Istio tutorial

https://www.oreilly.com/library/view/introducing-istio-service/9781491988770/

김잠제/김병민

Index

Background

Story of Istio background

1. Agile 의 등장으로 더 빠르고 잦은 서비스 배포 프로세스가 발생
   a. MSA(Micro Service Architecture) 등장

2. MSA 를 위해 팀과 서비스등을 작은 단위로 나누었을때 문제
   a. MSA 에서는 서비스간 네트워크가 더욱 중요해지고, 서비스 추가에 따른 네트워크 복잡도는 exponentially 하게 증가
   b. 몇달에 한번씩 배포하던 서비스를 일주일에 수십개의 서비스를 배포한다면 dev to production 운영

3. Best Practice Company
   a. Netflix - Ribbon, Hystrix, Eureka

4. Container 의 등장
   a. Docker, Kubernetes 의 등장으로 DevOps 팀을 위한 기반이 마련됨
   b. well-automated pipeline 과 빠르게 pipeline 을 통과하는 immutable image 이 중요해짐

5. polyglot services 를 배포하고 관리하는건 잘되고 있지만 각 서비스들간 interaction 에 대해 자동화 하는데에는 문제가 있음
   a. 이에 대한 해결책으로 Istio 출현

- Kubernetes = helmsman or ship's pilot = 키잡이 또는 항해사
- Istio = sail = 항해하다
- helm = (배의)키

Istio feature

1. 대표기능
    a. 서비스들 간 connection

2. 주요 특징
    a. traffic control
        i. declarative service discovery and routing
            1. not only round-robin
    b. service discovery
        i. observability of network flows (tracing)
    c. load balancing
    d. resilience
        i. retry, timeout, circuit-breaker
    e. observability
    f. security

Istio Basic

1. Data Plane
   a. Service proxy - Envoy Proxy
      i. retry, timeout, circuit breaker, service discovery, security 와 같은 기능을 처리하는 proxy
   b. Sidecar
      i. “istio-proxy” container
      ii. intercept all inbound and outbound network traffic
      iii. reroute the traffic
      iv. apply policies (ACL, rate limits, monitoring and tracing data)
2. Control Plane
   a. pilot
      i. up-to-date “routing table”
      ii. support for RouteRule (VirtualService) and DestinationPolicy (DestinationRule)
   b. mixer
      i. istio-proxy 들로부터 telemetry 를 전달 받아 정책을 관리
      ii. create ACL (whitelist and blacklist)
      iii. rate-limit rule 조절
      iv. plug-in 을 통해 custom metrics monitor 가능
   c. auth (= Istio CA (certificate authority))
      i. encrypting all traffic

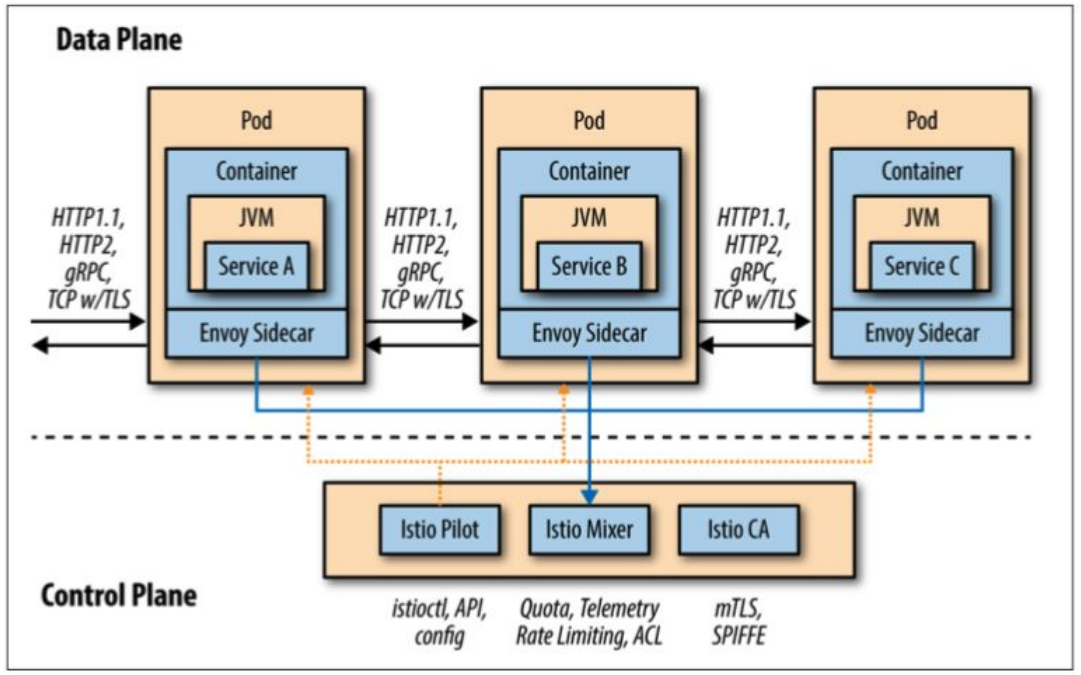


Figure 1-1. Data plane versus control plane

Install

Istio install

1. download link
   a. https://github.com/istio/istio/releases/download/${VERSION}/istio-${VERSION}-${OSEXT}.tar.gz
   b. 현재 최신버전은 1.1.2 (2019년 4월 7일)
   c. 테스트 버전은 1.0.2 (kiali)
2. 실제 가이드는 책보다 공식 문서를 참고
   a. https://istio.io/docs/setup/kubernetes/install/helm/
3. kubernetes 환경이 갖추어진 상태에서
   a. kubectl apply -f install/kubernetes/helm/helm-service-account.yaml
   b. helm init --service-account tiller
   c. 버전 1.1 부터
      i. helm install install/kubernetes/helm/istio-init --name istio-init --namespace istio-system
   d. helm upgrade --install istio ./temp/istio/istio-1.0.2/install/kubernetes/helm/istio --namespace istio-system --values ./custom-values.yaml
      i. custom-values.yaml : https://github.com/istiokrsg/handson/blob/master/custom-values.yaml

git clone git@github.com:istiokrsg/handson.git
git clone git@github.com:redhat-developer-demos/istio-tutorial.git

