SPRING CLOUD + KUBERNETES + ISTIO = ?

A MACRO PERSPECTIVE ON THE TOOLBOX FOR MICROSERVICES

MAGNUS LARSSON

CADEC 2020.01.23 & 2020.01.29 | CALLISTAENTERPRISE.SE

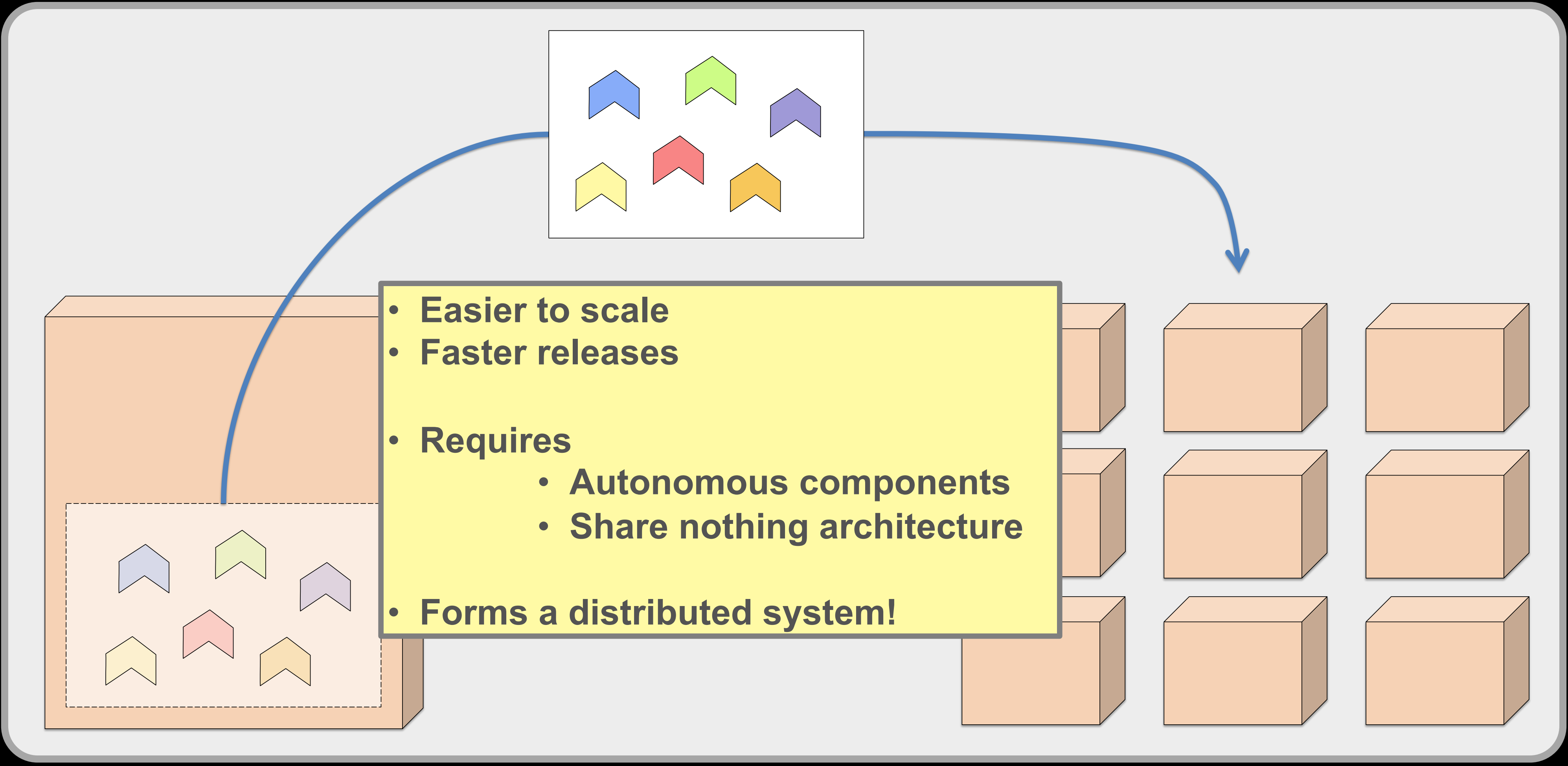
CALLISTA

AGENDA

- Why?
- Challenges
- Open Source to the rescue!
- Overlaps
- Demo
- Summary

CALLISTA

WHY?

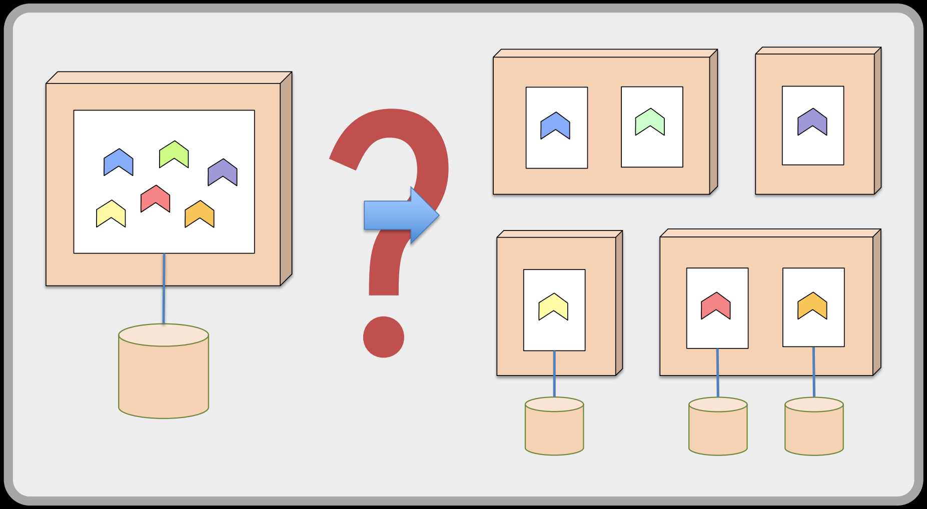


- Easier to scale
- Faster releases

- Requires
  - Autonomous components
  - Share nothing architecture

- Forms a distributed system!

CHALLENGES



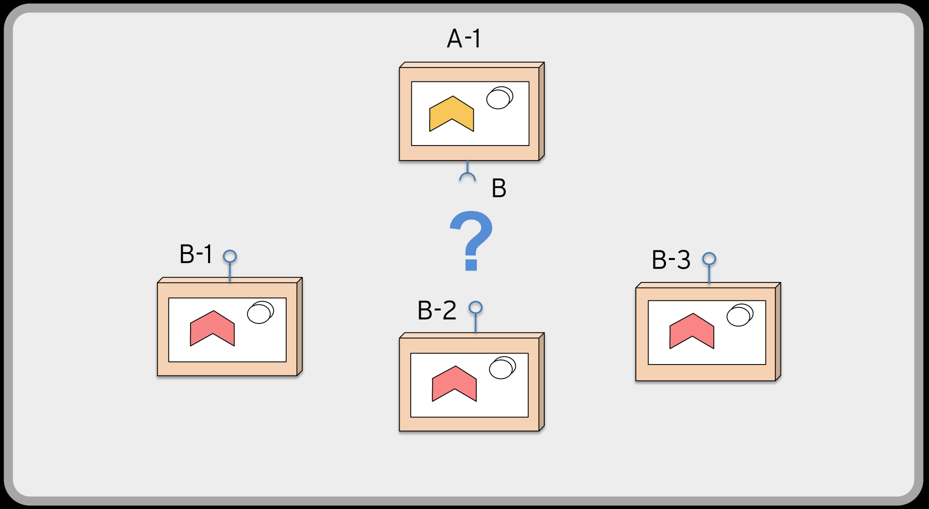
CALLISTA

CHALLENGES

DISCOVERY SERVER

WHERE ARE THE SERVICES?

WHICH SERVICE TO CALL?



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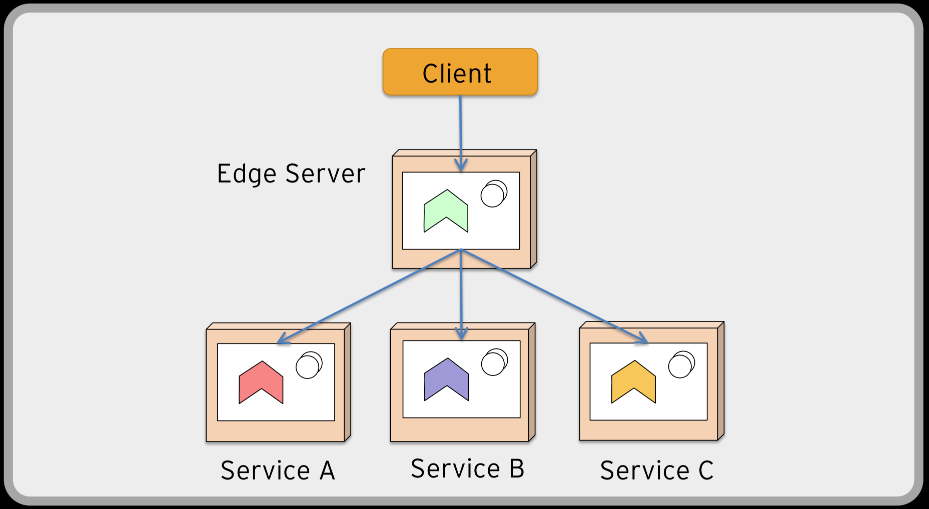
EDGE SERVER

HOW TO HIDE PRIVATE SERVICES?

HOW TO PROTECT PUBLIC SERVICES?



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WHERE IS MY CONFIGURATION?
ARE ALL SERVICES
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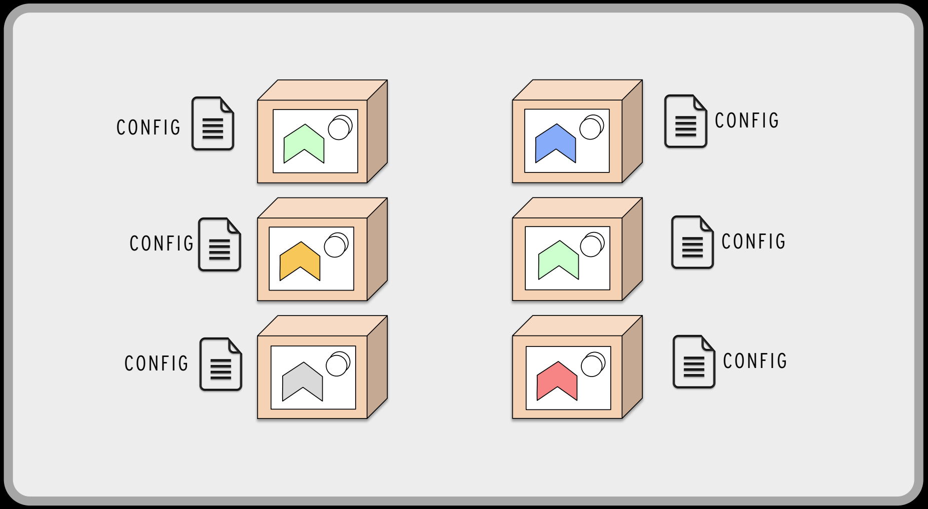

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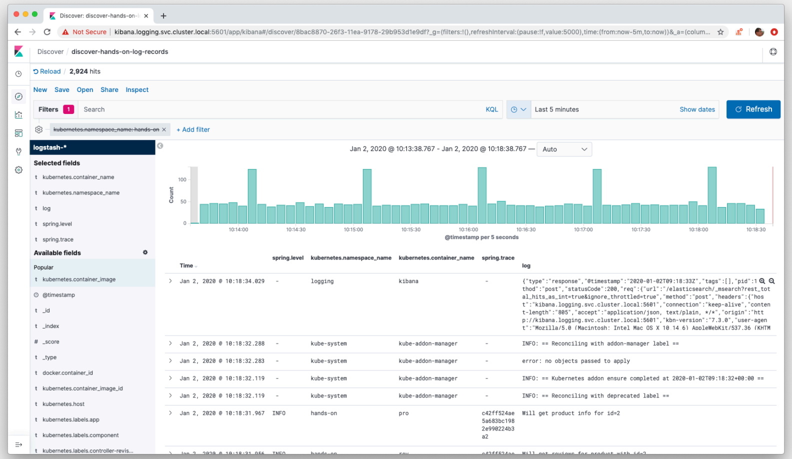

Discover: discover-hands-on-l
Not Secure
kibana.logging.svc.cluster.local:5601/app/kibana#/discover/8bac8870-26f3-11ea-9178-29b953d1e9df?_g=(filters:!(),refreshInterval:(pause:!f,value:5000),time:(from:now-5m,to:now))&_a=(colum...
Discover / discover-hands-on-log-records
Reload / 2,924 hits
New Save Open Share Inspect
Filters 1 Search KQL
Last 5 minutes Show dates Refresh
~~kubernetes.namespace_name: hands-on~~
+ Add filter
logstash-*
Selected fields
kubernetes.container_name
kubernetes.namespace_name
log
spring.level
spring.trace
Available fields
Popular
kubernetes.container_image
@timestamp
_id
_index
_score
_type
docker.container_id
kubernetes.container_image_id
kubernetes.host
kubernetes.labels.app
kubernetes.labels.component
kubernetes.labels.controller-revis...
Jan 2, 2020 @ 10:13:38.767 - Jan 2, 2020 @ 10:18:38.767 — Auto
Count
@timestamp per 5 seconds

