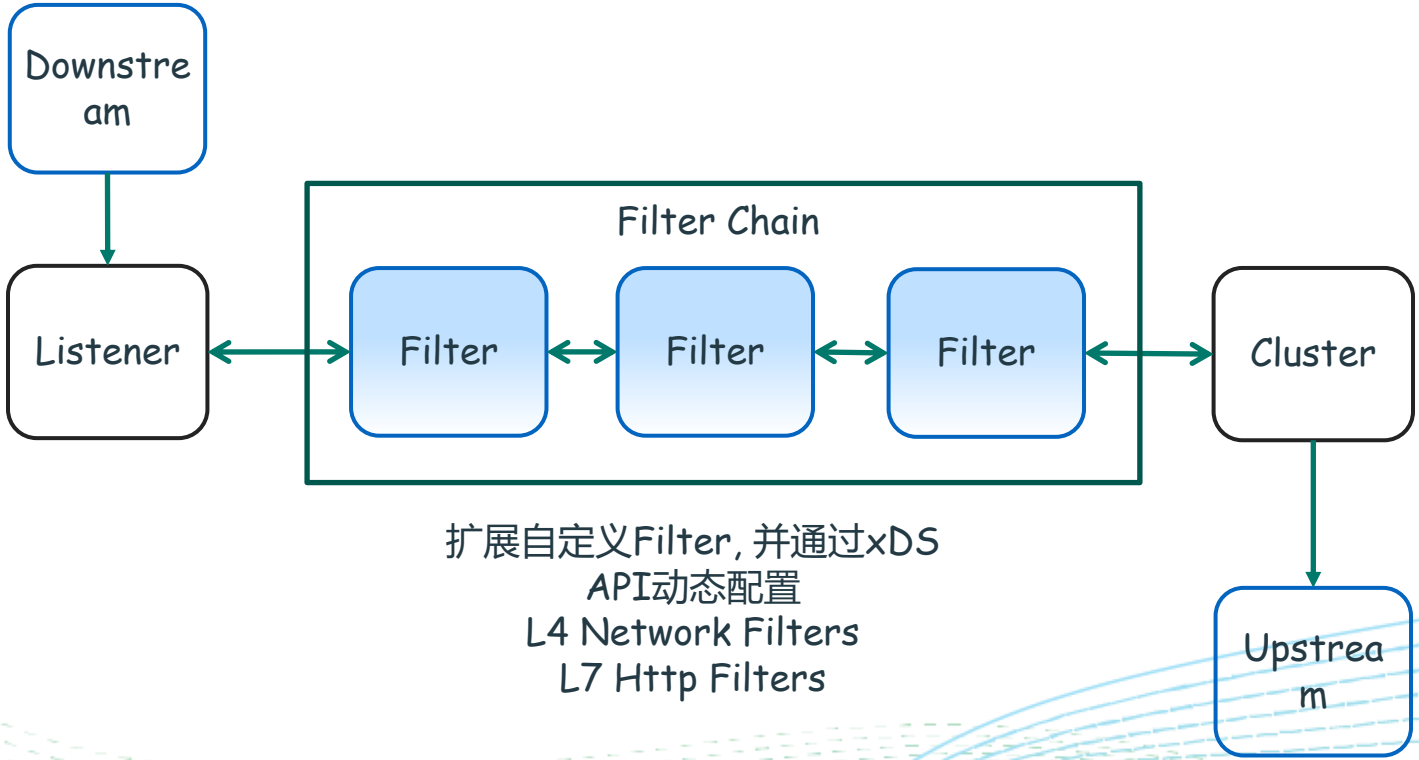
Extending service mesh capabilities using a streamlined way based on WASM and ORAS

