CloudWeGo

Bookinfo

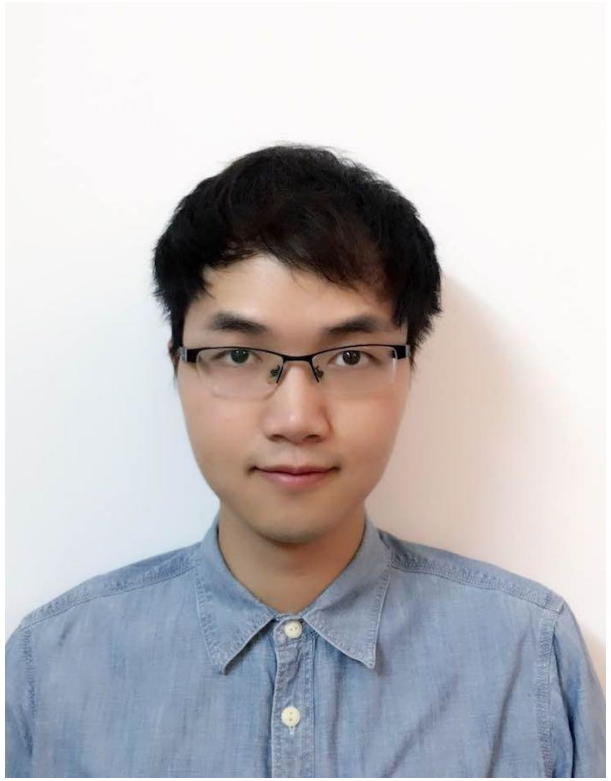
基于 CloudWeGo 重写 Istio 经典 demo

胡文（基础架构-火山引擎）

CloudWeGo 开源团队出品

2023/02/22

个人介绍



胡文

- 字节跳动基础架构研发工程师
- 长期耕耘在 可观测性、eBPF、ServiceMesh、服务框架等领域
- 云原生相关开源社区爱好者

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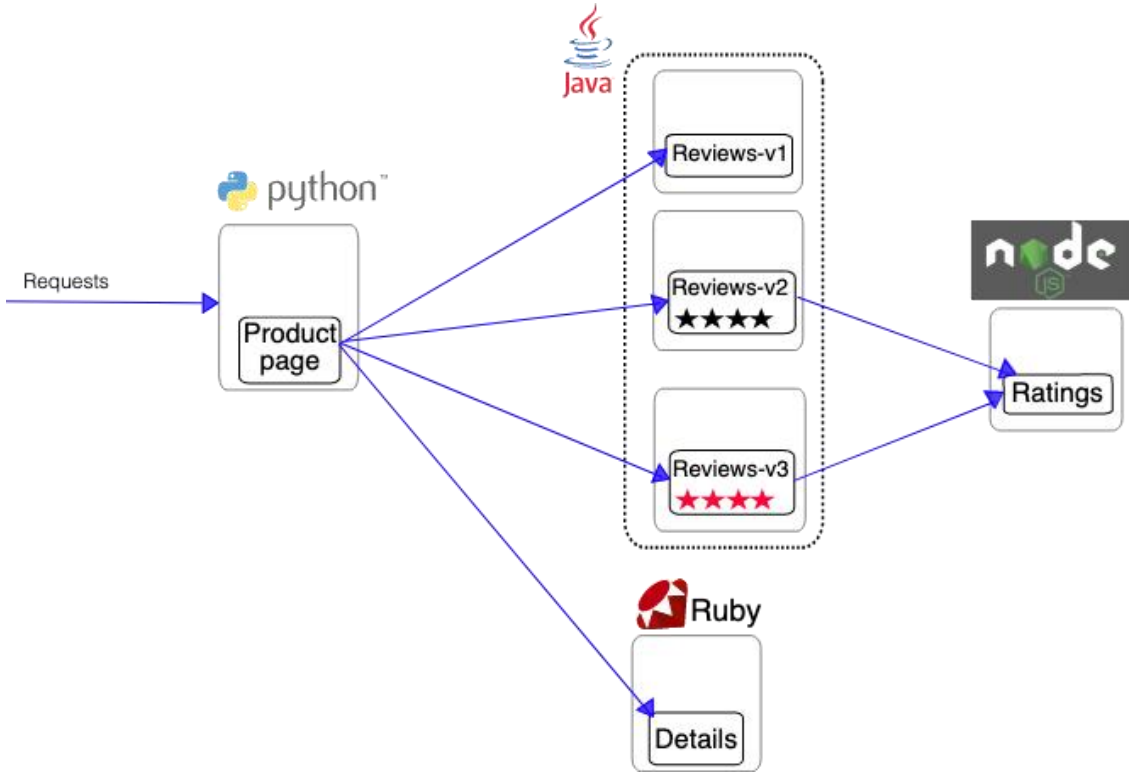
01 工程设计

项目介绍

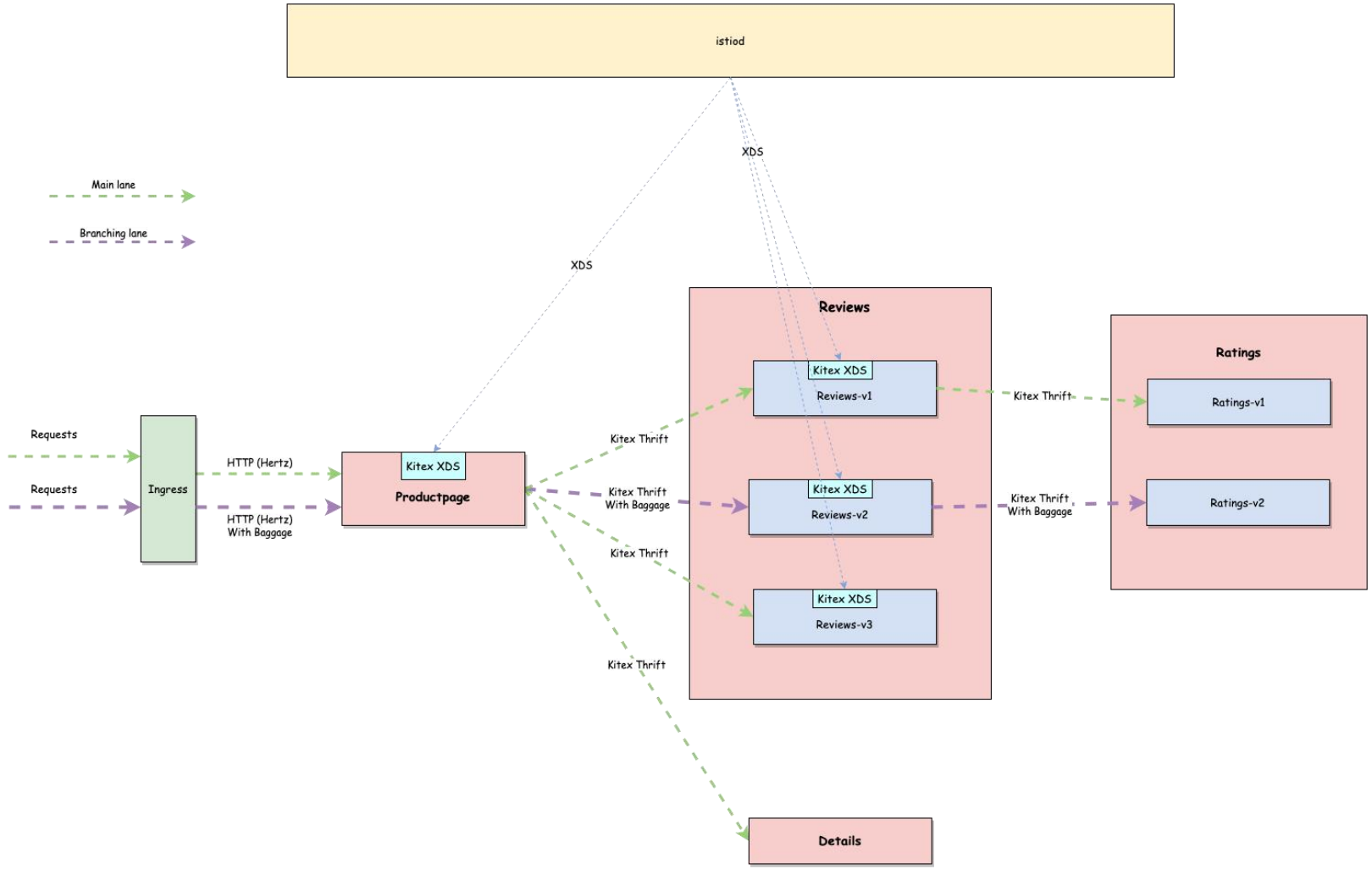
Bookinfo 是 Istio 官方提供的一个经典 Demo，用于演示多种 Istio 特性。

