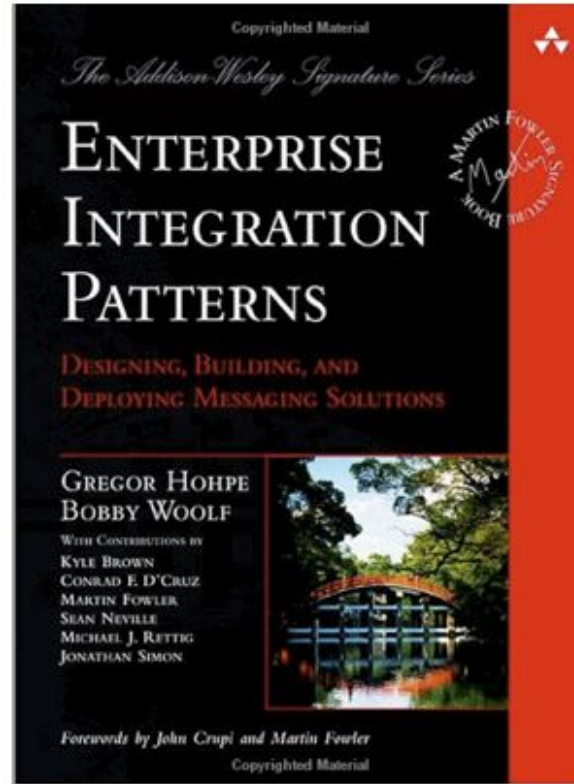
Develop integrations quickly in Java or XML.



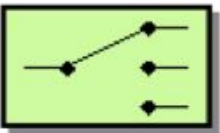
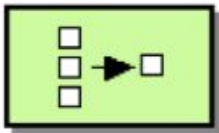

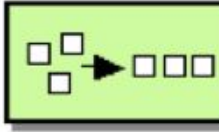
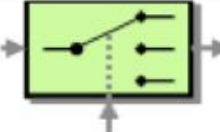
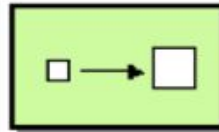
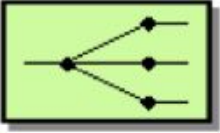
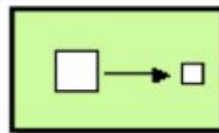
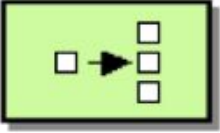
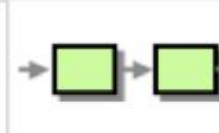
## NATIVE REST SUPPORT

Create, connect, and compose APIs with ease.

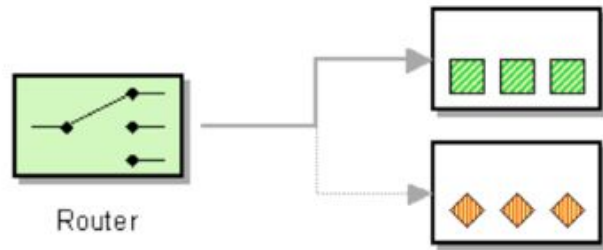
# Enterprise Integration Patterns



# Enterprise Integration Patterns

	Content Based Router		Aggregator
	Message Filter		Resequencer
	Dynamic Router		Content Enricher
	Recipient List		Content Filter
	Splitter		Pipes and Filters

# Camel Routes



```
from("file:data/inbox")  
  .to("jms:queue:order");
```

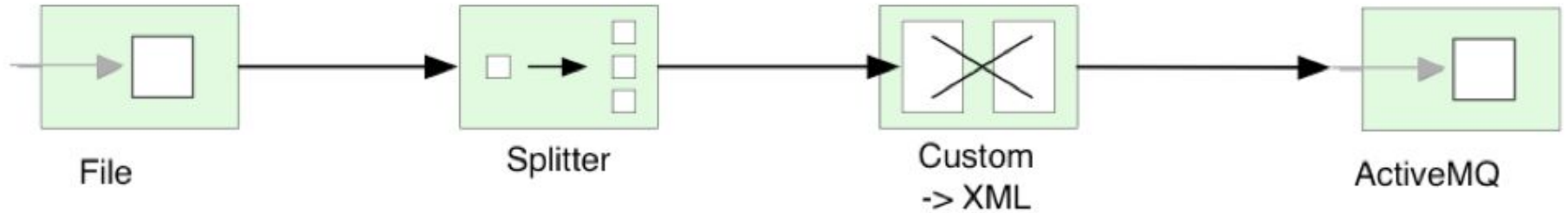
Java DSL

XML DSL

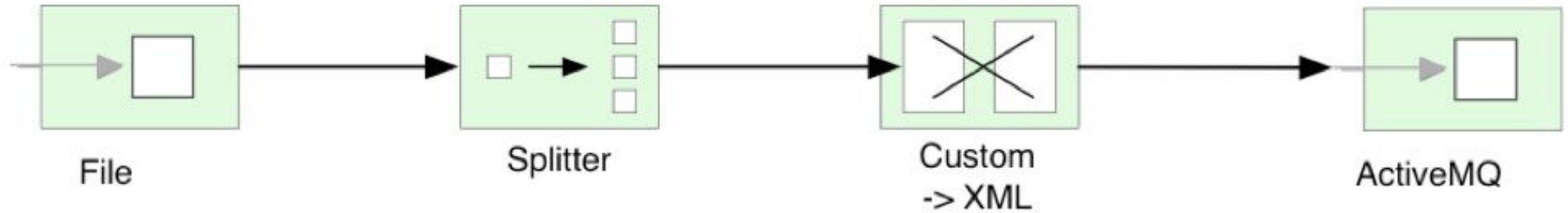
```
<route>  
  <from uri="file:data/inbox"/>  
  <to uri="jms:queue:order"/>  
</route>
```



# Camel Routes with Splitter

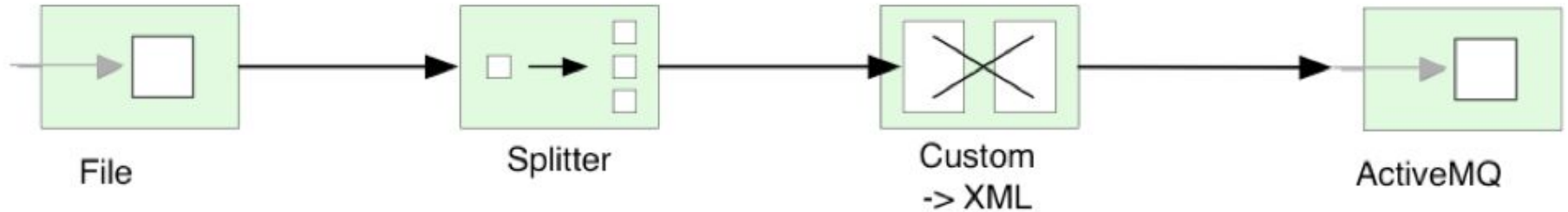


# Camel Routes with Splitter



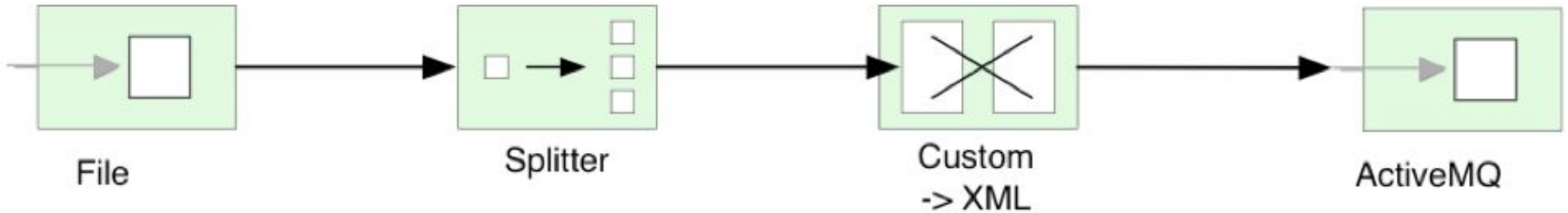
```
from("file:inbox")
```

# Camel Routes with Splitter



```
from("file:inbox")  
    .split(body().tokenize("\n"))
```

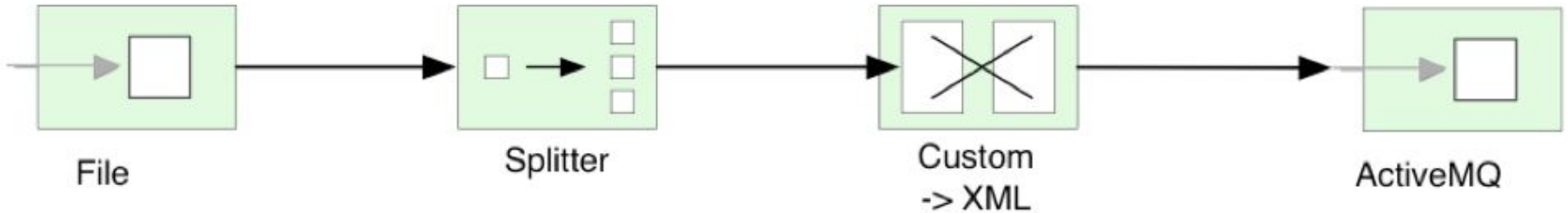
# Camel Routes with Splitter



```
from("file:inbox")  
    .split(body().tokenize("\n"))  
    .marshal(customToXml)
```