Time	spring.level	kubernetes.namespace_name	kubernetes.container_name	spring.trace	log
Jan 2, 2020 @ 10:18:34.029	-	logging	kibana	-	{"type":"response","@timestamp":"2020-01-02T09:18:33Z","tags":[],"pid":1 thod":"post","statusCode":200,"req":{"url":"/elasticsearch/_msearch?rest_total_hits_as_int=true&ignore_throttled=true","method":"post","headers":{"host":"kibana.logging.svc.cluster.local:5601","connection":"keep-alive","content-length":"805","accept":"application/json, text/plain, */*","origin":"http://kibana.logging.svc.cluster.local:5601","kbn-version":"7.3.0","user-agent":"Mozilla/5.0 (Macintosh; Intel Mac OS X 10_14_6) AppleWebKit/537.36 (KHTM
Jan 2, 2020 @ 10:18:32.288	-	kube-system	kube-addon-manager	-	INFO: == Reconciling with addon-manager label ==
Jan 2, 2020 @ 10:18:32.283	-	kube-system	kube-addon-manager	-	error: no objects passed to apply
Jan 2, 2020 @ 10:18:32.119	-	kube-system	kube-addon-manager	-	INFO: == Kubernetes addon ensure completed at 2020-01-02T09:18:32+00:00 ==
Jan 2, 2020 @ 10:18:32.119	-	kube-system	kube-addon-manager	-	INFO: == Reconciling with deprecated label ==
Jan 2, 2020 @ 10:18:31.967	INFO	hands-on	pro	c42ff524ae5a683bc1982e990224b3a2	Will get product info for id=2
Jan 2, 2020 @ 10:18:31.956	INFO	hands-on	rev	c42ff524ae	Will get reviews for product with id=2

LOG ANALYSIS
WHERE ARE THE LOGS?
HOW TO CORRELATE LOGS
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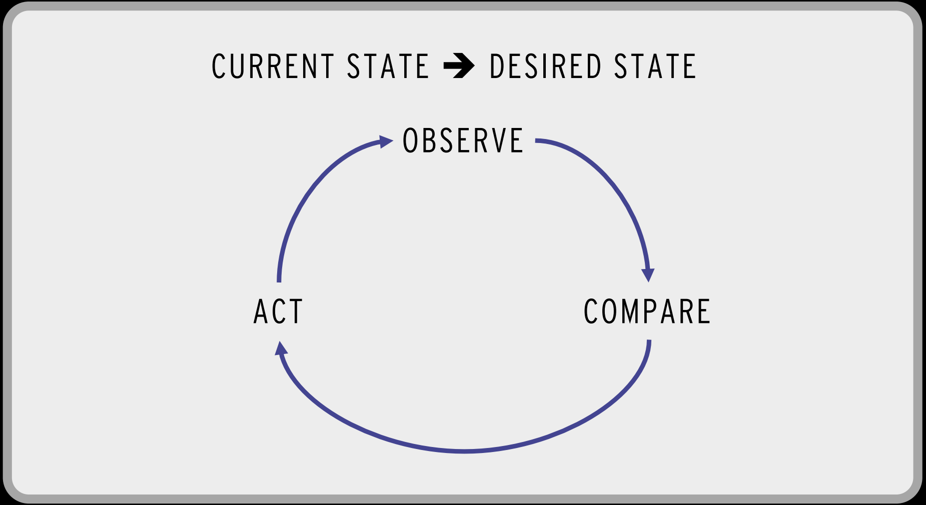

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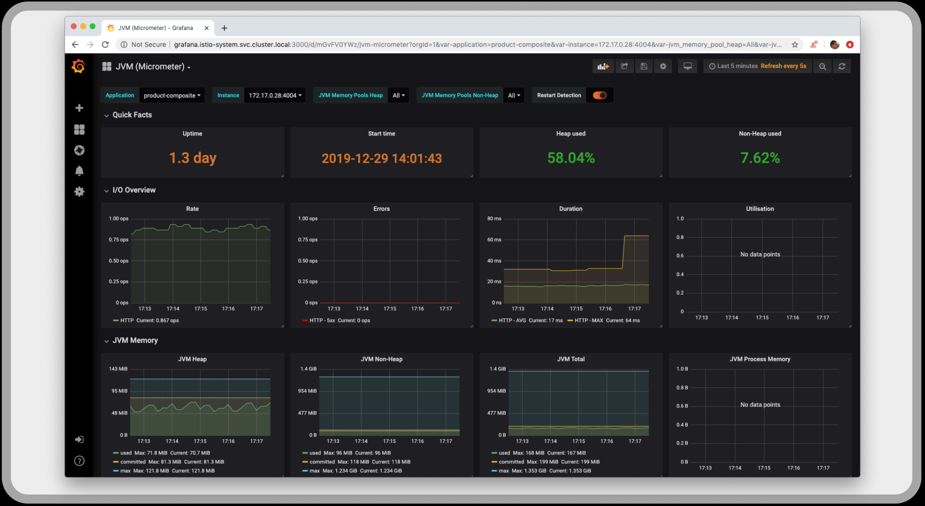

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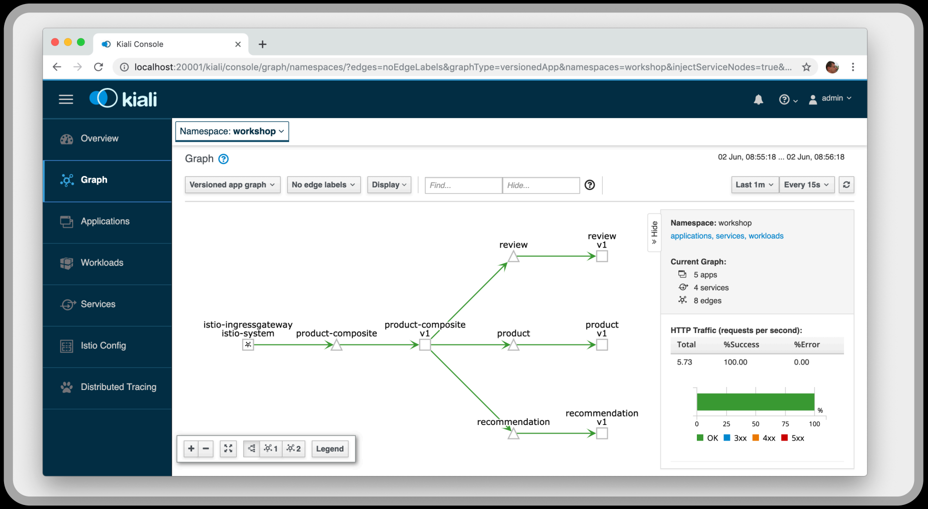

Total	%Success	%Error
5.73	100.00	0.00

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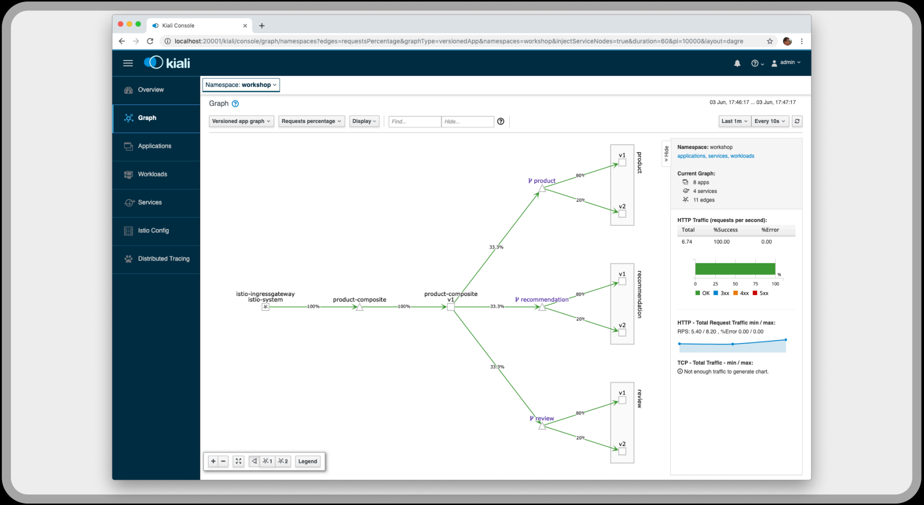

Namespace: workshop
applications, services, workloads

Current Graph:
8 apps
4 services
11 edges

HTTP Traffic (requests per second):

Total	%Success	%Error
6.74	100.00	0.00

HTTP - Total Request Traffic min / max:
RPS: 5.40 / 8.20 , %Error 0.00 / 0.00

TCP - Total Traffic - min / max:
Not enough traffic to generate chart.

TRAFFIC MANAGMENT
HOW TO CONTROL ROUTING?
- RATE LIMITING
- CANARY & BLUE/GREEN UPGRADES

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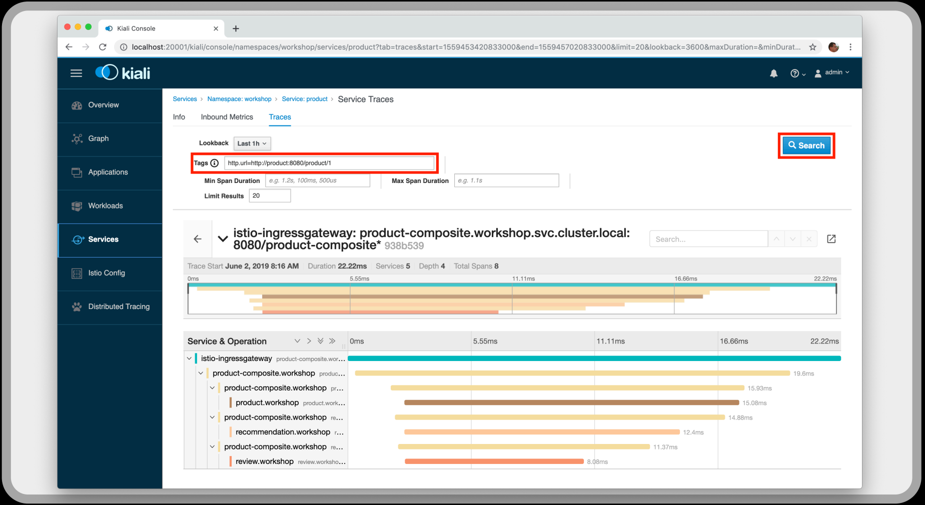
Kiali Console
localhost:20001/kiali/console/namespaces/workshop/services/product?tab=traces&start=1559453420833000&end=1559457020833000&limit=20&lookback=3600&maxDuration=&minDurat...
kiali
admin
Overview
Graph
Applications
Workloads
Services
Istio Config
Distributed Tracing
Services › Namespace: workshop › Service: product › Service Traces
Info
Inbound Metrics
Traces
Search

Lookback: Last 1h
Tags: http.url=http://product:8080/product/1
Min Span Duration: e.g. 1.2s, 100ms, 500us
Max Span Duration: e.g. 1.1s
Limit Results: 20

istio-ingressgateway: product-composite.workshop.svc.cluster.local:8080/product-composite* 938b539

Trace Start June 2, 2019 8:16 AM Duration 22.22ms Services 5 Depth 4 Total Spans 8

Service & Operation	Duration
istio-ingressgateway product-composite.wor...	
product-composite.workshop produc...	19.6ms
product-composite.workshop pr...	15.93ms
product.workshop product.work...	15.08ms
product-composite.workshop re...	14.88ms
recommendation.workshop r...	12.4ms
product-composite.workshop re...	11.37ms
review.workshop review.worksho...	8.08ms

DISTRIBUTED TRACING
WHO IS CALLING WHO?

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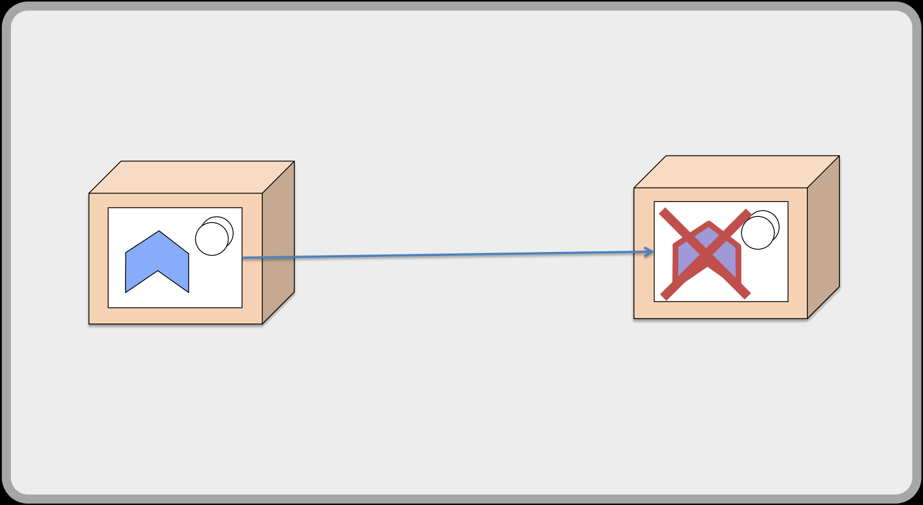

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REQUIRED CAPABILITIES!