本项目则是基于 CloudWeGo技术栈来重写该 Demo，旨在演示 CloudWeGo 如何与 Istio、OpenTelemetry 等开源生态结合。

项目地址：https://github.com/cloudwego/biz-demo/tree/main/bookinfo



架构设计


istiod
XDS
XDS
Main lane
Branching lane
Requests
Requests
Ingress
HTTP (Hertz)
HTTP (Hertz)
With Baggage
Kitex XDS
Productpage
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Reviews
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Reviews-v3
Kitex Thrift
Kitex Thrift
With Baggage
Ratings
Ratings-v1
Ratings-v2
Details

工程结构设计

```
1  ├── Makefile
2  ├── README.md
3  ├── README_CN.md
4  ├── build
5  │   └── Dockerfile
6  ├── cmd
7  │   ├── details
8  │   ├── main.go
9  │   ├── productpage
10 │   ├── ratings
11 │   └── reviews
12 ├── conf
13 ├── idl
14 ├── internal
15 │   ├── handler
16 │   ├── server
17 │   └── service
18 ├── kitex_gen
19 ├── manifest
20 │   └── bookinfo
21 └── pkg
```

Makefile 规范设计

```
# The old school Makefile, following are required targets. The Makefile is written
# to allow building multiple binaries. You are free to add more targets or change
# existing implementations, as long as the semantics are preserved.
#
#   make              - default to 'build' target
#   make lint         - code analysis
#   make test         - run unit test (or plus integration test)
#   make build        - alias to build-local target
#   make build-local  - build local binary targets
#   make build-linux  - build linux binary targets
#   make container    - build containers
#   $ docker login registry -u username -p xxxxx
#   make push         - push containers
#   make clean        - clean up targets   CoderPoet, 2022/9/19, 3:05 上午 • feat(bookinfo): add ma
#
# Not included but recommended targets:
#   make e2e-test
#
# The makefile is also responsible to populate project version information.
#
```

需要包含的

- 代码检查
- 单元测试
- 二进制构建
- 跨平台编译构建
- 镜像构建
- 镜像推送
- targets 清理

建议包含的

- e2e 测试

Makefile 规范设计

```
# more info about `GOGC` env: https://github.com/golangci/golangci-lint#memory-usage-of-golangci-lint
lint: $(GOLANGCI_LINT) $(HELM_LINT)
	@$(GOLANGCI_LINT) run
	@bash hack/helm-lint.sh

$(GOLANGCI_LINT):
	curl -sfL https://install.goreleaser.com/github.com/golangci/golangci-lint.sh | sh -s -- -b $(BIN_DIR) v1.23.6

$(HELM_LINT):
	curl https://raw.githubusercontent.com/helm/helm/master/scripts/get-helm-3 | sudo bash

test:
	@go test -race -coverprofile=coverage.out ./...
	@go tool cover -func coverage.out | tail -n 1 | awk '{ print "Total coverage: " $$3 }'

build-local:
	@go build -v -o $(OUTPUT_DIR)/$(NAME)                                \
	  -ldflags "-s -w -X $(GOCOMMON)/version.module=$(NAME)              \
	    -X $(GOCOMMON)/version.version=$(VERSION)                        \
	    -X $(GOCOMMON)/version.branch=$(BRANCH)                          \
	    -X $(GOCOMMON)/version.gitCommit=$(GITCOMMIT)                    \
	    -X $(GOCOMMON)/version.gitTreeState=$(GITTREESTATE)              \
	    -X $(GOCOMMON)/version.buildDate=$(BUILDDATE)"                   \
	  $(CMD_DIR);

container:
	@docker build -t $(REGISTRY)/$(IMAGE_NAME):$(VERSION)               \
	  --label $(DOCKER_LABELS)                                           \
	  -f $(BUILD_DIR)/Dockerfile .;
```

CoderPoet, 2022/9/19, 3:05 上午 • feat(bookinfo): add makefile、dockerfile、manifest

Dockerfile 规范设计

```dockerfile
FROM golang:1.16 as builder
COPY . /go/src/github.com/cloudwego/biz-demo/bookinfo
WORKDIR /go/src/github.com/cloudwego/biz-demo/bookinfo
RUN make build-linux

FROM alpine:latest
RUN mkdir -p /app && \
    chown -R nobody:nogroup /app
COPY --from=builder /go/src/github.com/cloudwego/biz-demo/bookinfo/bin/bookinfo /app
COPY --from=builder /go/src/github.com/cloudwego/biz-demo/bookinfo/conf /app/conf

USER        nobody
WORKDIR     /app
ENV         PSM=cwg.bizdemo.bookinfo HERTZ_CONF_DIR=conf HERTZ_LOG_DIR=output/log
ENTRYPOINT  ["/app/bookinfo"]
```

多阶段构建

编译阶段与运行阶段构建分离，减少运行时镜像体积

镜像精简原则

运行时镜像只需要包含二进制可执行文件以及配置目录即可

镜像安全

通常业务服务不需要特权执行，因此使用 USER 指令切换用户，避免在运行时使用 root 用户

02 技术选型

技术栈介绍

技术栈	用途
Kitex、 Hertz	服务端框架
Istio	作为服务网格控制面，负责 xDS 配置下发
Wire	用于依赖注入
OpenTelemetry	用于可观测性，主要包括全链路追踪
Kitex-xDS	实现以 Proxyless 的方式对接服务网格
React、 Arco-design	用于实现 Bookinfo UI 层

框架选型 – Hertz、Kitex

服务	框架	说明
productpage	hertz server、 kitex client	入口服务，对外提供 HTTP 接口； 会调用 details 和 reviews 两个微服务
reviews	kitex、 kitex client	这个微服务中包含了书籍相关的评论； 会调用 ratings 微服务
ratings	kitex	这个微服务中包含了由书籍评价组成的评级信息
details	kitex	这个微服务中包含了书籍的信息

依赖注入（Google Wire）

wire 是 Google 开源的一款依赖注入框架，基于 generate 和静态代码分析来实现

```go
// Handler productpage hertz handler
type Handler struct {
    reviewsClient reviewsservice.Client
    detailsClient detailsservice.Client
}

// New create handler
func New(reviewsClient reviewsservice.Client, detailsClient detailsservice.Client) *Handler {
    return &Handler{reviewsClient: reviewsClient, detailsClient: detailsClient}
}
```

