Multi–tenant management in HP OneCloud Platform

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Agenda

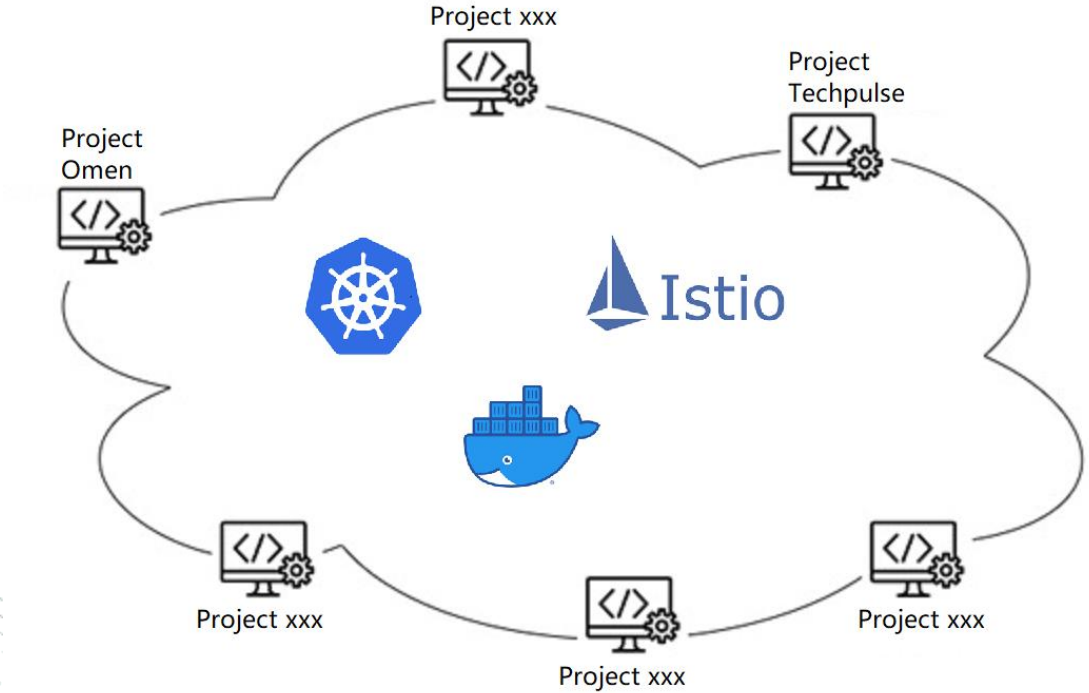
- HP OneCloud Platform
- API Rate Limit per tenant
- Authentication and Authorization for tenant
- Observability Enhancement for tenant
- Q & A

HP OneCloud Platform designed with Istio

HP OneCloud Platform

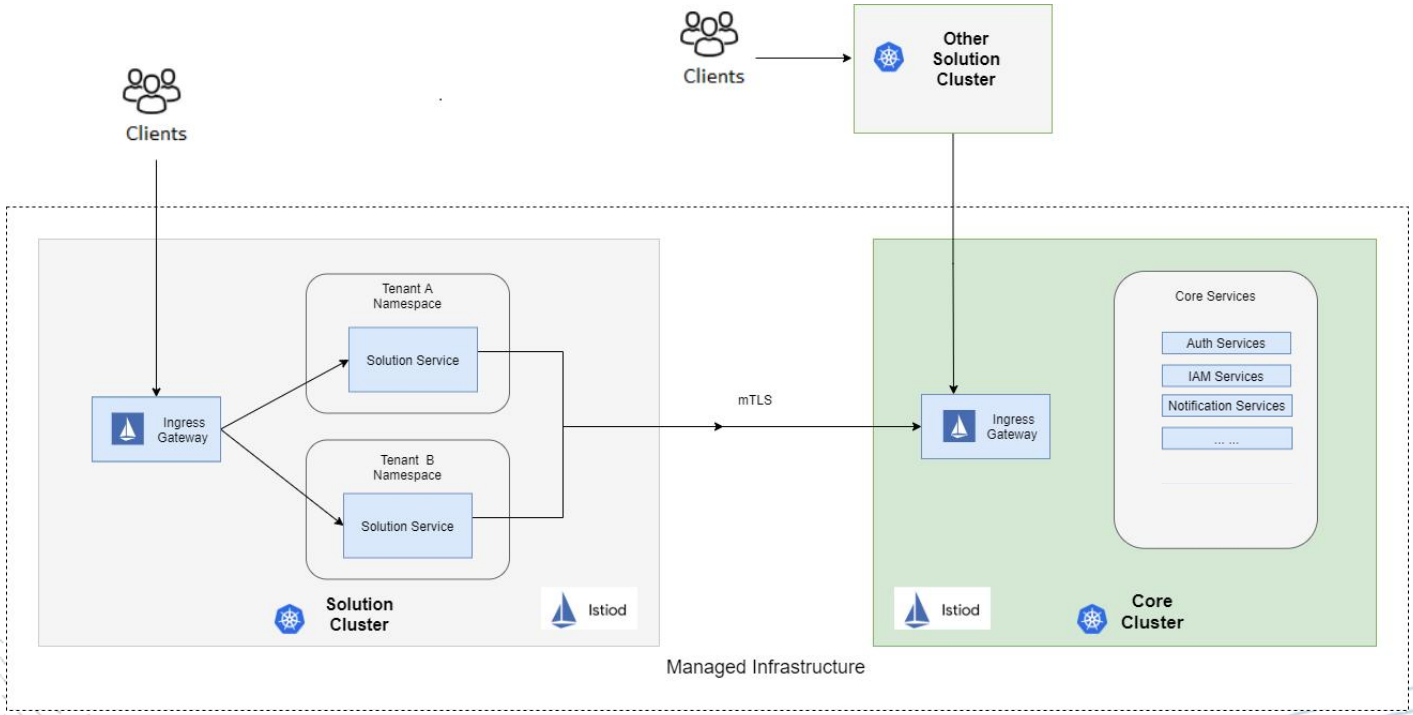
HP has lots of projects, deployed on cloud. They have common features, also have project specified feature.