Custom data  
transformation

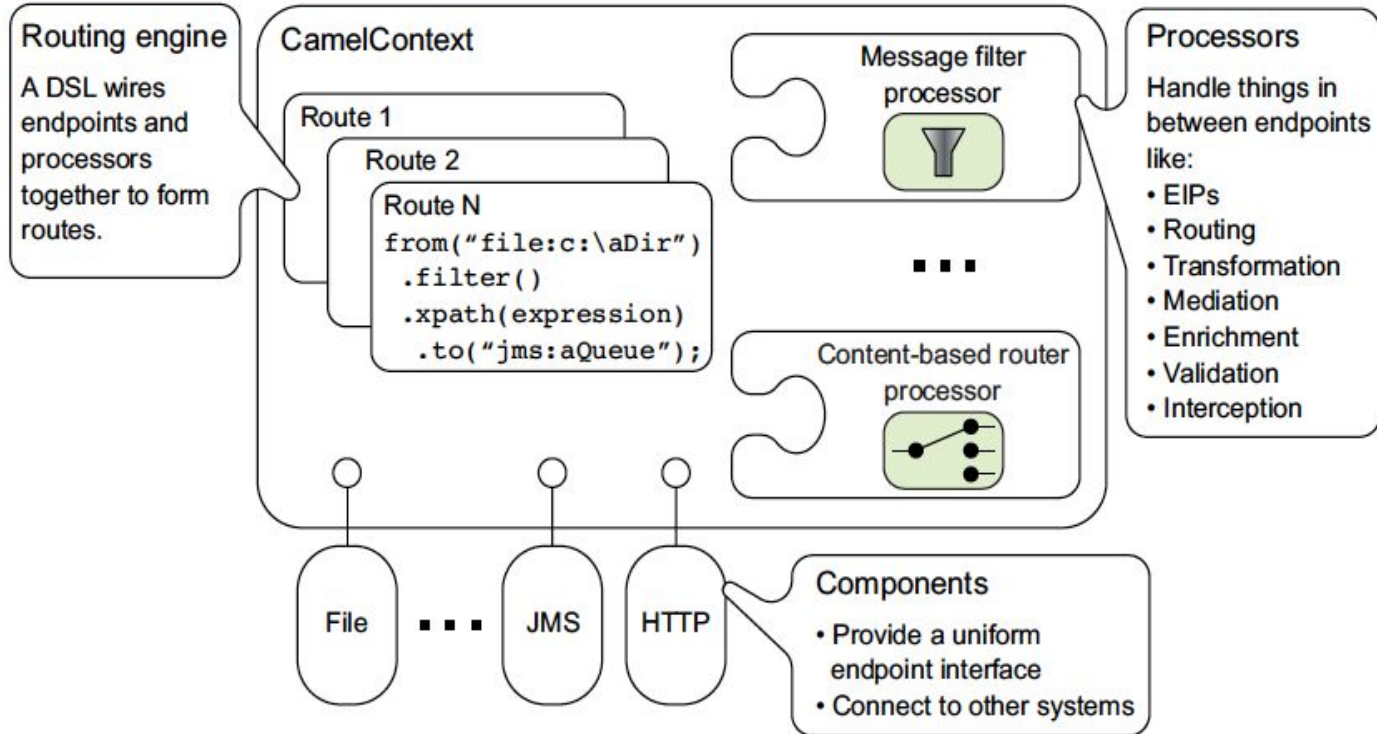
# Camel Routes with Splitter



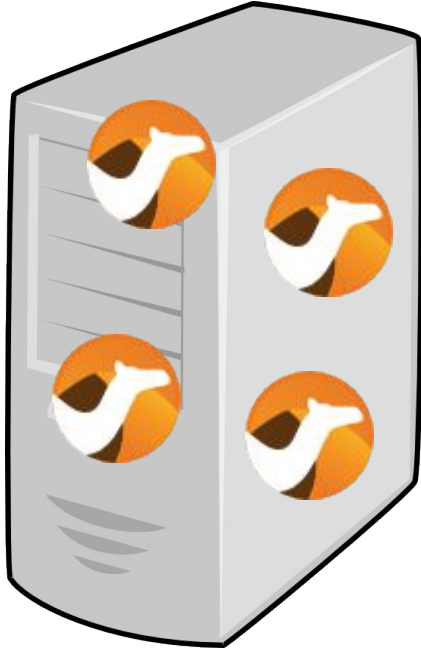
```
from("file:inbox")
    .split(body().tokenize("\n"))
    .marshal(customToXml)
    .to("activemq:line");
```

Custom data  
transformation

# Camel Architecture



# Camel runs everywhere

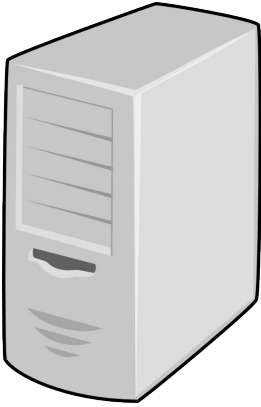


Application  
Servers

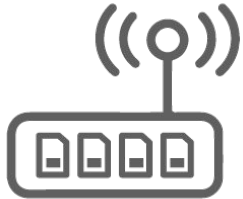


Linux  
Containers

# Camel connects everything



**Enterprise  
Systems**



**IoT**

- File
- FTP
- JMS
- AMQP
- JDBC
- SQL
- TCP/UDP
- Mail
- HDFS
- JPA
- MongoDB
- Kafka
- ...

- CoAP
- MQTT
- PubNub



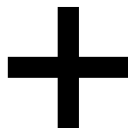
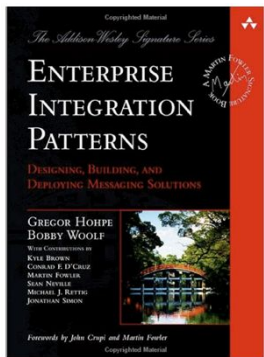
- AWS
  - S3
  - SQS
  - Kinesis
  - ...
- Google
  - BigQuery
  - PubSub
- Azure
  - Blob
  - Queue

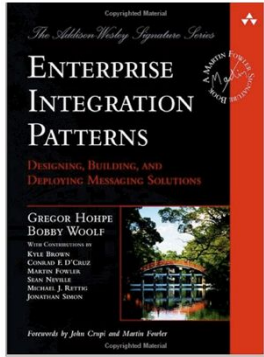
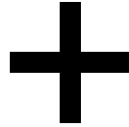
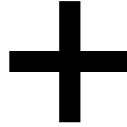
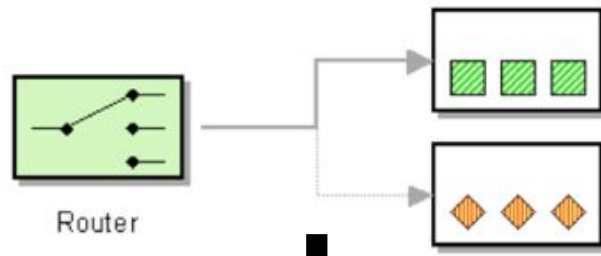


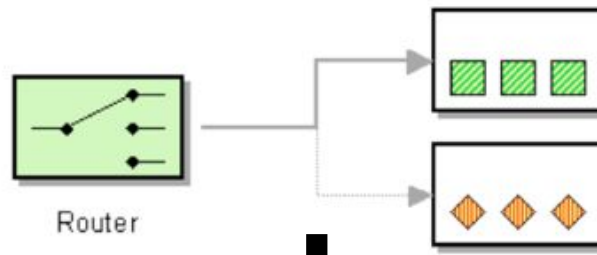
- Box
- Dropbox
- Facebook
- LinkedIn
- Salesforce
- SAP
- ServiceNow









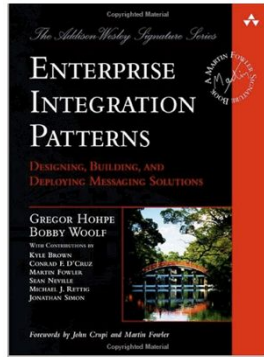
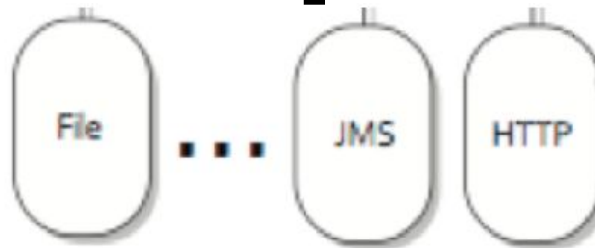


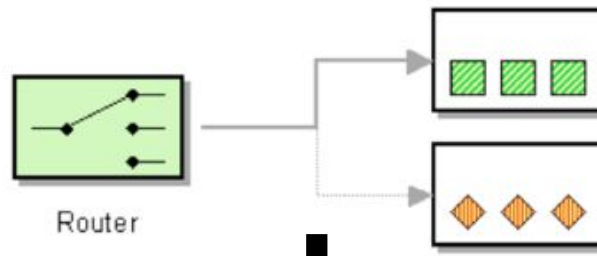
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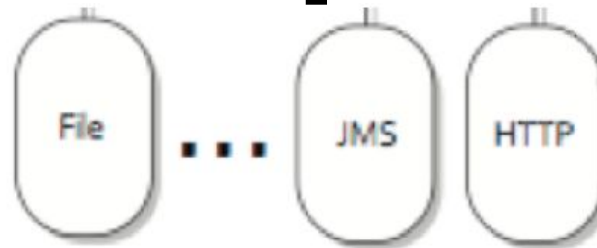


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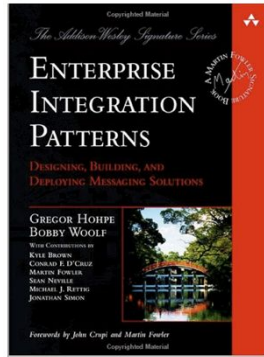
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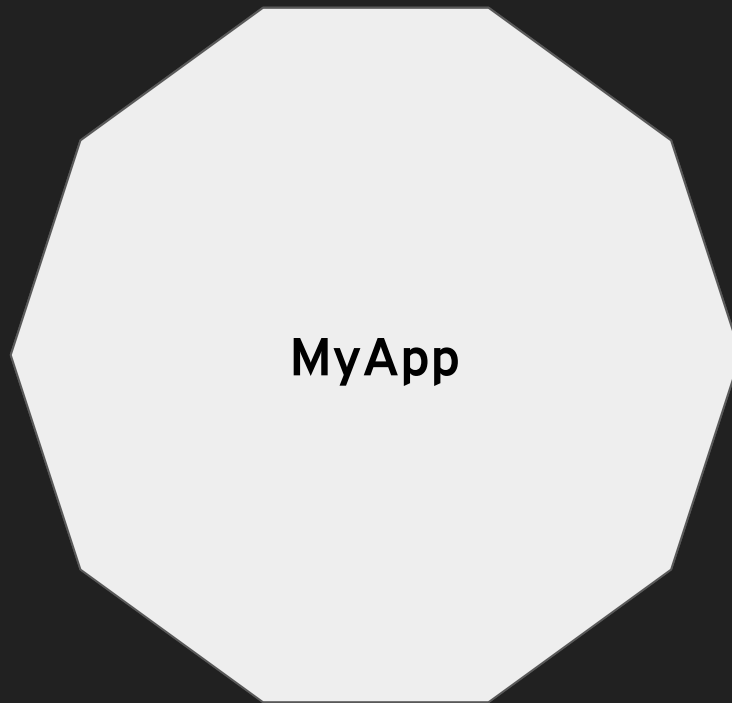
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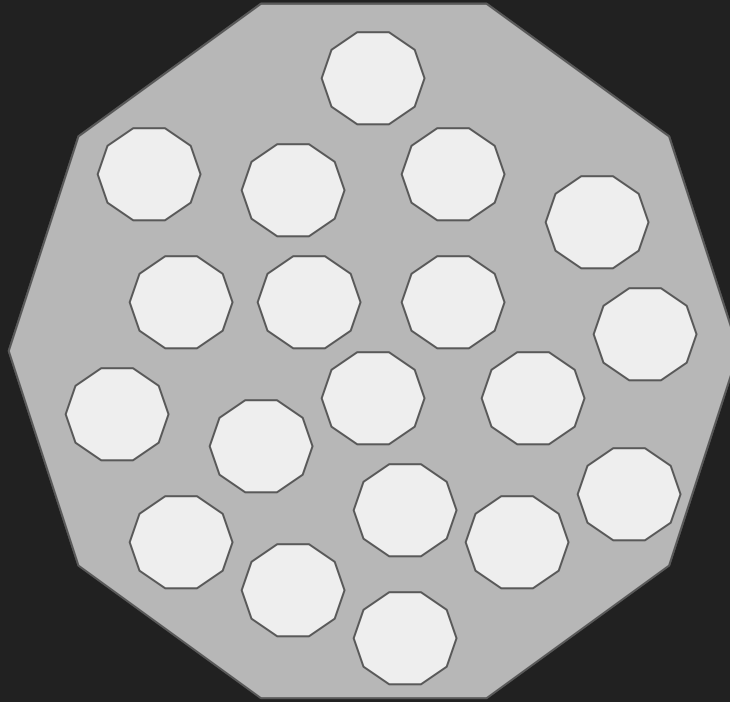