依赖注入（Google Wire）

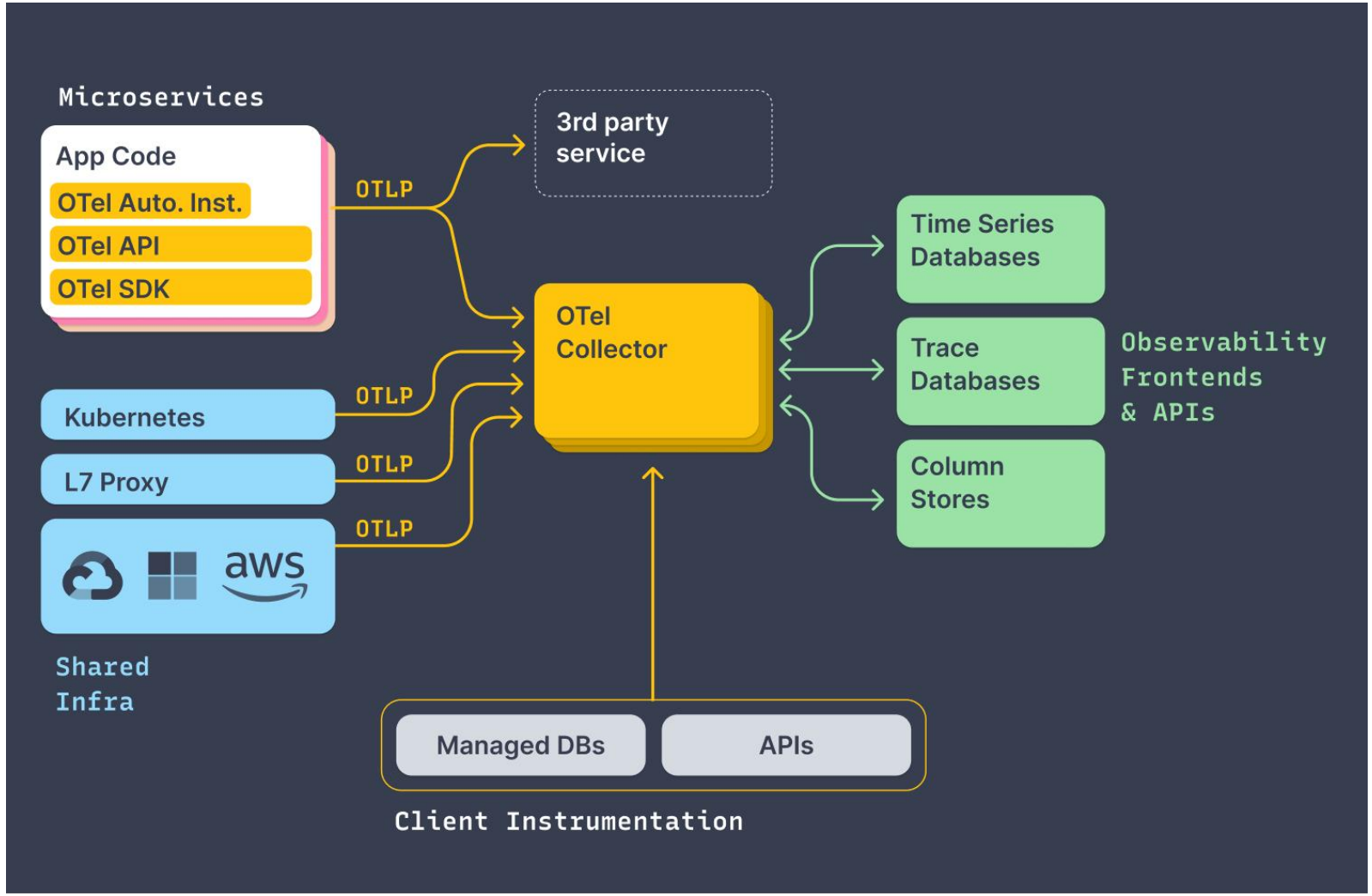
```go
// ReviewClientOptions client options
type ReviewClientOptions struct {
    Endpoint  string `mapstructure:"endpoint"`
    EnableXDS bool   `mapstructure:"enableXDS"`
    XDSAddr   string `mapstructure:"xdsAddr"`
}
  CoderPoet, 2022/9/8, 12:06 下午 • feat(bookinfo): add kitex + hertz bookinfo demo
// DefaultReviewClientOptions default options
func DefaultReviewClientOptions() *ReviewClientOptions {
    return &ReviewClientOptions{
        Endpoint:  "reviews:8082",
        EnableXDS: false,
        XDSAddr:   "istiod.istio-system.svc:15010",
    }
}

// ProvideReviewClient Provide review client
// 1、init xds manager: only init once
// 2、enable xds
// 3、enable opentelemetry
func ProvideReviewClient(opts *ReviewClientOptions) (reviewsservice.Client, error) {
    if opts.EnableXDS {
        if err := xdsmanager.Init(xdsmanager.WithXDSServerAddress(opts.XDSAddr)); err != nil {
            klog.Fatal(err)
        }
        return reviewsservice.NewClient(
            opts.Endpoint, // use svc fqdn
            kclient.WithSuite(tracing.NewClientSuite()),
            kclient.WithXDSSuite(xds.ClientSuite{
                RouterMiddleware: xdssuite.NewXDSRouterMiddleware(
                    xdssuite.WithRouterMetaExtractor(metadata.ExtractFromPropagator),
                ),
```

依赖注入（Google Wire）

```go
// NewServer build server with wire
func NewServer(ctx context.Context) (*Server, error) {
    panic(wire.Build(
        configparser.Default,
        Configure,

        injectors.ProvideReviewClient,
        injectors.ProvideDetailsClient,

        productpage.New,

        wire.FieldsOf(new(*Options),
            fieldNames...: "Server",
            "Reviews",
            "Details",
        ),
        wire.Struct(new(Server), fieldNames...: "*"),
    ))
}
```

```go
//go:build !wireinject
// +build !wireinject

package productpage

import ...

// Injectors from wire.go:

func NewServer(ctx context.Context) (*Server, error) {
    provider := configparser.Default()
    options, err := Configure(provider)
    if err != nil : nil, err ⤴
    serverOptions := options.Server
    reviewClientOptions := options.Reviews
    client, err := injectors.ProvideReviewClient(reviewClientOptions)
    if err != nil : nil, err ⤴
    detailsClientOptions := options.Details
    detailsserviceClient, err := injectors.ProvideDetailsClient(detailsClientOptions)
    if err != nil : nil, err ⤴
    handler := productpage.New(client, detailsserviceClient)   CoderPoet, 2022/9/8, 12
    server := &Server{
        opts:    serverOptions,
        handler: handler,
    }
    return server, nil
}
```

可观测 – OpenTelemetry



OpenTelemetry 提供了一个开源标准和一套可观测框架，用于捕获和导出云原生应用和基础架构中的 Metrics、Traces 和 Logs。

可观测 – OpenTelemetry

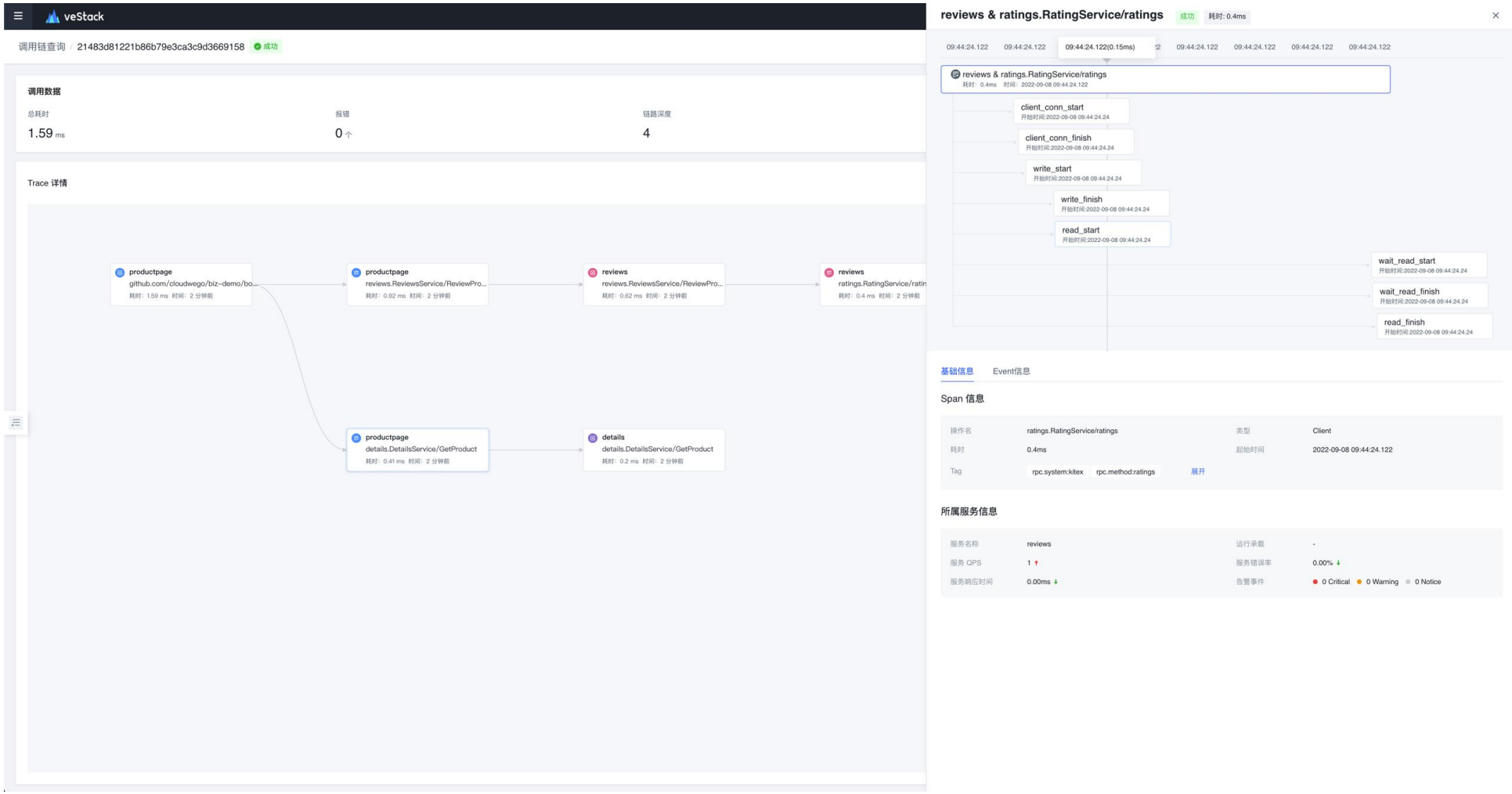
```go
// Run reviews server
func (s *Server) Run(ctx context.Context) error {
    klog.SetLogger(kitexlogrus.NewLogger())
    klog.SetLevel(s.opts.LogLevel.KitexLogLevel())

    p := provider.NewOpenTelemetryProvider(
        provider.WithServiceName(constants.ReviewsServiceName),
        provider.WithInsecure(),
    )
    defer func(p provider.OtelProvider, ctx context.Context) {
        _ = p.Shutdown(ctx)
    }(p, ctx)

    addr, err := net.ResolveTCPAddr( network: "tcp", s.opts.Addr)
    if err != nil {
        klog.Fatal(err)
    }
    svr := reviewsservice.NewServer(
        s.svc,
        server.WithServiceAddr(addr),
        server.WithSuite(tracing.NewServerSuite()),  CoderPoet, 2022/9/8, 12:06 下
    )
    if err := svr.Run(); err != nil {
        klog.Fatal(err)
    }

    return nil
}
```