HP OneCloud platform is HP's largest cloud platform and is recognized as **HP's only official cloud platform**, includes all common features, connect all projects.



OneCloud

HP OneCloud Platform Connect With Istio



Common services are in core cluster

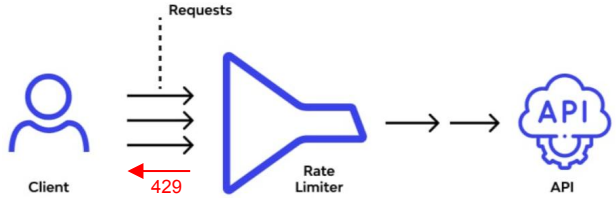
Projects shared solution cluster
- Different namespace
- Project runs as tenant, need control rights

Some standalone cluster without Istio can access core cluster also, as tenant.

OneCloud

API Rate Limit per tenant

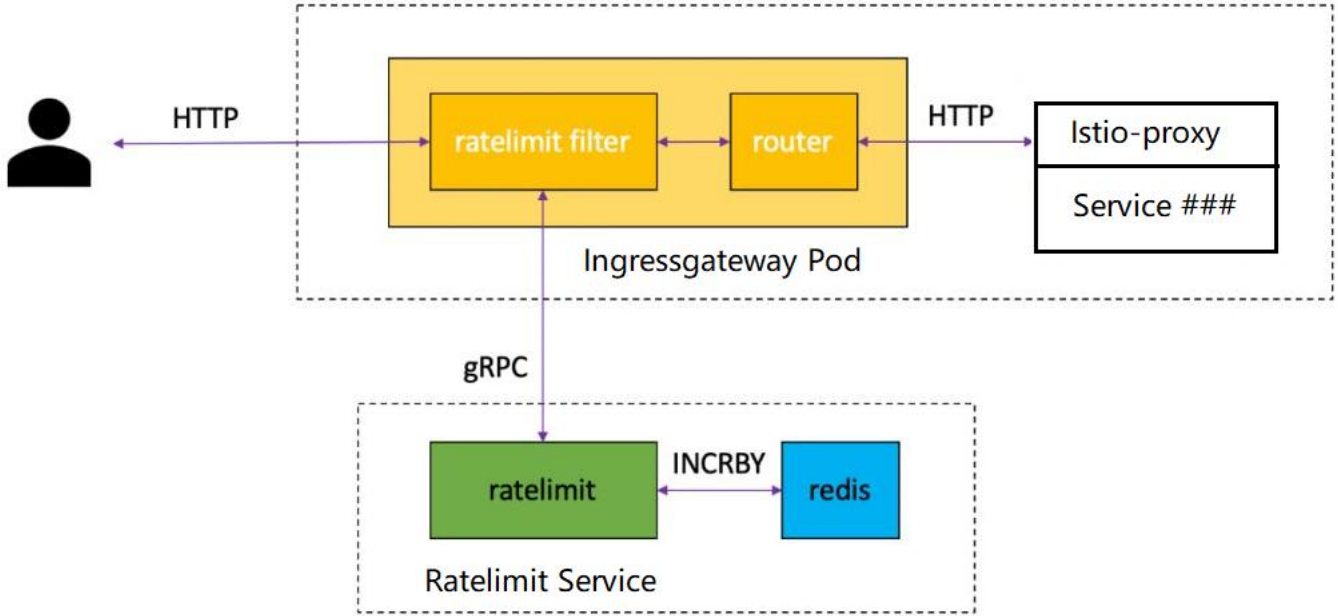
Rate Limit Requirements



- Security Concern
  - For each client IP, limit the number of requests per minute.
  - For some IP from known parnter cluster, we think it is securer, do not limit on this IP.
  - All projects need to apply this security purpose ratelimit.
- Business Concern
  - For tanent who has paid, for each api, limit the number of requests per minute to a high value.
  - For tanent who has not paid, for each api, limit the number of requests per minute to a low value.
  - Project owner can choose whether project api apply business purpose ratelimit or not.

Envoy Solution for rate limit

Envoy can be used to set up global rate limits for your mesh.
Global rate limiting in Envoy uses a gRPC API for requesting quota from a rate limiting service



Envoy Rate limit

Quick Start

Go through https://istio.io/latest/docs/tasks/policy-enforcement/rate-limit/

Further Practice

Go through https://github.com/johnzheng1975/istio-ratelimit-example

Best Practice as HP OneCloud

Go through https://github.com/johnzheng1975/istiocon2023/tree/main/samples/ratelimit

- Use a pre-handler envoyfilter, handle the complex logic.
- Generate additional request headers in the pre-handler envoyfilter.
- Rate limit is based on these new generated request headers.