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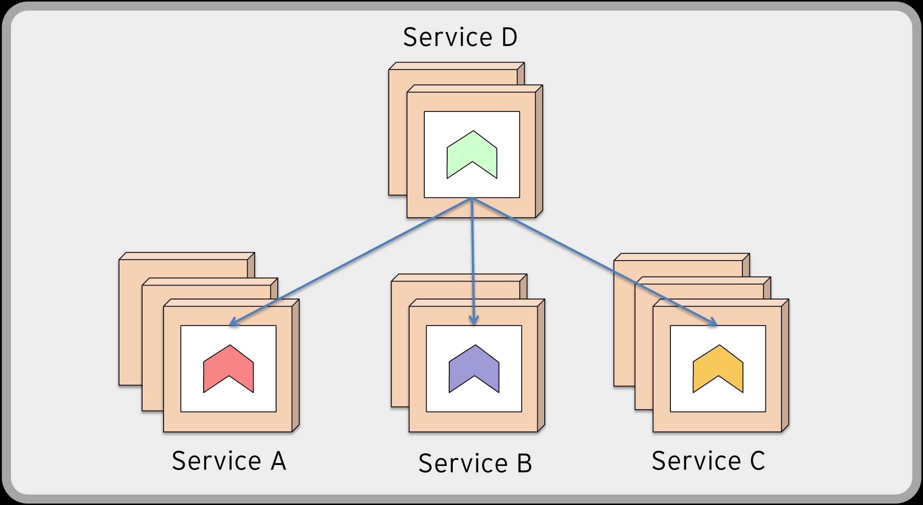

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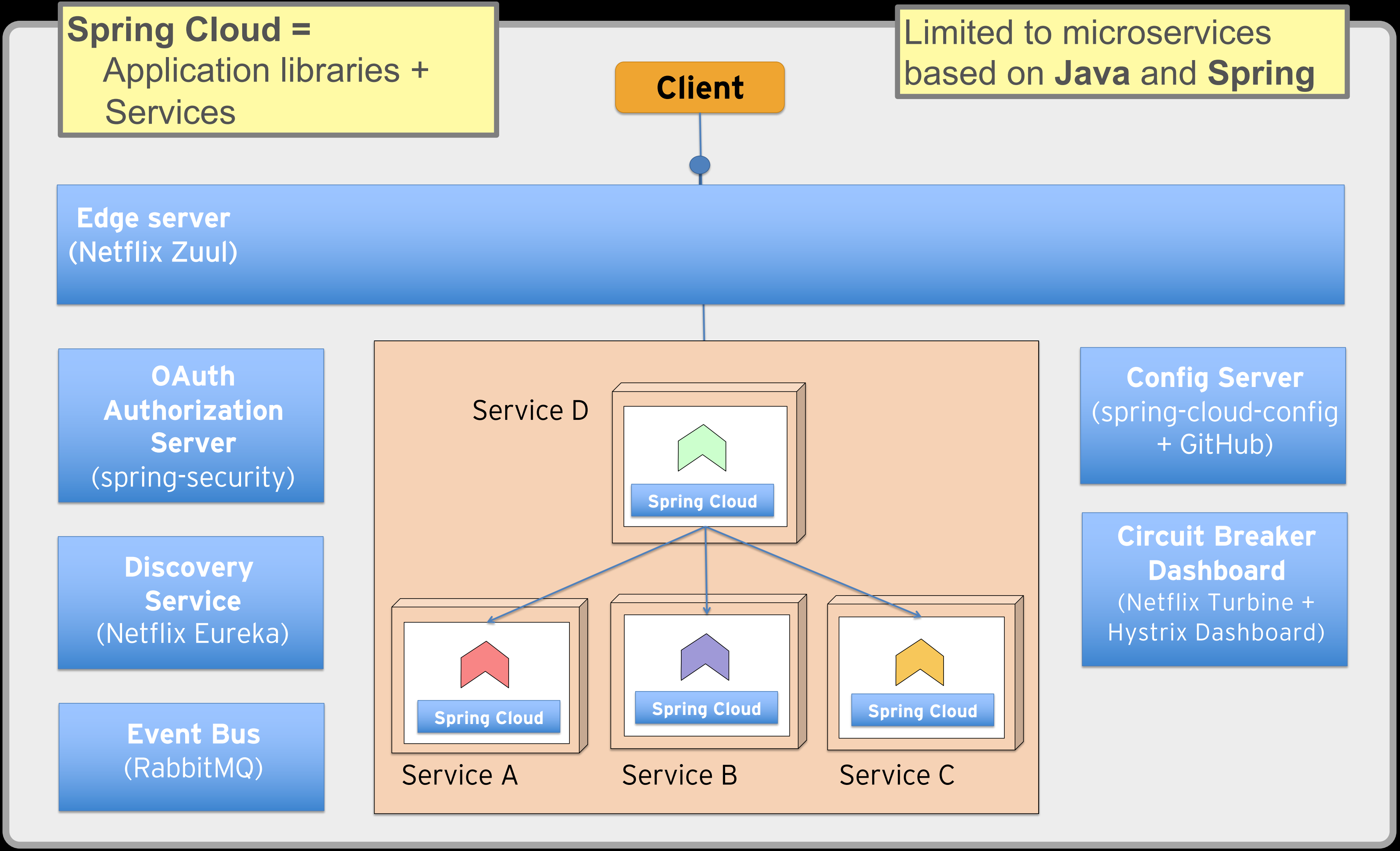
Spring Cloud =
Application libraries +
Services
Client
Limited to microservices
based on Java and Spring
Edge server
(Netflix Zuul)
OAuth
Authorization
Server
(spring-security)
Discovery
Service
(Netflix Eureka)
Event Bus
(RabbitMQ)
Service D
Spring Cloud
Spring Cloud
Spring Cloud
Spring Cloud
Service A
Service B
Service C
Config Server
(spring-cloud-config
+ GitHub)
Circuit Breaker
Dashboard
(Netflix Turbine +
Hystrix Dashboard)

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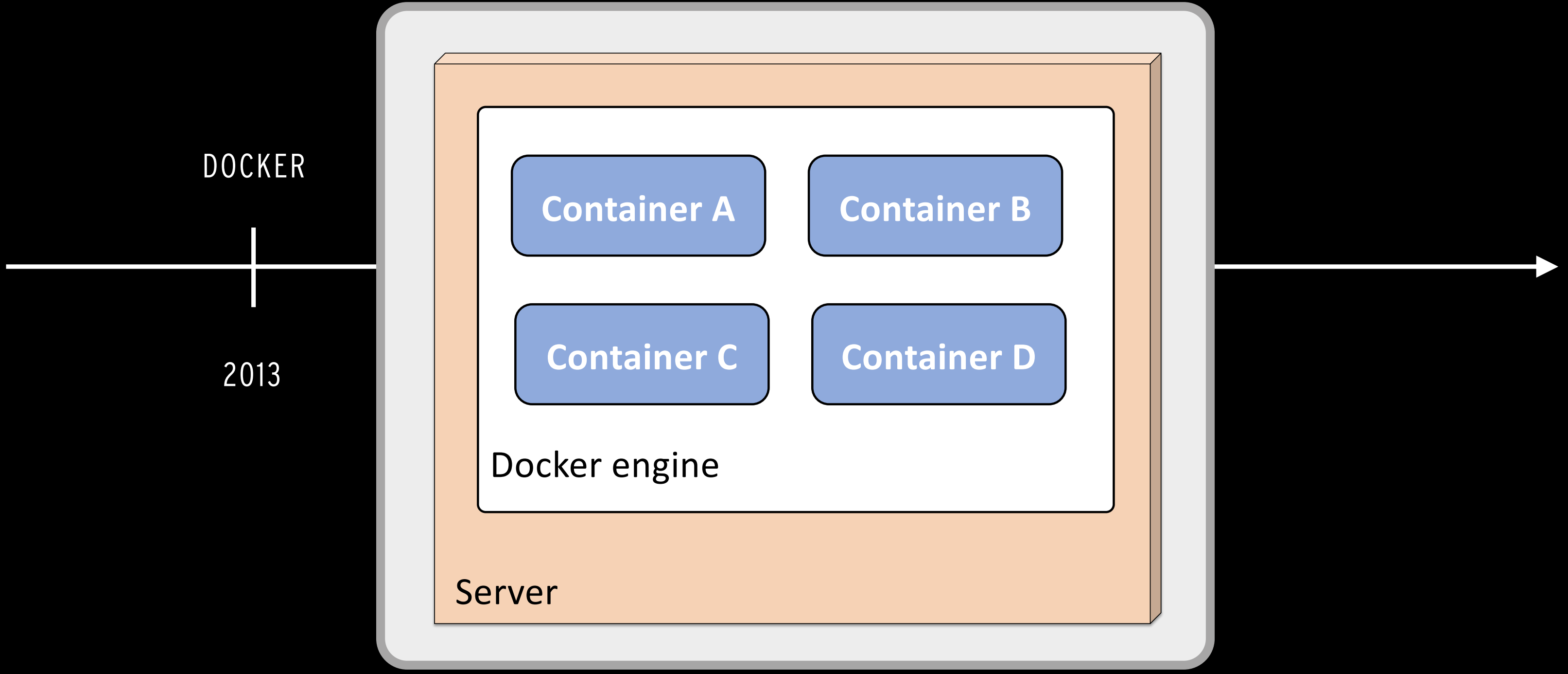
THE EVOLUTION



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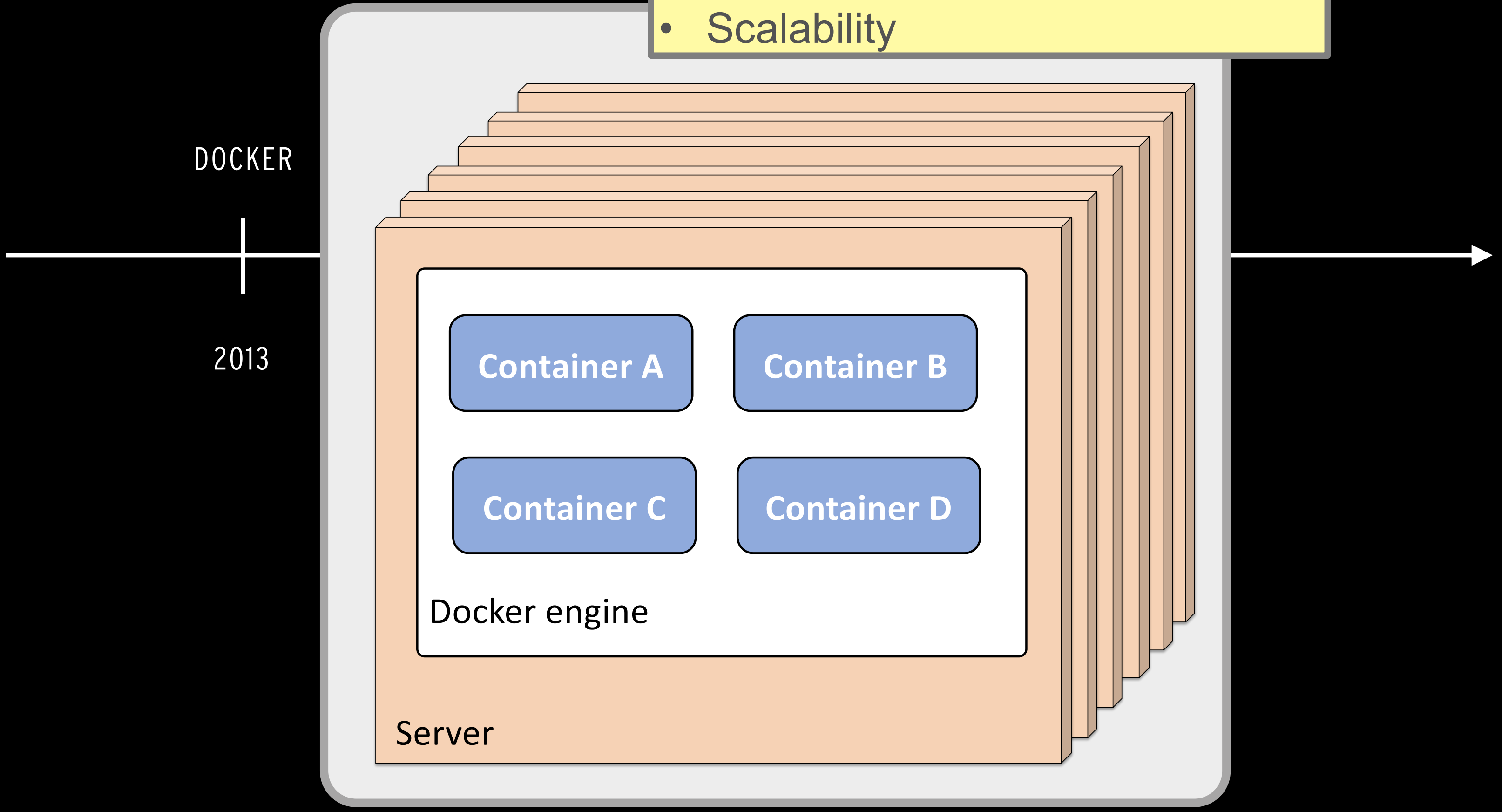
THE EVOLUTION