王夕宁 | 阿里云服务网格ASM

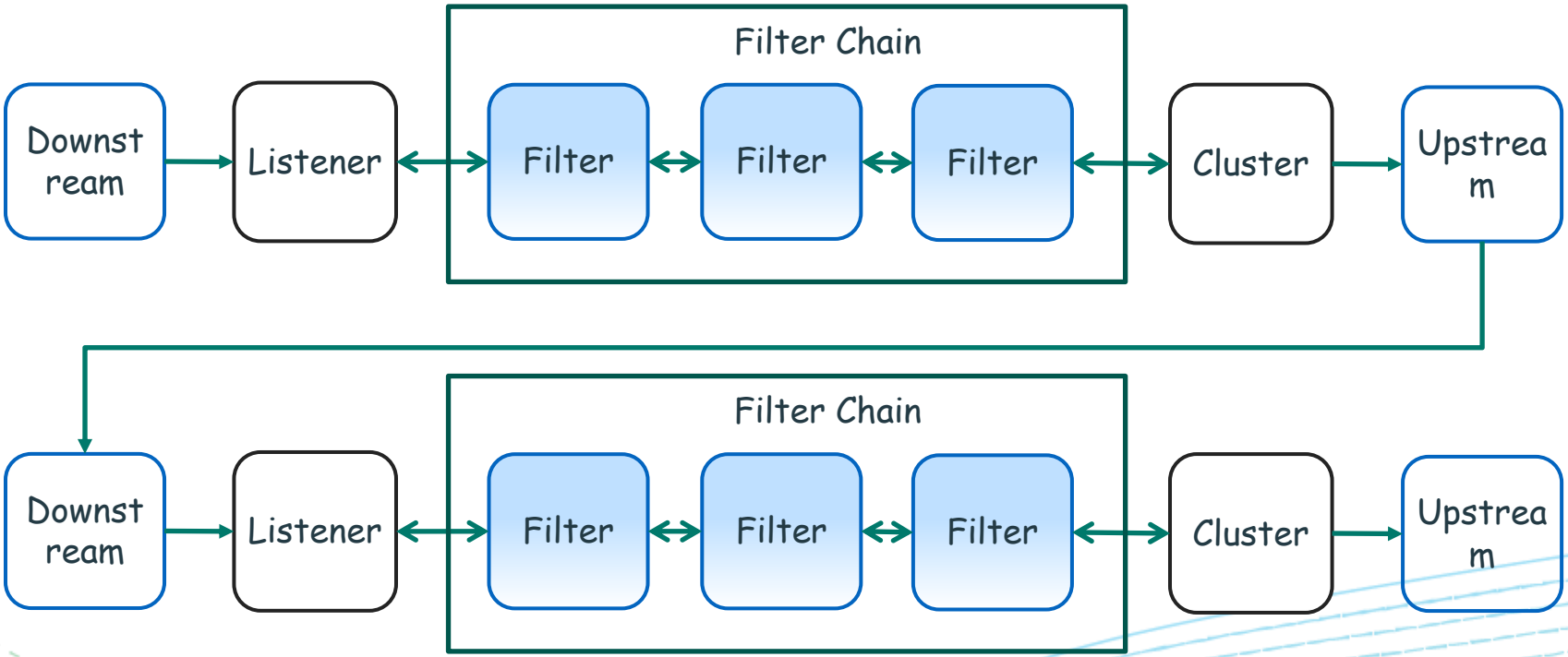
IstioCon

#IstioCon

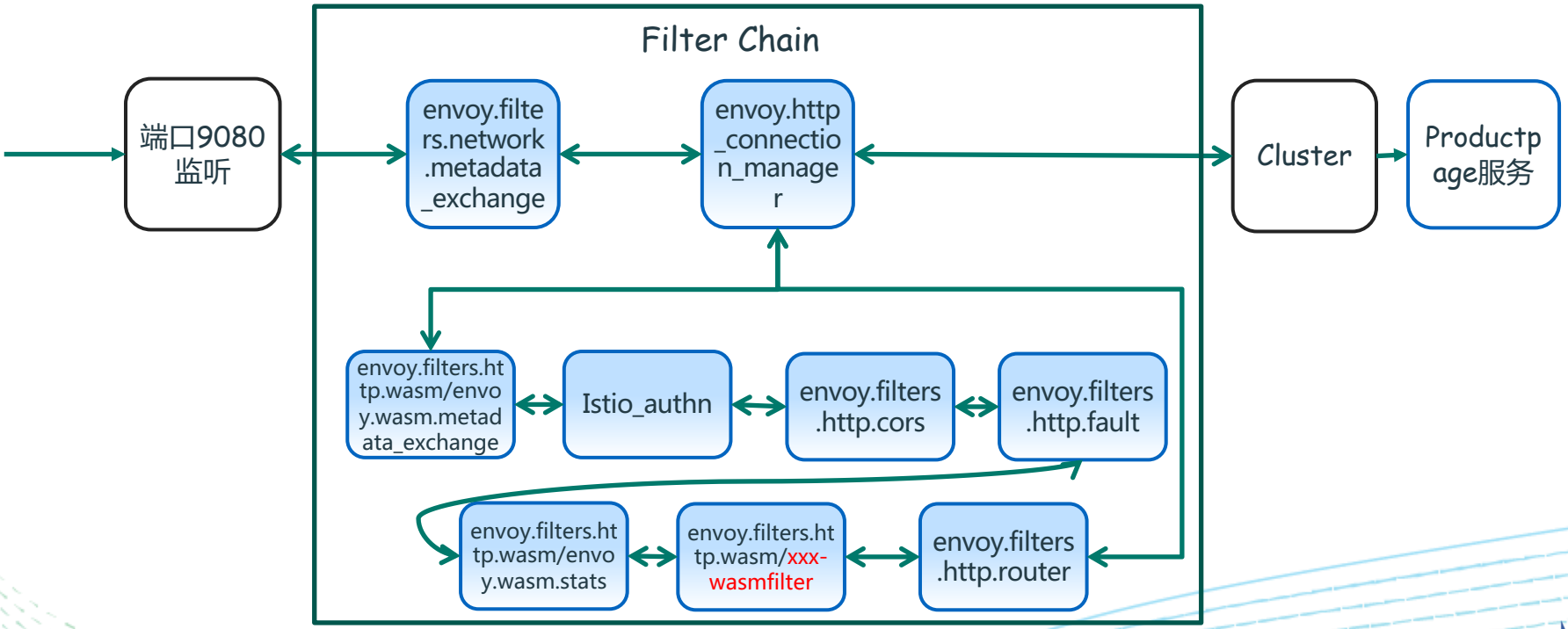
Envoy's Filter Chain



Listener & Filters before outbound services



实际示例中用到的Envoy Filters



kubectl exec -it [productpage-xxx] -c istio-proxy curl localhost:15000/config_dump