Kitex、Hertz 已经原生集成了 OpenTelemetry：[hertz-otel、kitex otel]

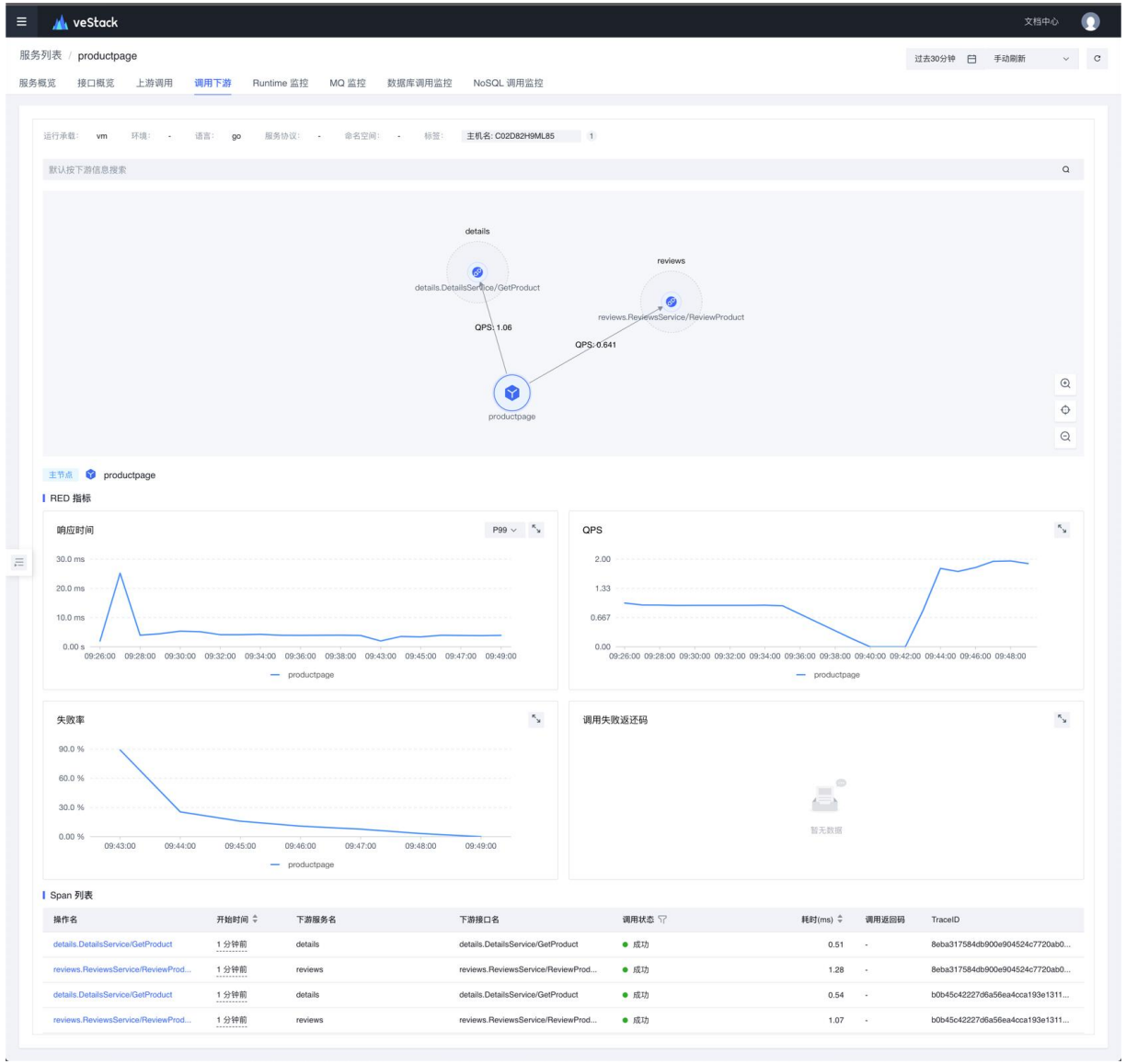
基于这些库，我们可以轻松在业务中集成 OpenTelemetry

例如：在 Kitex 中开启 OpenTelemetry，我们只需要引入对应依赖，初始化默认的 otel provider，并注入对应 suite 即可

可观测 – OpenTelemetry

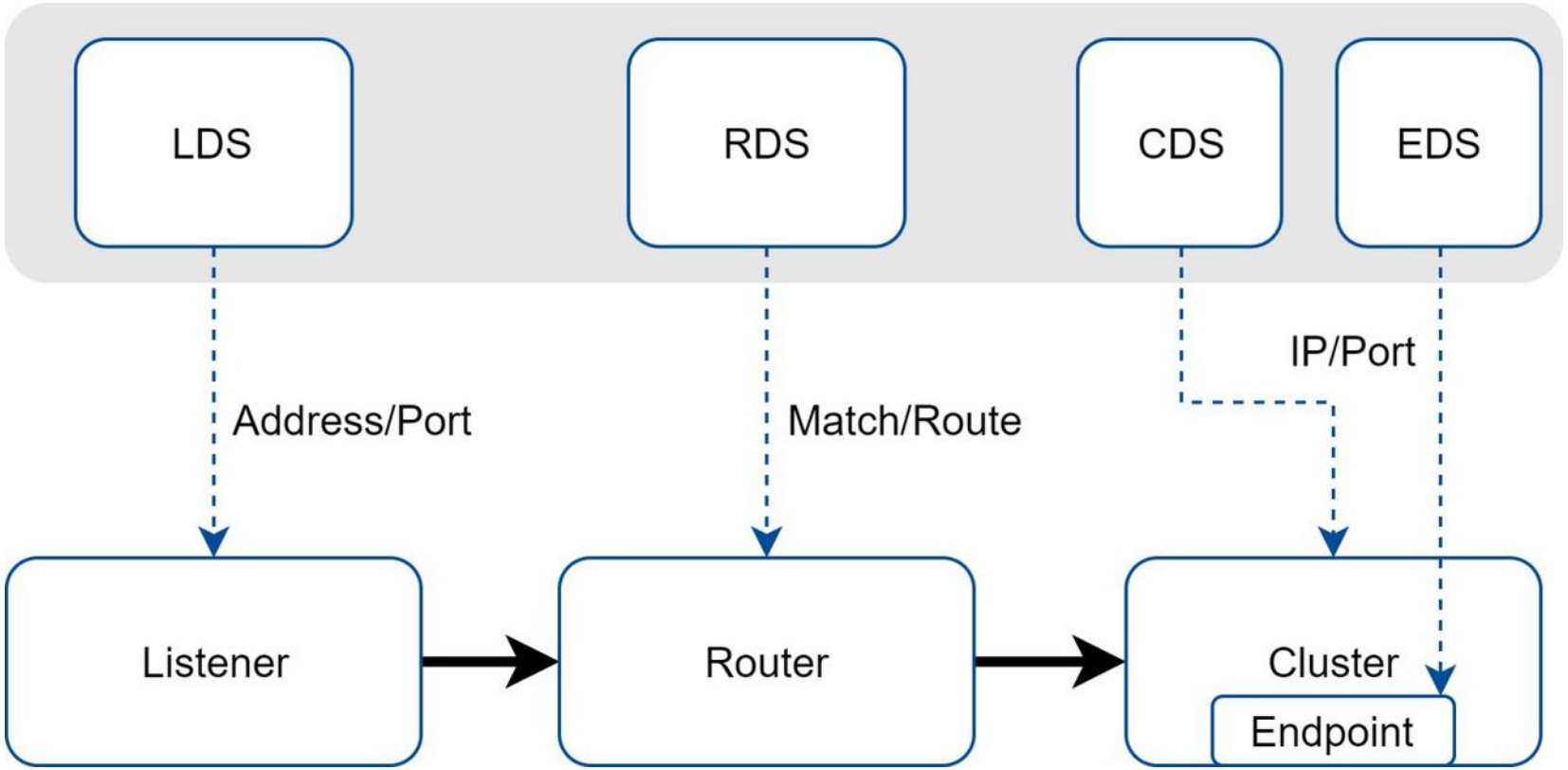


可观测 – OpenTelemetry



服务治理 - xDS 介绍

xDS 是一组发现服务的总称，全称为 “X Discovery Service”，其中的 “X” 代指多种发现服务，包含 LDS (Listener), RDS (RouteConfiguration), CDS (Cluster), 和 EDS (Endpoint/ClusterLoadAssignment) 等。 数据面可以利用 xDS API 与控制平面（如 Istio）通信，完成配置信息的动态发现。



