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全球开源技术峰会

THE GLOBAL OPENSOURCE TECHNOLOGY CONFERENCE

OPEN SOURCE , OPEN WORLD

「开源云原生计算时代论坛」专场

本期议题：生产环境下的 K8K 安全困境及应对措施

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个人介绍

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- Apache APISIX committer
- Kubernetes ingress-nginx reviewer
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Agenda

- 容器技术的利与弊
- K8S 环境下的安全挑战
- K8S 环境下安全问题的应对方式
- 总结

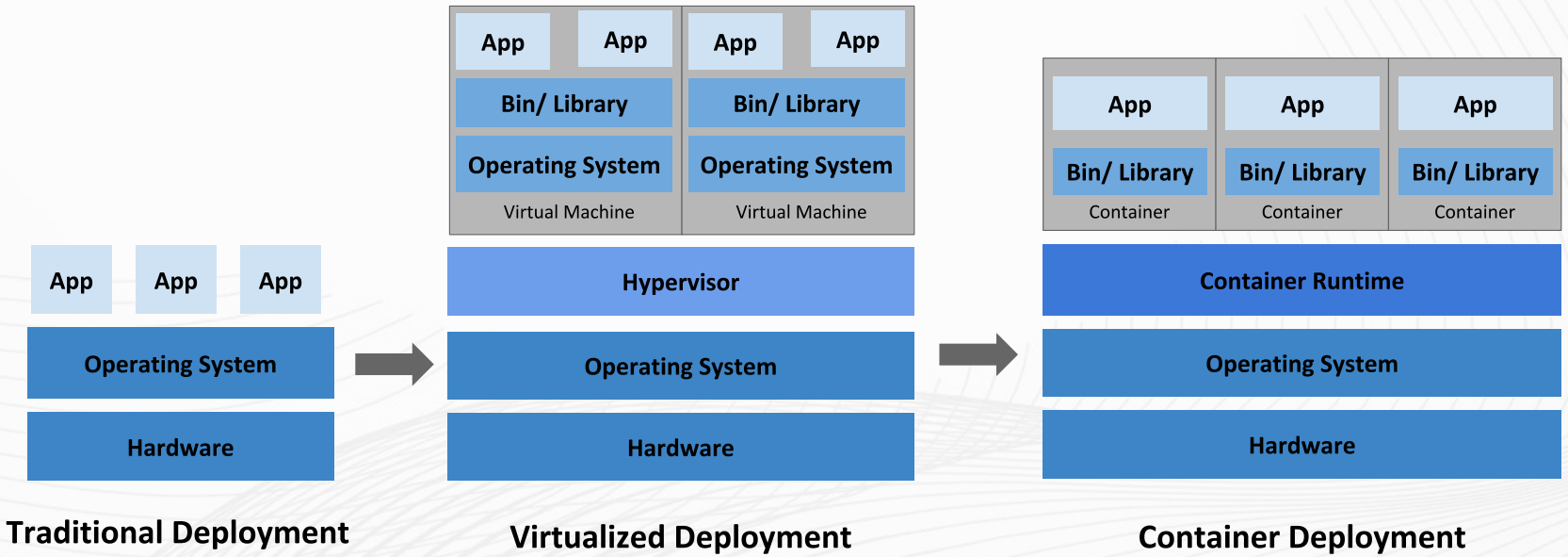
容器技术的利与弊

容器技术的优势

- 统一的交付单元
- 可移植性
- 资源隔离
  - Cgroups
  - Namespace
- 低成本
- 易于做 CI/CD

容器技术的弊端

- 隔离性不足
- 共享内核



K8S 环境下的安全挑战

- 攻击面增加
- 供应链攻击
- 权限提升
- 网络安全
- 资源安全
- 数据安全
- 组件安全
- 运行时安全

K8S 环境下的安全挑战

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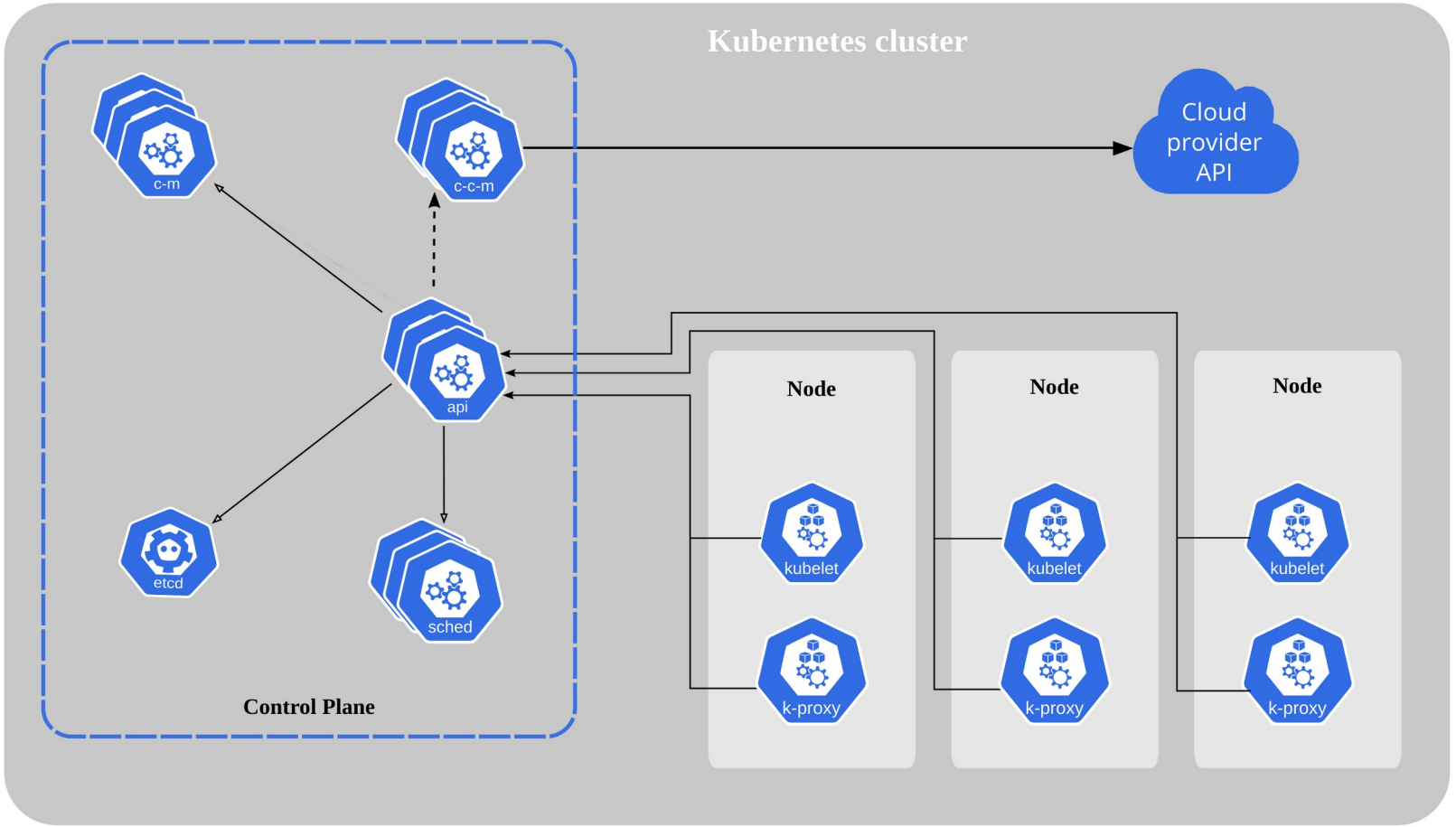
攻击面增加