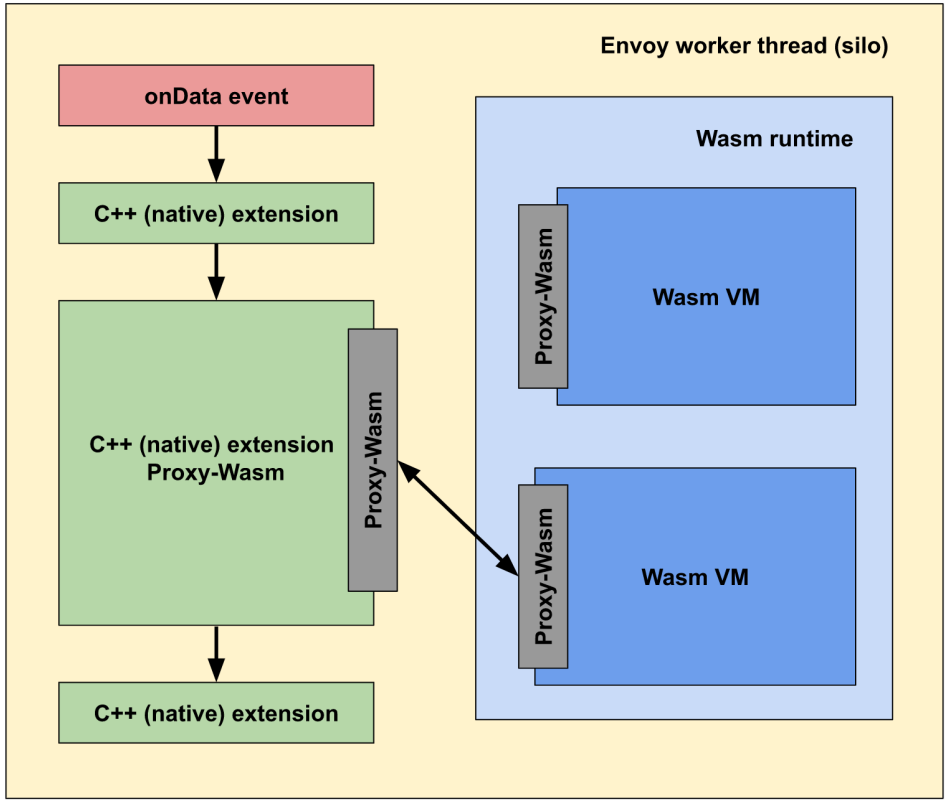
添加新Filter的方式

- Built-in Filter & Community Provided:
  - https://www.envoyproxy.io/docs/envoy/latest/configuration/http/http_filters/http_filters
  - ....
- 自定义开发：
  - 静态预编译：
    - 将其他过滤器集成到Envoy的源代码中，并编译新的Envoy版本。
    - 这种方法的缺点是您需要维护Envoy版本，并不断使其与官方发行版保持同步。
    - 此外，由于Envoy是用C++实现的，因此新开发的过滤器也必须用C++实现。
  - 动态运行时加载：
    - 在运行时将新的过滤器动态加载到Envoy代理中。
    - 简化了扩展Envoy的过程, 这种解决方案通常使用WebAssembly（WASM）的新技术，它是一种有效的可移植二进制指令格式，提供了可嵌入和隔离的执行环境。

使用Wasm for Proxy

- Pros
  - 敏捷性：过滤器可以动态加载到正在运行的Envoy进程中，而无需停止或重新编译。
  - 可维护性：不必更改Envoy自身基础代码库即可扩展其功能。
  - 多样性：可以将流行的编程语言（例如C/C++和Rust）编译为WASM，因此开发人员可以选择实现过滤器的编程语言。
  - 可靠性和隔离性：过滤器会被部署到VM沙箱中，因此与Envoy进程本身是隔离的；即使当WASM Filter出现问题导致崩溃时，它也不会影响Envoy进程。
  - 安全性：过滤器通过预定义API与Envoy代理进行通信，因此它们可以访问并只能修改有限数量的连接或请求属性。
- Cons
  - 性能约为C++编写的原生静态编译的Filter的70%;
  - 由于需要启动一个或多个WASM虚拟机，因此会消耗一定的内存使用量;
  - The WebAssembly ecosystem is still young;

Wasm in Envoy Proxy



- Wasm动态加载
- 一致性校验:
  - https://github.com/proxy-wasm/spec
- 内置的Wasm runtime
  - ~20MB for WAVM
  - ~10MB for V8
- 事件驱动模型
- 兼容native filter调用方式

Example Wasm filter configuration

- 下发到Envoy Proxy侧的配置

```
name: envoy.filters.http.wasm
typed_config:
  "@type": type.googleapis.com/envoy.extensions.filters.http.wasm.v3.Wasm
  config:
    config:
      name: "my_plugin"
      vm_config:
        runtime: "envoy.wasm.runtime.v8"
        code:
          local:
            filename: "/etc/envoy_filter_http_wasm_example.wasm"
        allow_precompiled: true
```


OCI Registry As Storage

- OCI Artifacts项目的参考实现, 可显著简化OCI注册库中任意内容的存储;
- 可以使用ORAS API/SDK Library来构建自定义工具,
  - 将WebAssembly模块推入到OCI注册库中;
  - 或者从OCI注册库中拉取WebAssembly模块;
- oras cli类似于docker cli

```
Usage:
  oras [command]

Available Commands:
  help        Help about any command
  login       Log in to a remote registry
  logout      Log out from a remote registry
  pull        Pull files from remote registry
  push        Push files to remote registry
  version     Show the oras version information

Flags:
  -h, --help   help for oras

Use "oras [command] --help" for more information about a command.
```