Design for Security Purpose Rate limit

- Get client IP from request header `x-forwarded-for`.
- Add this client IP as new request header `ratelimit-source-ip`.
- Define a list of partner cluster IP, if client IP is in this list, do not limit, set new request header `ratelimit-enabled-secure` with value `false`. Otherwise, set `ratelimit-enabled-secure` with value `true`.
- In ratelimit envoyfilter, based on `ratelimit-enabled-secure`, `ratelimit-source-ip`, configured as below

```
- key: header_match
  value: oc-ratelimit-enabled-secure  # enable_ratelimit_secure
  descriptors:
    - key: CLIENTIP                   # ratelimit-source-ip
      rate_limit:
        unit: minute
        requests_per_unit: 12         # number here is for testing purpose
```


Design for Business Purpose Rate limit

- In ratelimit envoyfilter, based on `ratelimit-enabled-business`, `ratelimit-project`, `ratelimit-path`, `:method`, `ratelimit-tenantid`, `ratelimit-level` configured as below

```
descriptors:
  - key: header_match
    value: oc-ratelimit-enabled-business                # ratelimit-enabled-business
    descriptors:
      - key: PROJECT                                    # ratelimit-project
        descriptors:
         - key: PATH                                    # ratelimit-path
           descriptors:
             - key: METHOD                              # header :method
               descriptors:
                 - key: TENANTID                        # ratelimit-tenantid
                   descriptors:
                     - key: TLEVEL                      # ratelimit-level
                       value: premium
                       rate_limit:
                         unit: minute
                         requests_per_unit: 8           # number here is for testing purpose
                     - key: TLEVEL
                       value: trial
                       rate_limit:
                         unit: minute
                         requests_per_unit: 4           # number here is for testing purpose
```


Good Code Structure

- Include below code:

```
- 00-namespace-ratelimit.yaml              # For namespace creation
- 10-configmap-ratelimit.yaml              # For configmap for ratelimit
- 20-service-ratelimit-redis.yaml          # For ratelimit deploy creation, redis creation.
- 30-envoyfilter-ratelimit.yaml            # For ratelimit envoyfilter
- 40-envoyfilter-ratelimit-svc.yaml        # For ratelimit envoyfilter
- 50-ef-ratelimit-pre-handle.yaml          # The pre-handler envoyfilter, make logic simple
```

- This code structure is simple, easy to maintain.
  - 00, 10, 20, 30, 40 need not change.
  - Only some variable in 50-ef-ratelimit-pre-handle.yaml need be changed， based on requirments change, as below:

```
-- Define a list of partner cluster IP, if client IP is in this list, do not enable secure limit
secure_platform_ips = { ["54.148.85.56"]=true, ["3.120.217.35"]=true, ["15.65.244.13"]=true, ["192.168.1.61"]=true }

-- Assume only three projects enabled ratelimit, includes project1, project3, project5
project_enabled_ratelimit = { ["project1"]=true, ["project3"]=true, ["project5"]=true }

-- Assume tenant01 and tenant02 are premium tenant, the others are trial tenant
premium_tenants = { ["tenant01"]=true, ["tenant03"]=true }
```


Apply & Test

Apply:

```
$ kubectl apply -f ./code
namespace/ratelimit created
configmap/ratelimit-config created
service/redis created
deployment.apps/redis created
service/ratelimit created
deployment.apps/ratelimit created
envoyfilter.networking.istio.io/filter-ratelimit created
envoyfilter.networking.istio.io/filter-ratelimit-svc created
envoyfilter.networking.istio.io/ef-ratelimit-pre-handle created
```

Test:

Test Scenario 01: Business ratelimit for premium tenants

Test Scenario 02: Business ratelimit for trial tenants

Test Scenario 03: Secure ratelimit only

Test Scenario 04: Both Secure ratelimit and Business ratelimit are disabled

Test Scenario 05: Both Secure ratelimit and Business ratelimit are enabled

Test Result is expected!

Sample

Introduction for tutorial:

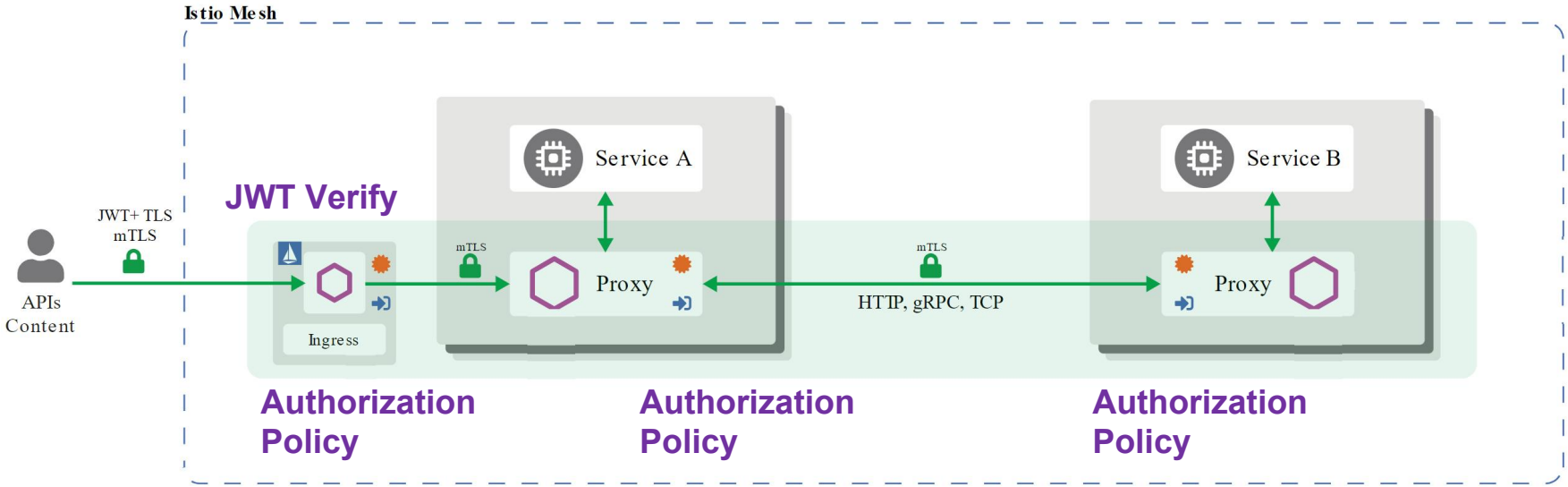
- https://github.com/johnzheng1975/istiocon2023/blob/main/samples/ratelimit/readme.md