- K8S 自身组件
- 底层容器运行时



CVE-2019-11253：发送大型 YAML/JSON 对 kube-apiserver DoS

K8S 环境下安全问题的应对方式

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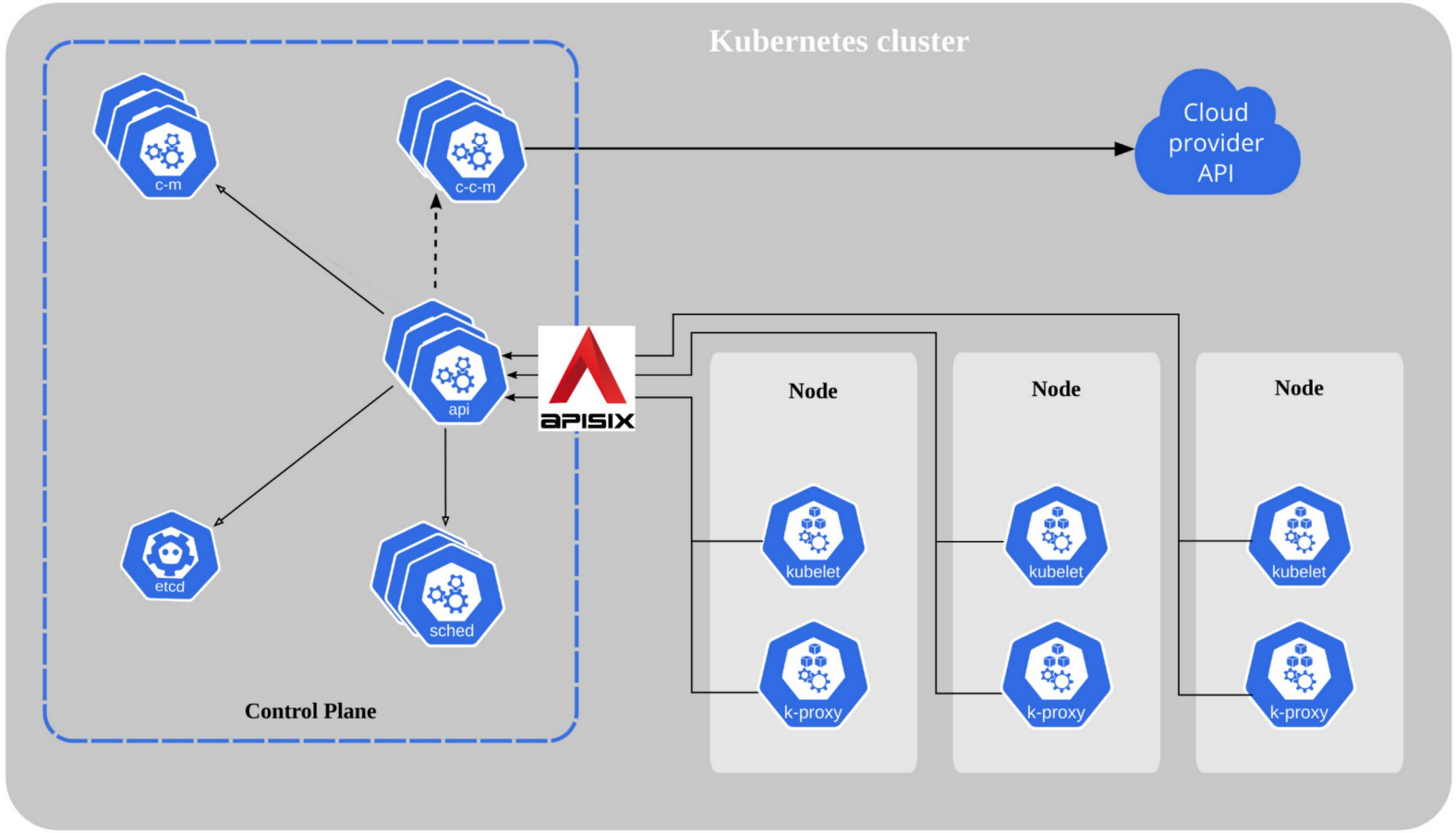
攻击面增加