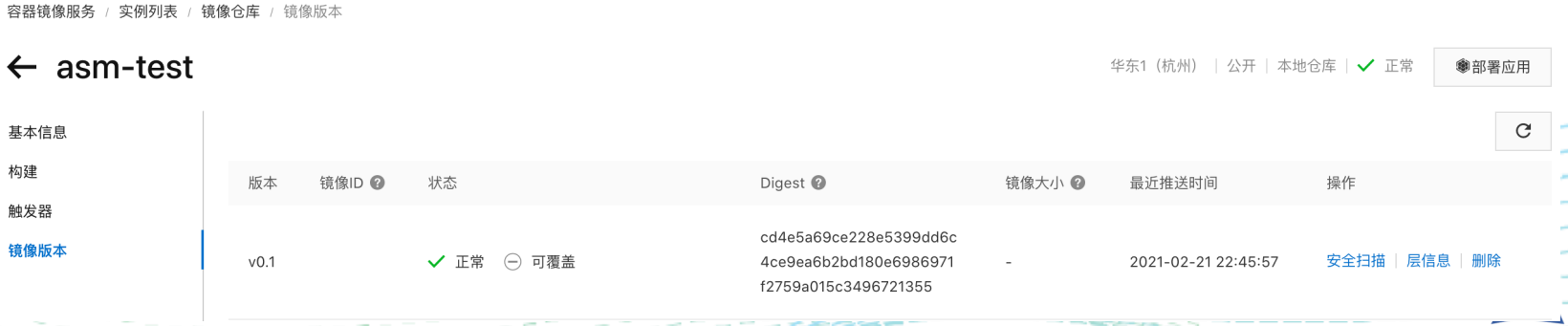

在ACR EE中使用ORAS CLI

- 阿里云容器镜像服务企业版ACR EE作为企业级云原生应用制品管理平台，提供容器镜像、Helm Chart以及符合OCI规范的制品的生命周期管理；

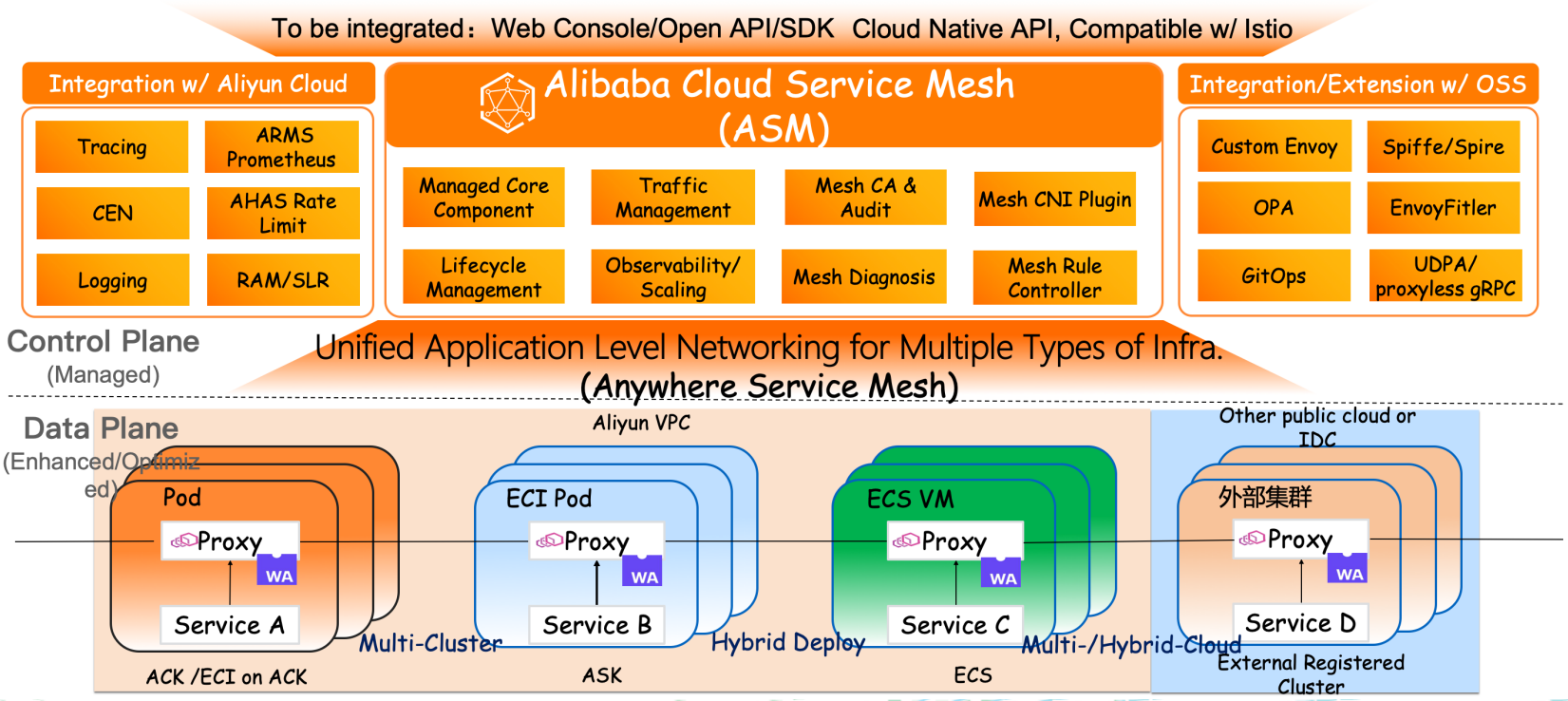
- oras login --username=<登录账号> acree-1-registry.cn-hangzhou.cr.aliyuncs.com