Istio install - result pods

```
❯ kubectl get po,svc -n istio-system
NAME                                        READY   STATUS    RESTARTS   AGE
pod/grafana-75485f89b9-p7nzl                1/1     Running   0          1m
pod/istio-citadel-84fb7985bf-q9hlp          1/1     Running   0          1m
pod/istio-egressgateway-bd9fb967d-drlgz     1/1     Running   0          1m
pod/istio-galley-655c4f9ccd-4qrnk           1/1     Running   0          1m
pod/istio-ingress-56795fd96c-w4gxr          1/1     Running   0          1m
pod/istio-ingress-56795fd96c-xkqxz          1/1     Running   0          21s
pod/istio-ingressgateway-688865c5f7-xl75g   1/1     Running   0          1m
pod/istio-pilot-6cd69dc444-zm5rk            2/2     Running   0          1m
pod/istio-policy-6b9f4697d-tss6k            2/2     Running   0          1m
pod/istio-sidecar-injector-8975849b4-4qp8s  1/1     Running   0          1m
pod/istio-statsd-prom-bridge-7f44bb5ddb-f745n  1/1     Running   0          1m
pod/istio-telemetry-6b5579595f-5r7nn        2/2     Running   0          1m
pod/istio-tracing-ff94688bb-82kx8           1/1     Running   0          1m
pod/kiali-644f5dd546-jp2g9                  1/1     Running   0          1m
pod/prometheus-84bd4b9796-7m6p8             1/1     Running   0          1m
pod/servicegraph-749b5b897c-cldr4           1/1     Running   0          1m
```

Istio install - result services

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)
service/grafana	ClusterIP	10.100.148.83	<none>	3000/TCP
service/istio-citadel	ClusterIP	10.106.49.149	<none>	8060/TCP,9093/TCP
service/istio-egressgateway	ClusterIP	10.103.236.161	<none>	80/TCP,443/TCP
service/istio-galley	ClusterIP	10.105.92.253	<none>	443/TCP,9093/TCP
service/istio-ingress	LoadBalancer	10.107.216.63	<pending>	80:32000/TCP,443:31717/TCP
service/istio-ingressgateway	LoadBalancer	10.102.128.44	localhost	80:31380/TCP,443:31390/TCP,31400:31400
service/istio-pilot	ClusterIP	10.103.198.84	<none>	15010/TCP,15011/TCP,8080/TCP,9093/TCP
service/istio-policy	ClusterIP	10.100.75.63	<none>	9091/TCP,15004/TCP,9093/TCP
service/istio-sidecar-injector	ClusterIP	10.109.77.29	<none>	443/TCP
service/istio-statsd-prom-bridge	ClusterIP	10.111.242.236	<none>	9102/TCP,9125/UDP
service/istio-telemetry	ClusterIP	10.108.154.55	<none>	9091/TCP,15004/TCP,9093/TCP,42422/TCP
service/jaeger-agent	ClusterIP	None	<none>	5775/UDP,6831/UDP,6832/UDP
service/jaeger-collector	ClusterIP	10.102.226.36	<none>	14267/TCP,14268/TCP
service/jaeger-query	ClusterIP	10.111.145.80	<none>	16686/TCP
service/kiali	ClusterIP	10.96.109.144	<none>	20001/TCP
service/prometheus	ClusterIP	10.108.213.84	<none>	9090/TCP
service/servicegraph	ClusterIP	10.110.140.45	<none>	8088/TCP
service/tracing	ClusterIP	10.111.236.40	<none>	80/TCP
service/zipkin	ClusterIP	10.99.157.163	<none>	9411/TCP

Istio uninstall

1. helm 으로 설치했으니 helm 으로 삭제
   a. helm del --purge istio
   b. 버전 1.1 부터
      i. helm del --purge istio-init
   c. kubectl delete crds {istio.io crds LIST}
   d. kubectl delete namespace istio-system

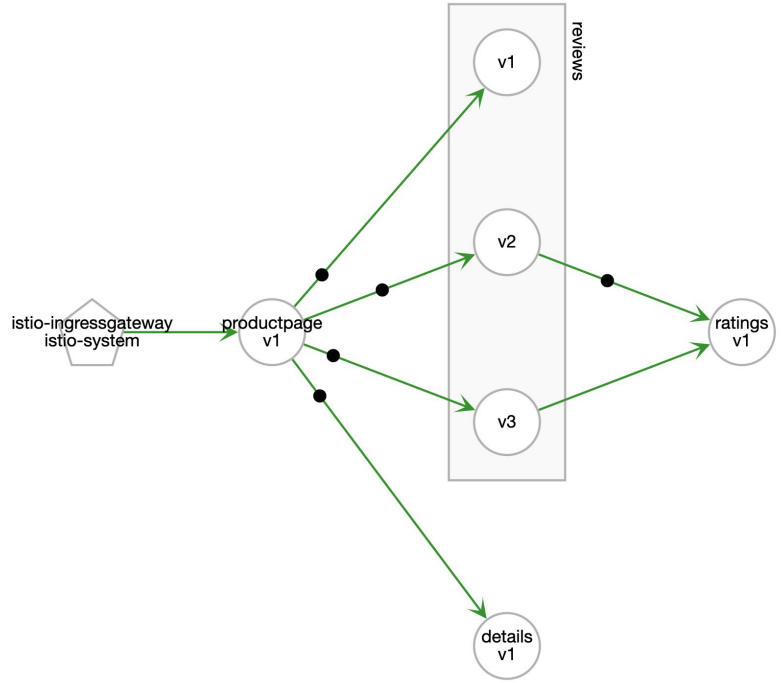
Sample application (bookinfo)