Sample Code:

- https://github.com/johnzheng1975/istiocon2023/tree/main/samples/ratelimit/code

Authentication and Authorization for tenant

Authentication and Authorization



Version 1

Authentication:

- Each tenant has its own JWKS file.
- JWT Verify is implemented with Istio Request Authentication.

Authorization:

- Service-to-service Authorization is using Authorization Policy.
- Based on
  - Method
  - path
  - request.auth.claims[tenant_id]
  - request.auth.claims[type]
  - source principals
  - … …

API Scope/ Role-based authorization :

- Invoke authz service with envoyfilter ext-authz

Version 1

Advantage:

- Both Request Authentication/ Authorization Policy are convenience, need not coding
- Both Request Authentication/ Authorization Policy are powerful, can handle all user cases

Disadvantage:

- When projects more and more, Authorization Policy/ Request Authentication are huge and difficult to manual maintain for DevOps.
- Authorization Policy logic is complex, easy to typo or error configuration

Version 1 Improvement

Further Solution for automation:

- We developed a tool called “Developer Portal”, let developer to configure on UI.
- “Developer Portal” generate request authentication/ authorization policy with Istio client-go lib (example)

Further Disadvantage:

- When Istio upgrade, need upgrade both Cluster and “Developer Portal”. It brings incompatible since their upgradation time is different.
- Version control is not as good as github.

Version 2

Authentication:

- Each tenant has its own JWKS file.
- JWT Verify is implemented with Istio Request Authentication.

Keep this. Maintained with ***Helm Charts*** + ***Flux***

Authorization:

- Service-to-service Authorization is using Authorization Policy.
- Based on
  - source principals
  - method
  - path
  - request.auth.claims[tenant_id]
  - request.auth.claims[type]
  - … …

API Scope/ Role-based authorization :

- Invoke authz service with envoyfilter ext-authz

Removed this.

Moved all validation to Authz Service, include:

- Old Authorization policy
- Token Blacklist Verify
- API Scope
- Role-based author

… …

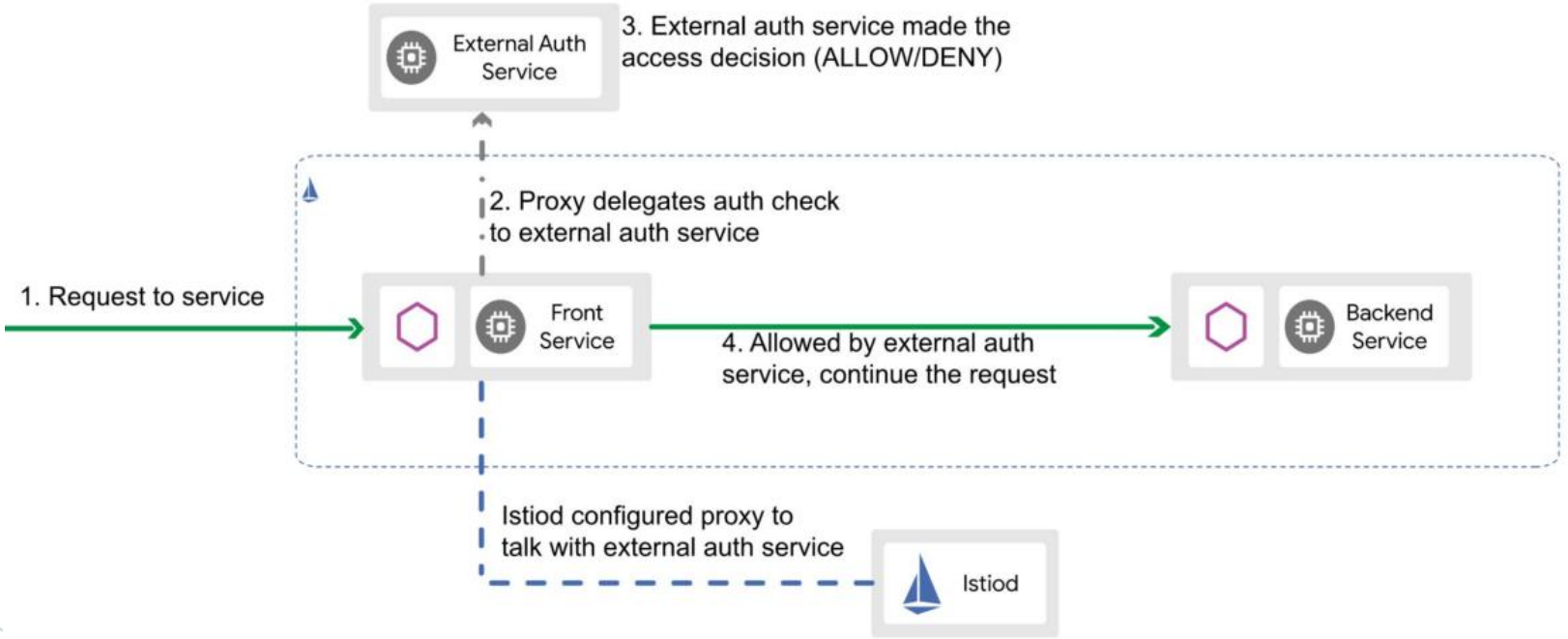
Using “External Authorization” to trigger validate.