>1 server required in production

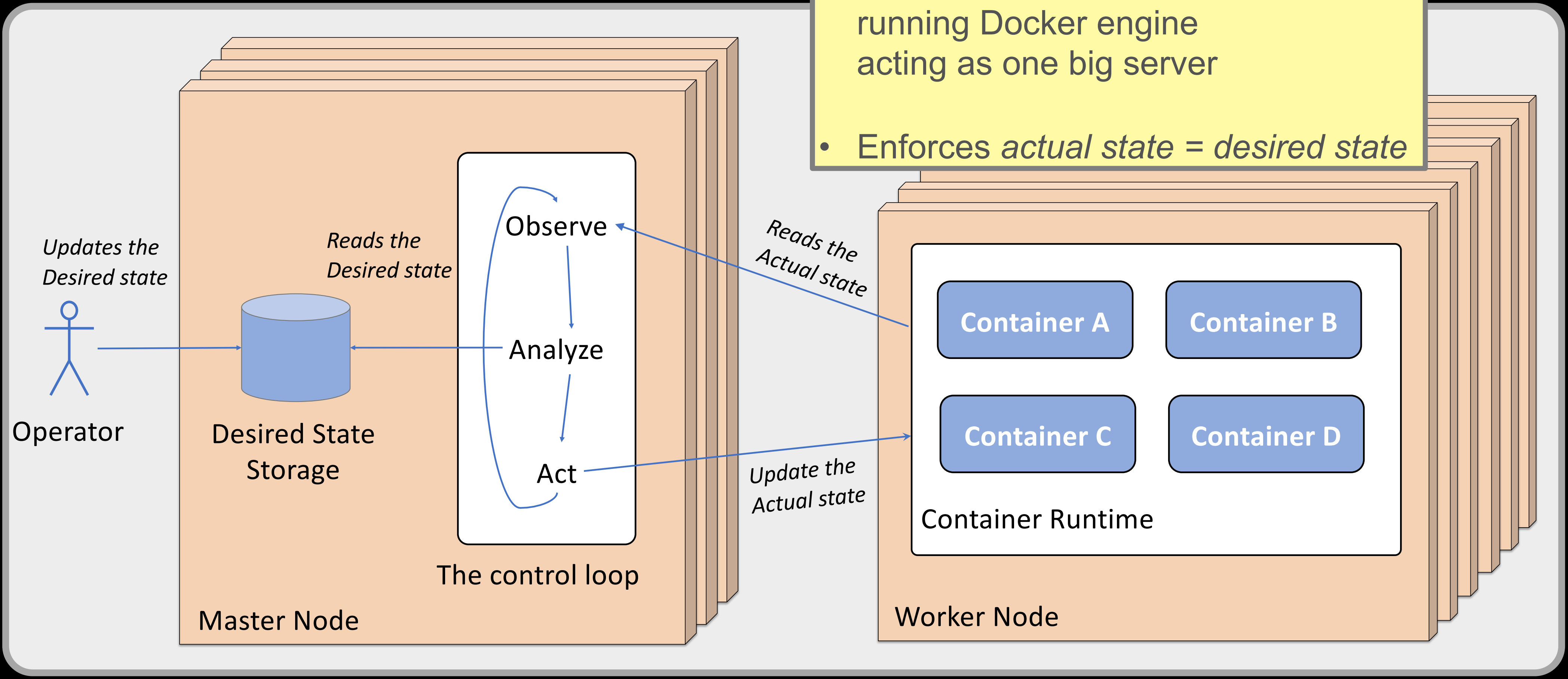
- High Availability
- Scalability



THE EVOLUTION

Kubernetes: A Container Orchestrator

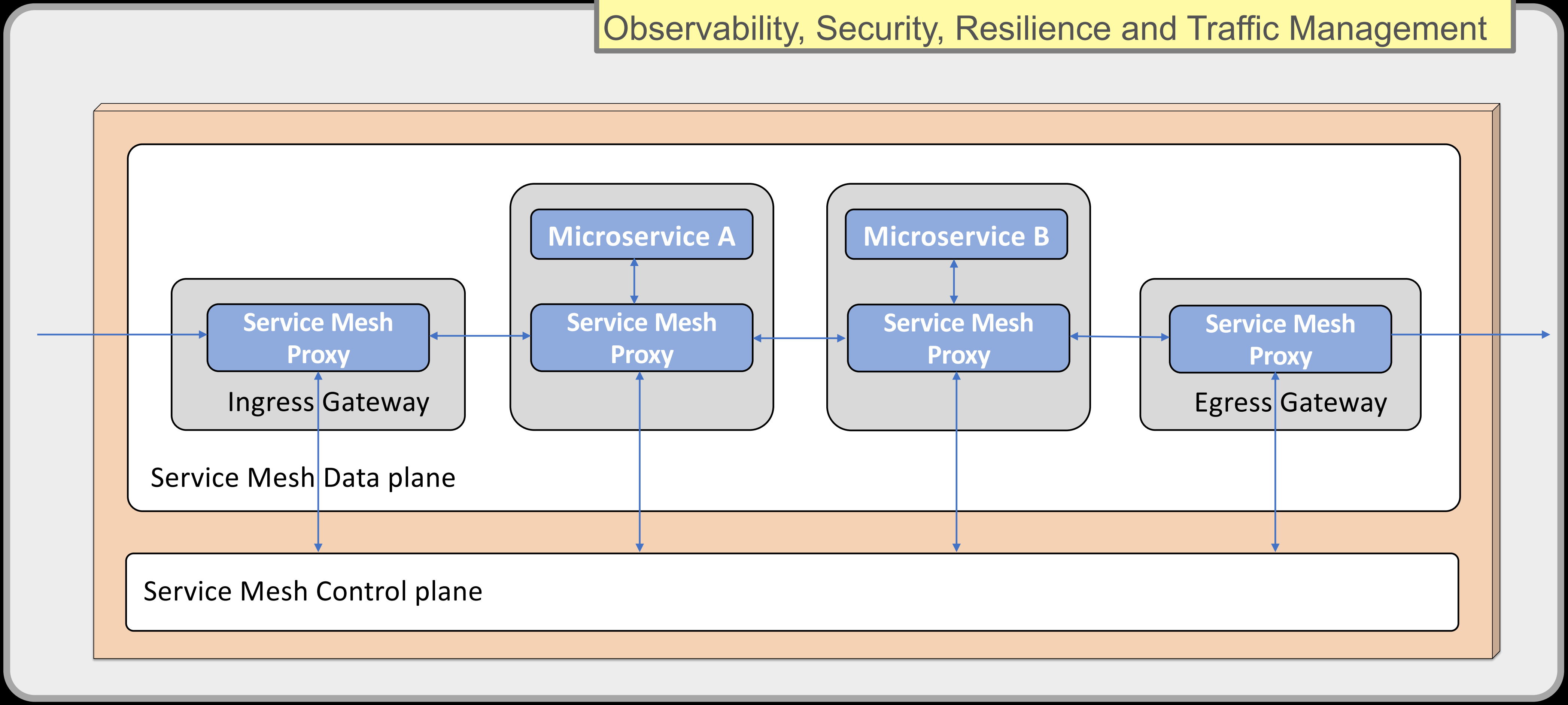
- A cluster of servers running Docker engine acting as one big server
- Enforces *actual state* = *desired state*



THE EVOLUTION

ISTIO: Service mesh

Observability, Security, Resilience and Traffic Management



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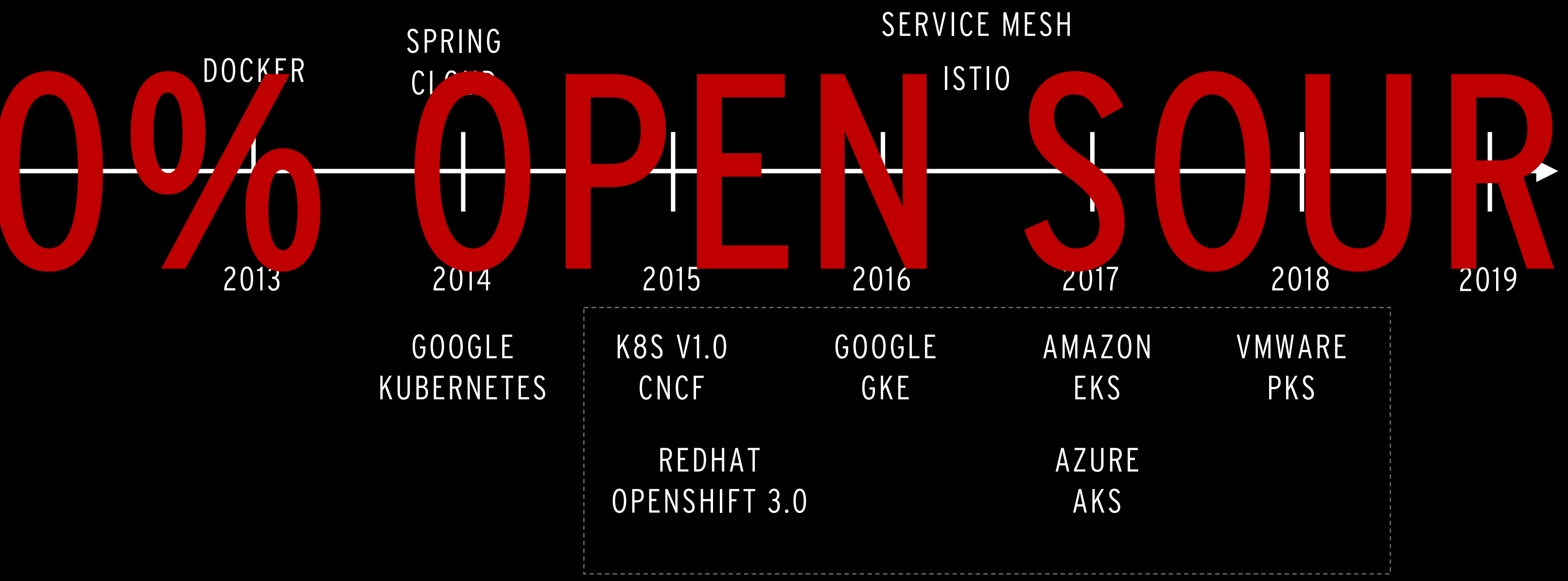

100% OPEN SOURCE

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CAPABILITY MAPPING

SPRING CLOUD

KUBERNETES

ISTIO

EFK

EDGE SERVER
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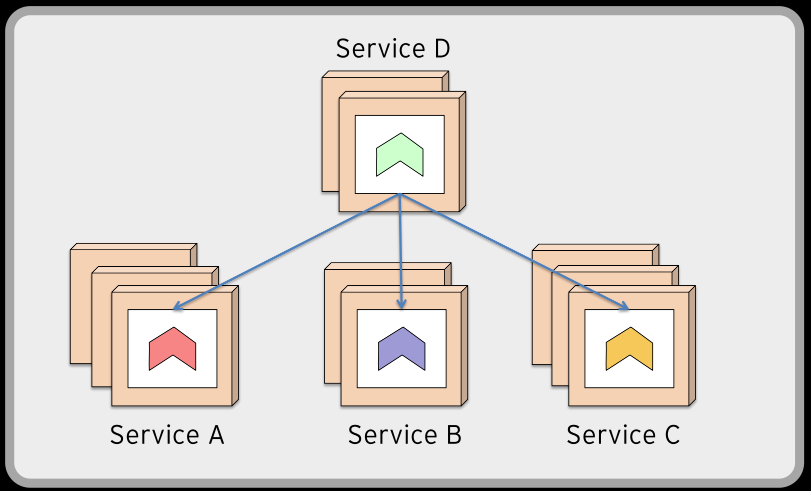

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OVERLAPS

Capability	Spring Cloud	Kubernetes	Istio
Service Discovery	X	X	
Central Configuration	X	X	
Edge Server	X	X	X
Distributed Tracing	X		X
Resilience	X		X

FEATURE COMPLETENESS, E.G. FOR AN EDGE SERVER

Feature	Spring Cloud Gateway	Kubernetes Ingress Controller	Istio Ingress Gateway
Security			
- OAuth 2.0 & OIDC	X	X	X
- Automated provisioning and renewal of certificates		X	X
Routing			
- URL path based	X	X	X
- Header based	X		X
Observability			X
Traffic Management			X

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OVERLAPS - HOW TO CHOOSE?

- Prefer platform over application library
  - Independence of microservice implementations
    - » E.g. language or frameworks

- Exceptions, i.e. use application library for

1. Managing trace ids in a microservice
   - » Setting inbound trace id on outbound requests
2. Resilience mechanisms, e.g. timeout, retry and circuit breakers
   - » Fine tuning often depends on business logic

   Note: Platform based resilience is much better than none at al…

OVERLAPS - SELECTIONS

Capability	Spring Cloud	Kubernetes	Istio
Service Discovery	X	**X**	
Central Configuration	X	**X**	
Edge Server	X	X	**X**
Distributed Tracing	**X**		**X**
Resilience	**X**		X

OVERLAPS - SELECTIONS

Capability	Spring Cloud	Kubernetes	Istio
Service Discovery	Netflix Eureka Spring Cloud Load Balancer	Kube Proxy & Service objects	
Central Configuration	Spring Cloud Config server	Config Maps & Secrets	
Edge Server	Spring Cloud Gateway	Ingress Controller	Ingress Gateway
Distributed Tracing	• Spring Cloud Sleuth • Zipkin		• Jaeger • Zipkin
Resilience	Resilience4J		Timeout, Retries & Outlier Detection

CAPABILITY MAPPING

SPRING CLOUD
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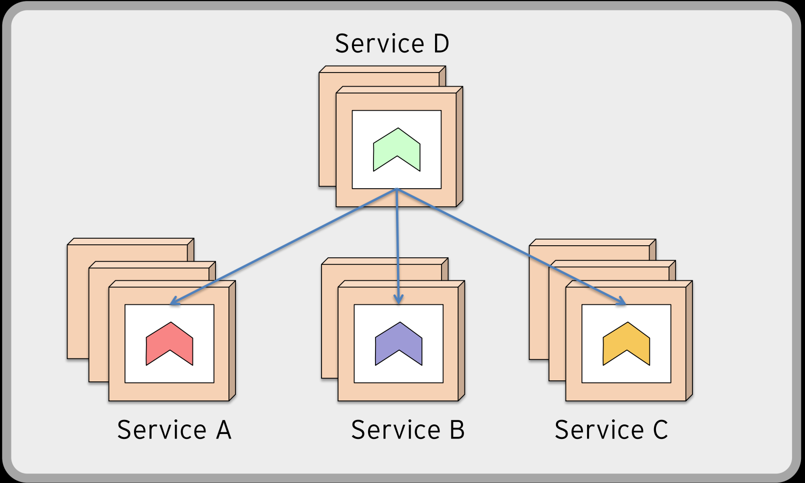