服务治理 - Kitex xDS

Kitex 通过外部扩展 kitex-contrib/xds 的形式对 xDS API 进行了支持，可通过代码配置开启 xDS 模块，让 Kitex 服务以 Proxyless 的模式运行，被服务网格统一纳管。具体的设计方案参见 proposal。

```
if opts.EnableXDS {
    if err := xdsmanager.Init(xdsmanager.WithXDSServerAddress(opts.XDSAddr)); err != nil {
        klog.Fatal(err)   CoderPoet, 2022/9/19, 3:05 上午 • feat(bookinfo): add makefile、dockerfile、man
    }
    return reviewsservice.NewClient(
        opts.Endpoint, // use svc fqdn
        kclient.WithSuite(tracing.NewClientSuite()),
        kclient.WithXDSSuite(xds.ClientSuite{
            RouterMiddleware: xdssuite.NewXDSRouterMiddleware(
                xdssuite.WithRouterMetaExtractor(metadata.ExtractFromPropagator),
            ),
            Resolver: xdssuite.NewXDSResolver(),
        }),
    )
}
```

开启 opentelemetry

开启 kitex xds（proxyless）

服务治理 – 为服务实例按照版本分组

```yaml
apiVersion: apps/v1   CoderPoet, 2022/9/19, 3:05 上午 • feat(bookinfo): add
kind: Deployment
metadata:
  labels:
    app.kubernetes.io/instance: reviews
    app.kubernetes.io/name: reviews
  name: reviews-v1
spec:
  replicas: 1
  selector:
    matchLabels:
      app.kubernetes.io/instance: reviews
      app.kubernetes.io/name: reviews
      version: v1
  template:
    metadata:
      annotations:
        sidecar.istio.io/inject: "false"
      labels:
        app.kubernetes.io/instance: reviews
        app.kubernetes.io/name: reviews
        version: v1
    spec:
      containers:
        - args:
            - reviews
            - --config=config/reviews.yaml
          env:
```

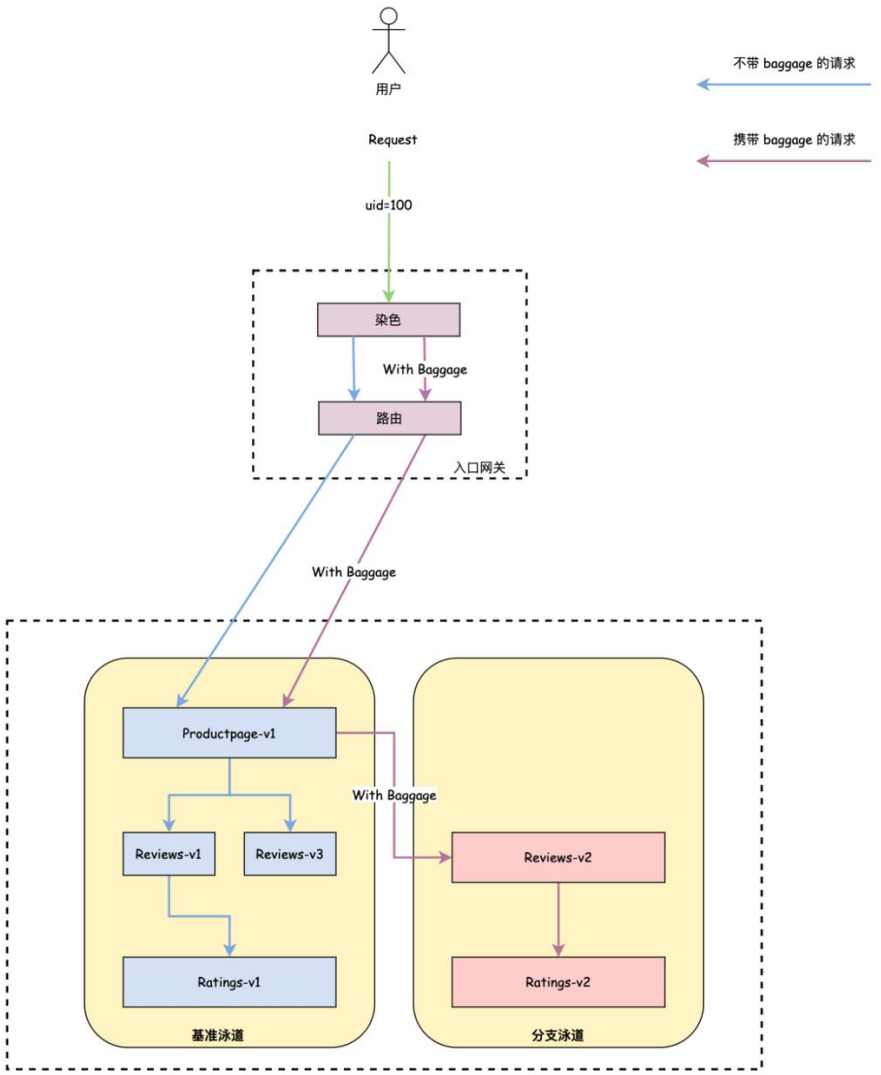
```yaml
apiVersion: networking.istio.io/v1alpha3
kind: DestinationRule
metadata:
  name: reviews
spec:
  host: reviews
  subsets:
  - name: v1
    labels:
      version: v1
  - name: v2
    labels:
      version: v2
  - name: v3
    labels:
      version: v3
```

服务治理 – 定义流量路由规则

```yaml
apiVersion: networking.istio.io/v1alpha3
kind: VirtualService
metadata:
  name: ratings
spec:
  hosts:
    - ratings
  http:
    - match:
        - headers:
            baggage:
              exact: "env=dev"
      route:
        - destination:   CoderPoet, 2022/9/22, 9:57 上午 • fea
            host: ratings
            subset: v2
          weight: 100
    - route:
        - destination:
            host: ratings
          weight: 100
```