Version 2

Advantage:

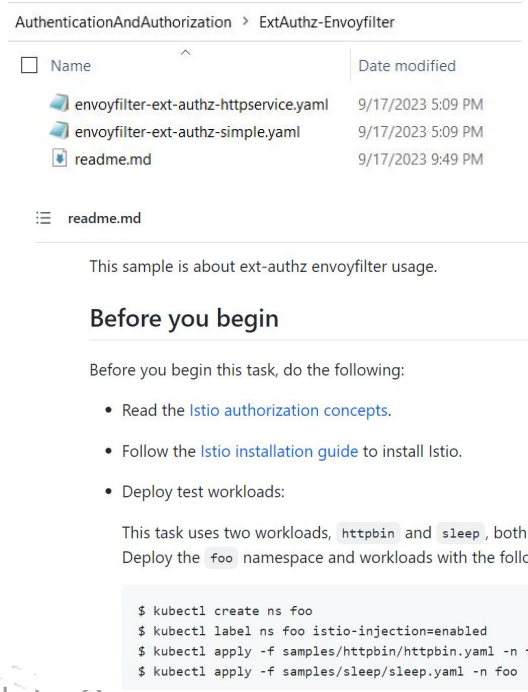
- Do not use *Developer Portal* with Istio client-go , thus no upgradation incompatible issue.
- Use *Helm Charts template + Flux* for request authentication automation, flexible and less error-prone.
- **Put all authorization logic into single check method of Authz service**, logic is simpler.
- Use "Istio External Authorization" instead of “Envoy ext-auth envoyfilter”
  - Easier usage and simpler troubleshooting
  - Triggering the ext-authz flow conditionally

Istio External Authorization

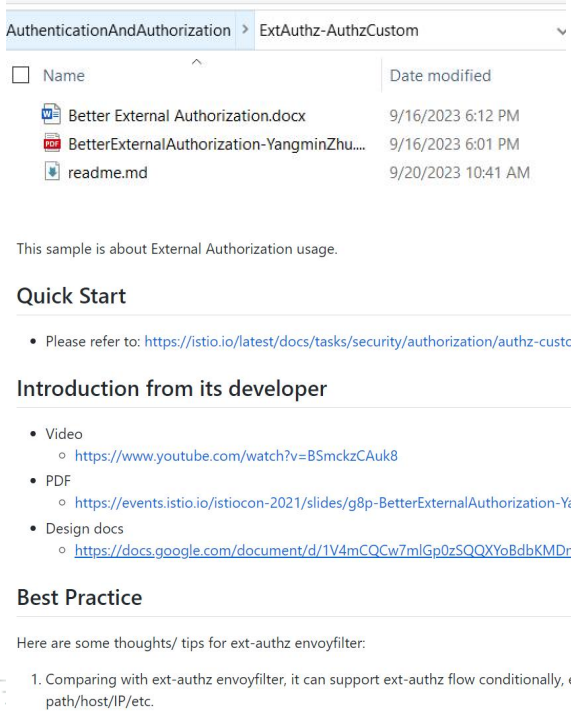


Samples & Best Practice

Envoyfilter Ext-authz



Istio External Authorization



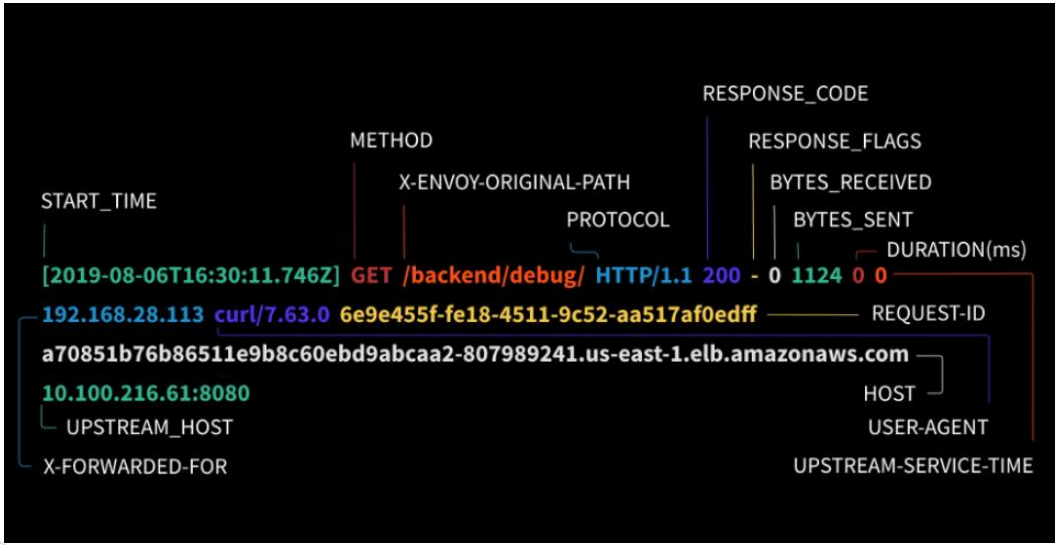
Observability Enhance for tenant

Customize Access Logs

Access Log

Istio(envoy) can generate access logs for service traffic in a configurable set of formats.