- 定义边界
- kube-apiserver 放在 LB 后，或者不暴露在公网
- Node 禁止 SSH
- 最小化权限



K8S 环境下的安全挑战

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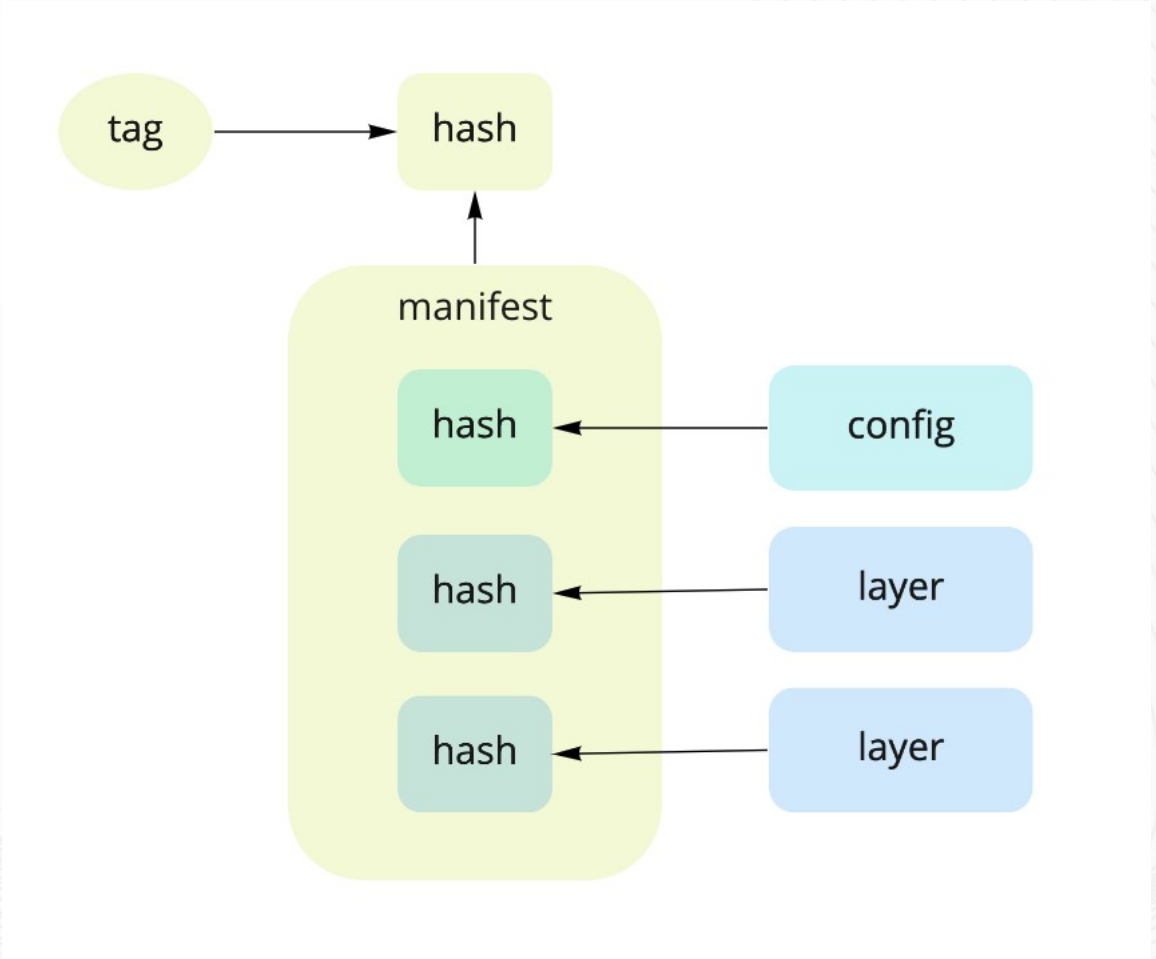
供应链攻击

- 不易生成 SBOM （软件材料清单）
- 恶意容器镜像
- 镜像内软件漏洞



图源： https://nishakm.github.io/code/metadata/

K8S 环境下安全问题的应对方式

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供应链攻击

- 使用可信基础镜像（Docker 官方镜像）
- 及时更新
- 不安装 debug 工具
- Distroless
- 镜像漏洞扫描
- DevSecOps

```
➜  ~ docker scan redis:alpine

Testing redis:alpine ...

Package manager:   apk
Project name:      docker-image|redis
Docker image:      redis:alpine
Platform:          linux/amd64

√ Tested 17 dependencies for known vulnerabilities, no vulnerable paths found.
```

K8S 环境下的安全挑战

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权限提升

- RBAC 不合理 (各种 controller/operator 中常见)
- 进入 Pod 内可操作 API
- 基础软件提权

```
/ # TOKEN=$(cat /var/run/secrets/kubernetes.io/serviceaccount/token)
/ # curl --cacert /var/run/secrets/kubernetes.io/serviceaccount/ca.crt -H "Authorization: Bearer
$TOKEN" -s  https://kubernetes.default:443/api/v1/xxxxx
```

K8S 环境下安全问题的应对方式

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权限提升

- RBAC 配置 review
- 如何开启 audit log
  - audit-log-path
  - audit-policy-file

```yaml
kind: Cluster
apiVersion: kind.x-k8s.io/v1alpha4
nodes:
- role: control-plane
  extraMounts:
  - hostPath: /home/tao/audit/audit
    containerPath: /tmp/audit
- role: worker
kubeadmConfigPatches:
- |
  kind: ClusterConfiguration
  apiServer:
    extraArgs:
      audit-log-path: "/tmp/audit/audit.log"
      audit-policy-file:
"/tmp/audit/policy.yaml"
    extraVolumes:
    - name: audit
      hostPath: /tmp/audit
      mountPath: /tmp/audit
```

K8S 环境下安全问题的应对方式

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权限提升

- Audit log 可记录操作行为，响应状态码， UA ，时间等
- authorization.k8s.io/reason： 说明了 RBAC 规则决策的原因


```
{"kind":"Event","apiVersion":"audit.k8s.io/v1","level":"Request","auditID":"027ddabb-c691-4524-aadd-0f1cf48efb34","stage":"ResponseComplete","requestURI":"/api/v1/namespaces/kube-system/configmaps","verb":"list","user":{"username":"system:serviceaccount:default:redis","uid":"1982601b-4967-40cf-96f1-c456352bf1d2","groups":["system:serviceaccounts","system:serviceaccounts:default","system:authenticated"],"extra":{"authentication.kubernetes.io/pod-name":["redis"],"authentication.kubernetes.io/pod-uid":["ba8c23b8-928b-4bc0-8bdd-3b227dab903e"]}},"sourceIPs":["172.18.0.3"],"userAgent":"curl/7.77.0","objectRef":{"resource":"configmaps","namespace":"kube-system","apiVersion":"v1"},"responseStatus":{"metadata":{},"code":200},"requestReceivedTimestamp":"2021-07-01T01:36:01.571190Z","stageTimestamp":"2021-07-01T01:36:01.574197Z","annotations":{"authorization.k8s.io/decision":"allow","authorization.k8s.io/reason":"RBAC: allowed by ClusterRoleBinding \"redis-admin\" of ClusterRole \"cluster-admin\" to ServiceAccount \"redis/default\""}}
```