**What about Camel  
in the Cloud?**

# Monolith

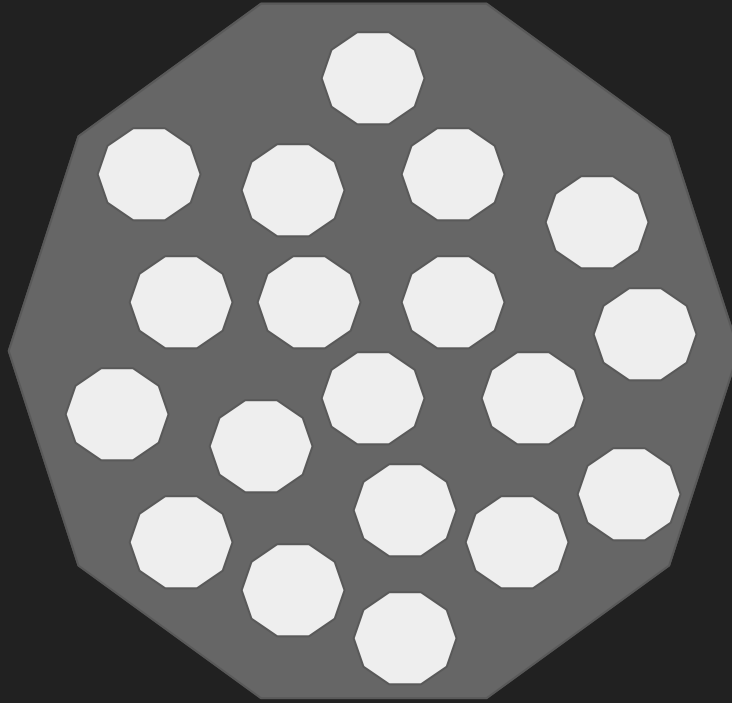


# Microservices

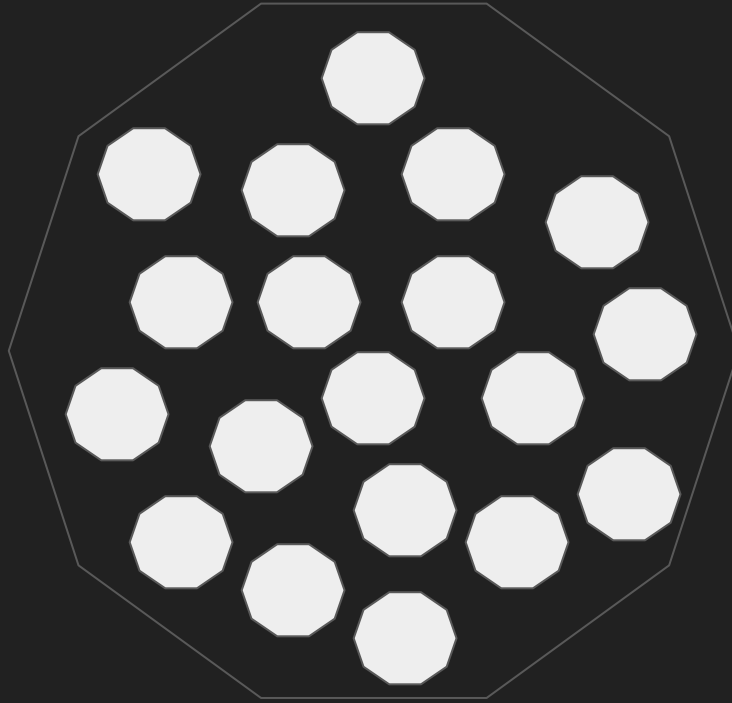




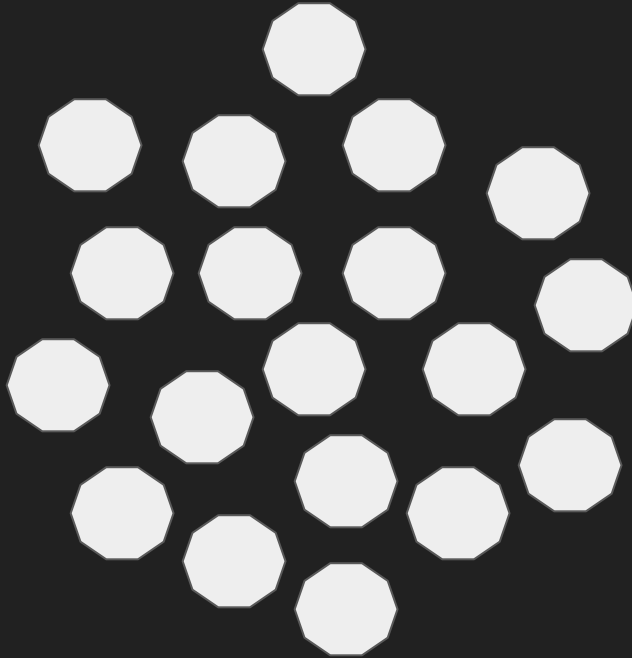
# Microservices



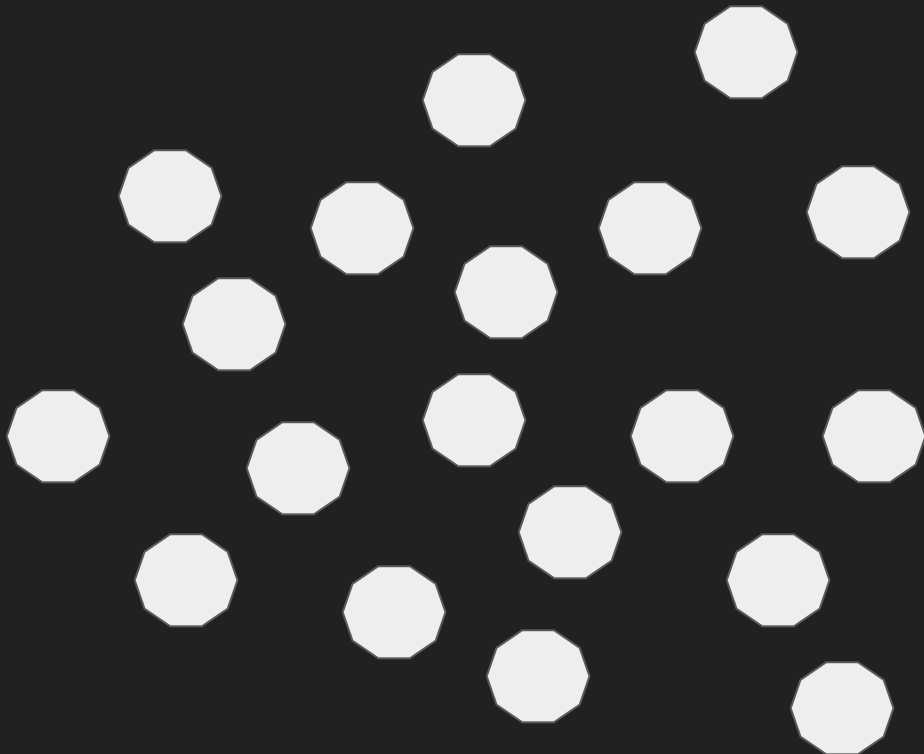
# Microservices



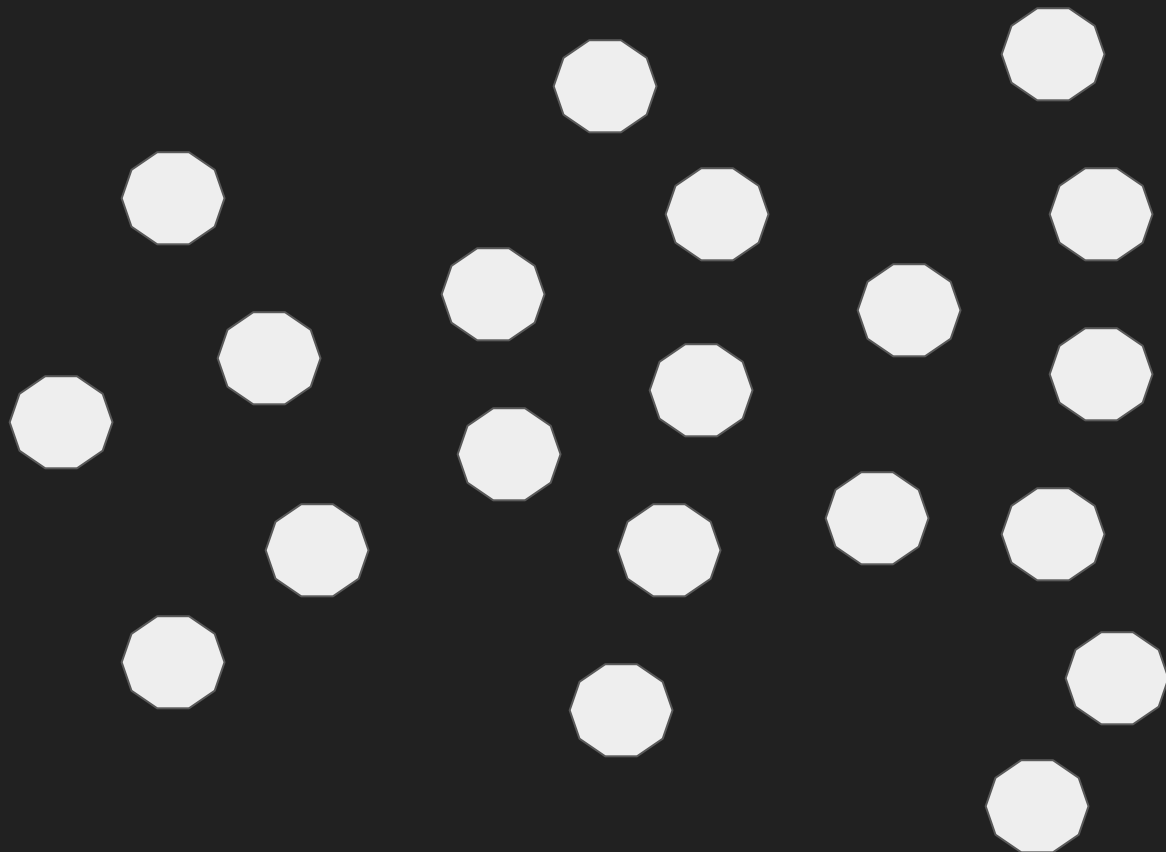