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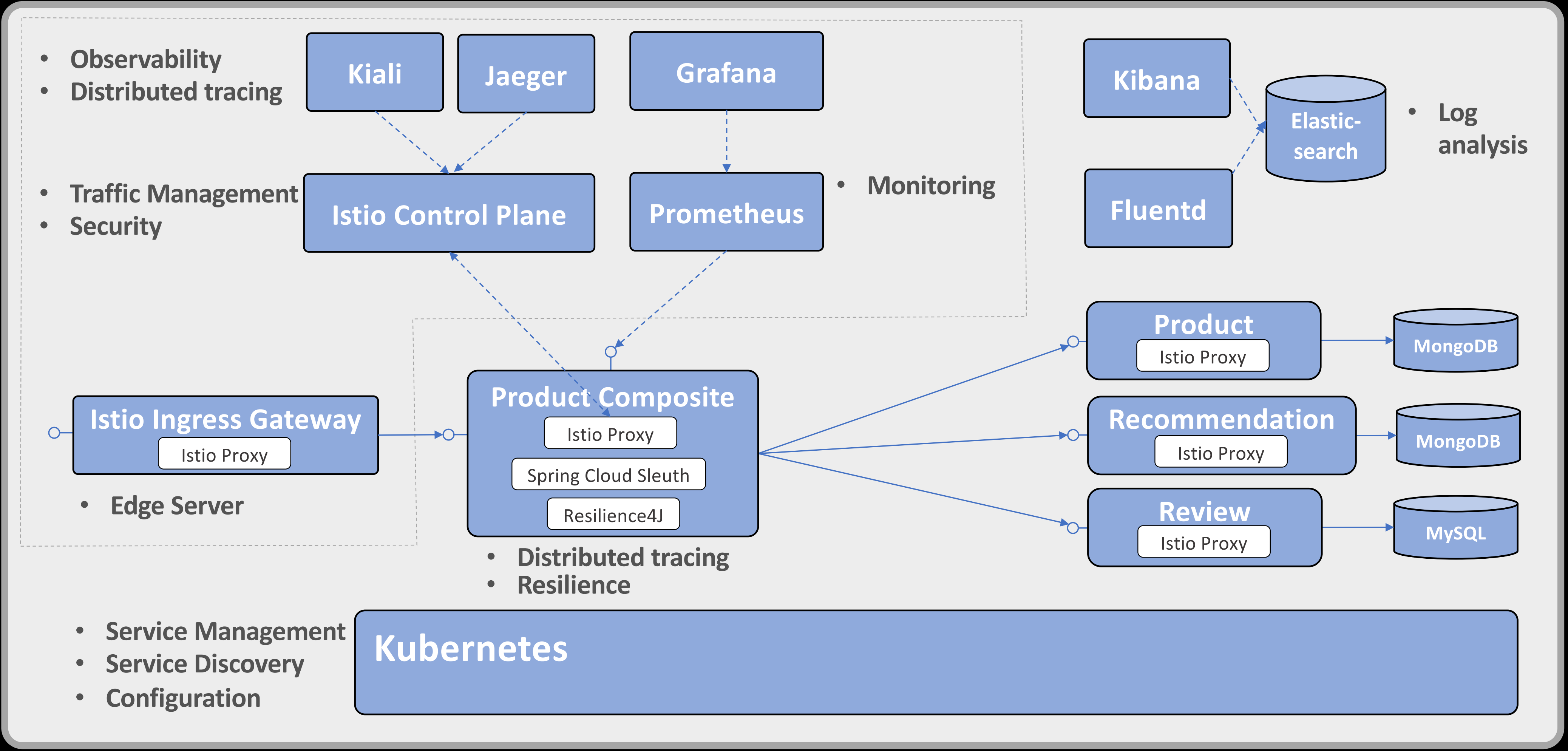

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- **Demo**
  - Observability
  - Logging
  - Tracing
  - Monitoring
  - Resilience
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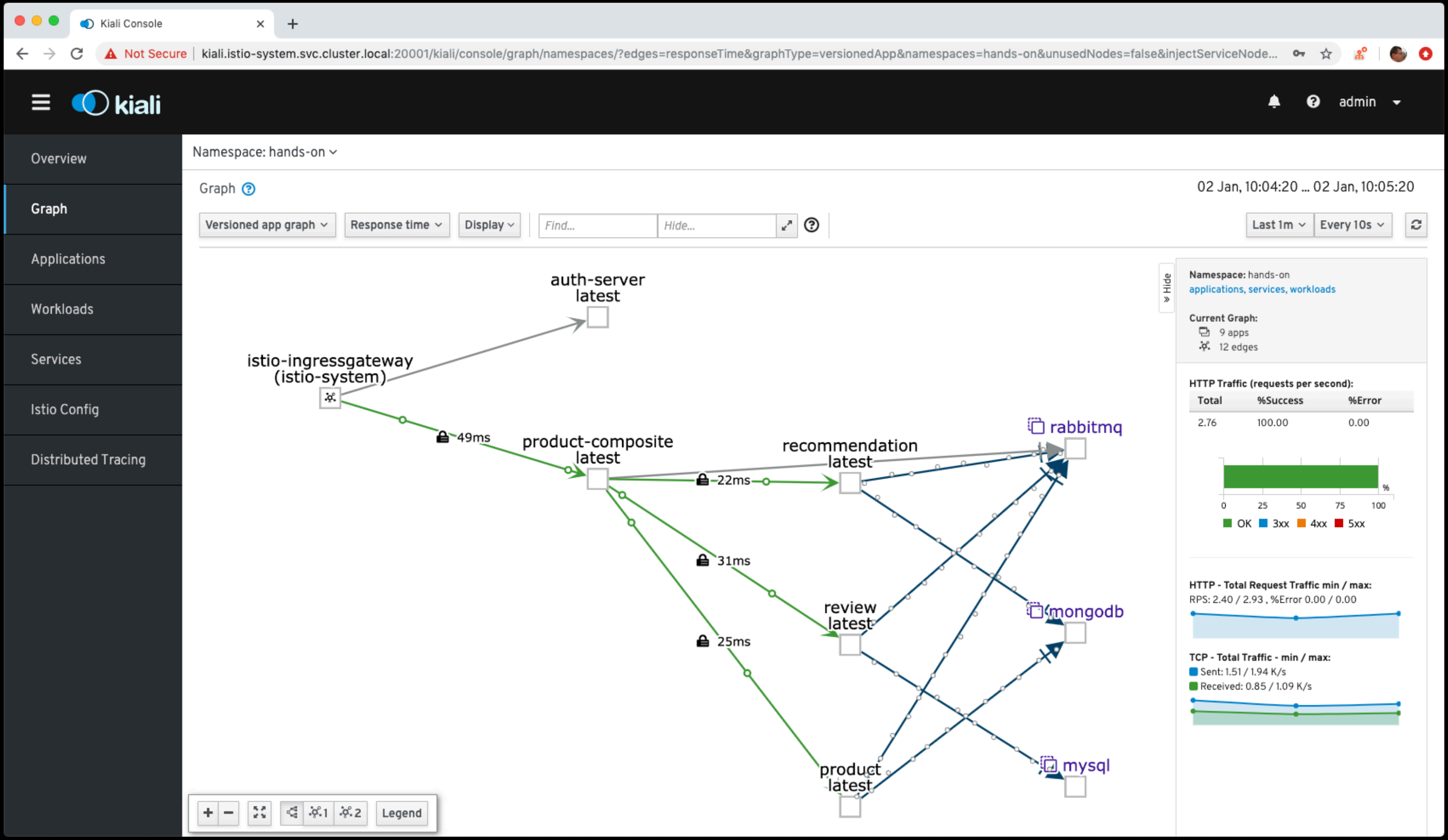
DEMO - OBSERVABILITY



Namespace: hands-on
applications, services, workloads

Current Graph:
9 apps
12 edges

HTTP Traffic (requests per second):

Total	%Success	%Error
2.76	100.00	0.00

🟩 OK 🟦 3xx 🟧 4xx 🟥 5xx

HTTP - Total Request Traffic min / max:
RPS: 2.40 / 2.93 , %Error 0.00 / 0.00

TCP - Total Traffic - min / max:
Sent: 1.51 / 1.94 K/s
Received: 0.85 / 1.09 K/s

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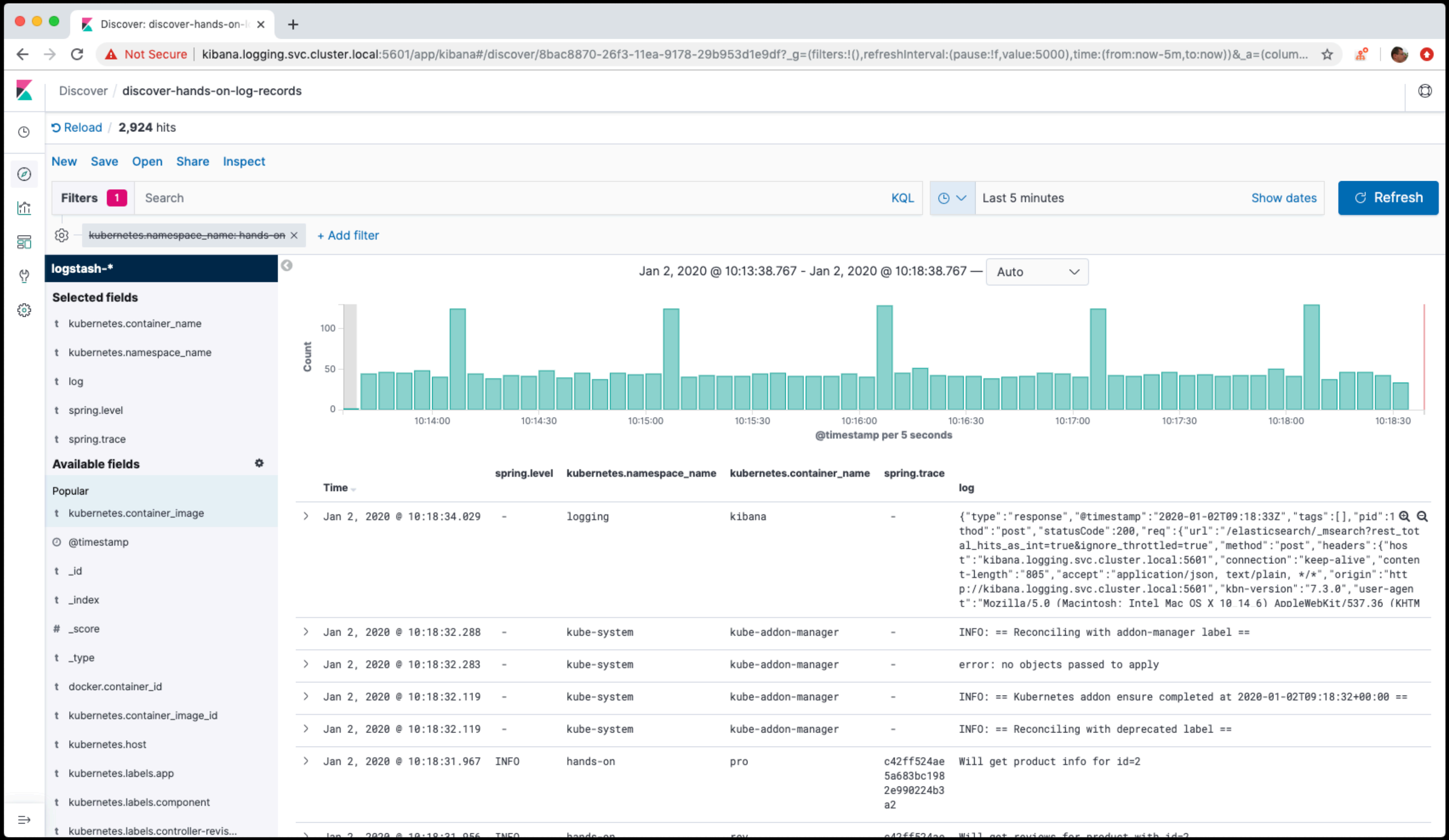
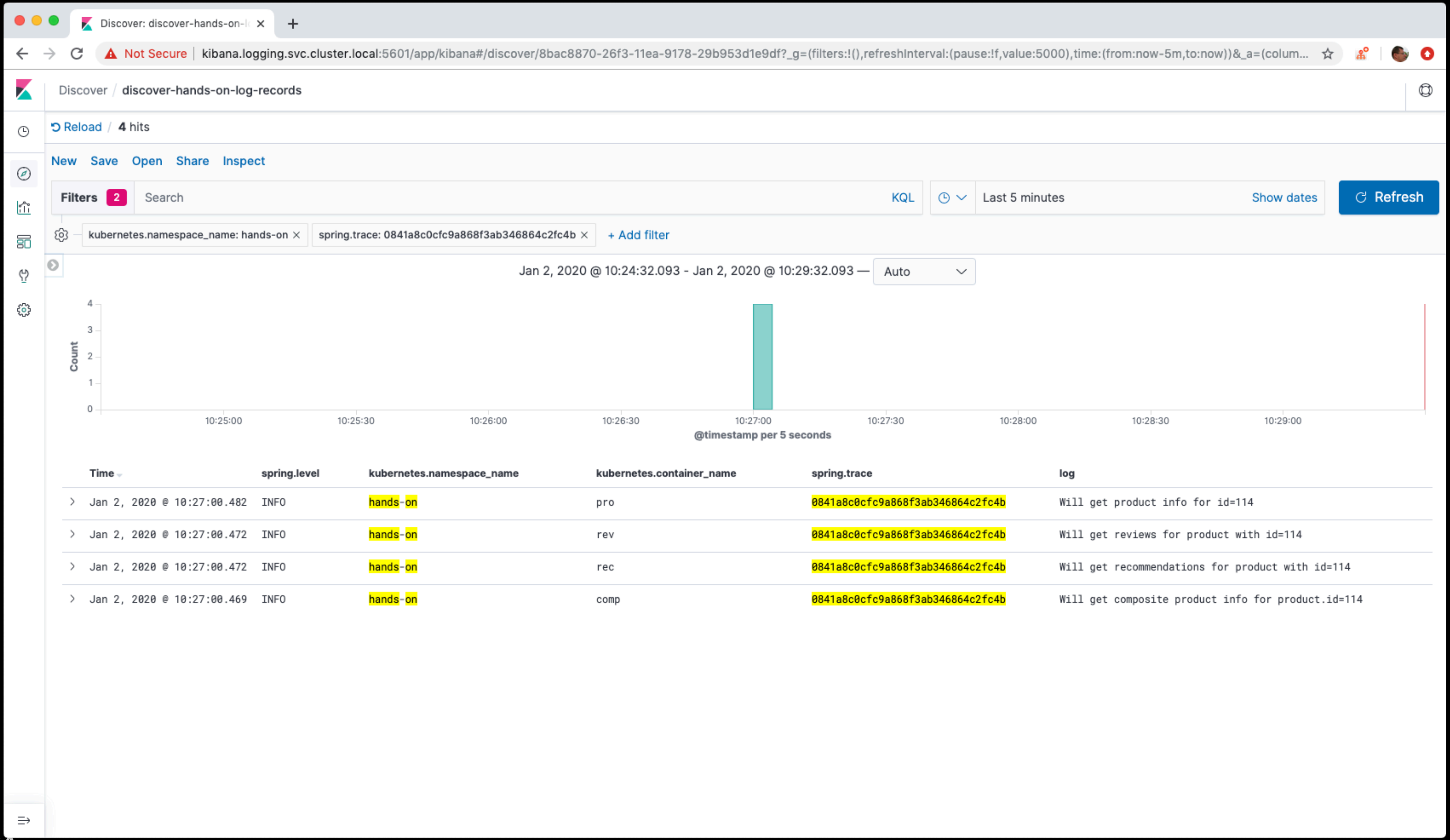
DEMO - CENTRALIZED LOGGING