- We know API count/ latency/ error from access log
- We monitor and set alert based on access log



Access Log Customization

Requirements:

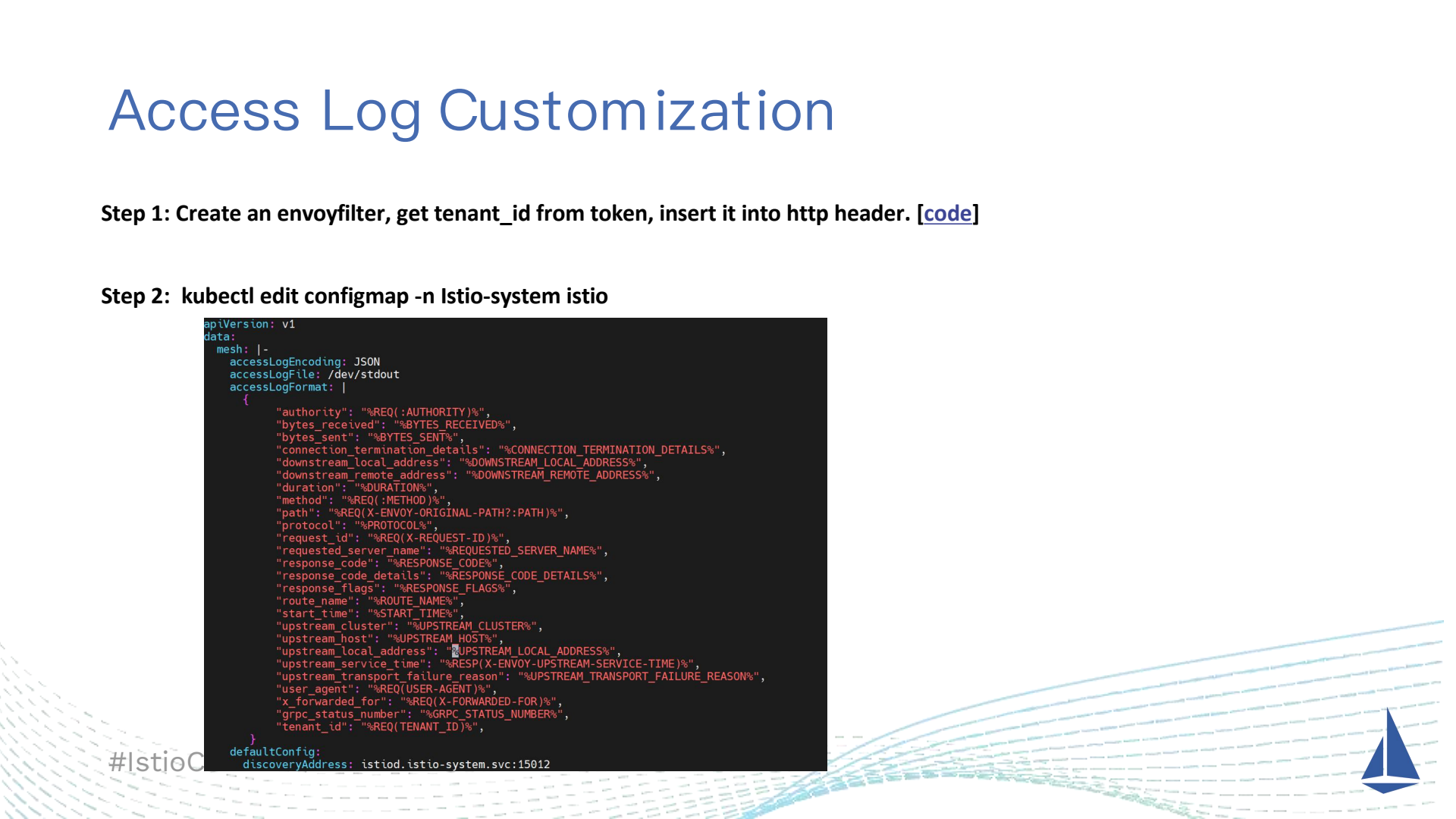
1. Add tenant_id for each API log
    - Calculate API usage for each tenant, to know how much each tenant should pay.
    - Before deprecating the old version of the API, you can know which tenants are still using the old version of the API and notify them to use the new version.
    - Know impact to tenant for each accident.
2. Know grpc status since half of our services are grpc services.
    - Show grpc status in access log, to know grpc api error rate, trigger alert in case error rate is high.

Access Log Customization

Step 1: Create an envoyfilter, get tenant_id from token, insert it into http header. [code]