# Microservices



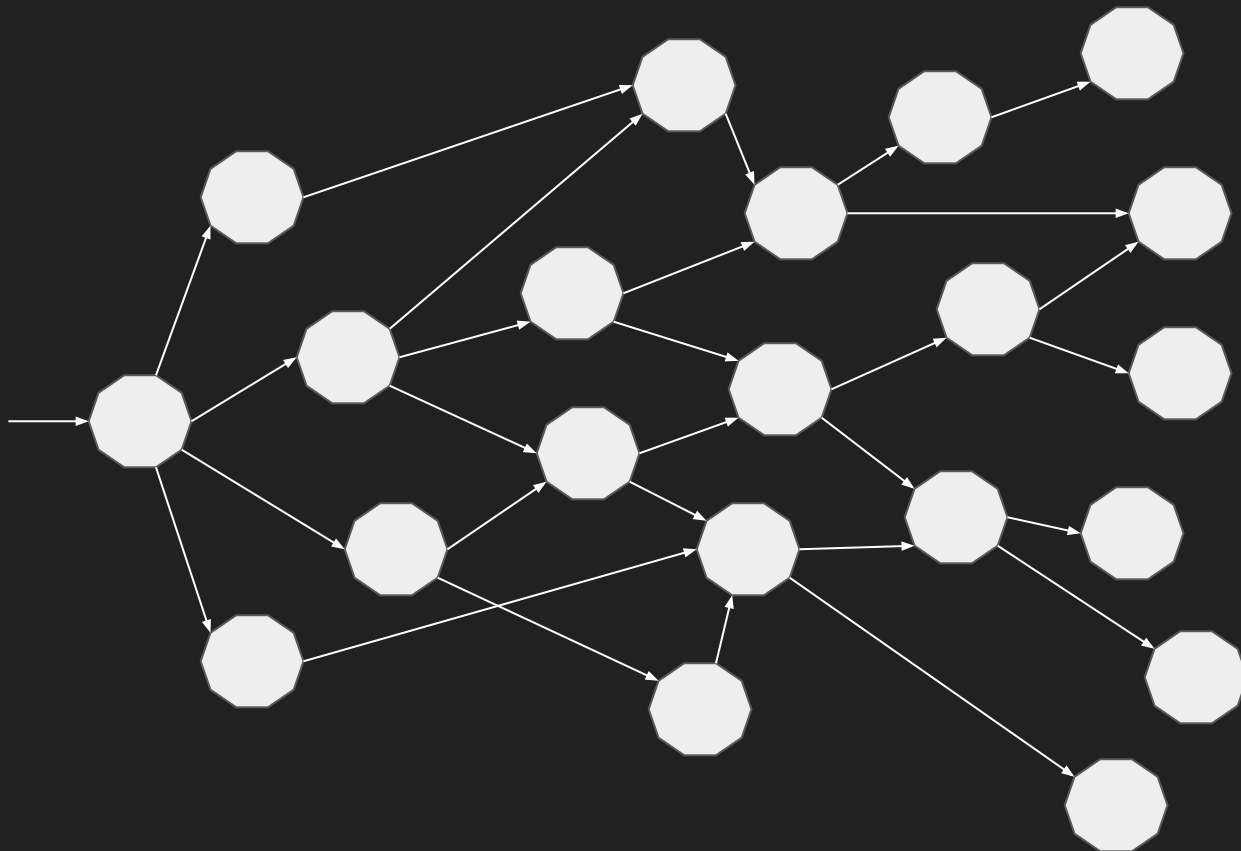
# Microservices



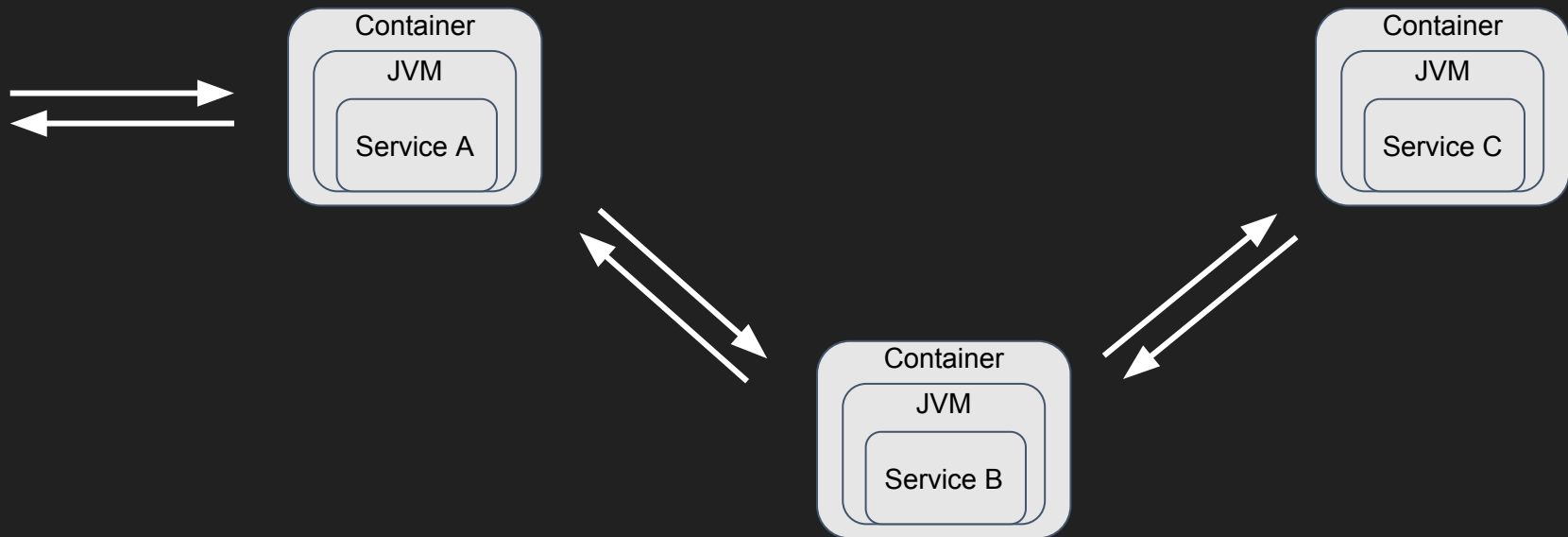
# Microservices



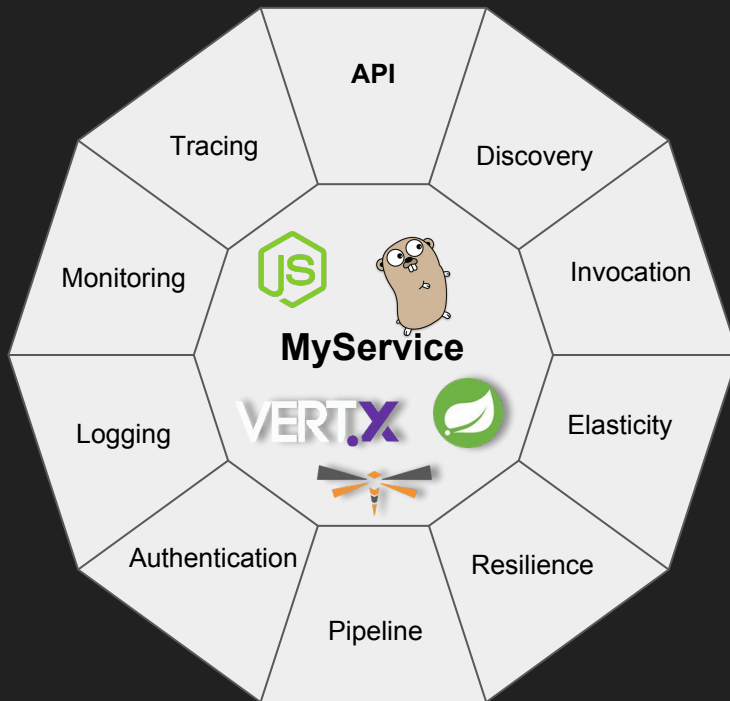
# Network of Services



# Microservices == Distributed Computing



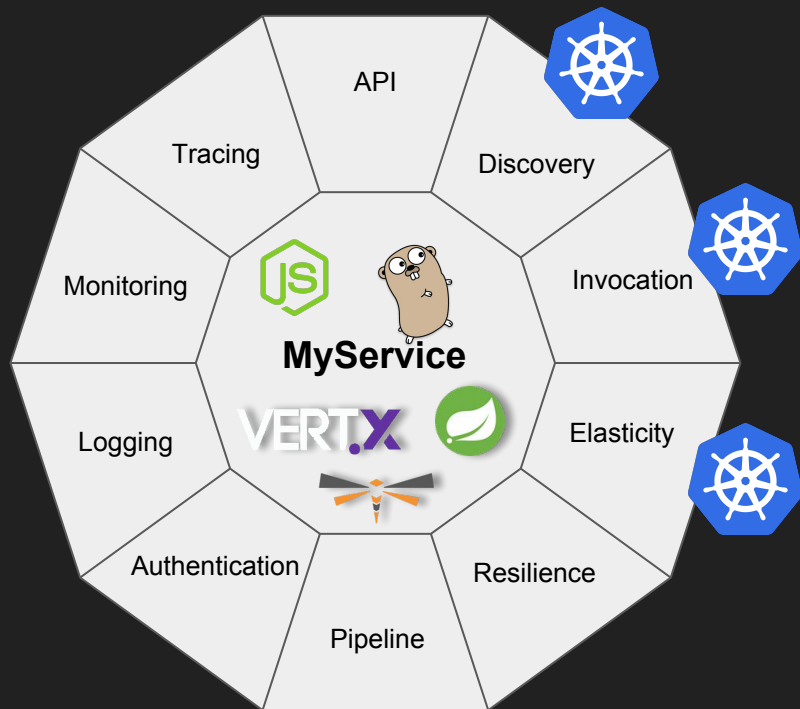
# Microservices'ilities



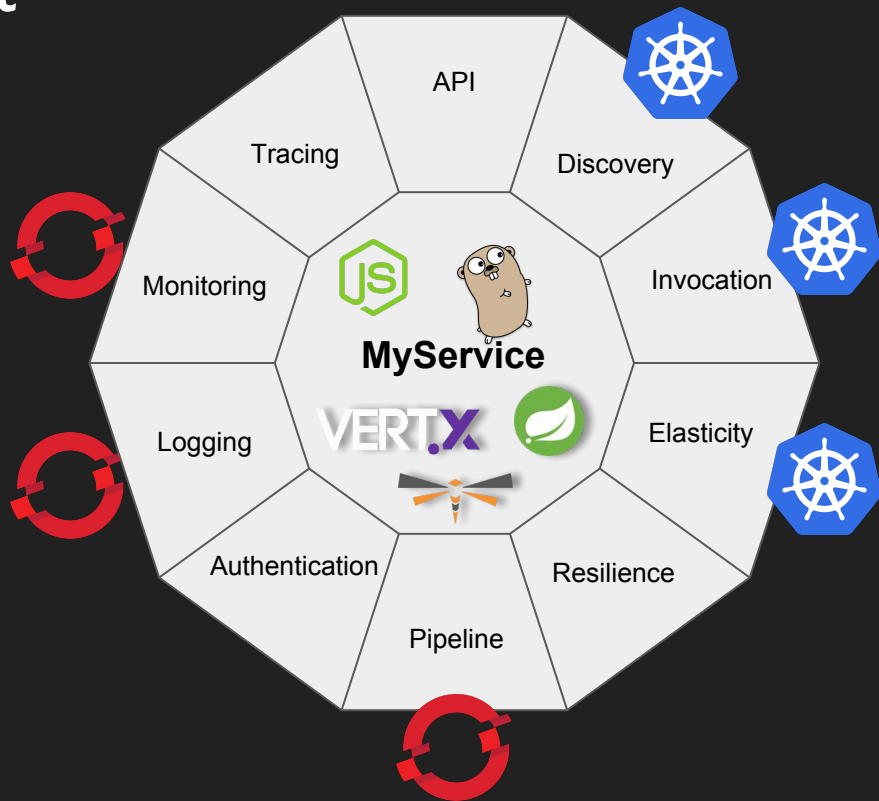