K8S 环境下的安全挑战

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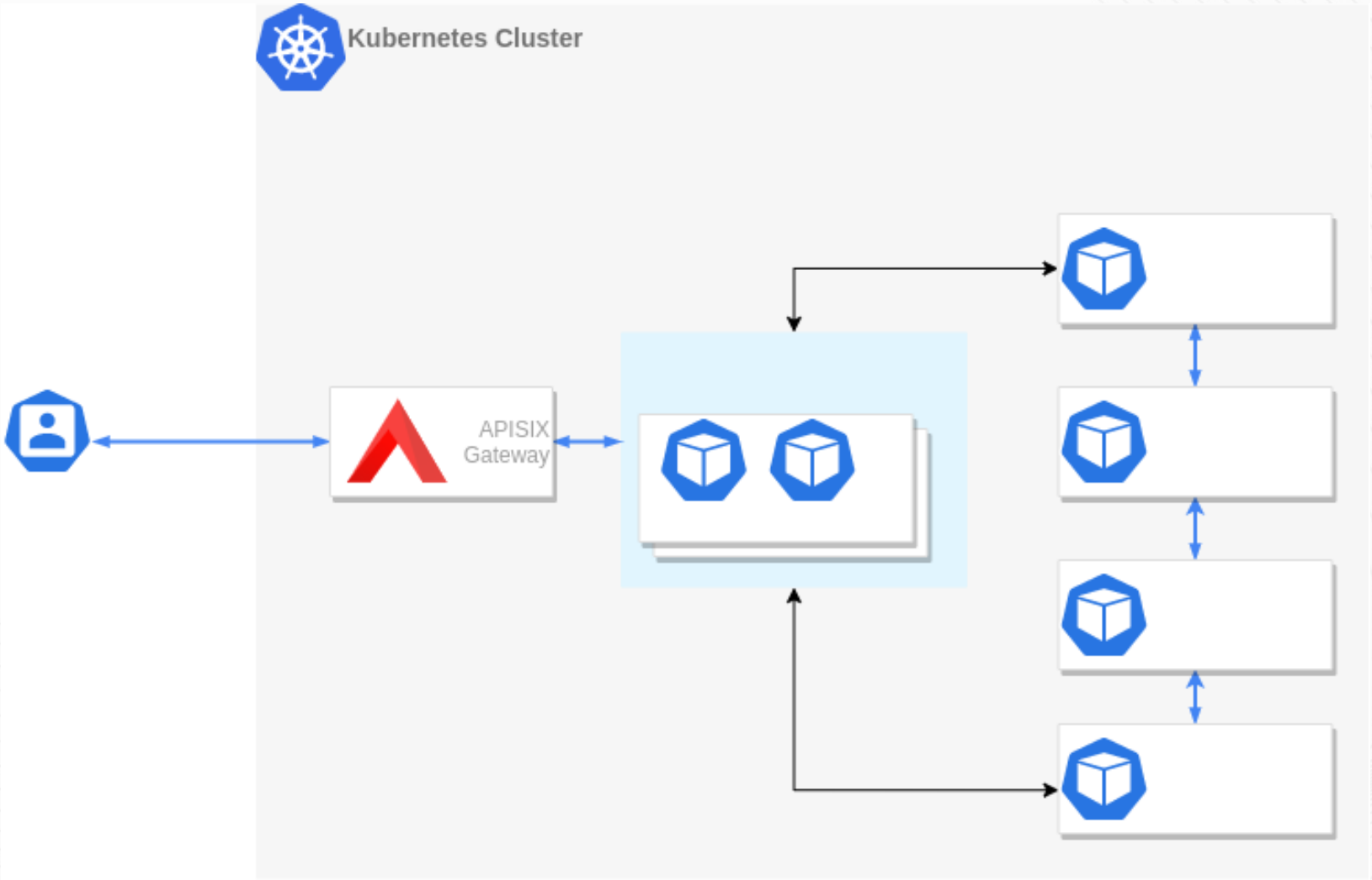
网络安全

- 恶意访问
- 容器身份未标识
- 链接未加密
- 外层网关提供入口保护
  （南北向流量）



K8S 环境下安全问题的应对方式

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网络安全

- 使用 NetworkPolicy 控制进出流量规则

Network Policy Editor: https://editor.cilium.io/

```yaml
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: test-network-policy
spec:
  podSelector:
    matchLabels:
      role: db
  policyTypes:
  - Ingress
  ingress:
  - from:
    - ipBlock:
        cidr: 172.17.0.0/16
        except:
        - 172.17.1.0/24
    - namespaceSelector:
        matchLabels:
          project: myproject
    - podSelector:
        matchLabels:
          role: frontend
    ports:
    - protocol: TCP
      port: 6379
```