Istio 공식 샘플

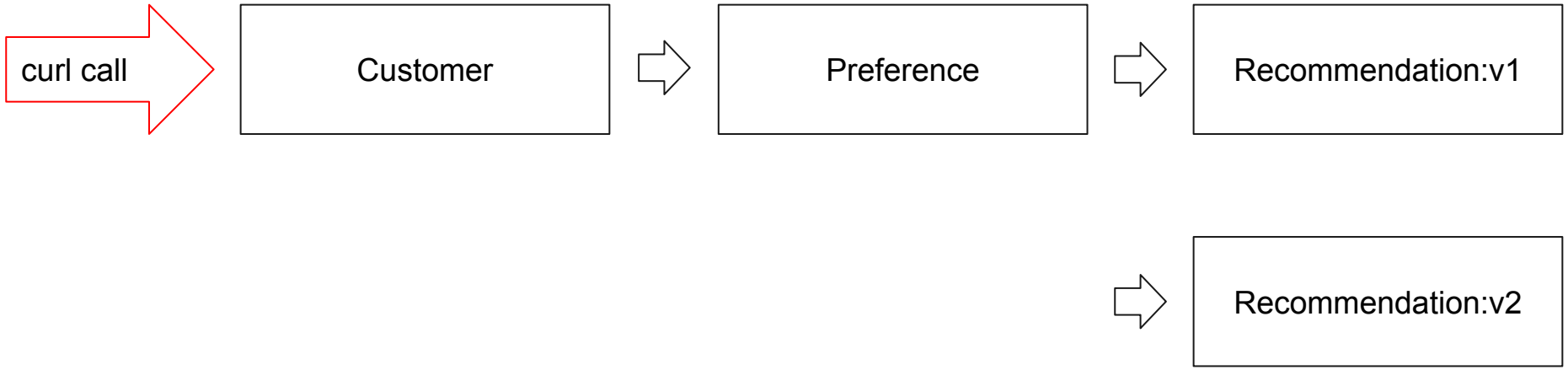
1. # auto injection
   a. kubectl label namespace default istio-injection=enabled

2. # install pod, service
   a. kubectl apply -f {ISTIOHOME}/samples/bookinfo/platform/kube/bookinfo.yaml

3. # set network resources (gateway, virtualservices)
   a. kubectl apply -f {ISTIOHOME}/samples/bookinfo/networking/bookinfo-gateway.yaml



Original 예제



customer

1. 책 예제를 git clone
   a. https://github.com/redhat-developer-demos/istio-tutorial
   b. git clone git@github.com:redhat-developer-demos/istio-tutorial.git
2. customer 소스코드 위치로 이동 후 빌드
   a. cd istio-tutorial/customer/java/quarkus
   b. mvn clean package -DskipTests
3. package 의 결과 target directory 가 만들어졌음을 확인후 docker image 생성
   a. docker build -t example/customer .
   b. 확인 : docker images | grep example
4. injection
   a. injection 확인 : istioctl kube-inject -f ../../kubernetes/Deployment.yml
   b. kubectl create namespace tutorial
   c. kubectl apply -f <(istioctl kube-inject -f ../../kubernetes/Deployment.yml) -n tutorial
5. service apply
   a. oc 로 expose 할거라면
      i. kubectl apply -f ../../kubernetes/Service.yml -n tutorial
   b. kubectl 의 nodeport 로 expose 할거라면
      i. kubectl expose deployment customer -n tutorial --type=NodePort --name=customer
6. check
   a. kubectl get po,svc -n tutorial
   b. curl localhost:32722
      i. NodePort 에서 할당된 포트 확인

preference

1. preference 소스코드 위치로 이동 후 빌드
   a. cd istio-tutorial/preference/java/quarkus
   b. mvn clean package -DskipTests
2. package 의 결과 target directory 가 만들어졌음을 확인후 docker image 생성
   a. docker build -t example/preference:v1 .
   b. 확인 : docker images | grep example
3. injection
   a. injection 확인 : istioctl kube-inject -f ../../kubernetes/Deployment.yml
   b. kubectl apply -f <(istioctl kube-inject -f ../../kubernetes/Deployment.yml) -n tutorial
4. service apply
   a. kubectl apply -f ../../kubernetes/Service.yml -n tutorial
5. check
   a. kubectl get po,svc -n tutorial

recommendation

1. recommendation 소스코드 위치로 이동 후 빌드
   a. cd istio-tutorial/preference/java/quarkus
   b. mvn clean package -DskipTests
2. package 의 결과 target directory 가 만들어졌음을 확인후 docker image 생성
   a. docker build -t example/recommendation:v1 .
   b. 확인 : docker images | grep example
3. injection
   a. injection 확인 : istioctl kube-inject -f ../../kubernetes/Deployment.yml
   b. kubectl apply -f <(istioctl kube-inject -f ../../kubernetes/Deployment.yml) -n tutorial
4. service apply
   a. kubectl apply -f ../../kubernetes/Service.yml -n tutorial
5. check
   a. kubectl get po,svc -n tutorial