Discover: discover-hands-on-l
Not Secure
kibana.logging.svc.cluster.local:5601/app/kibana#/discover/8bac8870-26f3-11ea-9178-29b953d1e9df?_g=(filters:!(),refreshInterval:(pause:!f,value:5000),time:(from:now-5m,to:now))&_a=(colum...
Discover / discover-hands-on-log-records
Reload / 2,924 hits
New Save Open Share Inspect
Filters 1
Search
KQL
Last 5 minutes
Show dates
Refresh
~~kubernetes.namespace_name: hands-on~~
+ Add filter
logstash-*
Selected fields
kubernetes.container_name
kubernetes.namespace_name
log
spring.level
spring.trace
Available fields
Popular
kubernetes.container_image
@timestamp
_id
_index
_score
_type
docker.container_id
kubernetes.container_image_id
kubernetes.host
kubernetes.labels.app
kubernetes.labels.component
kubernetes.labels.controller-revis...
Jan 2, 2020 @ 10:13:38.767 - Jan 2, 2020 @ 10:18:38.767 — Auto
Count
100
50
0
10:14:00
10:14:30
10:15:00
10:15:30
10:16:00
10:16:30
10:17:00
10:17:30
10:18:00
10:18:30
@timestamp per 5 seconds

```
  Time                        spring.level  kubernetes.namespace_name  kubernetes.container_name  spring.trace  log
> Jan 2, 2020 @ 10:18:34.029  -             logging                    kibana                     -             {"type":"response","@timestamp":"2020-01-02T09:18:33Z","tags":[],"pid":1
                                                                                                                thod":"post","statusCode":200,"req":{"url":"/elasticsearch/_msearch?rest_tot
                                                                                                                al_hits_as_int=true&ignore_throttled=true","method":"post","headers":{"hos
                                                                                                                t":"kibana.logging.svc.cluster.local:5601","connection":"keep-alive","conten
                                                                                                                t-length":"805","accept":"application/json, text/plain, */*","origin":"htt
                                                                                                                p://kibana.logging.svc.cluster.local:5601","kbn-version":"7.3.0","user-agen
                                                                                                                t":"Mozilla/5.0 (Macintosh; Intel Mac OS X 10_14_6) AppleWebKit/537.36 (KHTM
> Jan 2, 2020 @ 10:18:32.288  -             kube-system                kube-addon-manager         -             INFO: == Reconciling with addon-manager label ==
> Jan 2, 2020 @ 10:18:32.283  -             kube-system                kube-addon-manager         -             error: no objects passed to apply
> Jan 2, 2020 @ 10:18:32.119  -             kube-system                kube-addon-manager         -             INFO: == Kubernetes addon ensure completed at 2020-01-02T09:18:32+00:00 ==
> Jan 2, 2020 @ 10:18:32.119  -             kube-system                kube-addon-manager         -             INFO: == Reconciling with deprecated label ==
> Jan 2, 2020 @ 10:18:31.967  INFO          hands-on                   pro                        c42ff524ae    Will get product info for id=2
                                                                                                  5a683bc198
                                                                                                  2e990224b3
                                                                                                  a2
> Jan 2, 2020 @ 10:18:31.956  INFO          hands-on                   rev                        c42ff524ae    Will get reviews for product with id=2
```

DEMO - CENTRALIZED LOGGING



kibana.logging.svc.cluster.local:5601/app/kibana#/discover/8bac8870-26f3-11ea-9178-29b953d1e9df?_g=(filters:!(),refreshInterval:(pause:!f,value:5000),time:(from:now-5m,to:now))&_a=(colum...

kubernetes.namespace_name: hands-on

spring.trace: 0841a8c0cfc9a868f3ab346864c2fc4b

Jan 2, 2020 @ 10:24:32.093 - Jan 2, 2020 @ 10:29:32.093 —

Time	spring.level	kubernetes.namespace_name	kubernetes.container_name	spring.trace	log
Jan 2, 2020 @ 10:27:00.482	INFO	hands-on	pro	0841a8c0cfc9a868f3ab346864c2fc4b	Will get product info for id=114
Jan 2, 2020 @ 10:27:00.472	INFO	hands-on	rev	0841a8c0cfc9a868f3ab346864c2fc4b	Will get reviews for product with id=114
Jan 2, 2020 @ 10:27:00.472	INFO	hands-on	rec	0841a8c0cfc9a868f3ab346864c2fc4b	Will get recommendations for product with id=114
Jan 2, 2020 @ 10:27:00.469	INFO	hands-on	comp	0841a8c0cfc9a868f3ab346864c2fc4b	Will get composite product info for product.id=114

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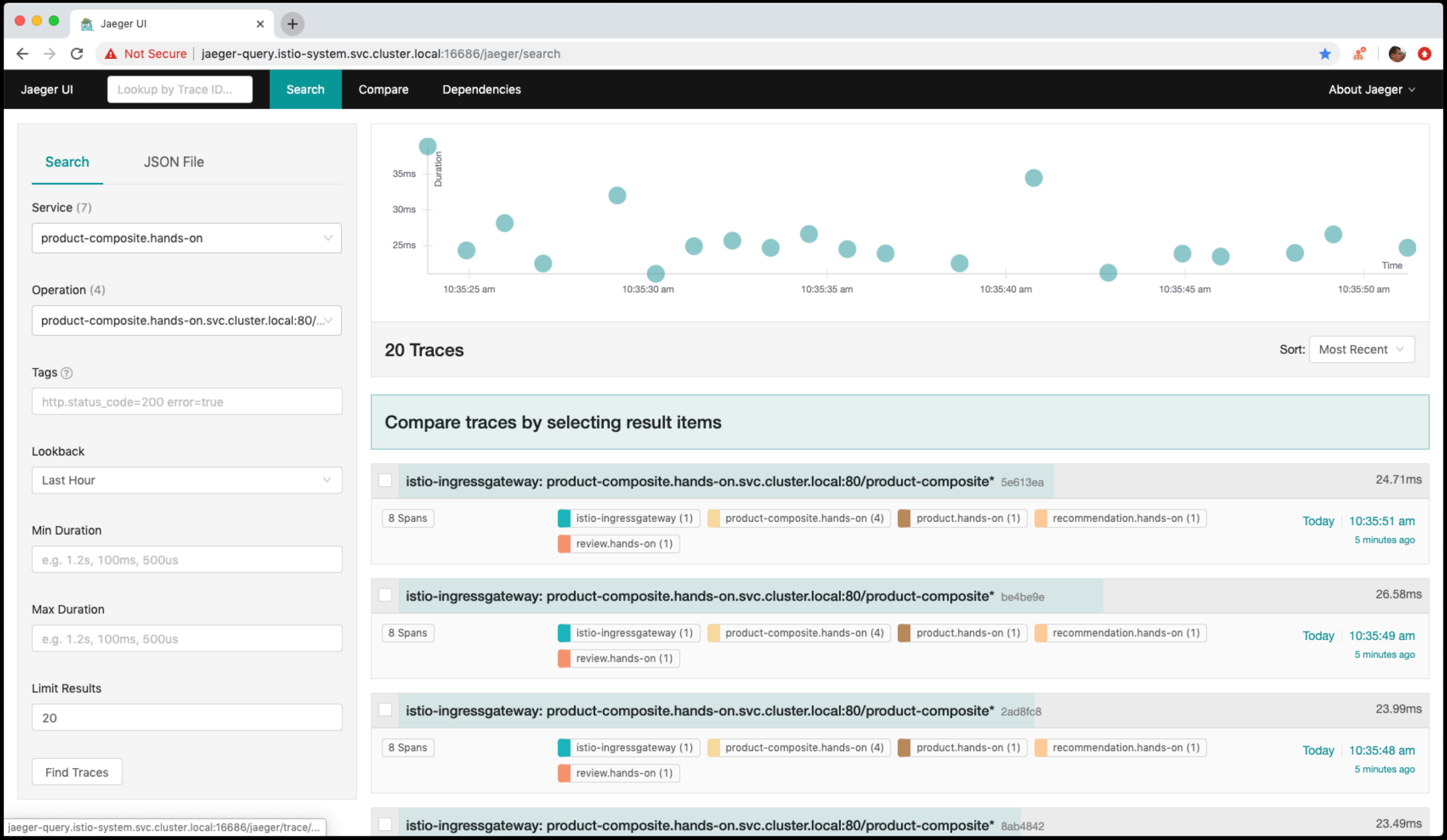
DEMO - DISTRIBUTED TRACING



Service (7): product-composite.hands-on

Operation (4): product-composite.hands-on.svc.cluster.local:80/...

Tags: http.status_code=200 error=true

Lookback: Last Hour

Min Duration: e.g. 1.2s, 100ms, 500us

Max Duration: e.g. 1.2s, 100ms, 500us

Limit Results: 20

Find Traces

20 Traces — Sort: Most Recent

Compare traces by selecting result items

istio-ingressgateway: product-composite.hands-on.svc.cluster.local:80/product-composite* 5e613ea — 24.71ms
8 Spans — istio-ingressgateway (1), product-composite.hands-on (4), product.hands-on (1), recommendation.hands-on (1), review.hands-on (1) — Today | 10:35:51 am, 5 minutes ago

istio-ingressgateway: product-composite.hands-on.svc.cluster.local:80/product-composite* be4be9e — 26.58ms
8 Spans — istio-ingressgateway (1), product-composite.hands-on (4), product.hands-on (1), recommendation.hands-on (1), review.hands-on (1) — Today | 10:35:49 am, 5 minutes ago

istio-ingressgateway: product-composite.hands-on.svc.cluster.local:80/product-composite* 2ad8fc8 — 23.99ms
8 Spans — istio-ingressgateway (1), product-composite.hands-on (4), product.hands-on (1), recommendation.hands-on (1), review.hands-on (1) — Today | 10:35:48 am, 5 minutes ago

istio-ingressgateway: product-composite.hands-on.svc.cluster.local:80/product-composite* 8ab4842 — 23.49ms

jaeger-query.istio-system.svc.cluster.local:16686/jaeger/trace/...