K8S 环境下安全问题的应对方式

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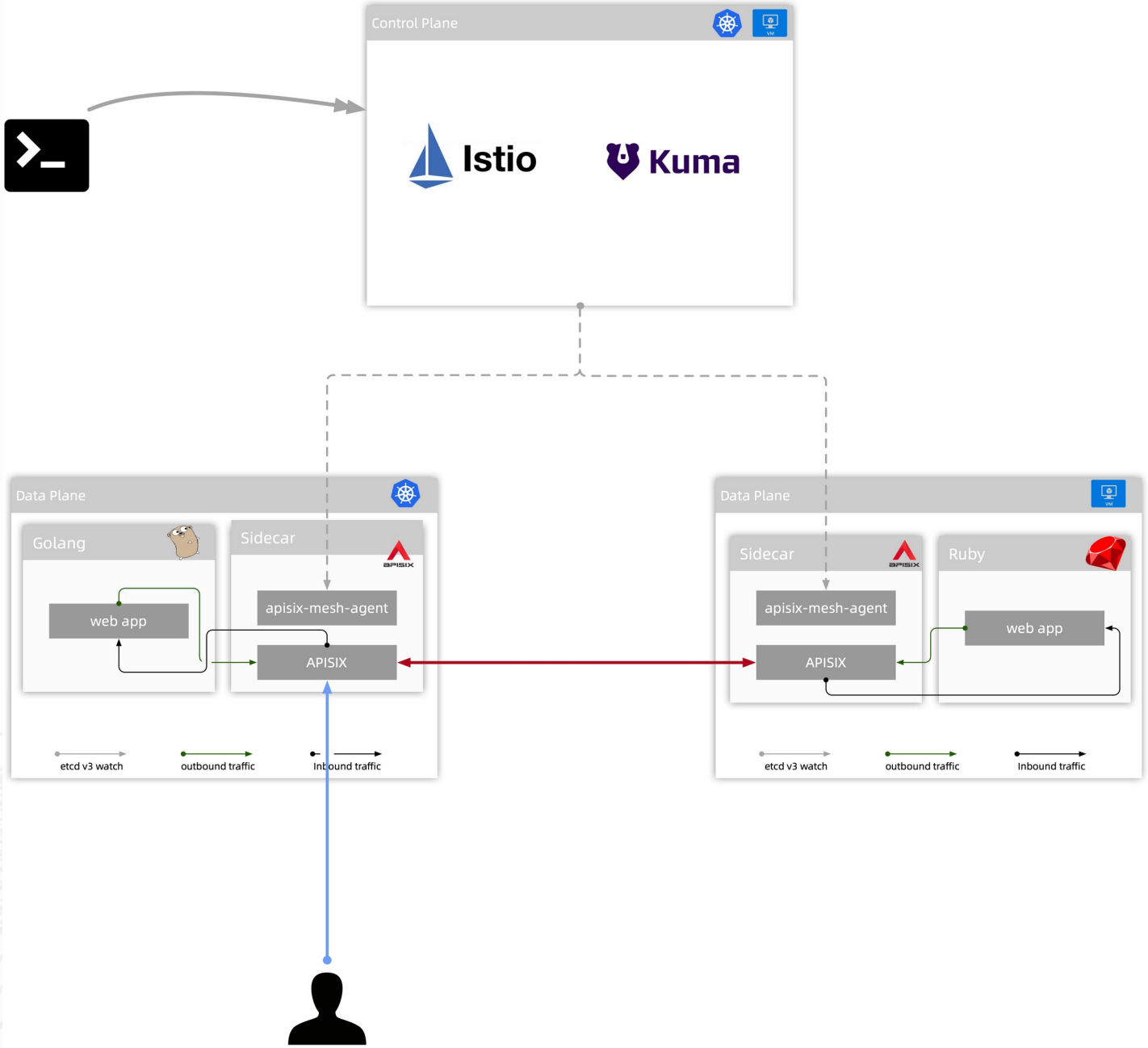
网络安全

- service mesh
- mTLS
- 东西向流量



K8S 环境下的安全挑战

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资源安全

- 资源超售
- 过度征用资源
- OOM
- 驱逐

K8S 环境下安全问题的应对方式

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资源安全

- 为 namespace 设置 Limit Range
- 设置 request 和 limit
- 合理的 QoS
  - Guaranteed
  - Burstable
  - BestEffort

```
✗ cat <<EOF | kubectl apply -f -
apiVersion: v1
kind: LimitRange
metadata:
  name: cpu-limit-range
spec:
  limits:
  - max:
      cpu: "800m"
    min:
      cpu: "200m"
    type: Container
---
apiVersion: v1
kind: Pod
metadata:
  name: pod-cpu-oversize
spec:
  containers:
  - name: cpu-oversize
    image: redis:alpine
    resources:
      limits:
        cpu: "1000m"
      requests:
        cpu: "500m"
EOF
limitrange/cpu-limit-range created
Error from server (Forbidden): error when creating "STDIN":
pods "pod-cpu-oversize" is forbidden:
maximum cpu usage per Container is 800m, but limit is 1
```

K8S 环境下的安全挑战

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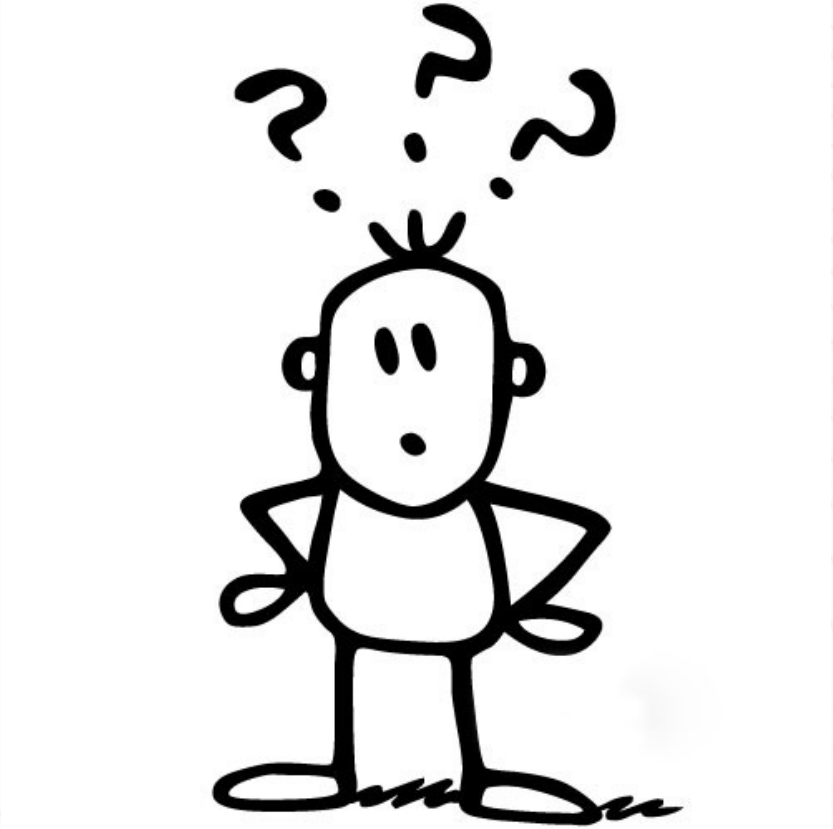
数据安全