customer, preference, recommendation

```
~/git/github/study/istio-tutorial/recommendation/java/quarkus master
❯ kubectl get po,svc -n tutorial
NAME                                     READY   STATUS    RESTARTS   AGE
pod/customer-5c77b74458-zp2ns            2/2     Running   0          1h
pod/preference-v1-74499588c9-7nx4l       2/2     Running   0          13m
pod/recommendation-v1-579db4dcb9-rwpfr   2/2     Running   0          20s

NAME                     TYPE        CLUSTER-IP       EXTERNAL-IP   PORT(S)                                        AGE
service/customer         NodePort    10.98.95.80      <none>        8080:32722/TCP,8778:31495/TCP,9779:30216/TCP   1h
service/preference       ClusterIP   10.105.37.219    <none>        8080/TCP                                       11m
service/recommendation   ClusterIP   10.111.167.131   <none>        8080/TCP                                       14s

~/git/github/study/istio-tutorial/recommendation/java/quarkus master
❯ curl localhost:32722
customer => preference => recommendation v1 from '579db4dcb9-rwpfr': 1
```

Traffic Control

Smarter Canaries

1. 광부들이 탄광에 들어갈때 위험한 가스누출을 알아챌수 있도록 카나리아 새를 데리고 들어가는것에서 유래
2. 운영환경에 새로운 버전을 배포할때 문제점을 미리 알아챌수 있도록 배포하는 subset 을 의미
3. 카나리 배포 방식
   a. kubernetes 는 service 에 있는 모든 pod 에 대해 round-robin load balancing 으로 동작한다.
   b. 만약 10%의 사용자에게만 새버전을 제공하여 테스트 하고 싶다면
   c. pod 10개중 1개를 새버전의 container 로 배포한다.
   d. Istio 를 사용하면 더 상세하게 설정할 수 있다.
   e. 트래픽 2%만 새로배포된 3개의 pod 로 route 되도록 설정할 수 있다.
   f. 그리고 서서히 트래픽을 늘려가면서 이전 버전을 제거할 수 있다.

Traffic Routing

1. recommendation v2 를 배포
   a. recommendationResource.java 에서 STRING_FORMAT 변경해서 재빌드
      i. **private static final** String ***RESPONSE_STRING_FORMAT*** = "recommendation v2 from '%s': %d\n";
   b. mvn clean package -DskipTests
   c. docker build -t example/recommendation:v2 .
   d. kubectl apply -f <(istioctl kube-inject -f ../../kubernetes/Deployment-v2.yml) -n tutorial
   e. kubectl get pods -w -n tutorial

Traffic Routing

```
~/git/github/study/istio-tutorial/recommendation/java/quarkus master* 39s
❯ kubectl get po,svc -n tutorial
NAME                                        READY   STATUS    RESTARTS   AGE
pod/customer-5c77b74458-zp2ns               2/2     Running   0          2h
pod/preference-v1-74499588c9-7nx4l          2/2     Running   0          47m
pod/recommendation-v1-579db4dcb9-rwpfr      2/2     Running   0          34m
pod/recommendation-v2-86c9458d5c-v5k9g      2/2     Running   0          44s

NAME                     TYPE        CLUSTER-IP       EXTERNAL-IP   PORT(S)                                        AGE
service/customer         NodePort    10.98.95.80      <none>        8080:32722/TCP,8778:31495/TCP,9779:30216/TCP   1h
service/preference       ClusterIP   10.105.37.219    <none>        8080/TCP                                       46m
service/recommendation   ClusterIP   10.111.167.131   <none>        8080/TCP                                       34m

~/git/github/study/istio-tutorial/recommendation/java/quarkus master*
❯ curl localhost:32722
customer => preference => recommendation v1 from '579db4dcb9-rwpfr': 11

~/git/github/study/istio-tutorial/recommendation/java/quarkus master*
❯ curl localhost:32722
customer => preference => recommendation v2 from '86c9458d5c-v5k9g': 1

~/git/github/study/istio-tutorial/recommendation/java/quarkus master*
❯ curl localhost:32722
customer => preference => recommendation v1 from '579db4dcb9-rwpfr': 12

~/git/github/study/istio-tutorial/recommendation/java/quarkus master*
❯ curl localhost:32722
customer => preference => recommendation v2 from '86c9458d5c-v5k9g': 2

~/git/github/study/istio-tutorial/recommendation/java/quarkus master*
❯ curl localhost:32722
customer => preference => recommendation v1 from '579db4dcb9-rwpfr': 13

~/git/github/study/istio-tutorial/recommendation/java/quarkus master*
❯ curl localhost:32722
customer => preference => recommendation v2 from '86c9458d5c-v5k9g': 3
```

Traffic Routing using Istio

1. v2 로만 패킷이 가도록 설정
   a. kubectl create -f istiofiles/destination-rule-recommendation-v1-v2.yml -n tutorial
   b. kubectl create -f istiofiles/virtual-service-recommendation-v2.yml -n tutorial
   c.

```yaml
apiVersion: networking.istio.io/v1alpha3
kind: VirtualService
metadata:
  name: recommendation
spec:
  hosts:
  - recommendation
  http:
  - route:
    - destination:
        host: recommendation
        subset: version-v2
      weight: 100
```

```yaml
apiVersion: networking.istio.io/v1alpha3
kind: DestinationRule
metadata:
  name: recommendation
spec:
  host: recommendation
  subsets:
  - labels:
      version: v1
    name: version-v1
  - labels:
      version: v2
    name: version-v2
---
```