03 全链路泳道

泳道设计



流量染色

在网关层进行流量染色，根据原始请求中的元数据，来进行一定规则（条件、比例）转换成对应的染色标识

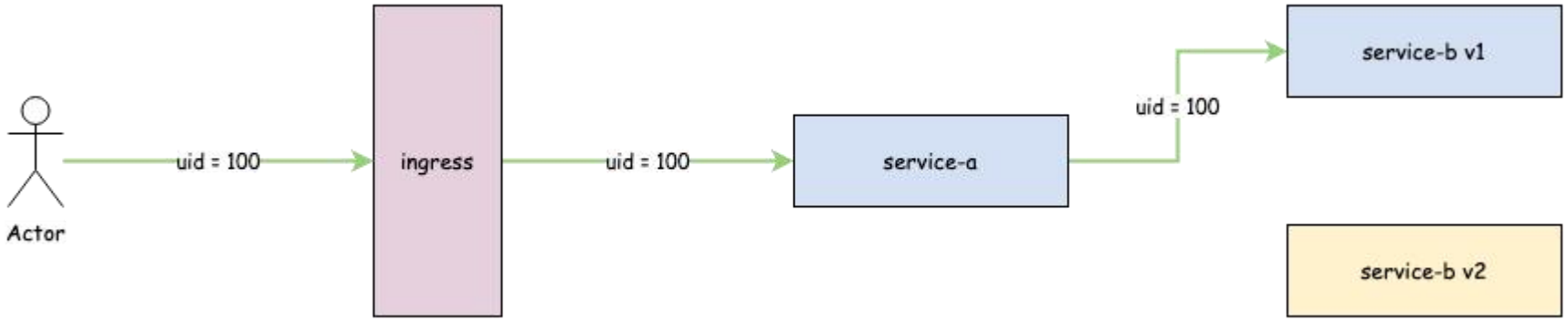
基准泳道

未被染色的流量会被路由到基准泳道中

分支泳道

被染色的流量会被路由到 reviews-v2 ->ratings-v2 的分支泳道中

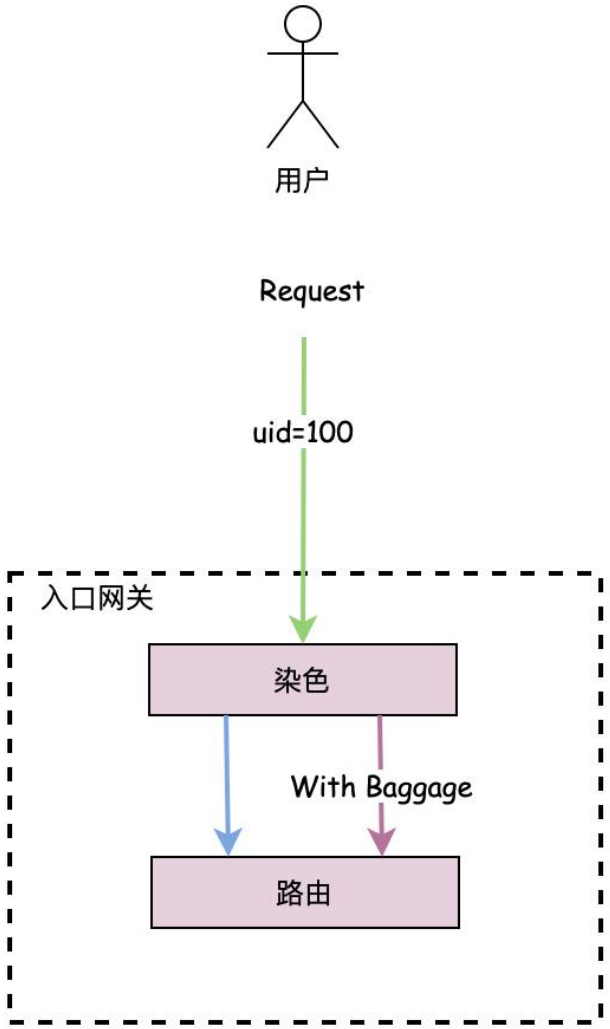
泳道设计 - 传统流量路由方式



1. 不够通用：以具体某个业务属性标识（如：uid）作为流量路由匹配规则，我们需要将这个业务属性手动在全链路里透传，这本身对业务侵入性较大，需要业务配合改造。并且当我们要使用其他业务属性的时候，又需要全链路业务都改造一遍，可想而知，是非常不通用的做法

2. 路由规则容易频繁变动，容易造成规则臃肿：以具体某个业务属性标识（如：uid）作为流量路由匹配规则，假设我们要换一个业务属性，或者给其他用户设置路由规则的时候，得去改造原有的路由规则，或者针对不同业务属性重复定义多套路由规则，很容易就会造成路由臃肿，以至于难以维护

泳道设计 – 流量染色



我们可以在网关层进行流量染色，通常会根据原始请求中的元数据，来进行一定规则（条件、比例）转换成对应的染色标识。

- 按条件染色：当请求元数据满足一定条件之后，就给当前请求打上染色标识，如：请求头中 uid=100、cookie 匹配等等。
- 按比例染色：按照一定比例，给请求打上染色标识。

有了一套统一的流量染色机制之后，我们配置路由规则的时候，就不需要关心具体的业务属性标识了，只需要根据 染色标识 来配置即可。

泳道设计 – 染色标识全链路透传（Baggage）

染色标识通常会依靠 Tracing Baggage 来透传，Baggage 是用于在整个链路中传递业务自定义 KV 属性，例如传递流量染色标识、传递 AccountID 等业务标识等等。

```
if opts.EnableXDS {
    if err := xdsmanager.Init(xdsmanager.WithXDSServerAddress(opts.XDSAddr)); err != nil {
        klog.Fatal(err)   CoderPoet, 2022/9/19, 3:05 上午 • feat(bookinfo): add makefile、dockerfi
    }
    return reviewsservice.NewClient(
        opts.Endpoint, // use svc fqdn
        kclient.WithSuite(tracing.NewClientSuite()),
        kclient.WithXDSSuite(xds.ClientSuite{
            RouterMiddleware: xdssuite.NewXDSRouterMiddleware(
                xdssuite.WithRouterMetaExtractor(metadata.ExtractFromPropagator),
            ),
            Resolver: xdssuite.NewXDSResolver(),
        }),
    )
}
```

开启 opentelemetry 即可自动透传 baggage

泳道设计 – 泳道效果（基准泳道）

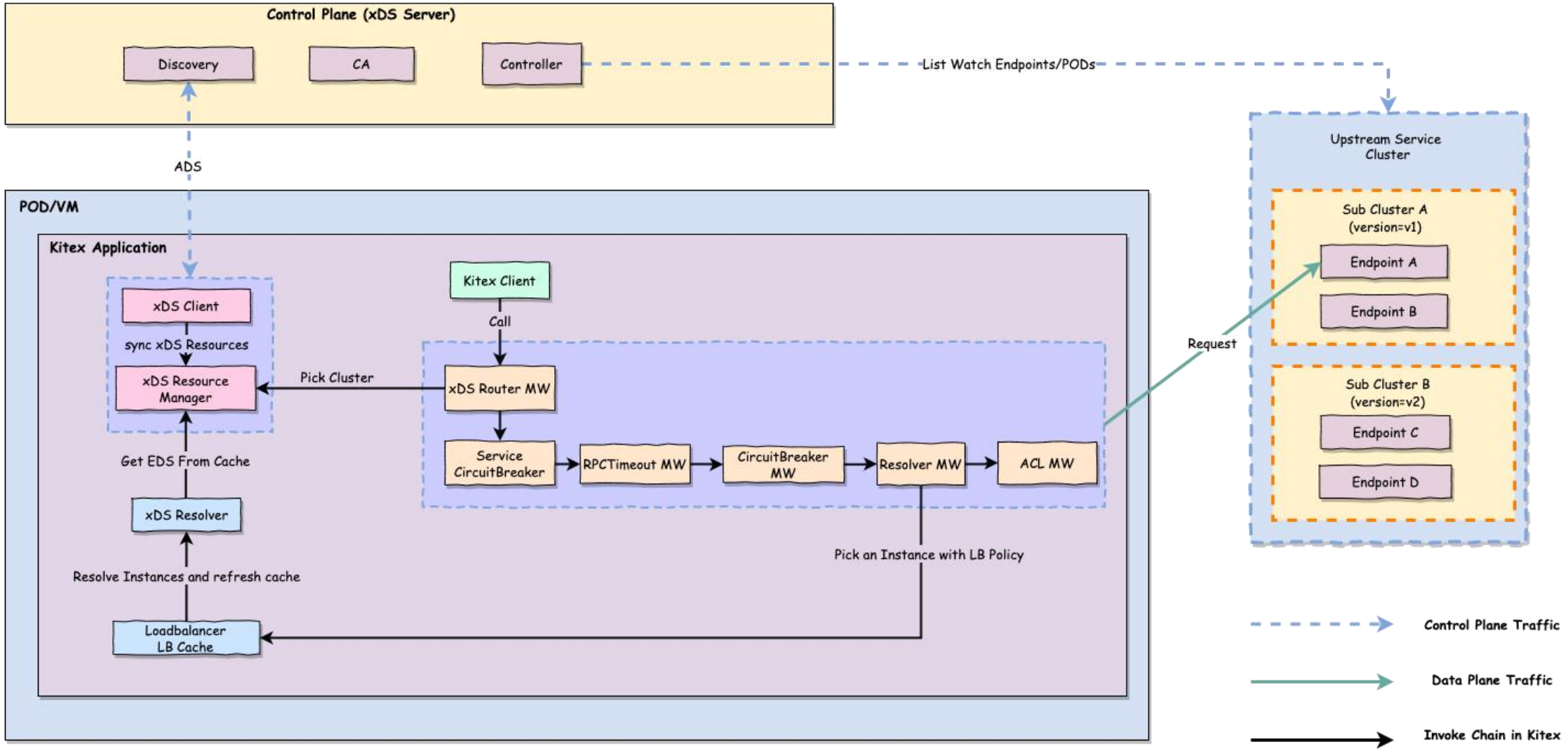
入口流量请求头中不带 uid=100 的请求，会自动路由到基准泳道服务，reviews v1 和 v3 服务间轮询，展示的效果是评分为 0 或 1 随机。