- Secrets not secret
- Base64 编码
- etcd 中数据可获取



K8S 环境下安全问题的应对方式

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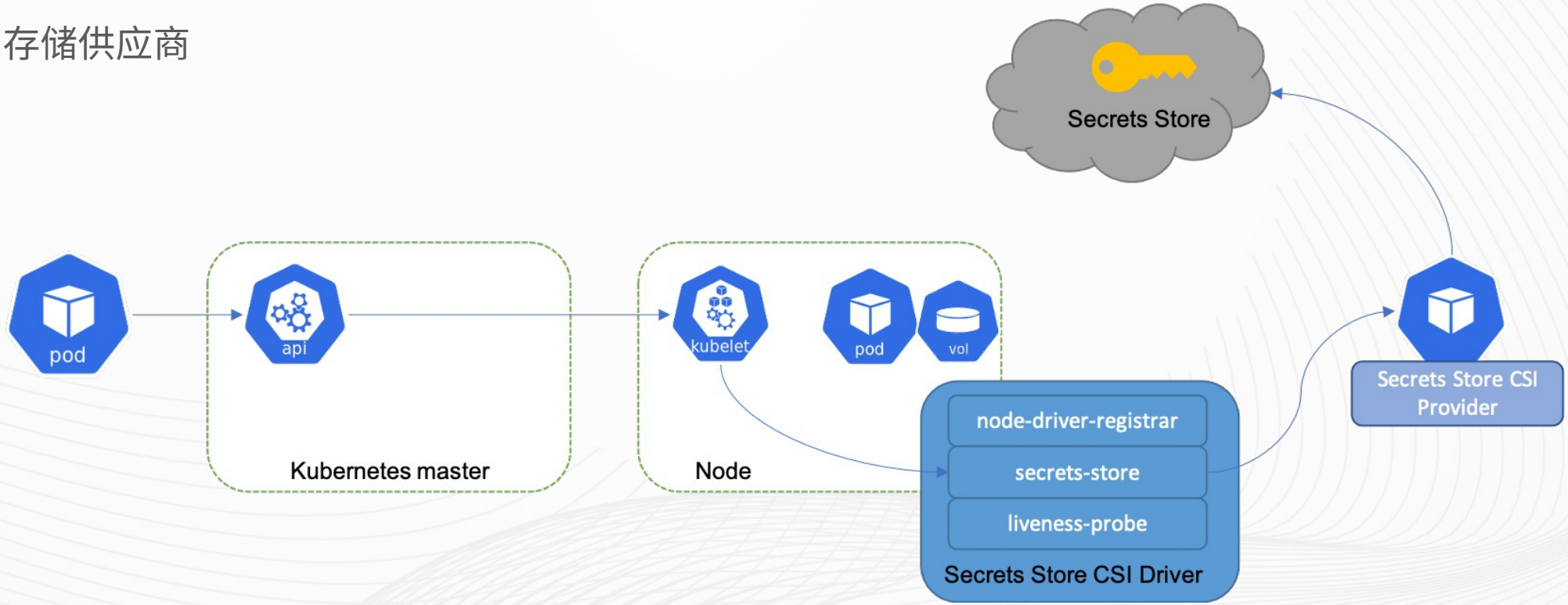
数据安全

- Kubernetes Secrets Store CSI Driver
  - kubernetes-sigs/secrets-store-csi-driver

- 支持多种密钥存储供应商
  - AWS
  - Azure
  - GCP
  - Vault



K8S 环境下的安全挑战

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组件安全

- CVE 漏洞及 POC
- 配置不规范
- 直接暴露在公网
- 匿名访问

[Security Advisory] CVE-2021-25737: Holes in EndpointSlice Validation Enable Host Network Hijack — A security issue w…	5月19日
[Kubernetes Java Client] CVE-2021-25738: Code exec via yaml parsing — Hello Kubernetes Community, A security issue …	5月18日
[Security Advisory] CVE-2021-25736: Windows kube-proxy LoadBalancer contention — Hello Kubernetes Community, A s…	5月11日
[Security Advisory] CVE-2020-8562: Bypass of Kubernetes API Server proxy TOCTOU — Hello Kubernetes Community, A …	5月5日
CVE-2021-25735: Validating Admission Webhook does not observe some previous fields — A security issue was discove…	4月15日
Fwd: [Security Advisory] CVE-2020-8570: Path Traversal bug in the Java Kubernetes Client — ---------- Forwarded message…	1月12日

K8S 环境下安全问题的应对方式

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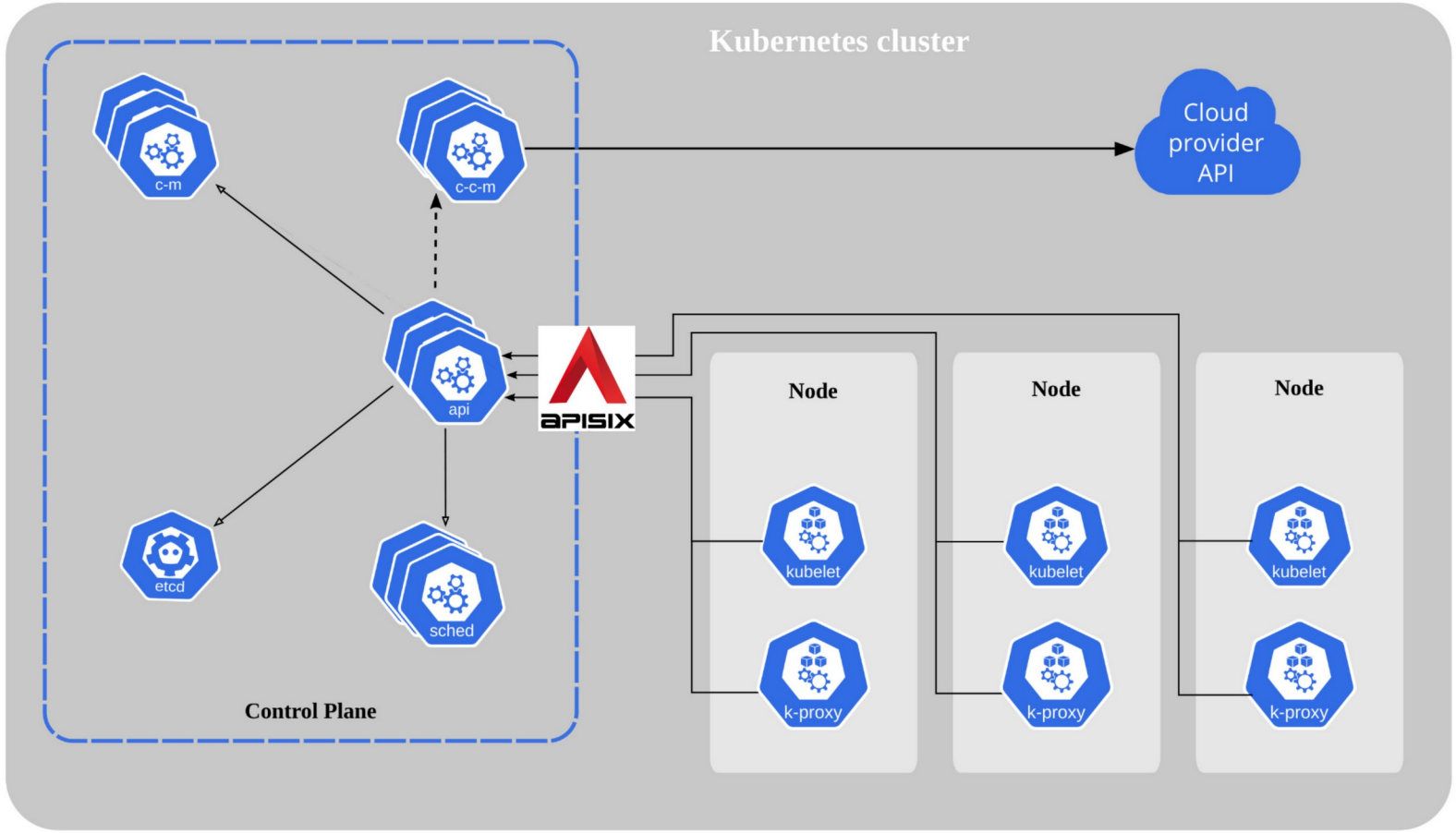
组件安全