Traffic Routing using Istio

```
~/git/github/study/istio-tutorial master* 8s
❯ kubectl create -f istiofiles/destination-rule-recommendation-v1-v2.yml -n tutorial
destinationrule.networking.istio.io/recommendation created

~/git/github/study/istio-tutorial master*
❯ kubectl create -f  istiofiles/virtual-service-recommendation-v2.yml -n tutorial
virtualservice.networking.istio.io/recommendation created

~/git/github/study/istio-tutorial master*
❯ curl localhost:32722
customer => preference => recommendation v2 from '86c9458d5c-v5k9g': 4

~/git/github/study/istio-tutorial master*
❯ curl localhost:32722
customer => preference => recommendation v2 from '86c9458d5c-v5k9g': 5

~/git/github/study/istio-tutorial master*
❯ curl localhost:32722
customer => preference => recommendation v2 from '86c9458d5c-v5k9g': 6

~/git/github/study/istio-tutorial master*
❯ curl localhost:32722
customer => preference => recommendation v2 from '86c9458d5c-v5k9g': 7
```

Traffic Routing using Istio

1. v1 로만 패킷이 가도록 재설정
   a. kubectl replace -f istiofiles/virtual-service-recommendation-v1.yml -n tutorial
2. virtual service 삭제
   a. kubectl delete -f istiofiles/virtual-service-recommendation-v1.yml -n tutorial

```yaml
apiVersion: networking.istio.io/v1alpha3
kind: VirtualService
metadata:
  name: recommendation
spec:
  hosts:
  - recommendation
  http:
  - route:
    - destination:
        host: recommendation
        subset: version-v1
      weight: 100
```

canary deployment

1. scenario
   a. v2 를 새 버전이라고 가정한다
   b. v1 : 90%, v2 : 10% 의 비율로 트래픽을 조절
2. virtual service 적용
   a. kubectl create -f istiofiles/virtual-service-recommendation-v1_and_v2.yml -n tutorial
3. 부하
   a. while(true){ curl localhost:32722; sleep 2 }
4. virtual service 교체 (트래픽 비율 수정 75:25)
   a. kubectl replace -f istiofiles/virtual-service-recommendation-v1_and_v2_75_25.yml -n tutorial

```yaml
apiVersion: networking.istio.io/v1alpha3
kind: VirtualService
metadata:
  name: recommendation
spec:
  hosts:
  - recommendation
  http:
  - route:
    - destination:
        host: recommendation
        subset: version-v1
      weight: 90
    - destination:
        host: recommendation
        subset: version-v2
      weight: 10
```

```yaml
apiVersion: networking.istio.io/v1alpha3
kind: VirtualService
metadata:
  name: recommendation
spec:
  hosts:
  - recommendation
  http:
  - route:
    - destination:
        host: recommendation
        subset: version-v1
      weight: 75
    - destination:
        host: recommendation
        subset: version-v2
      weight: 25
```

canary deployment based on user-agent header (advanced)

1. customer 에서 request header 에 baggage-user-agent 를 추가
   a. Safari 가 포함된 문자열이면 v2 로 트래픽을 route
2. test 방법
   a. Mac 에서는 크롬으로 접속해도 Safari 임
   b. curl -A Safari localhost:32722

같은 방법으로 모바일로 접근한 유저만 v2 로 보낼수 있음

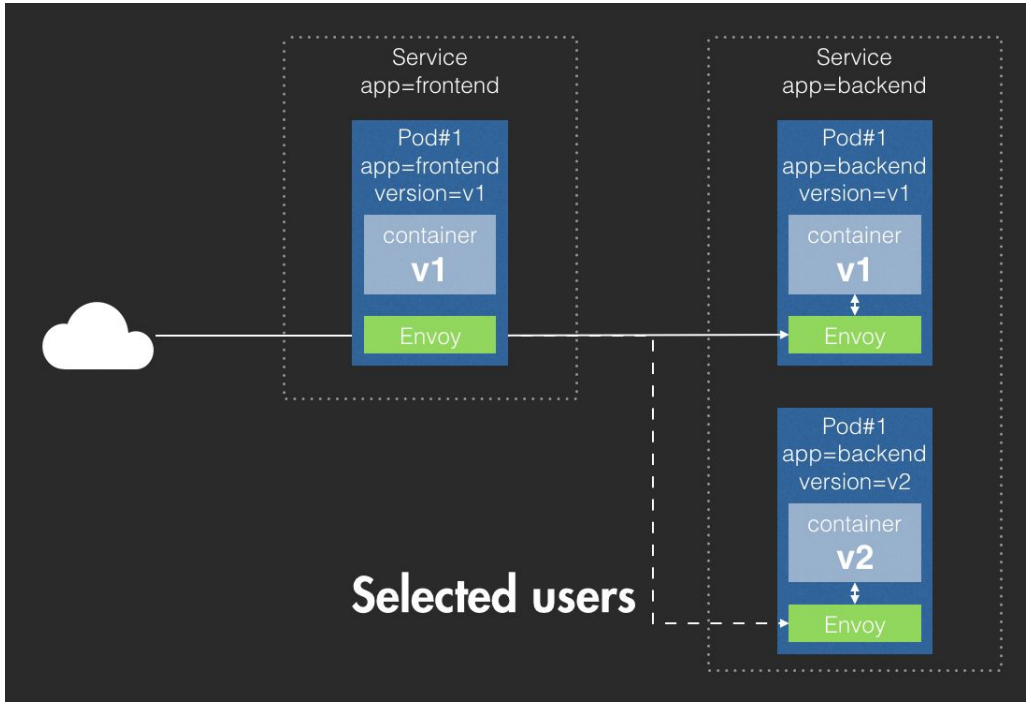
```java
public class BaggageHeadersFactory implements ClientHeadersFactory {

    @Override
    public MultivaluedMap<String, String> update(MultivaluedMap<String, String> in
        MultivaluedHashMap<String, String> headers = new MultivaluedHashMap<>();
        String userAgent = incomingHeaders.getFirst("user-agent");
        headers.putSingle("baggage-user-agent", userAgent);
        return headers;
    }

}
```

```yaml
apiVersion: networking.istio.io/v1alpha3
kind: VirtualService
metadata:
  name: recommendation
spec:
  hosts:
  - recommendation
  http:
  - match:
    - headers:
        baggage-user-agent:
          regex: .*Mobile.*
    route:
    - destination:
        host: recommendation
        subset: version-v2
  - route:
    - destination:
        host: recommendation
        subset: version-v1
```

```yaml
apiVersion: networking.istio.io/v1alpha3
kind: VirtualService
metadata:
  name: recommendation
spec:
  hosts:
  - recommendation
  http:
  - match:
    - headers:
        baggage-user-agent:
          regex: .*Safari.*
    route:
    - destination:
        host: recommendation
        subset: version-v2
  - route:
    - destination:
        host: recommendation
        subset: version-v1
---
```