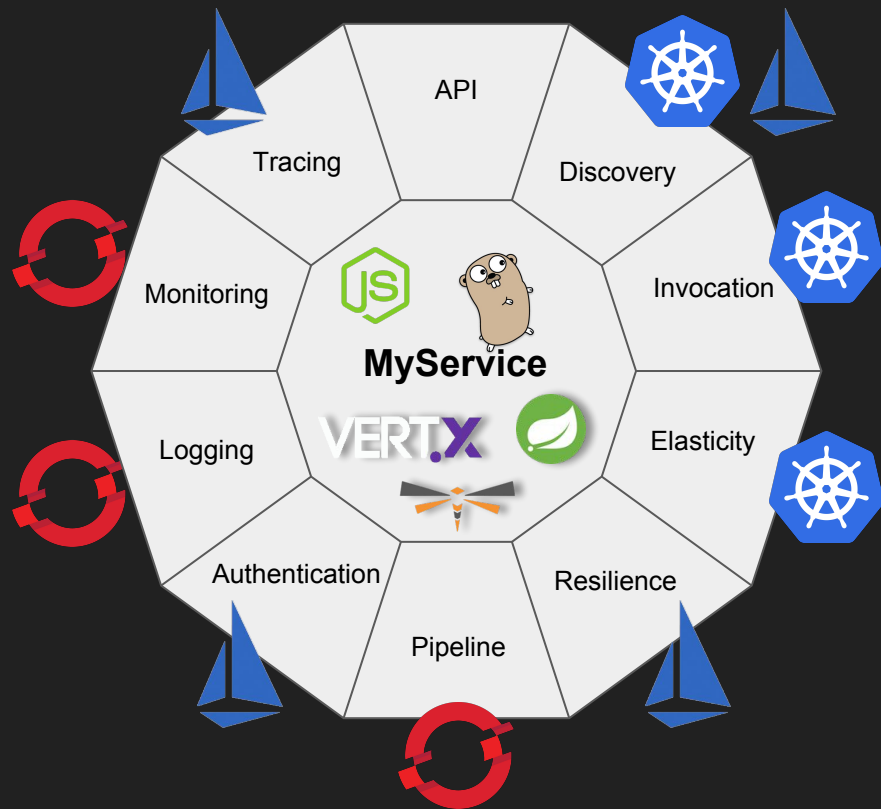
# Microservices'ilities + Kubernetes



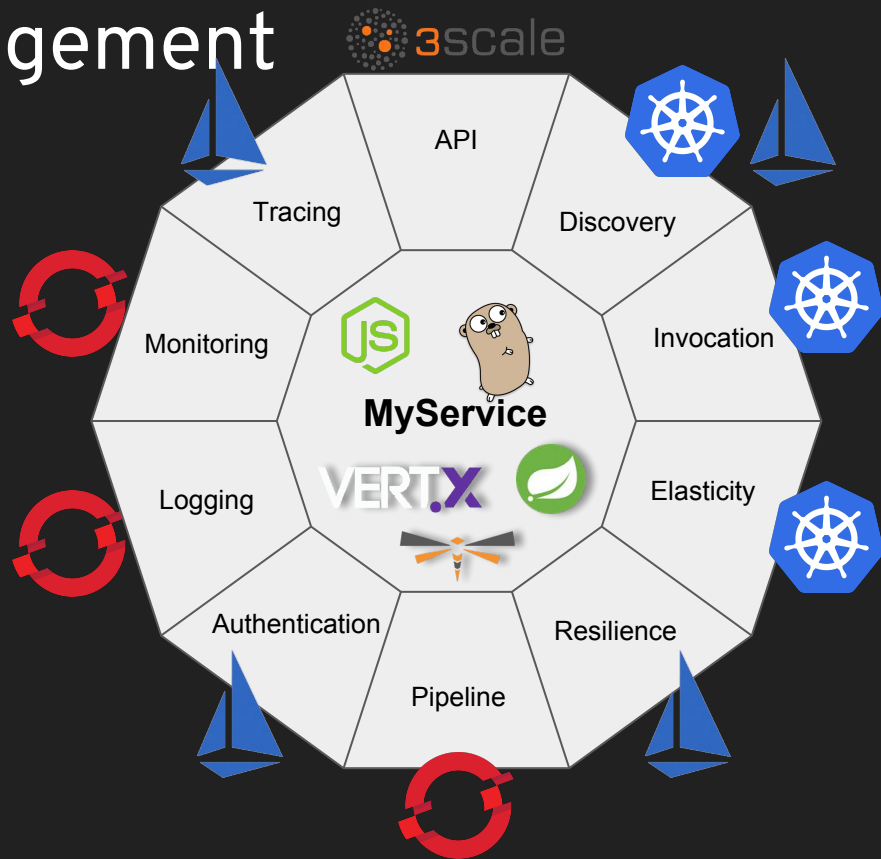
# Microservices'ilities + OpenShift



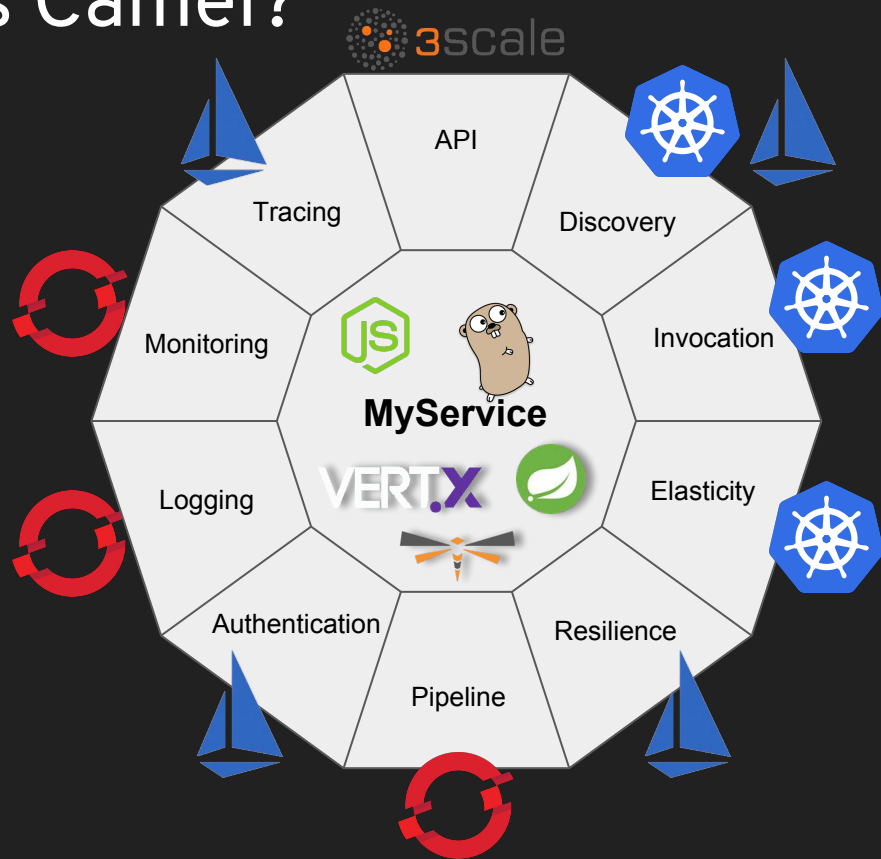
# Microservices'ilities + Istio



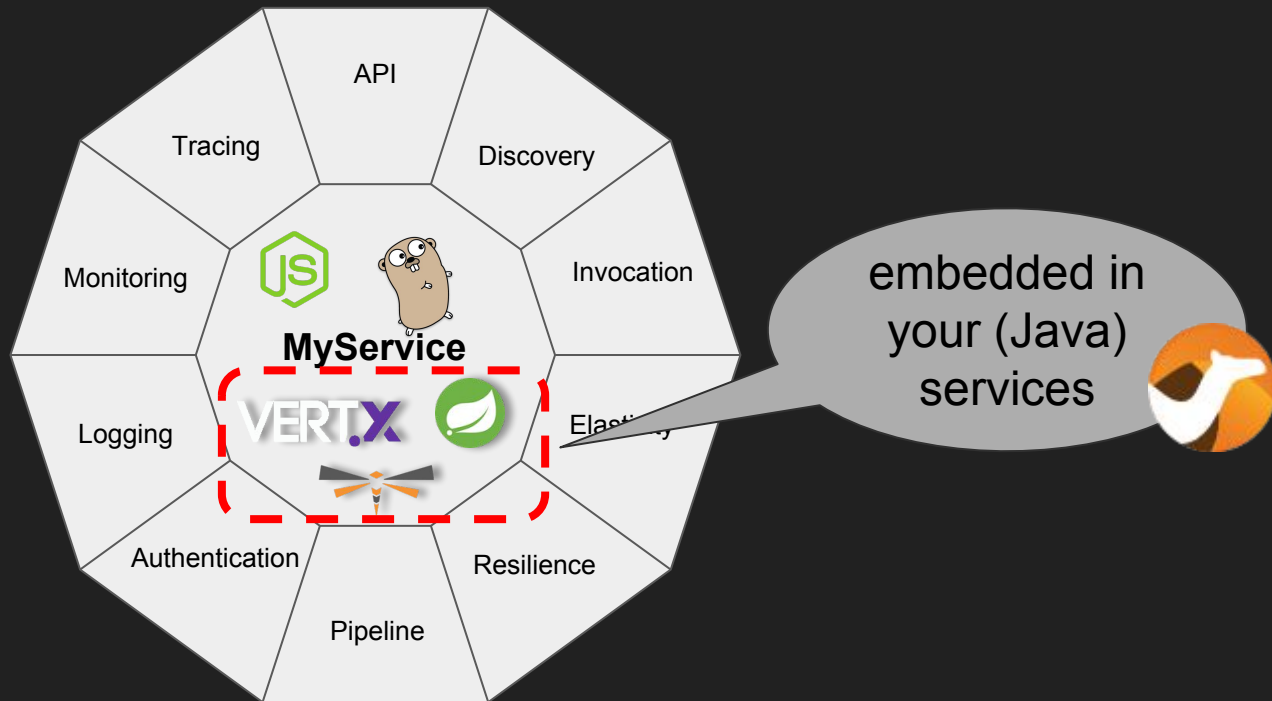
# Microservices'ilities + API management