通过oras push命令推送

- oras push acree-1-registry.cn-hangzhou.cr.aliyuncs.com/asm/asm-test:v0.1 --manifest-config runtime-config.json:application/vnd.module.wasm.config.v1+json example-filter.wasm:application/vnd.module.wasm.content.layer.v1+wasm
  - Wasm Artifact镜像规范参考
    - https://github.com/solo-io/wasm/blob/master/spec/README.md
    - https://istio.io/latest/blog/2020/wasmhub-istio/
- Wasm filter被推送到ACR EE注册库中

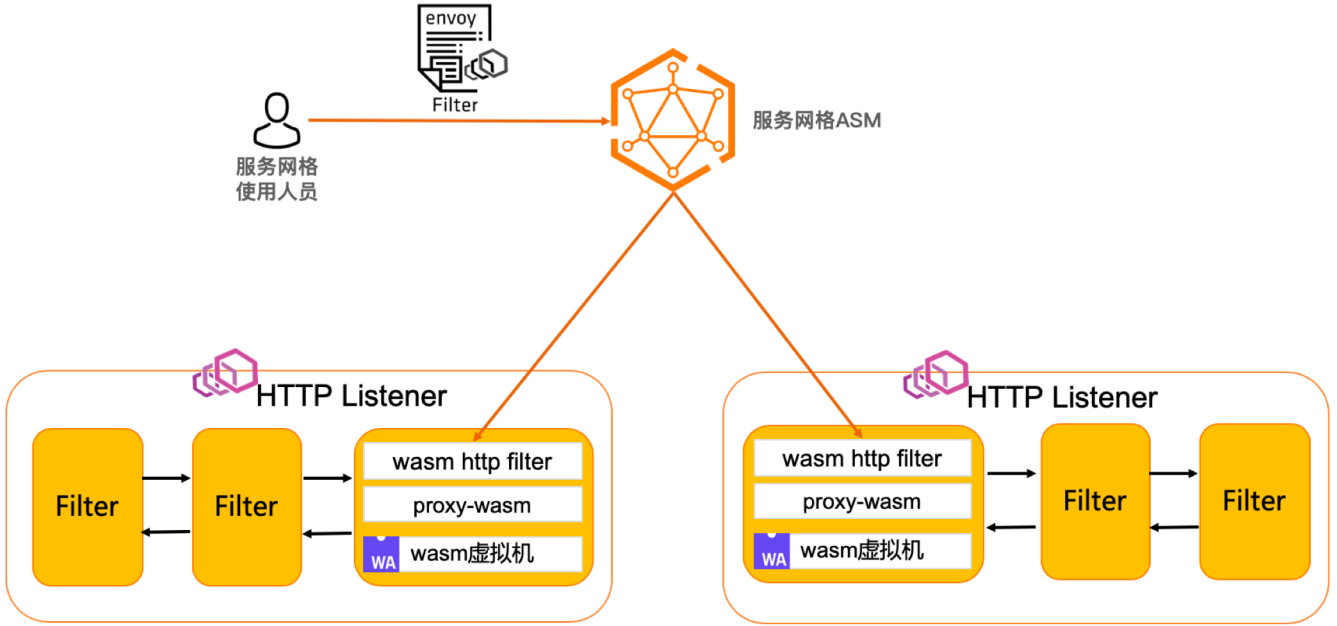


阿里云服务网格ASM架构



在阿里云服务网格ASM中使用WASM

- 进行统一的代理扩展插件的生命周期管理



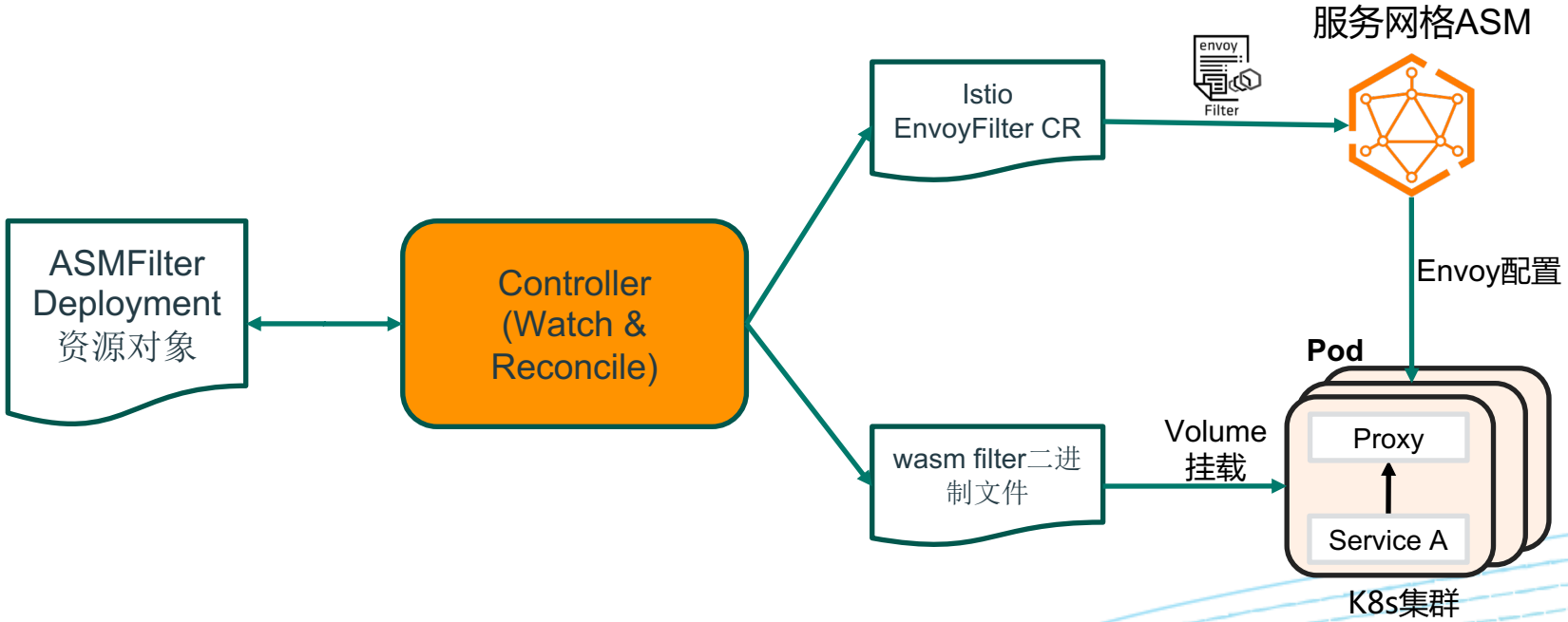
在ASM中启用wasm部署功能

- aliyun servicemesh UpdateMeshFeature --ServiceMeshId=xxxxxx --WebAssemblyFilterEnabled=true
  - 部署一个DaemonSet(asmwasm-controller)到K8s集群中
  - asmwasm-controller监听一个configmap, 该configmap存放要拉取的wasm filter的地址, 例如： acree-1-registry.cn-hangzhou.cr.aliyuncs.com/asm/sample:v0.1
  - 如果需要授权认证, 该asmwasm-controller会根据定义的pullSecret值获得相应的secret值;
  - 然后,调用oras API从注册库中动态拉取wasm filter;
  - 该asmwasm-controller使用HostPath方式挂载volume, 所以拉取的wasm filter会落盘到对应的节点上;

创建私钥仓库登录Secret

- 获取私有仓库登录信息之后，按照如下命令创建Secret
  - kubectl create secret generic asmwasm-cache -n istio-system --from-file=.dockerconfigjson=myconfig.json --type=kubernetes.io/dockerconfigjson

在ASM中WASM filter的生命周期管理



ASMFilterDeployment CR示例

```yaml
apiVersion: istio.alibabacloud.com/v1beta1
kind: ASMFilterDeployment
metadata:
  name: details-v1-wasmfiltersample
spec:
  deployment:
    kind: Deployment
    labels:
      app: details
      version: v1
  filter:
    parameters: '{"name":"hello","value":"details"}'
    image: 'acree-1-registry.cn-hangzhou.cr.aliyuncs.com/asm/asm-test:v0.1'
    imagePullOptions:
      pullSecret: 'asmwasm-cache'
    rootID: 'my_root_id'
    id: 'details-v1-wasmfiltersample.default'