Dark Launch

1. 운영환경에 배포하지만 일부 사용자(내부직원 등)에게만 새버전을 노출 하는 방식
   a. facebook 에서는 Gatekeeper (https://www.facebook.com/notes/facebook-engineering/building-and-testing-at-facebook/10151004157328920/) 라는 dark launch tool 이 있음
   b. 실제 고객은 새버전의 존재를 모름
   c. duplication or mirror production traffic 을 새버전으로 routing 하여 새버전을 운영환경에서 테스트할 수 있음
2. Istio 를 가지고 mirror traffic 을 사용할 수 있음
   a. 클러스터 안에서 mirrored request 를 async 하게 보내기 때문에 이전 버전에는 영향이 없음
3. kubectl apply -f istiofiles/virtual-service-recommendation-v1-mirror-v2.yml -n tutorial




```yaml
apiVersion: networking.istio.io/v1alpha3
kind: VirtualService
metadata:
  name: recommendation
spec:
  hosts:
  - recommendation
  http:
  - route:
    - destination:
        host: recommendation
        subset: version-v1
    mirror:
      host: recommendation
      subset: version-v2
```

Egress

1. Istio 는 클러스터 밖으로 나가는 모든 outbound 를 block 하는게 default
2. 명시적으로 routing rule 을 만들어줘야 외부로 트래픽이 나갈수 있음
3. Resource name : ServiceEntry
4. 1.1.0 버전 이후 부터 config map 의 설정이 추가되었음 (global.outboundTrafficPolicy.mode)
   a. https://istio.io/docs/tasks/traffic-management/egress/
   b. ALLOW_ALL, REGISTRY_ONLY
   c. REGISTRY_ONLY 하고 service entry 설정해서 사용하는방법을 권장

Service Resiliency

https://www.oreilly.com/library/view/introducing-istio-service/9781491988770/ch04.html

Service Resiliency

1. 서비스의 복원력을 구현하기 위해 다음과 같은 기능들을 제공하고 있다
    a. Client-side load balancing
        i. 쿠버네티스의 load balancing 을 강화
    b. Timeout
        i. 응답을 기다린후 N (초) 후에 give up
    c. Retry
        i. 하나의 pod 가 에러 나면, 다른 pod 로 재시도
    d. Circuit breaker
        i. 서비스가 내려가는 대신, 더이상의 request 를 reject 하는 circuit 제공
    e. Pool ejection
        i. 에러가 발생하는 pod를 load balancing pool 에서 제거

Load Balancing

1. Client side load balancing(http://blog.leekyoungil.com/?p=259)
   a. L4, L7 같은 고가의 장비가 필요없다 (no more HAProxy)
   b. client 에서 로드밸런싱 알고리즘이 동작해야 한다
   c. 오류가 발생했을때 적절하게 동작해야한다 (timeout, retry)
2. Istio 에서 지원하는 LB 기능들
   a. ROUND_ROBIN
      i. 순서대로 돌아가며 한번씩(default)
   b. RANDOM
      i. 랜덤
   c. LEAST_CONN
      i. weighted least request load balancing 을 구현
      ii. https://www.envoyproxy.io/docs/envoy/latest/intro/arch_overview/load_balancing/load_balancers
      iii. TL;DR : 랜덤하게 2개(default) 골라서 active request 가 적은 서버로 call

```yaml
apiVersion: networking.istio.io/v1alpha3
kind: DestinationRule
metadata:
  name: recommendation
spec:
  host: recommendation
  trafficPolicy:
    loadBalancer:
      simple: RANDOM
```

```
claud@claud-500R5N-500R5Y-501R5N:~/git/openshift/istio-tutorial/istiofiles$ istioctl create -f destination-rule-recommendation-random.yml
Created config destination-rule/default/recommendation at revision 67948
claud@claud-500R5N-500R5Y-501R5N:~/git/openshift/istio-tutorial/istiofiles$ while true; do curl http://192.168.99.96:80/customer; sleep .5; done
customer => preference => recommendation v1 from '679dfdf957-ctkfr': 34
customer => preference => recommendation v2 from '66bd89d66c-wqzs6': 32
customer => preference => recommendation v2 from '66bd89d66c-wqzs6': 33
customer => preference => recommendation v2 from '66bd89d66c-wqzs6': 34
customer => preference => recommendation v2 from '66bd89d66c-sncsd': 11
customer => preference => recommendation v1 from '679dfdf957-ctkfr': 35
customer => preference => recommendation v2 from '66bd89d66c-wqzs6': 35
customer => preference => recommendation v1 from '679dfdf957-ctkfr': 36
customer => preference => recommendation v1 from '679dfdf957-ctkfr': 37
customer => preference => recommendation v1 from '679dfdf957-ctkfr': 38
customer => preference => recommendation v2 from '66bd89d66c-sncsd': 12
customer => preference => recommendation v1 from '679dfdf957-ctkfr': 39
customer => preference => recommendation v2 from '66bd89d66c-wqzs6': 36
```