Step 2: kubectl edit configmap -n Istio-system istio

```
apiVersion: v1
data:
  mesh: |-
    accessLogEncoding: JSON
    accessLogFile: /dev/stdout
    accessLogFormat: |
      {
            "authority": "%REQ(:AUTHORITY)%",
            "bytes_received": "%BYTES_RECEIVED%",
            "bytes_sent": "%BYTES_SENT%",
            "connection_termination_details": "%CONNECTION_TERMINATION_DETAILS%",
            "downstream_local_address": "%DOWNSTREAM_LOCAL_ADDRESS%",
            "downstream_remote_address": "%DOWNSTREAM_REMOTE_ADDRESS%",
            "duration": "%DURATION%",
            "method": "%REQ(:METHOD)%",
            "path": "%REQ(X-ENVOY-ORIGINAL-PATH?:PATH)%",
            "protocol": "%PROTOCOL%",
            "request_id": "%REQ(X-REQUEST-ID)%",
            "requested_server_name": "%REQUESTED_SERVER_NAME%",
            "response_code": "%RESPONSE_CODE%",
            "response_code_details": "%RESPONSE_CODE_DETAILS%",
            "response_flags": "%RESPONSE_FLAGS%",
            "route_name": "%ROUTE_NAME%",
            "start_time": "%START_TIME%",
            "upstream_cluster": "%UPSTREAM_CLUSTER%",
            "upstream_host": "%UPSTREAM_HOST%",
            "upstream_local_address": "%UPSTREAM_LOCAL_ADDRESS%",
            "upstream_service_time": "%RESP(X-ENVOY-UPSTREAM-SERVICE-TIME)%",
            "upstream_transport_failure_reason": "%UPSTREAM_TRANSPORT_FAILURE_REASON%",
            "user_agent": "%REQ(USER-AGENT)%",
            "x_forwarded_for": "%REQ(X-FORWARDED-FOR)%",
            "grpc_status_number": "%GRPC_STATUS_NUMBER%",
            "tenant_id": "%REQ(TENANT_ID)%",
      }
    defaultConfig:
      discoveryAddress: istiod.istio-system.svc:15012
```

Access Log Customization

Test:

```
$ curl -I $gateway_url/productpage?id=13570 -H "Authorization: Bearer $token"
```

Token:

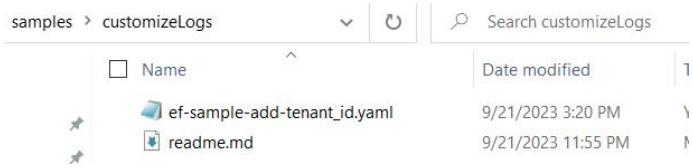
PAYLOAD: DATA


```
{
  "sub": "1234567890",
  "name": "John Doe",
  "tenant_id": "tenant0002_fromtoken",
  "iat": 1516239022
}
```


Logs:


```
$ kubectl logs -n istio-system istio-ingressgateway-7485484874-gzz9s | grep "id=13570" | grep "{" | jq .
{
  "user_agent": "curl/7.68.0",
  "response_code": 200,
  "upstream_transport_failure_reason": null,
  "authority": "a37a73937493a427db222f8deecd65ca-1310205472.us-east-1.elb.amazonaws.com",
  "protocol": "HTTP/1.1",
  "upstream_host": "192.168.30.230:9080",
  "x_forwarded_for": "192.168.1.61",
  "start_time": "2023-09-21T16:21:02.809Z",
  "connection_termination_details": null,
  "response_flags": "-",
  "tenant_id": "tenant0002_fromtoken",
  "upstream_local_address": "192.168.48.162:37810",
  "route_name": null,
  "request_id": "19f38af1-b668-4837-9448-8f49fb57c52a",
  "upstream_service_time": "27",
  "downstream_remote_address": "192.168.1.61:54975",
  "bytes_sent": 0,
  "grpc_status_number": 2,
  "bytes_received": 0,
  "upstream_cluster": "outbound|9080||productpage.default.svc.cluster.local",
  "method": "HEAD",
  "duration": 29,
  "requested_server_name": null,
  "response_code_details": "via_upstream",
  "path": "/productpage?id=13570",
  "downstream_local_address": "192.168.48.162:8080"
}
```


Samples Code



[View Details]

This sample is about customize logs, adding tenant_id, grpc_status.

Before you begin

1. Setup Istio in a Kubernetes cluster by following the instructions in the Installation Guide.
2. Deploy the Bookinfo sample application.
3. Had better remove enovyfilter from ratelimit sample, to make logs clear.