```

生成的Istio Envoy Filter资源(1)

```
apiVersion: networking.istio.io/v1alpha3
kind: EnvoyFilter
metadata:
 ....
spec:
   configPatches:
   - applyTo: HTTP_FILTER
      match: ....
      patch:  ....
   workloadSelector:
       labels:
          app: productpage
          version: v1
```


```
match:
  context: SIDECAR_INBOUND
  listener:
    filterChain:
      filter:
        name: envoy.http_connection_manager
        subFilter:
          name: envoy.router
```


生成的Istio Envoy Filter资源(2)

```yaml
apiVersion: networking.istio.io/v
kind: EnvoyFilter
metadata:
 ....
spec:
   configPatches:
   - applyTo: HTTP_FILTER
      match: ....
      patch: ....
   workloadSelector:
      labels:
         app: productpage
         version: v1
```


```yaml
patch:
  operation: INSERT_BEFORE
  value:
    name: envoy.filters.http.wasm
    typed_config:
      '@type': type.googleapis.com/udpa.type.v1.TypedStruct
      type_url: type.googleapis.com/envoy.extensions.filters.http.wasm.v3.Wasm
      value:
        config:
          name: details-v1-wasmfiltersample.default
          rootId: my_root_id
          vmConfig:
            allow_precompiled: true
            code:
              local:
                filename: >-
                  /var/local/lib/wasm-filters/c49d54bb6751531e89c110054ec74ab5
            configuration:
              '@type': type.googleapis.com/google.protobuf.StringValue
              value: '{"name":"hello","value":"productpage"}'
            runtime: envoy.wasm.runtime.v8
            vmId: details-v1-wasmfiltersample.default
```

更新后的Deployment

- 以hostpath方式挂载wasm filter文件到Proxy容器

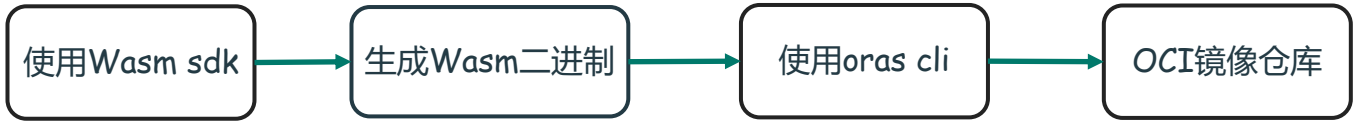
```
apiVersion: extensions/v1beta1
kind: Deployment
metadata:
....
spec:
   ....
   template:
      metadata:
         annotations:
            sidecar.istio.io/userVolume: '[{"name":"wasmfilters-
dir","hostPath":{"path":"/var/local/lib/wasm-filters"}}]'
            sidecar.istio.io/userVolumeMount:
'[{"mountPath":"/var/local/lib/wasm-filters","name":"wasmfilters-dir"}]'
```


执行结果, wasm filter生效

```
d:/$ curl -v details:9080/details/123
*   Trying 172.21.9.191...
* TCP_NODELAY set
* Connected to details (172.21.9.191) port 9080 (#0)
> GET /details/123 HTTP/1.1
> Host: details:9080
> User-Agent: curl/7.58.0
> Accept: */*
>
< HTTP/1.1 200 OK
< content-type: application/json
< server: istio-envoy
< date: Mon, 22 Feb 2021 14:49:01 GMT
< content-length: 180
< x-envoy-upstream-service-time: 1
< resp-header-demo: added by our filter
<
* Connection #0 to host details left intact
{"id":123,"author":"William Shakespeare","year":1595,"type":"paperback","pages":200,"publisher":"Pub
anguage":"English","ISBN-10":"1234567890","ISBN-13":"123-1234567890"}istio-proxy@productpage-v1-658b
```


Summary & Tips

- 开发阶段



- 部署运行阶段

1.可以登录到proxy container进行查看 wasm filter是否挂载成功
2.调整wasm log level： curl -X POST http://localhost:15000/logging?wasm=debug

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Thank you!