Timeout

1. 서비스에 타임아웃을 설정하여 사용자에게 응답성을 빠르게 하는 기능
2. 무한 대기 방지

```
customer => preference => recommendation v2 from '751265691-qdznv': 2

real    0m3.054s
user    0m0.003s
sys     0m0.003s
```

```
apiVersion: networking.istio.io/v1alpha3
kind: VirtualService
metadata:
  name: recommendation
spec:
  hosts:
  - recommendation
  http:
  - route:
    - destination:
        host: recommendation
    timeout: 1.000s
```

```
claud@claud-500R5N-500R5Y-501R5N:~/git/openshift/istio-tutorial/recommendation/java/vertx$ while true; do time curl http://192.168.99.96:80/; sleep
 .5; done
customer => preference => recommendation v1 from '679dfdf957-ctkfr': 40

real    0m0.023s
user    0m0.007s
sys     0m0.000s
customer => 503 preference => 504 upstream request timeout

real    0m1.041s
user    0m0.013s
sys     0m0.008s
customer => 503 preference => 504 upstream request timeout
```

Retry

1. 간헐적인 오류일 때, Retry 설정으로 서비스의 견고성을 갖출 수 있다.
2. VirtualService 설정으로 503 에러를 설정함
3. 재시도 3회, 1회시 2초 제한 최대6초

```
apiVersion: networking.istio.io/v1alpha3
kind: VirtualService
metadata:
  name: recommendation
spec:
  hosts:
  - recommendation
  http:
  - route:
    - destination:
        host: recommendation
    retries:
      attempts: 3
      perTryTimeout: 2s
```

```
apiVersion: networking.istio.io/v1alpha3
kind: VirtualService
metadata:
  name: recommendation
spec:
  hosts:
  - recommendation
  http:
  - fault:
      abort:
        httpStatus: 503
        percent: 50
    route:
    - destination:
        host: recommendation
        subset: app-recommendation
```

Circuit Breaker

1. 느린 서비스를 뺀다라는 개념으로 이해-> 느린 서비스를 룰에 의해 제거 됨으로써 서비스의 탄력성을 지키게 됨.
2. Netflix의 Hystrix 라이브러리가 2012 년에 출시되면서 circuit Breaker패턴이 대중화됨.
3. Eureka (서비스 검색), 리본 (로드 밸런싱) 및 Hystrix (circuit Breaker 및 bulk head)와 같은 Netflix 라이브러리는 빠르게 대중화됨.
4. Netflix OSS는 Kubernetes / OpenShift가 출시되기 전에 만들어졌으며 몇 가지 단점이 있습니다.
5. 하나는 Java 전용이고 두 가지는 응용 프로그램 개발자가 포함 라이브러리를 올바르게 사용해야한다는 것입니다..