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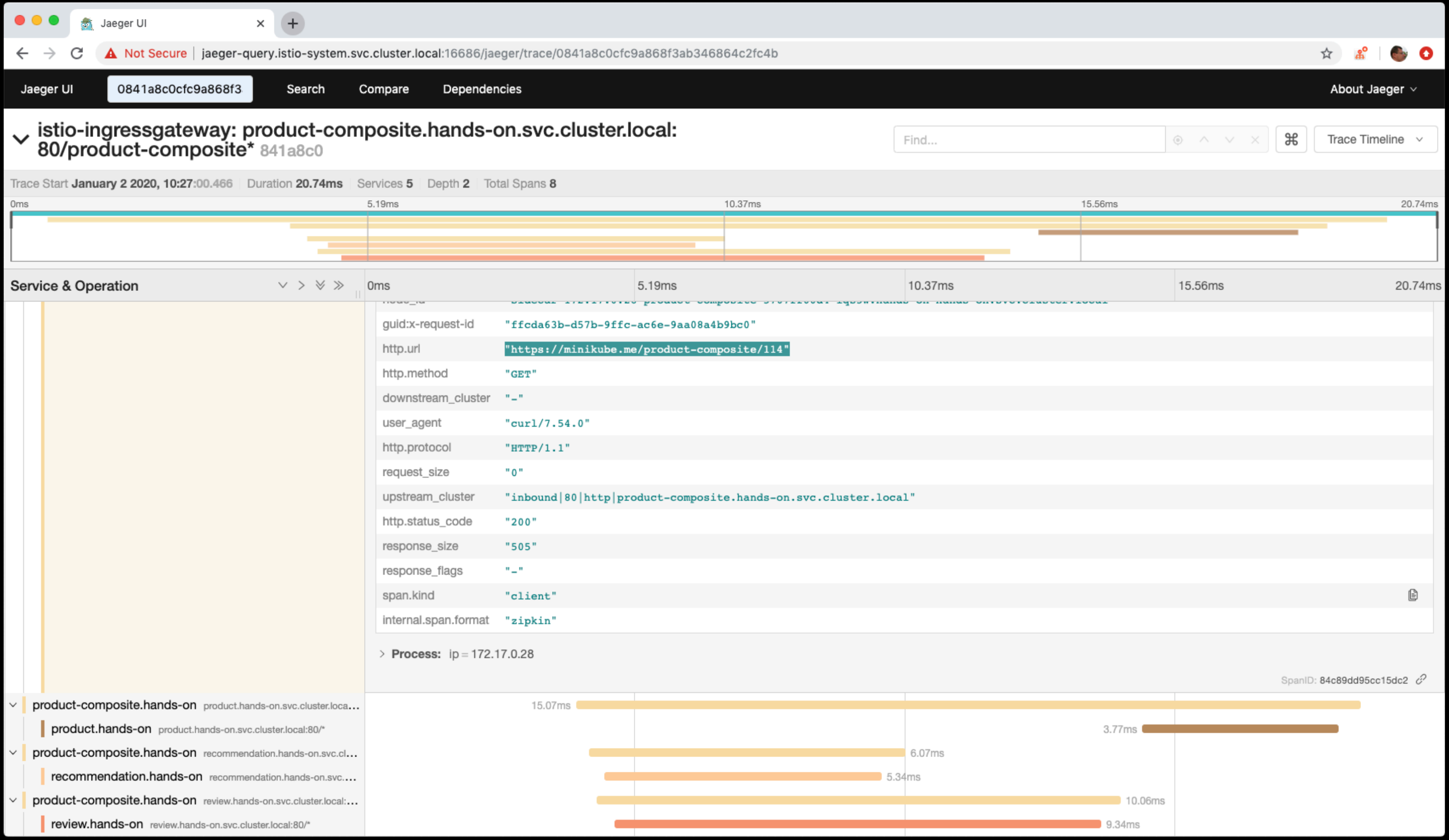
DEMO - DISTRIBUTED TRACING



Jaeger UI

Not Secure | jaeger-query.istio-system.svc.cluster.local:16686/jaeger/trace/0841a8c0cfc9a868f3ab346864c2fc4b

Jaeger UI | 0841a8c0cfc9a868f3 | Search | Compare | Dependencies | About Jaeger

istio-ingressgateway: product-composite.hands-on.svc.cluster.local:80/product-composite* 841a8c0

Find... | Trace Timeline

Trace Start **January 2 2020, 10:27**:00.466 | Duration **20.74ms** | Services **5** | Depth **2** | Total Spans **8**

0ms | 5.19ms | 10.37ms | 15.56ms | 20.74ms

Service & Operation | 0ms | 5.19ms | 10.37ms | 15.56ms | 20.74ms

guid:x-request-id	"ffcda63b-d57b-9ffc-ac6e-9aa08a4b9bc0"
http.url	"https://minikube.me/product-composite/114"
http.method	"GET"
downstream_cluster	"-"
user_agent	"curl/7.54.0"
http.protocol	"HTTP/1.1"
request_size	"0"
upstream_cluster	"inbound|80|http|product-composite.hands-on.svc.cluster.local"
http.status_code	"200"
response_size	"505"
response_flags	"-"
span.kind	"client"
internal.span.format	"zipkin"

Process: ip = 172.17.0.28

SpanID: 84c89dd95cc15dc2

product-composite.hands-on product.hands-on.svc.cluster.loca...	15.07ms
product.hands-on product.hands-on.svc.cluster.local:80/*	3.77ms
product-composite.hands-on recommendation.hands-on.svc.cl...	6.07ms
recommendation.hands-on recommendation.hands-on.svc....	5.34ms
product-composite.hands-on review.hands-on.svc.cluster.local:...	10.06ms
review.hands-on review.hands-on.svc.cluster.local:80/*	9.34ms

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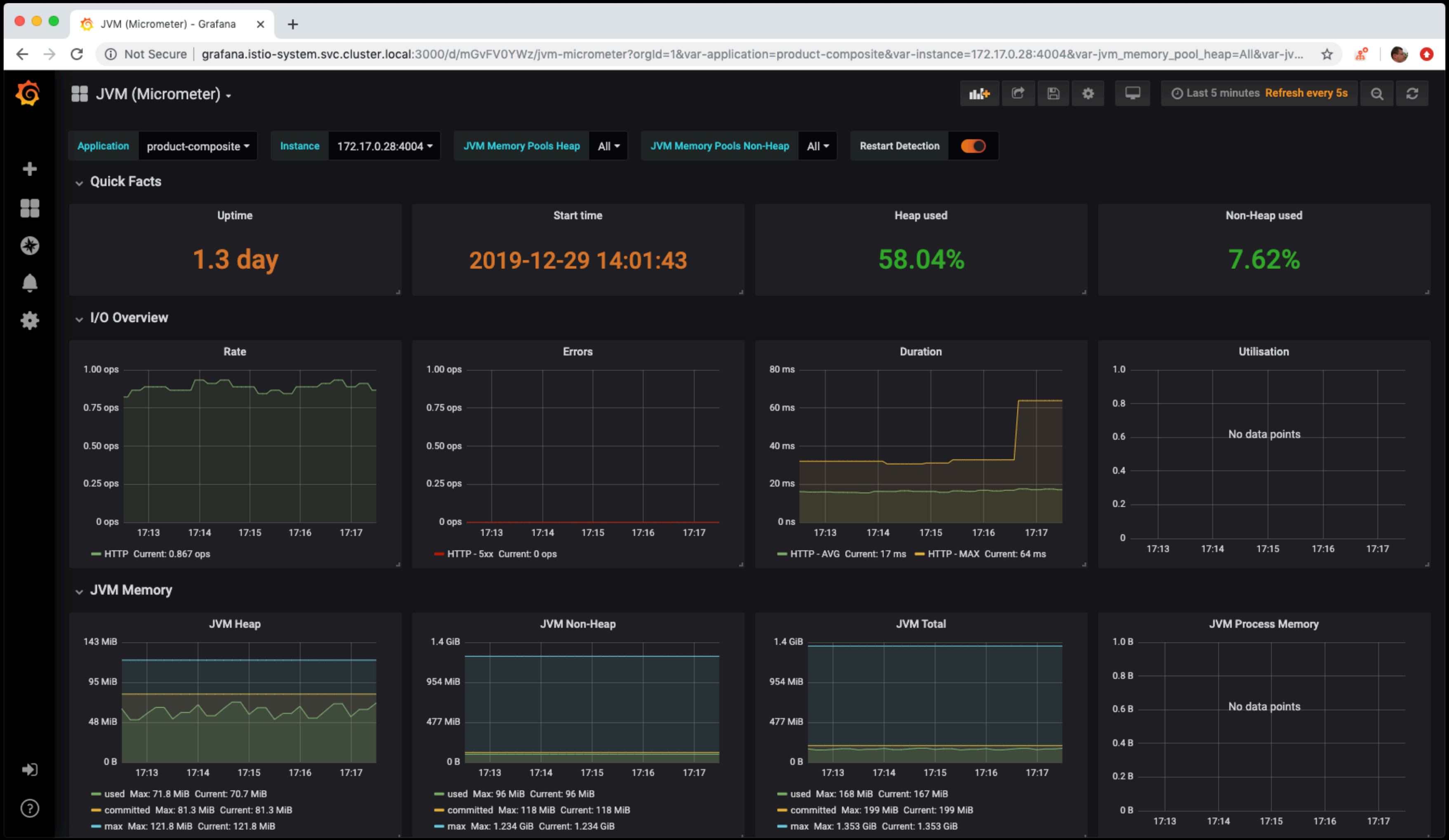
DEMO - MONITORING



JVM (Micrometer) - Grafana
Not Secure | grafana.istio-system.svc.cluster.local:3000/d/mGvFV0YWz/jvm-micrometer?orgId=1&var-application=product-composite&var-instance=172.17.0.28:4004&var-jvm_memory_pool_heap=All&var-jv...
JVM (Micrometer)
Last 5 minutes Refresh every 5s
Application product-composite
Instance 172.17.0.28:4004
JVM Memory Pools Heap All
JVM Memory Pools Non-Heap All
Restart Detection
Quick Facts
Uptime 1.3 day
Start time 2019-12-29 14:01:43
Heap used 58.04%
Non-Heap used 7.62%
I/O Overview
Rate
Errors
Duration
Utilisation
No data points
HTTP Current: 0.867 ops
HTTP - 5xx Current: 0 ops
HTTP - AVG Current: 17 ms
HTTP - MAX Current: 64 ms
JVM Memory
JVM Heap
JVM Non-Heap
JVM Total
JVM Process Memory
No data points
used Max: 71.8 MiB Current: 70.7 MiB
committed Max: 81.3 MiB Current: 81.3 MiB
max Max: 121.8 MiB Current: 121.8 MiB
used Max: 96 MiB Current: 96 MiB
committed Max: 118 MiB Current: 118 MiB
max Max: 1.234 GiB Current: 1.234 GiB
used Max: 168 MiB Current: 167 MiB
committed Max: 199 MiB Current: 199 MiB
max Max: 1.353 GiB Current: 1.353 GiB

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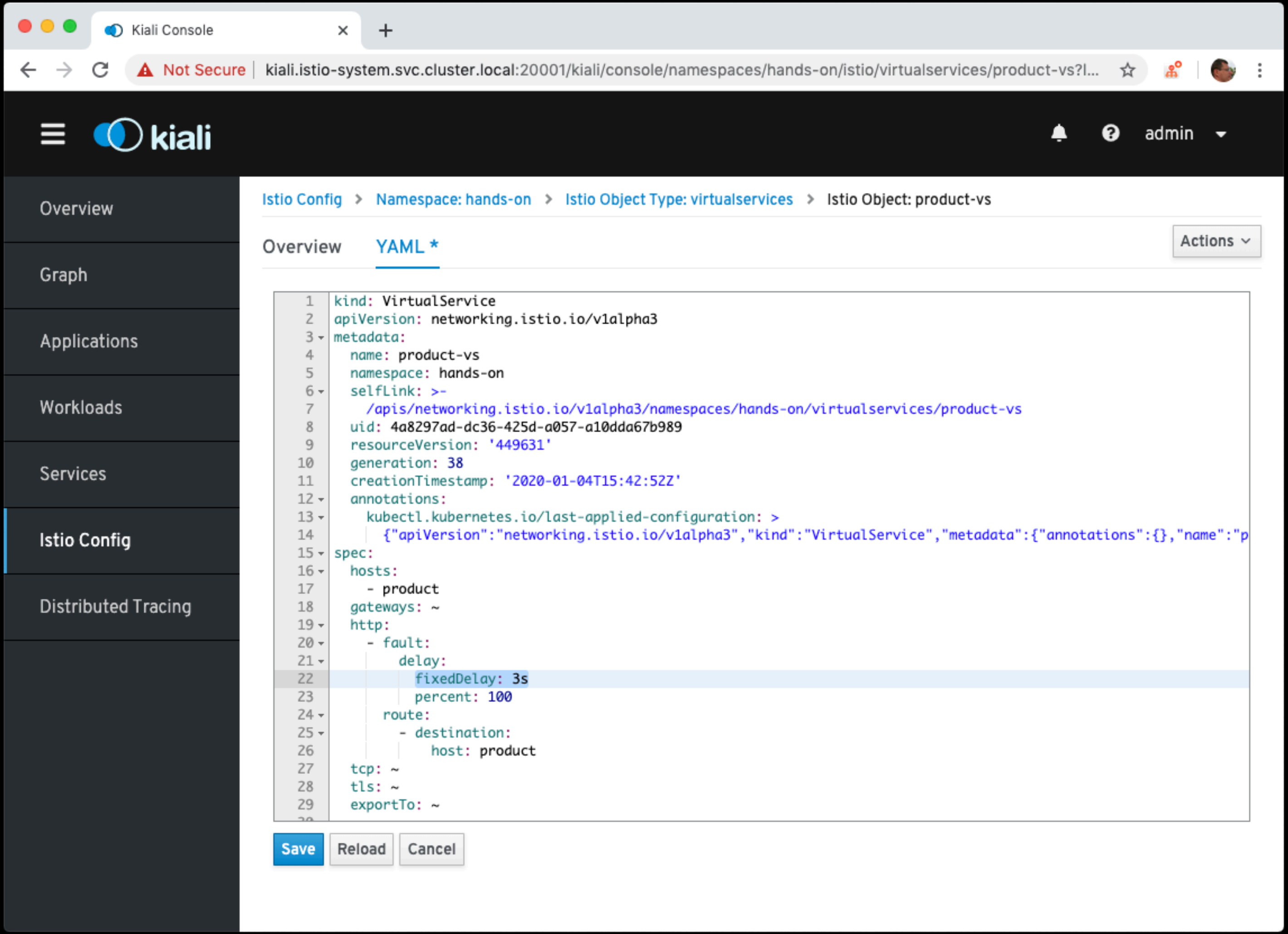
DEMO - RESILIENCE