Customize Access Logs For tenant

1. Create envoyfilter to generate tenant_id from token.

```
kubectl apply -f ./ef-sample-add-tenant_id.yaml
```

2. Edit serice mesh in istio configmap.

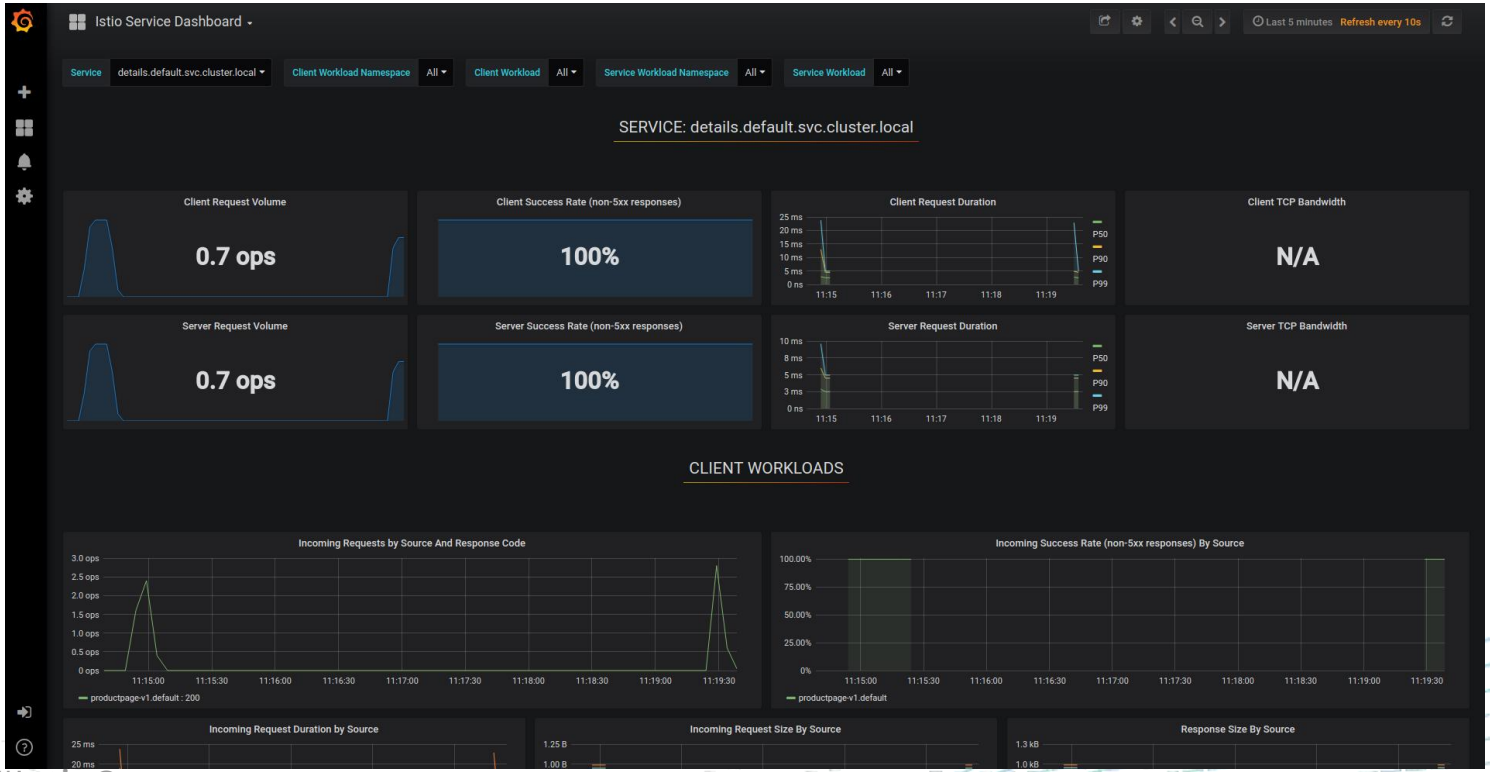
```
$ kubectl edit configmap -n istio-system istio

data:
  mesh: |-
    ### Add logs config begin
    accessLogEncoding: JSON
    accessLogFile: /dev/stdout
```


Observability Enhance for tenant

Customize Istio Metrics

Istio Metrics



Istio Metrics Customization

Requirements:

- Add tenant_id to istio_requests_total metrics

Implement for Metrics Customize

Step 1: Create an envoyfilter, get tenant_id from token, insert it into http header.

Step 2: kubectl edit cm -n Istio-system Istio

```
apiVersion: v1
data:
  mesh: |-
    defaultConfig:
      extraStatTags:
        - tenant_id
```

Step 3: kubectl apply -f telemetry.yaml

```
apiVersion: telemetry.istio.io/v1alpha1
kind: Telemetry
metadata:
  name: global-metrics
  namespace: istio-system
spec:
  metrics:
  - overrides:
    - tagOverrides:
        tenant_id:
          operation: UPSERT
          value: request.headers["tenant_id"]
    providers:
    - name: prometheus
```


Test for Metrics Customize

Test:

```
$ curl -I $gateway_url/productpage?id=13570 -H "Authorization: Bearer $token"
```

Token:

PAYLOAD: DATA

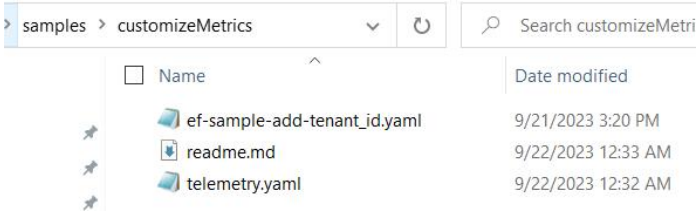

```
{
  "sub": "1234567890",
  "name": "John Doe",
  "tenant_id": "tenant0002_fromtoken",
  "iat": 1516239022
}
```


Metrics:

```
$ k exec -ti productpage-v1-75875cf969-nsv55 -c istio-proxy -- curl -sS 'localhost:15000/stats/prometheus' | grep istio_requests_total
```


```
istio_requests_total{reporter="destination",source_workload="istio-ingressgateway",source_canonical_service="istio-ingressgateway",source_canonical_revision="latest",source_workload_namespace="istio-system",source_principal="spiffe://cluster.local/ns/istio-system/sa/istio-ingressgateway-service-account",source_app="istio-ingressgateway",source_version="unknown",source_cluster="Kubernetes",destination_workload="productpage-v1",destination_workload_namespace="default",destination_principal="spiffe://cluster.local/ns/default/sa/bookinfo-productpage",destination_app="productpage",destination_version="v1",destination_service="productpage.default.svc.cluster.local",destination_canonical_service="productpage",destination_canonical_revision="v1",destination_service_name="productpage",destination_service_namespace="default",destination_cluster="Kubernetes",request_protocol="http",response_code="200",grpc_response_status="",response_flags="-",connection_security_policy="mutual_tls",tenant_id="tenant0002_fromtoken"} 4
```

Samples Code



View Details

This sample is about customize metrics, adding tenant_id.

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1. Create envoyfilter to generate tenant_id from token.

```
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```

2. Edit serice mesh in istio configmap.

```
$ kubectl edit configmap -n istio-system istio

data:
  mesh: |-

    defaultConfig:
      ### Add metrics config begin
      extraStatTags:
       - tenant_id
      ### Add metrics config end
      ... ...
```

3. Create telemetry for new added metrics.

```
$ kubectl apply -f telemetry.yaml
```

Q & A
Thank you!

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#IstioCon