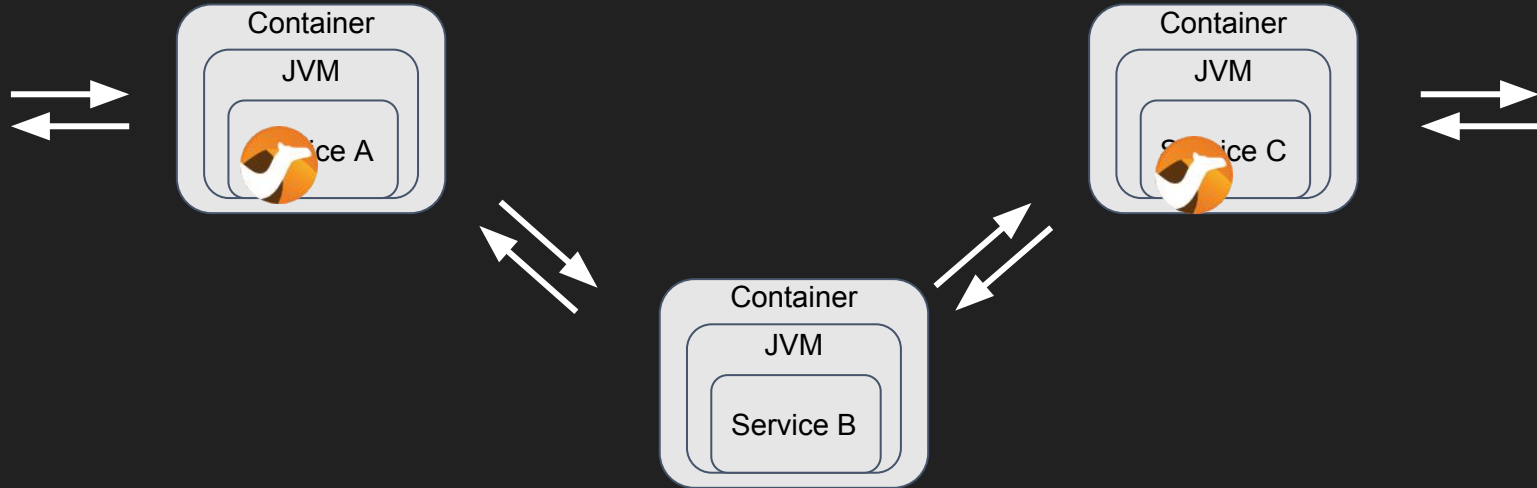
# But where is Camel?



# But where is Camel?

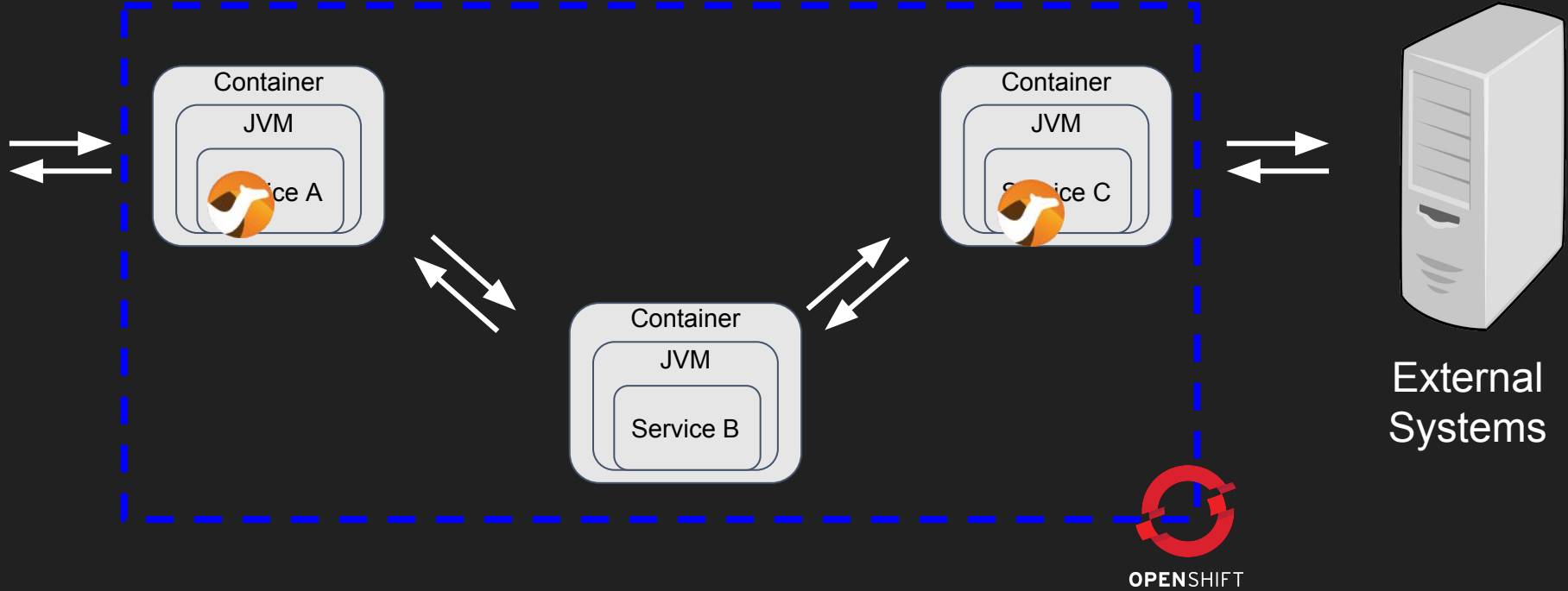


# Microservices == Distributed Integration





# Microservices == Distributed Integration



# THE THREE PILLARS OF AGILE INTEGRATION

Key foundational capabilities needed by today's enterprises

## DISTRIBUTED INTEGRATION

---

- LIGHTWEIGHT
- PATTERN BASED
- EVENT ORIENTED
- COMMUNITY SOURCED

## FLEXIBILITY



## CONTAINERS

---

- CLOUD NATIVE SOLUTIONS
- LEARN ARTIFACTS,  
INDIVIDUALLY DEPLOYABLE
- CONTAINER BASED SCALING  
AND HIGH AVAILABILITY

## SCALABILITY



## APIs

---

- WELL DEFINED, REUSABLE,  
AND WELL MANAGED  
END-POINTS
- ECOSYSTEM LEVERAGE

## RE-USABILITY



# Camel in the Cloud



# Best Practice - Small in Size

- Camel is light-weight
  - (camel-core 4mb)
  - + what you need
- Single fat-jar via:



VERT.X



# Best Practice - Stateless

- Favour stateless applications
- If state is needed:
  - Data-grid
    - camel-infinispan
    - camel-hazelcast
    - camel-ignite
    - ...
  - Storage
    - camel-sql
    - camel-jpa
    - camel-kafka
    - ...
  - Kubernetes
    - Stateful-set

# Best Practice - Configuration Management

- Kubernetes ConfigMap
  - Inject via ENV
  - Inject via files
- Kubernetes Secrets
  - Inject via ENV
  - Inject via files



```
// inject configuration via spring-style @Value  
@Value("${fallback}")  
private String fallback;
```



```
.simple( text: "{{fallback}}")
```

```
$ kubectl get cm -o yaml my-configmap  
apiVersion: v1  
data:  
  fallback: I still got no response  
kind: ConfigMap
```

# Best Practice - Fault Tolerant

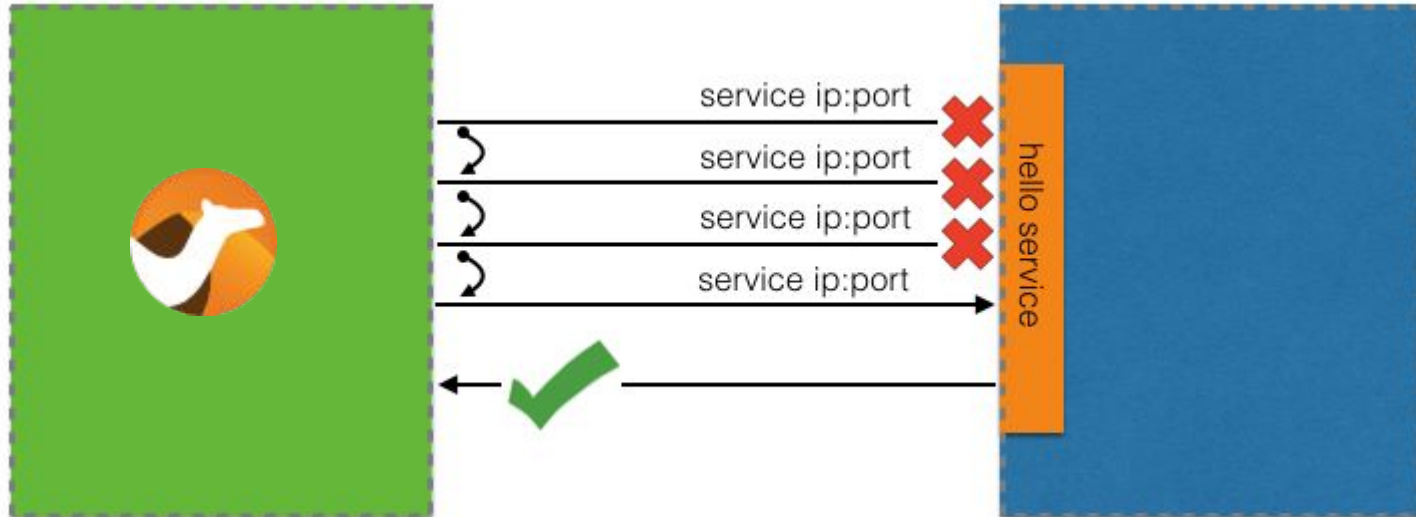
- Camel Retry
  - onException
  - errorHandler
- Camel Hystrix
  - circuit breaker



# Best Practice - Fault Tolerant

- Camel Retry
  - `onException`
  - `errorHandler`

```
onException(Exception.class)  
    .maximumRedeliveries(10)  
    .redeliveryDelay(1000);
```