- 关注 CVE 漏洞及 POC
- 及时升级或绕过漏洞
- 不直接暴露在公网或增加认证
- 关闭匿名访问



K8S 环境下的安全挑战

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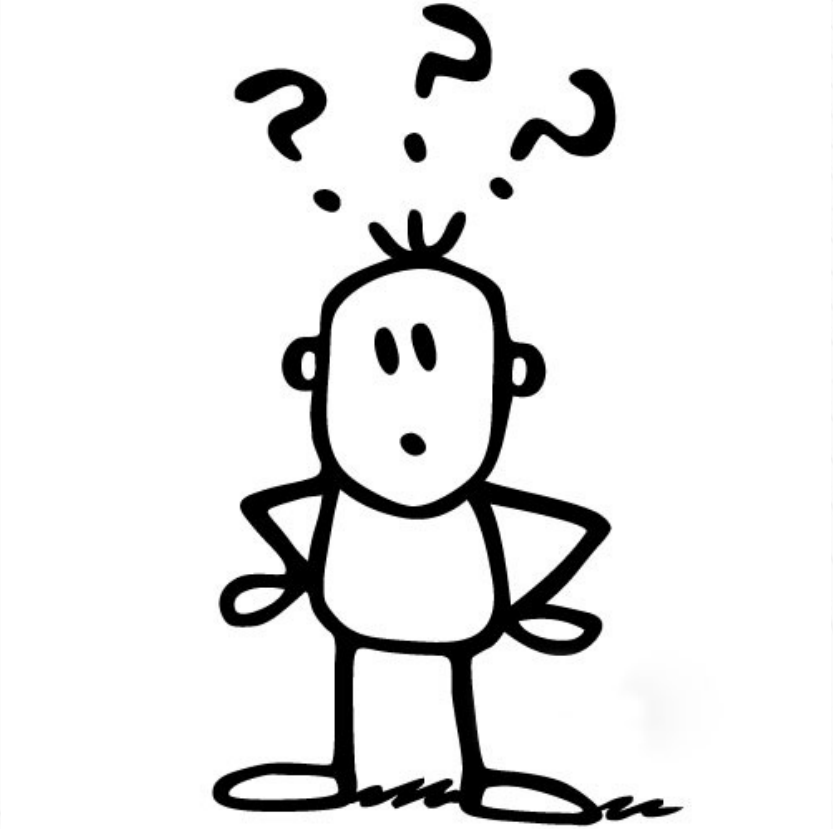
运行时安全