泳道设计 – 泳道效果（分支泳道）

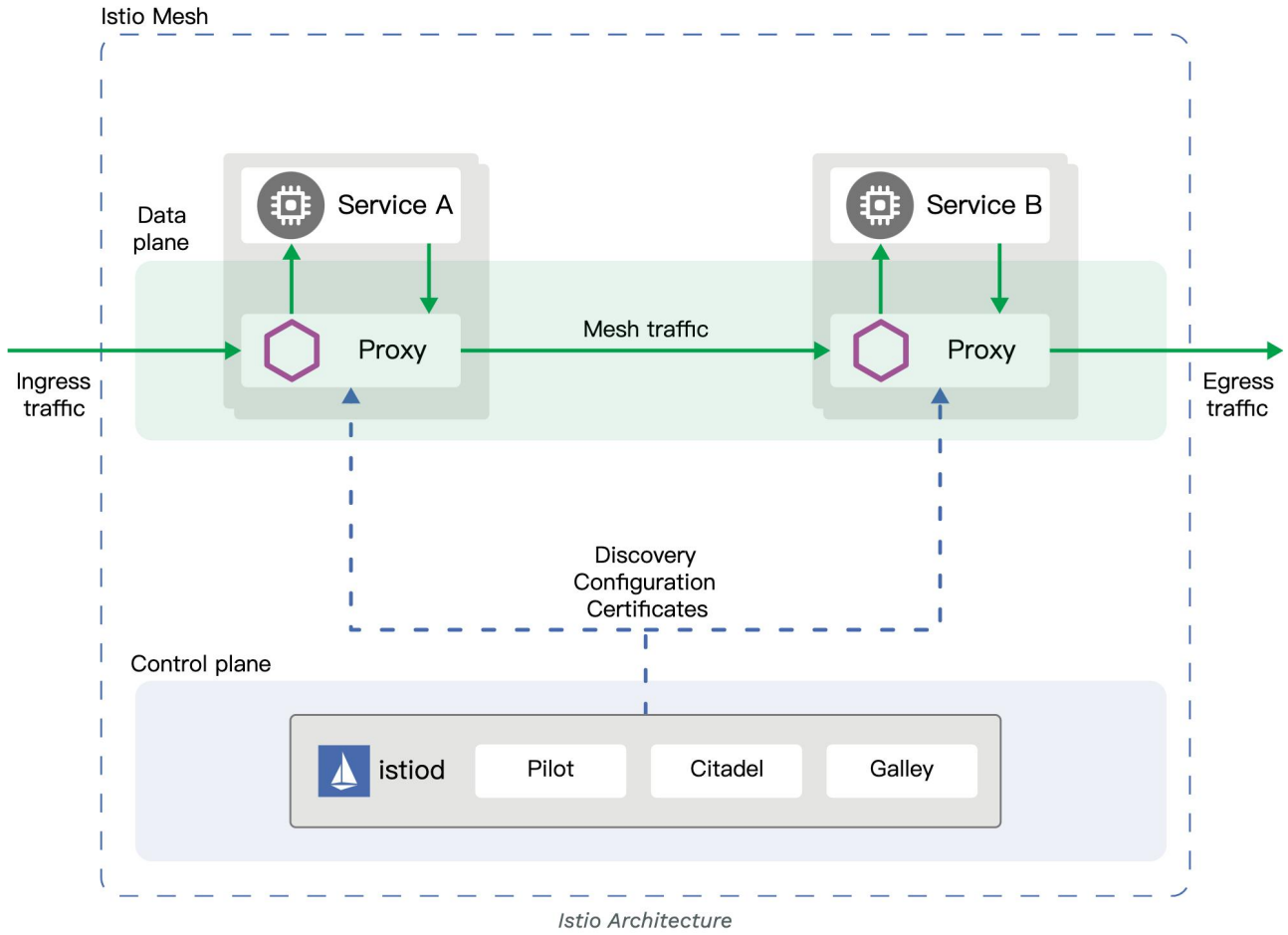
入口流量请求头中携带了 uid=100 的请求，会被精准路由到分支泳道

04 Proxyless 与 ServiceMesh

Kitex Proxyless 模式



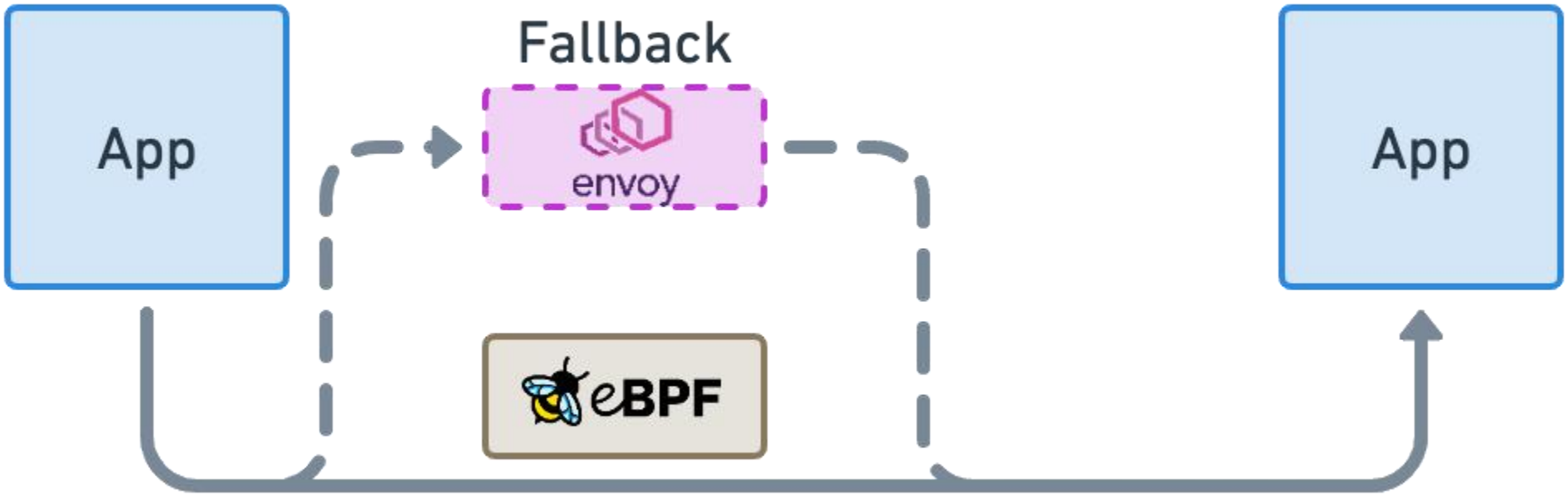
标准 Sidecar 模式



Istio Architecture

（图片引用于：https://istio.io）

eBPF 内核 Mesh 模式（cilium）



（图片引用：https://isovalent.com/blog/post/cilium-service-mesh/）

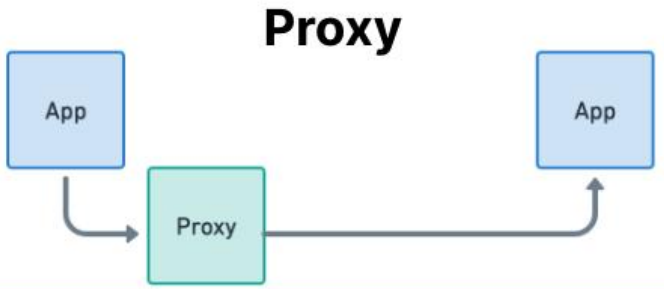
eBPF 内核 Mesh 模式（cilium）

Features Available in eBPF

Traffic Management
- L3/L4 forwarding & Load-balancing
- Canary, Topology Aware Routing
- Multi-cluster

Security
- Network Policy
- mTLS

Observability
- Tracing, OpenTelemetry, & Metrics
- HTTP, TLS, DNS, TCP, UDP, ...



Features that require Proxy fallback

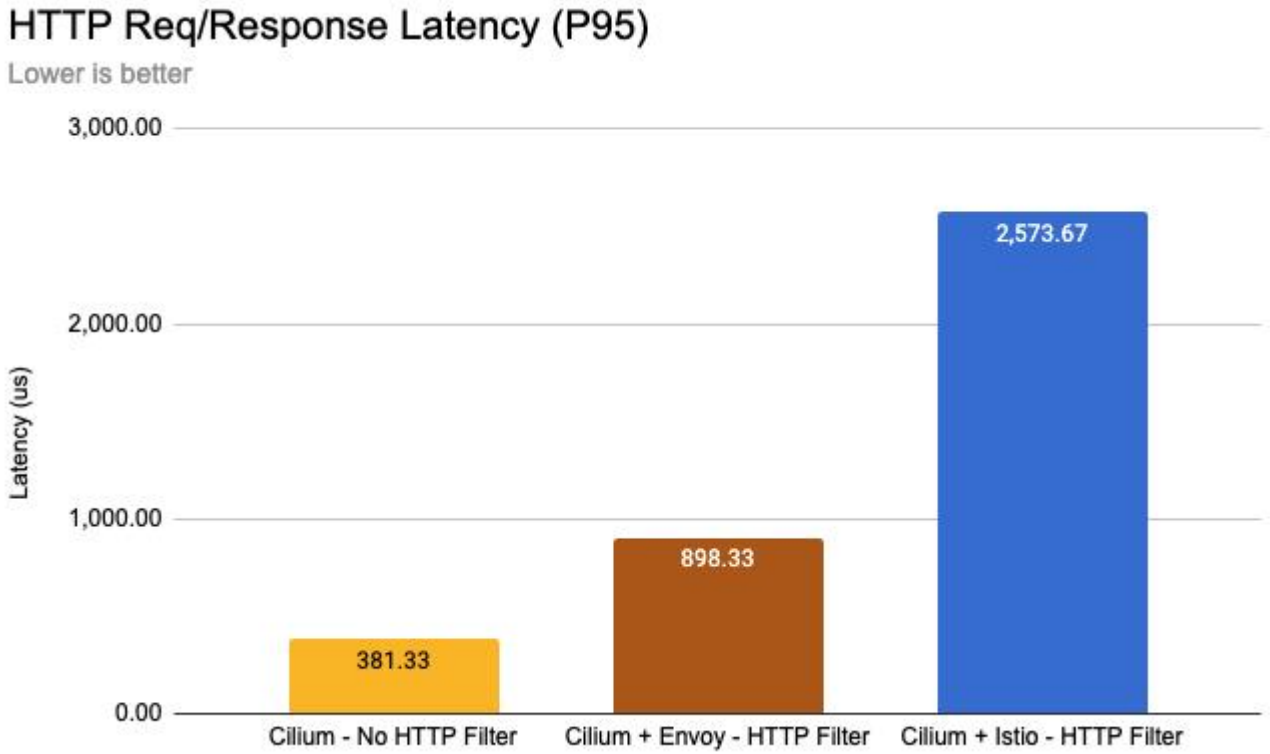
Traffic Management
- L7 Load-balancing & Ingress