Kiali Console
Not Secure
kiali.istio-system.svc.cluster.local:20001/kiali/console/namespaces/hands-on/istio/virtualservices/product-vs?l...
kiali
admin
Overview
Graph
Applications
Workloads
Services
Istio Config
Distributed Tracing
Istio Config > Namespace: hands-on > Istio Object Type: virtualservices > Istio Object: product-vs
Overview
YAML *
Actions
Save
Reload
Cancel

```yaml
kind: VirtualService
apiVersion: networking.istio.io/v1alpha3
metadata:
  name: product-vs
  namespace: hands-on
  selfLink: >-
    /apis/networking.istio.io/v1alpha3/namespaces/hands-on/virtualservices/product-vs
  uid: 4a8297ad-dc36-425d-a057-a10dda67b989
  resourceVersion: '449631'
  generation: 38
  creationTimestamp: '2020-01-04T15:42:52Z'
  annotations:
    kubectl.kubernetes.io/last-applied-configuration: >
      {"apiVersion":"networking.istio.io/v1alpha3","kind":"VirtualService","metadata":{"annotations":{},"name":"p
spec:
  hosts:
    - product
  gateways: ~
  http:
    - fault:
        delay:
          fixedDelay: 3s
          percent: 100
      route:
        - destination:
            host: product
  tcp: ~
  tls: ~
  exportTo: ~
```

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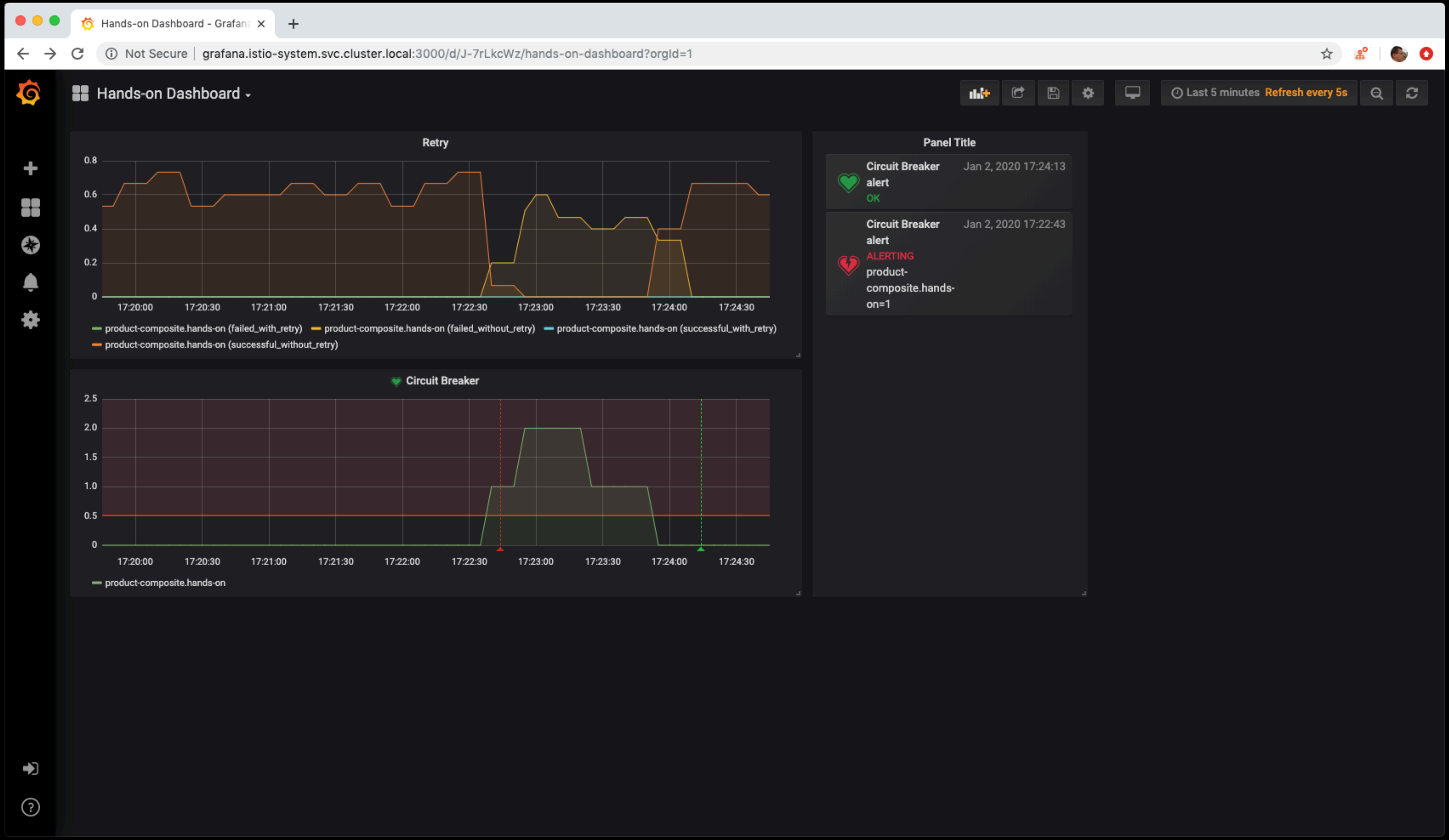
DEMO - RESILIENCE


Hands-on Dashboard - Grafana
Not Secure
grafana.istio-system.svc.cluster.local:3000/d/J-7rLkcWz/hands-on-dashboard?orgId=1
Hands-on Dashboard
Last 5 minutes Refresh every 5s
Retry
Circuit Breaker
product-composite.hands-on (failed_with_retry)
product-composite.hands-on (failed_without_retry)
product-composite.hands-on (successful_with_retry)
product-composite.hands-on (successful_without_retry)
product-composite.hands-on

Panel Title

Circuit Breaker alert OK — Jan 2, 2020 17:24:13

Circuit Breaker alert ALERTING product-composite.hands-on=1 — Jan 2, 2020 17:22:43

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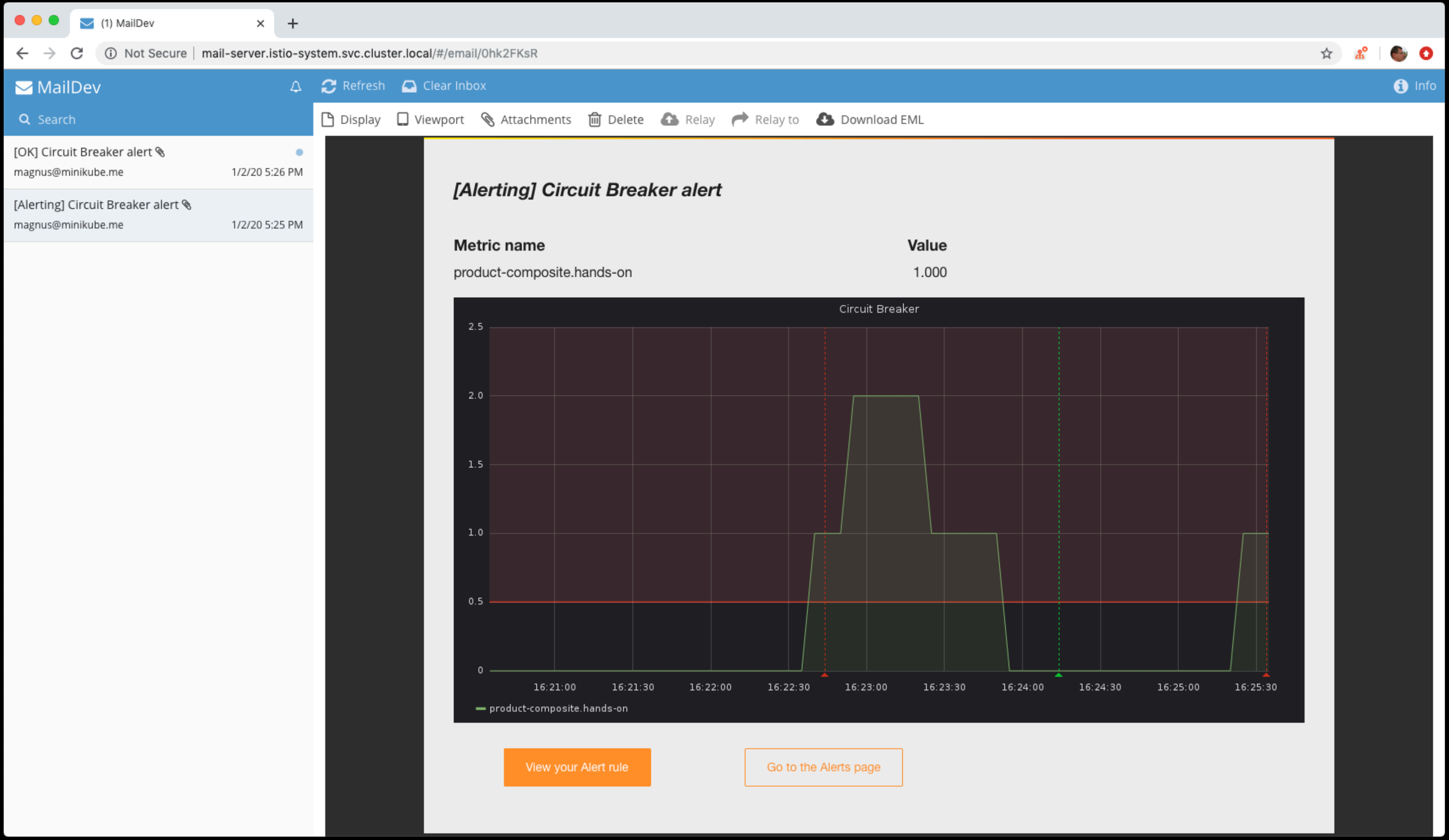
DEMO - RESILIENCE



[OK] Circuit Breaker alert
magnus@minikube.me 1/2/20 5:26 PM

[Alerting] Circuit Breaker alert
magnus@minikube.me 1/2/20 5:25 PM

[Alerting] Circuit Breaker alert

Metric name	Value
product-composite.hands-on	1.000

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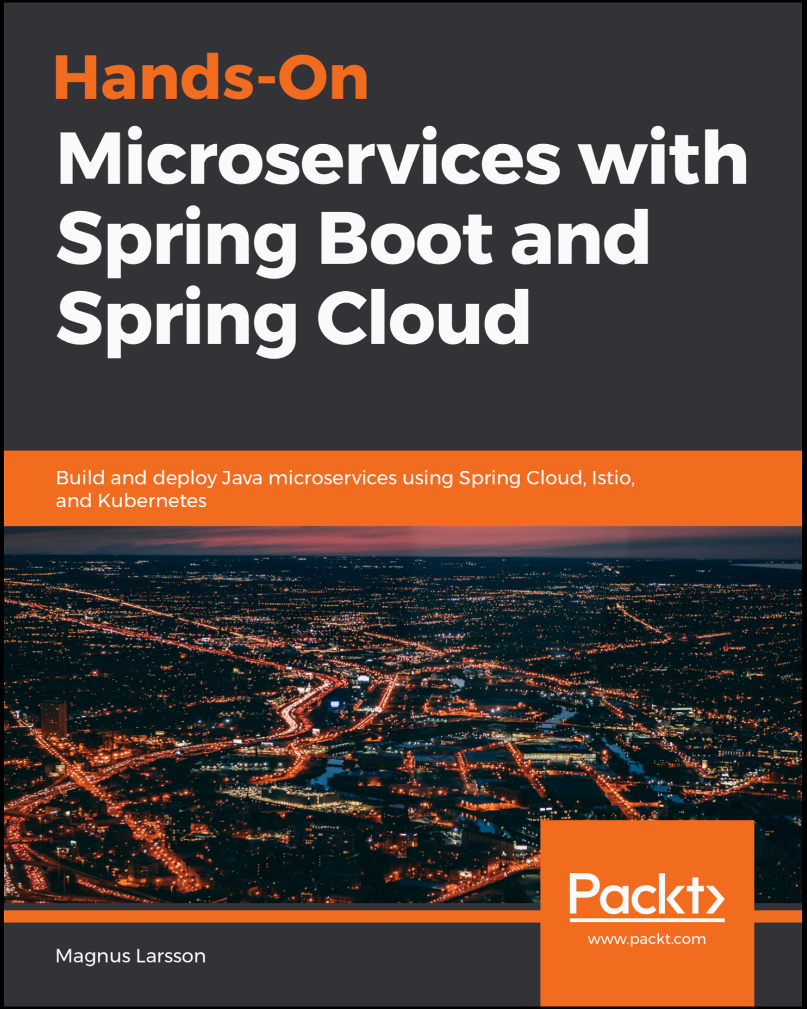
SUMMARY

- Microservices promise
  - Easier to scale
  - Faster release cycles
- Cooperating microservices ➔ Distributed System
  - Inherent complexity
  - Can be managed with Open Source
    - » Application library, e.g. **Spring Cloud**
    - » Container orchestrators, e.g. **Kubernetes**
    - » Service mesh, e.g. **Istio**
- Handle overlaps
- Works great together!
  - …if used correctly

CALLISTA

RECOMMENDED READING


Hands-On
Microservices with Spring Boot and Spring Cloud
Build and deploy Java microservices using Spring Cloud, Istio, and Kubernetes
Packt>
www.packt.com
Magnus Larsson

- Book – Hands-on microservices

  https://www.packtpub.com/web-development/hands-on-microservices-with-spring-boot-and-spring-cloud

- Blog series – Java & GO based microservices

  https://callistaenterprise.se/blogg/teknik/2015/05/20/blog-series-building-microservices/

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