- 恶意操作
- 被攻击
- 非预期行为
- 未解决的漏洞
- 不安全配置
- 用户证书泄漏



K8S 环境下安全问题的应对方式

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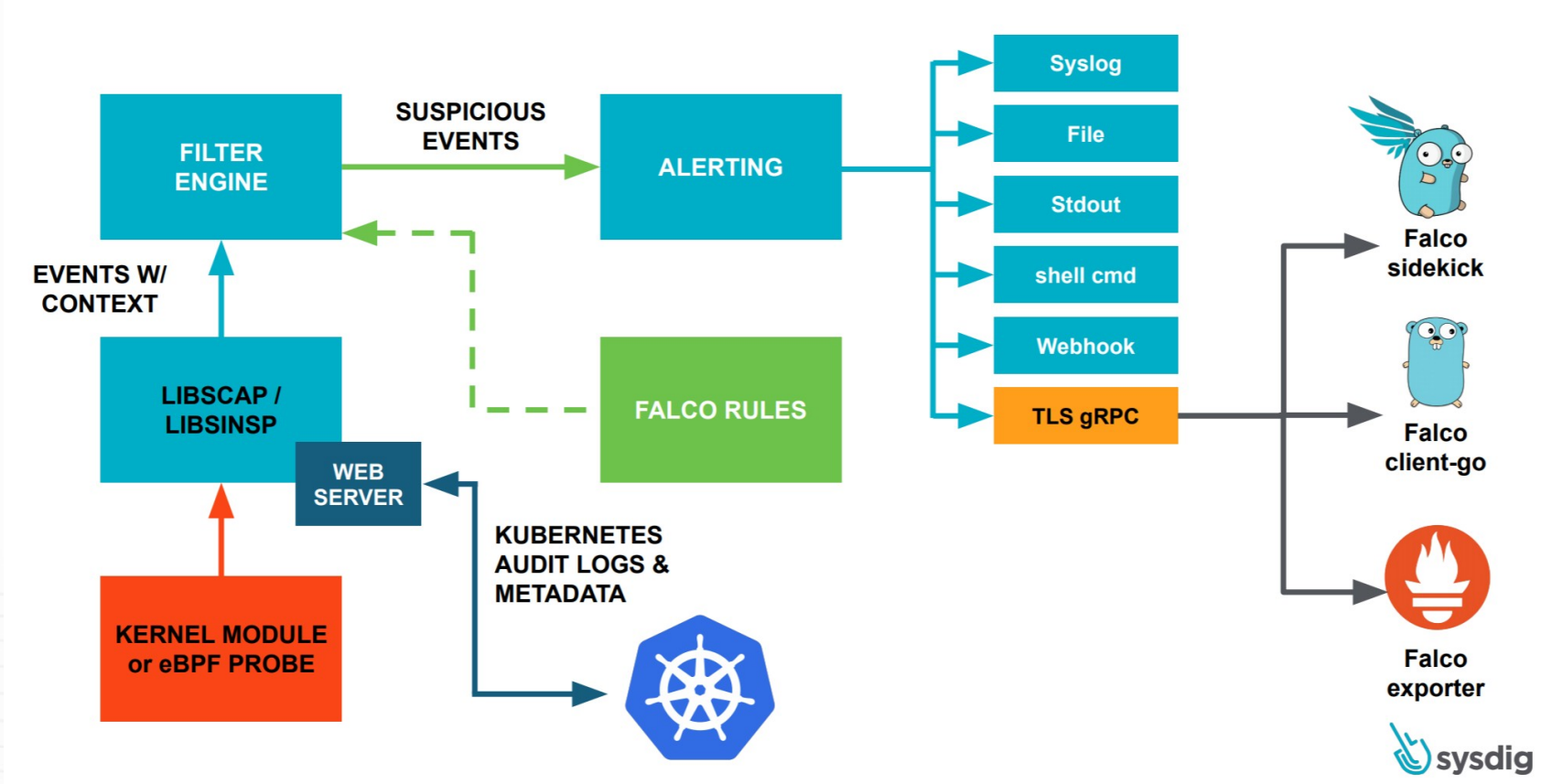
运行时安全

- Falco



K8S 环境下安全问题的应对方式

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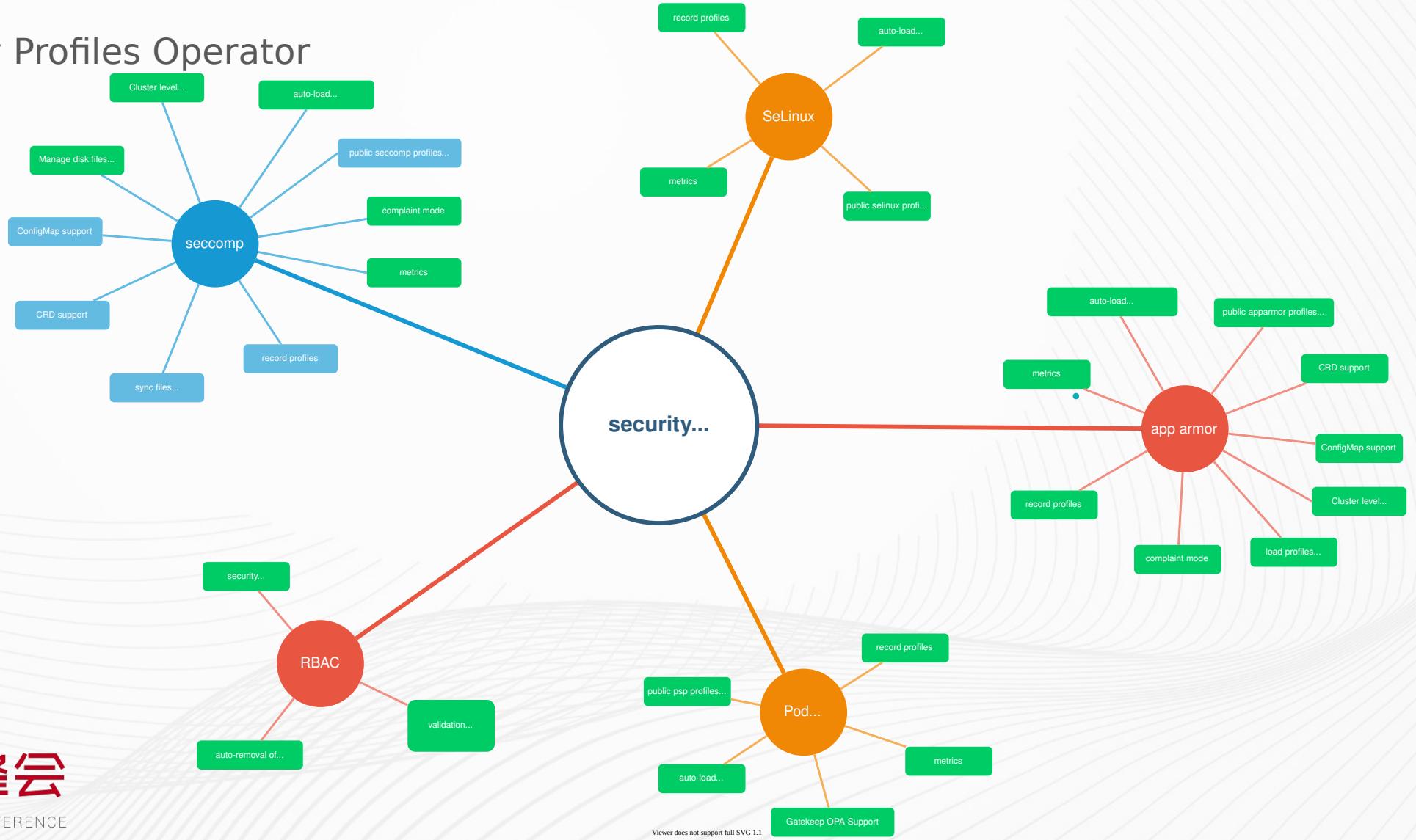
运行时安全

- Kubernetes Security Profiles Operator
- seccomp is GA
- 权限最小化



总结

- 权限最小化
- 使用 Apache APISIX 等 LB 提供边界安全
- 及时关注安全漏洞和更新
- 优化配置
- 关注日志
- K8S 生态周报
- https://github.com/tao12345666333/practical-kubernetes

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THANKS

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