Resilience
- Retries, L7 Rate Limiting

Security
- TLS Termination & Origination

（图片引用：https://isovalent.com/blog/post/cilium-service-mesh/）

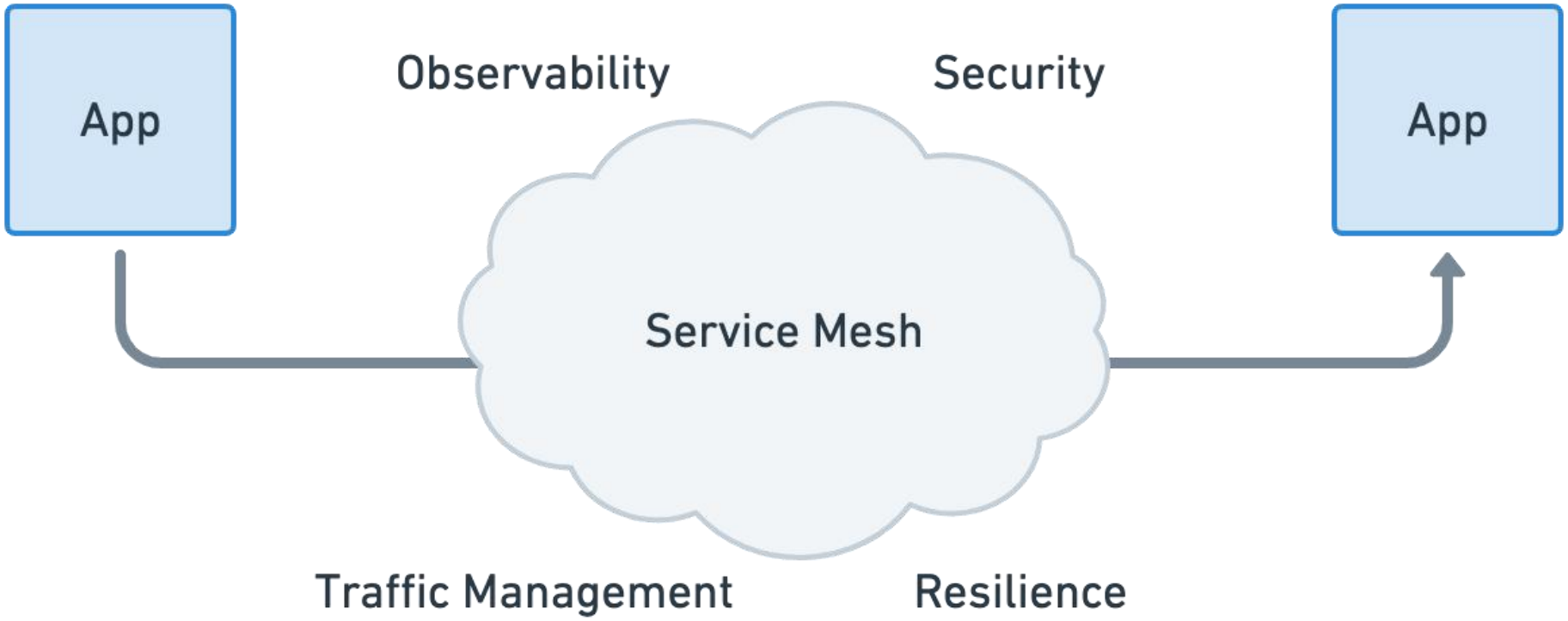
eBPF 内核 Mesh 模式（cilium）



（图片引用：https://isovalent.com/blog/post/cilium-service-mesh/）

所以，Service mesh 究竟是什么？

ServiceMesh —— 无关模式，服务间通信基础设施标准抽象



（图片引用：https://isovalent.com/blog/post/cilium-service-mesh/）

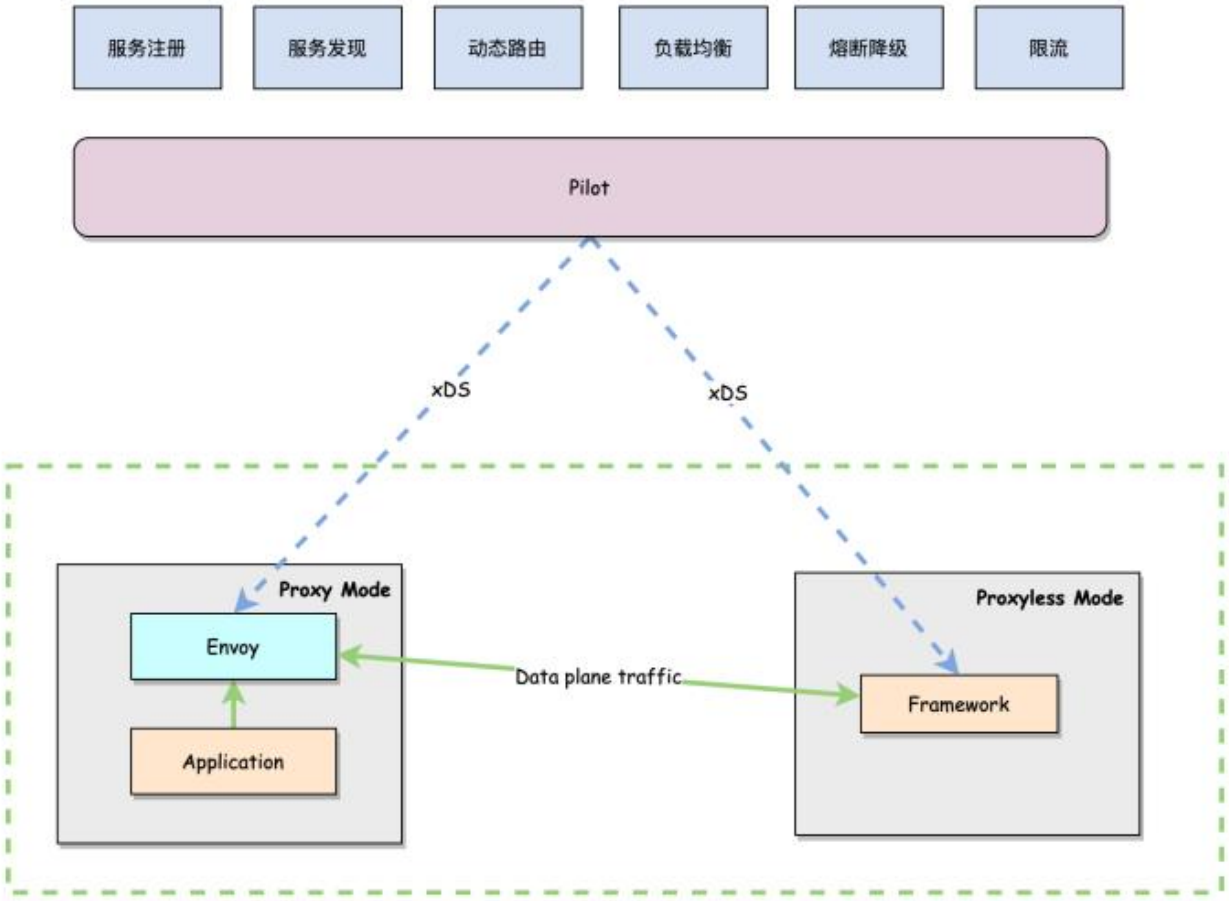
ServiceMesh —— 基于统一标准去构建服务治理平台

统一服务治理规则模型 Spec

统一服务治理控制面

统一服务治理规则下发协议

统一异构数据面治理能力



相关项目链接

项目	链接
bookinfo	https://github.com/cloudwego/biz-demo/tree/main/bookinfo
Kitex	https://github.com/cloudwego/kitex
Hertz	https://github.com/cloudwego/hertz
kitex-contrib/xds	https://github.com/kitex-contrib/xds
kitex-contrib/obs-opentelemetry	https://github.com/kitex-contrib/obs-opentelemetry
hertz-contrib/obs-opentelemetry	https://github.com/hertz-contrib/obs-opentelemetry

THANKS

CloudWeGo