# Best Practice - Fault Tolerant

- Camel Retry
  - `onException`
  - `errorHandler`

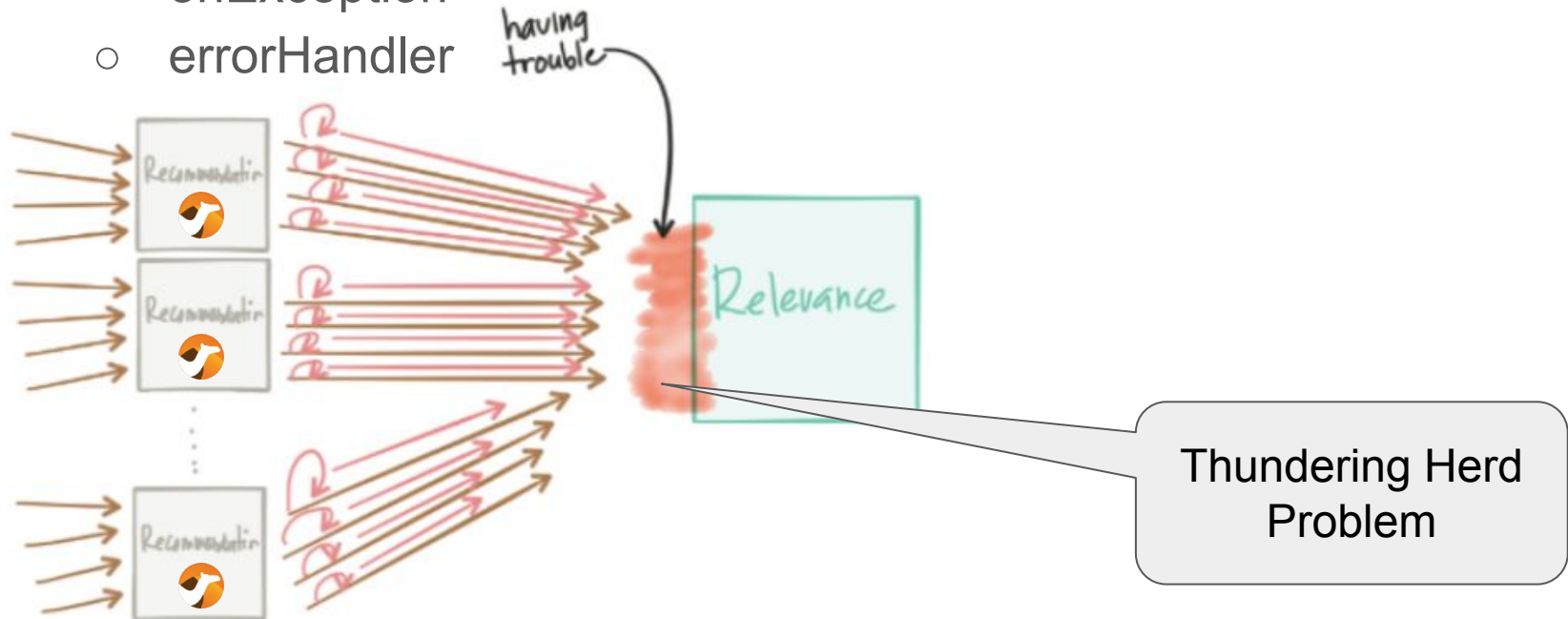


Figure by Christian Posta

# Best Practice - Health Checks

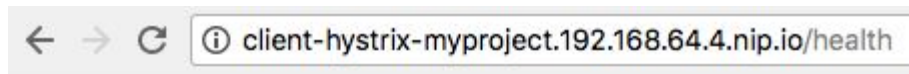
- Health Checks
  - camel-spring-boot actuator
  - wildfly-swarm monitor



- Readiness Probe
  - Kubernetes



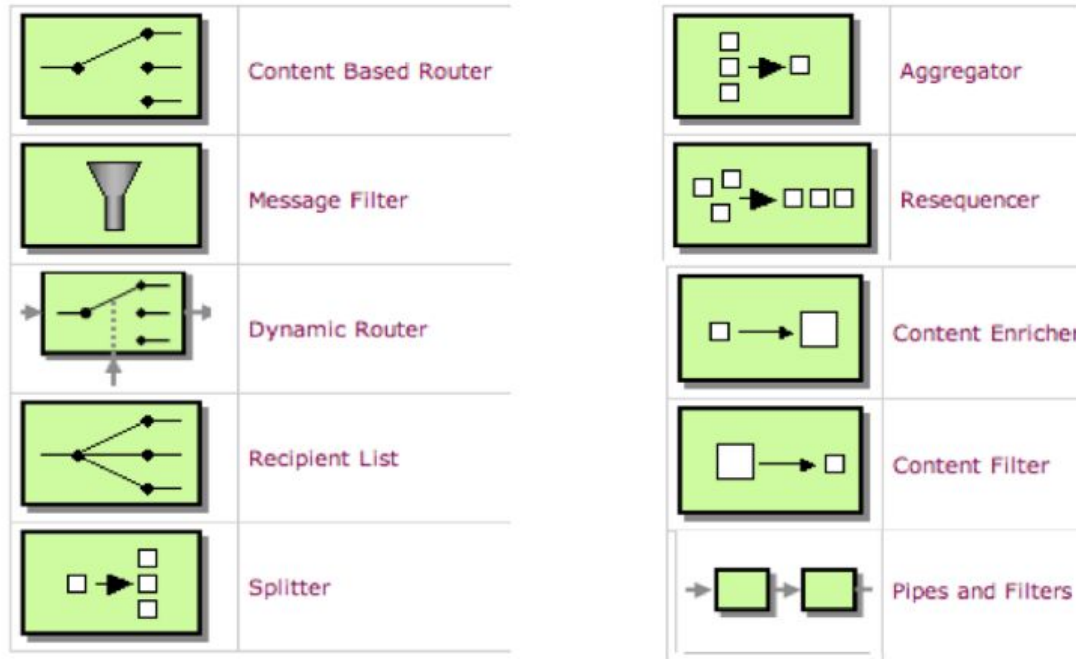
- Liveness Probe
  - Kubernetes



```
{
  status: "UP",
  - camel: {
    status: "UP",
    name: "camel-1",
    version: "2.20.2",
    contextStatus: "Started",
  },
  - camel-health-checks: {
    status: "UP",
    route:routel: "UP",
  },
  - diskSpace: {
    status: "UP",
    total: 19195224064,
    free: 5747757056,
    threshold: 10485760,
  },
}
```

# Best Practice - EIP Patterns

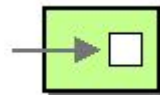
- Works anywhere



## Plugins

- Consul
- Etcd
- Kubernetes
- Ribbon
- Zookeeper

# EIP Cloud Patterns



Service Call

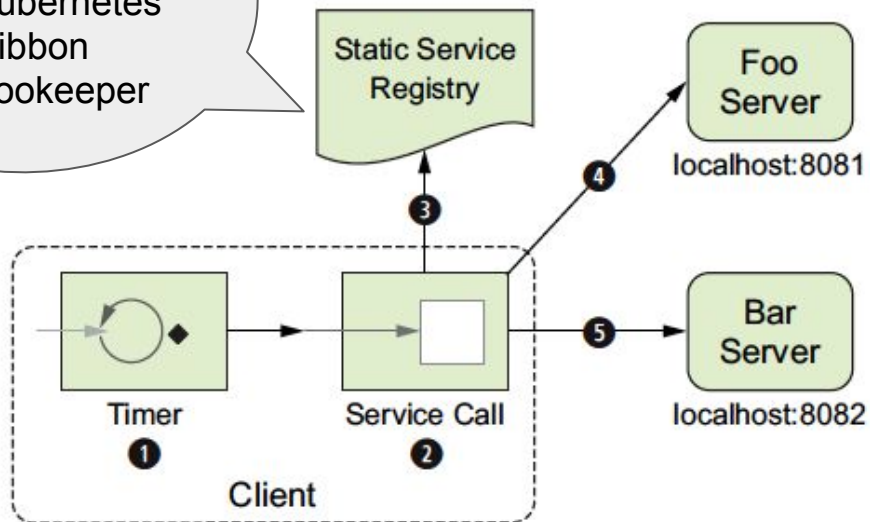
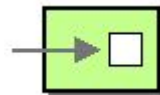


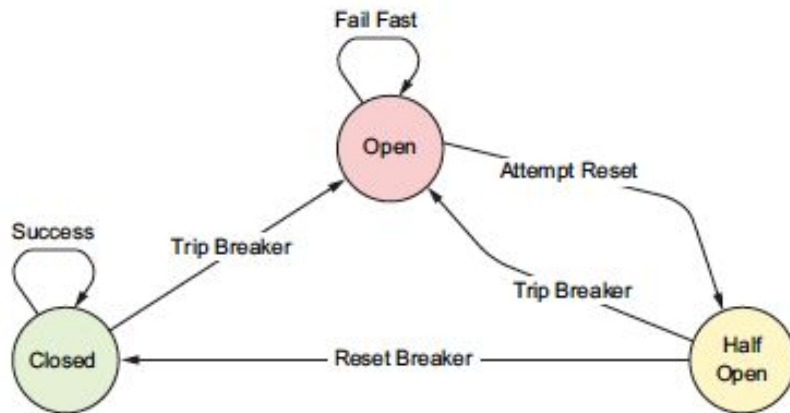
Figure 17.9 A timer ① triggers the Service Call EIP ② to call a clustered service. The physical locations of the service are looked up in the service registry ③. The service is then called in a round-robin fashion by calling either Foo server ④ or Bar server ⑤.

```
from("timer")
    .serviceCall("hello-service");
```

# EIP Cloud Patterns

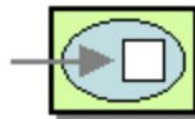


Hystrix EIP

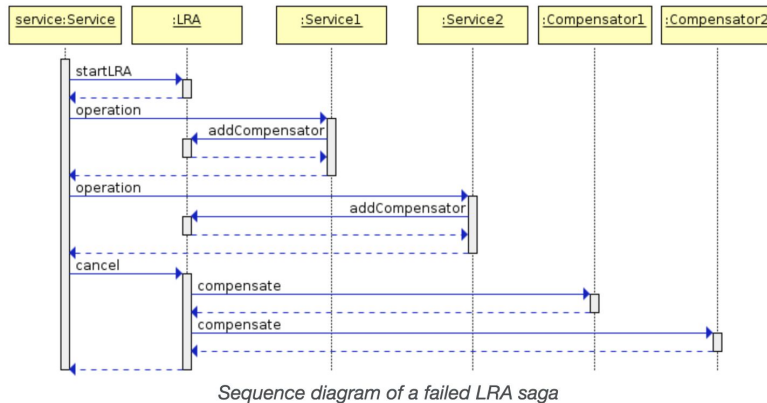


```
from("timer:foo")
  .hystrix()
    .to("http:myservice")
  .onFallback()
    .to("bean:myfallback")
  .end()
```

# EIP Cloud Patterns



Saga EIP



```
rest().post("train/buy/seat")
    .saga()
      .compensation("direct:cancel")
      ...
    .to("http:trainservice/buy")
```