Circuit Breaker

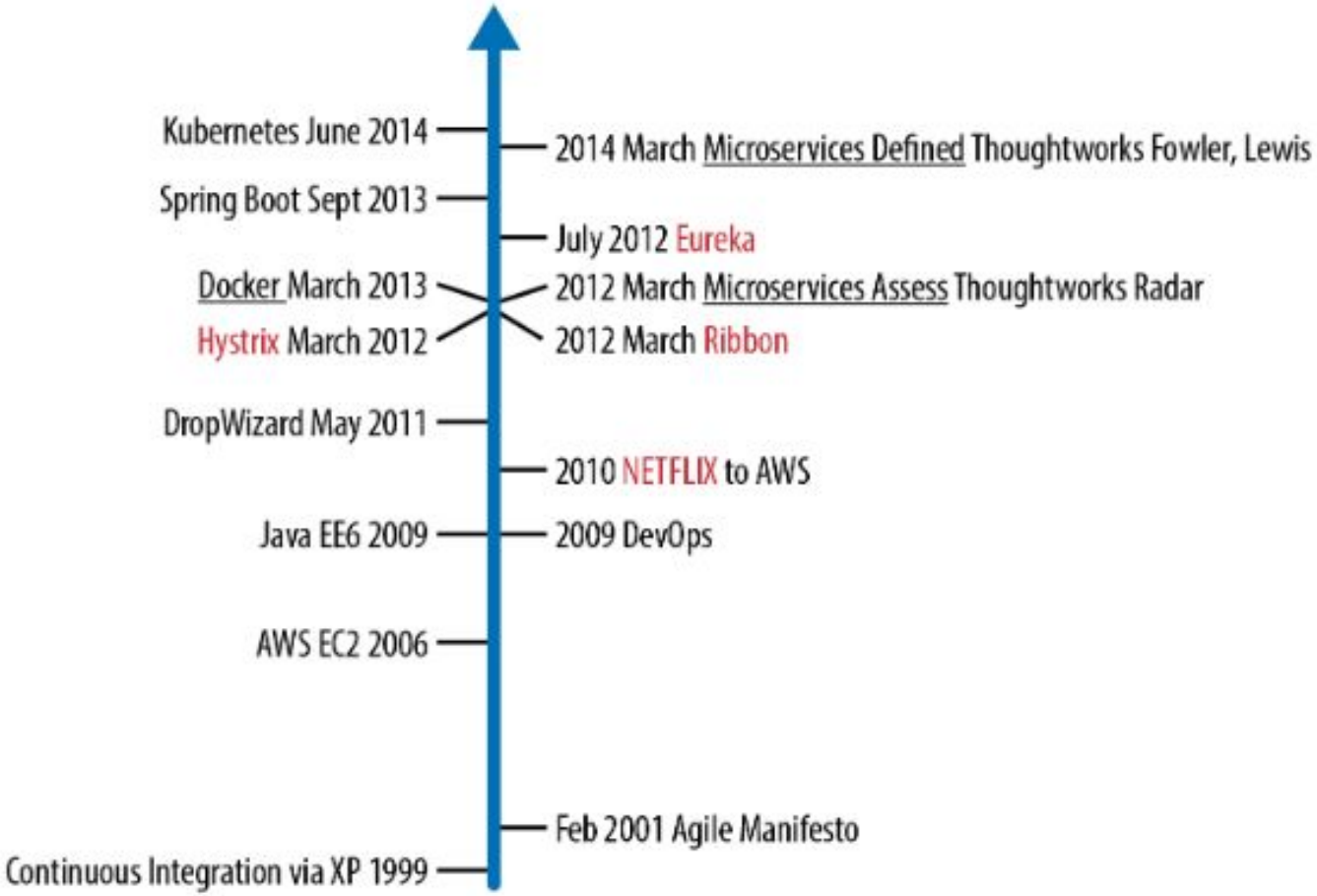


Figure 4-1. Microservices timeline

Circuit Breaker

```
Transactions:                    40 hits
Availability:                100.00 %
Elapsed time:                  6.17 secs
Data transferred:              0.00 MB
Response time:                 1.66 secs
Transaction rate:              6.48 trans/sec
Throughput:                    0.00 MB/sec
Concurrency:                  10.77
Successful transactions:         40
Failed transactions:              0
Longest transaction:           3.15
Shortest transaction:          0.02
```

```
Transactions:                    23 hits
Availability:                 57.50 %
Elapsed time:                  9.10 secs
Data transferred:              0.00 MB
Response time:                 0.87 secs
Transaction rate:              2.53 trans/sec
Throughput:                    0.00 MB/sec
Concurrency:                   2.19
Successful transactions:         23
Failed transactions:             17
Longest transaction:           6.08
Shortest transaction:          0.01
```

```yaml
apiVersion: config.istio.io/v1alpha2
kind: DestinationPolicy
metadata:
  name: recommendation-circuitbreaker
spec:
  destination:
    namespace: tutorial
    name: recommendation
    labels:
      version: v2
  circuitBreaker:
    simpleCb:
      maxConnections: 1
      httpMaxPendingRequests: 1
      sleepWindow: 2m
      httpDetectionInterval: 1s
      httpMaxEjectionPercent: 100
      httpConsecutiveErrors: 1
      httpMaxRequestsPerConnection: 1
```

Pool Ejection

1. 잘못 동작 하는 서비스를 Envoy 를 통해 풀에서 빼는 동작하는 하는 것이 기본개념
2. httpConsecutiveErrors : 에러를 추출하는 횟수
3. sleepWindow : 에러가 추출 되었을 때, 풀에서 제거되는 시간
4. httpDetectionInterval : 검사주기
5. httpMaxEjectionPercent : 검출 되었을 때, 해당 서비스가 제거 되는 비율

```
circuitBreaker:
  simpleCb:
    httpConsecutiveErrors: 1
    sleepWindow: 15s
    httpDetectionInterval: 5s
    httpMaxEjectionPercent: 100
```

```
customer => preference => recommendation v1 from '2039379827': 509
customer => 503 preference => 503 recommendation misbehavior from
'2036617847'
customer => preference => recommendation v1 from '2039379827': 510
customer => preference => recommendation v1 from '2039379827': 511
customer => preference => recommendation v1 from '2039379827': 512
customer => preference => recommendation v1 from '2039379827': 513
customer => preference => recommendation v1 from '2039379827': 514
customer => preference => recommendation v2 from '2036617847': 256
customer => preference => recommendation v2 from '2036617847': 257
customer => preference => recommendation v1 from '2039379827': 515
customer => preference => recommendation v2 from '2036617847': 258
customer => preference => recommendation v2 from '2036617847': 259
customer => preference => recommendation v2 from '2036617847': 260
customer => preference => recommendation v1 from '2039379827': 516
customer => preference => recommendation v1 from '2039379827': 517
customer => preference => recommendation v1 from '2039379827': 518
customer => 503 preference => 503 recommendation misbehavior from
'2036617847'
customer => preference => recommendation v1 from '2039379827': 519
```

로컬환경 설정 및 테스트

https://github.com/claud-kim/istio-tutorial/blob/master/minikube_istio.md

학습자료 : http://learn.openshift.com/servicemesh

To be continue...

https://www.oreilly.com/library/view/introducing-istio-service/9781491988770/

next