# EIP Cloud Patterns

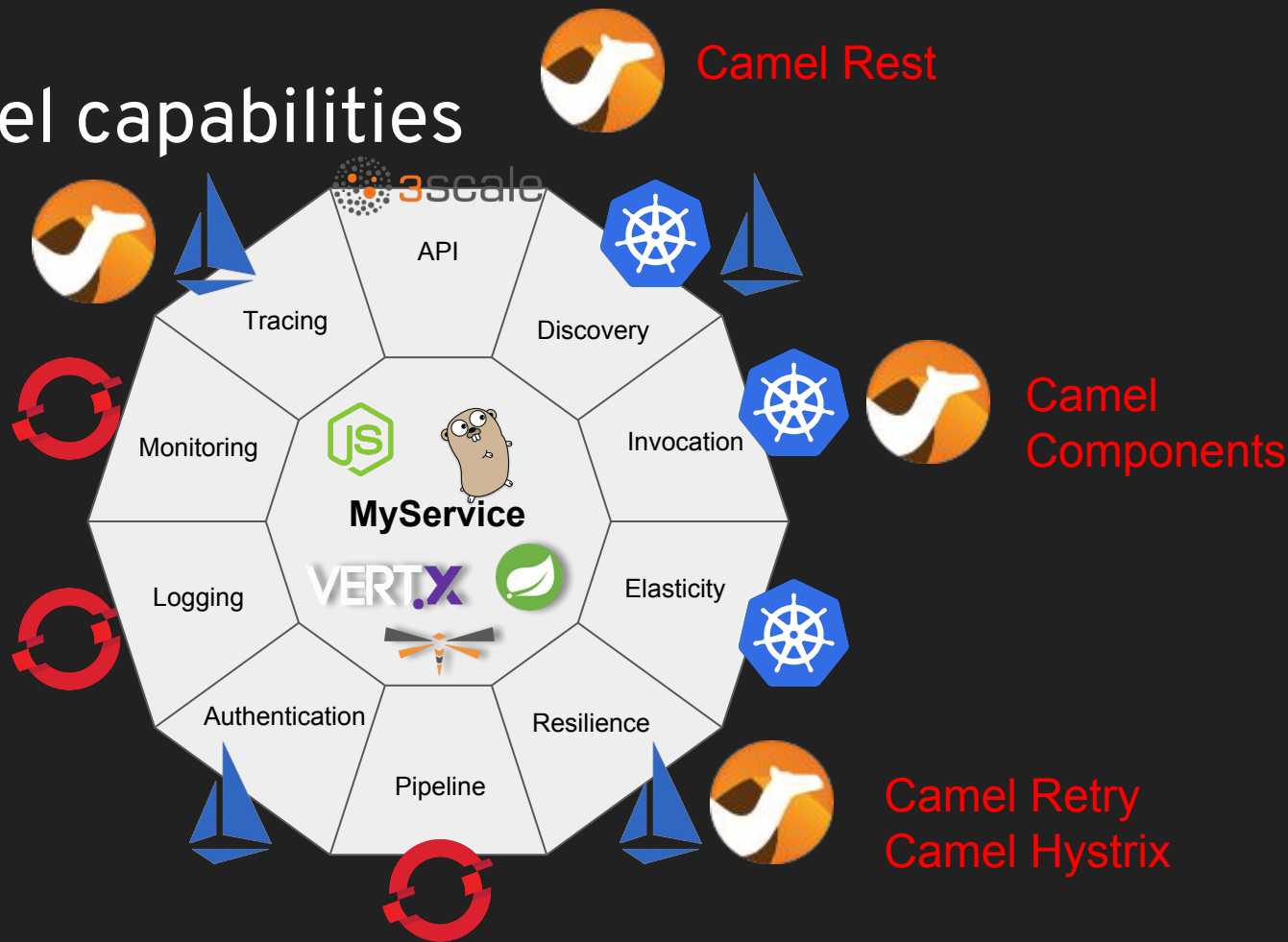


Distributed  
Tracing



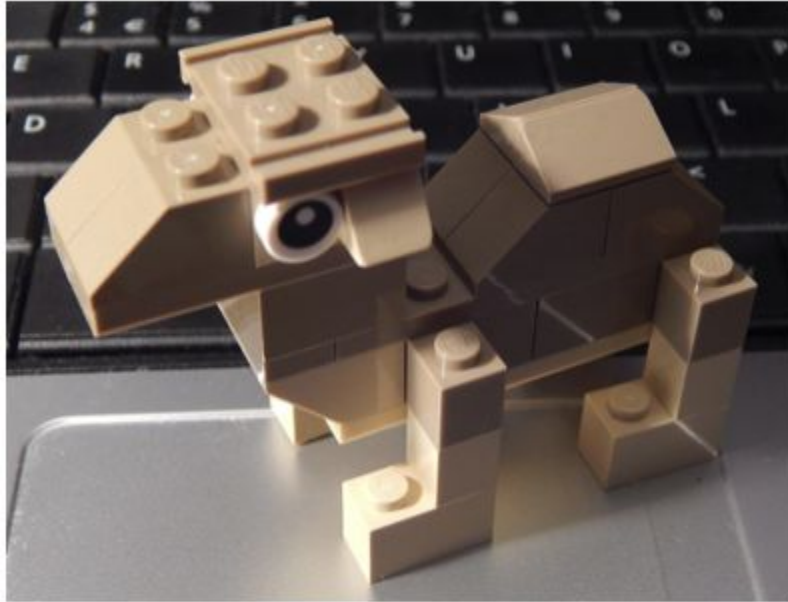
# Usable Camel capabilities

Camel Zipkin  
Camel OpenTracing

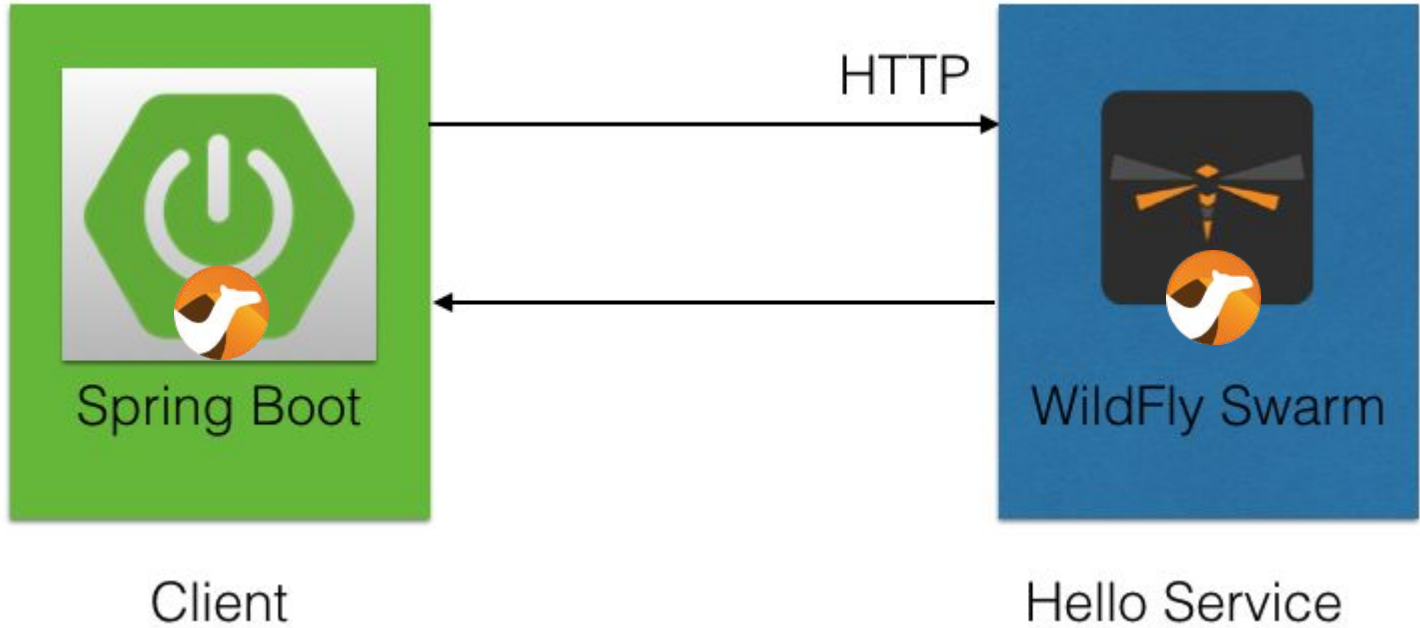




# Demo Time



# Basic Demo

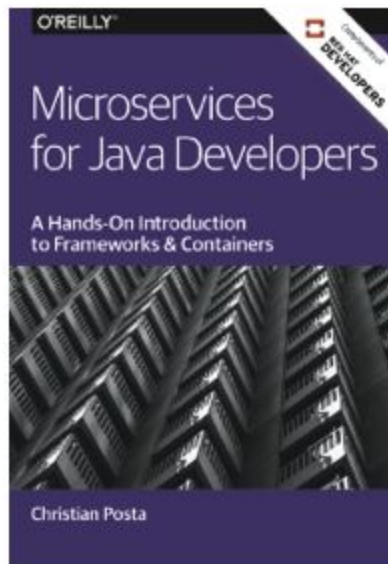


# Tip of the iceberg



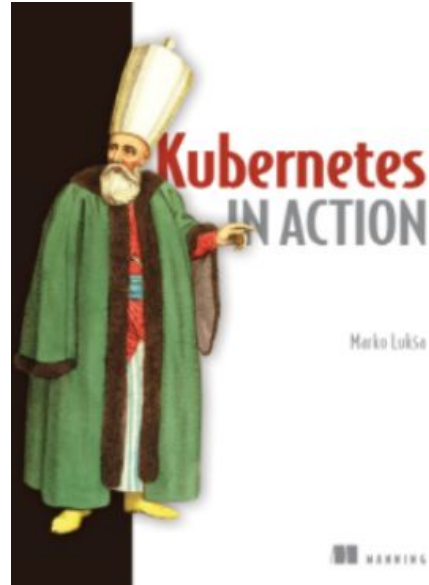
Figure by Bilgin Ibryam

# Free book



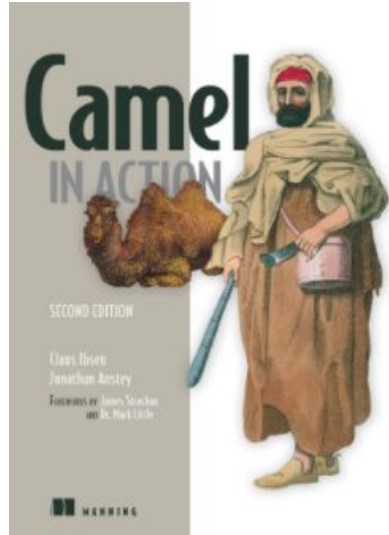
<http://developers.redhat.com/promotions/microservices-for-java-developers>

# Not so free book



<https://www.manning.com/books/kubernetes-in-action>

# Free first 3-chapters



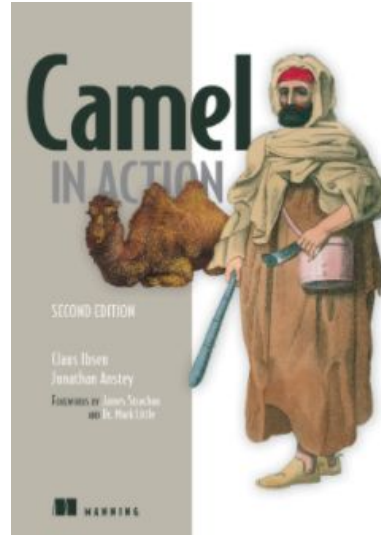
<https://developers.redhat.com/books/selections-camel-action/>

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<https://www.manning.com/books/camel-in-action-second-edition>

# Free e-book

E-BOOK

## **AGILE INTEGRATION:**

THE BLUEPRINT FOR ENTERPRISE ARCHITECTURE

By Steve Willmott and David Codelli

Edited by Deon Ballard

<https://www.redhat.com/en/resources/mi-agile-integration-ebook>



# More Information

- Slides and Demo source code:  
<https://github.com/davsclaus/camel-riders-in-the-cloud/tree/webinar>
- Apache Camel website:  
<http://camel.apache.org>
- Best "What is Apache Camel" article:  
<https://dzone.com/articles/open-source-integration-apache>
- My blog:  
<http://www.davsclaus.com>
- DevNation Webinars:  
<https://developers.redhat.com/devnationlive>

Q & A