ISOVALENT

The Swiss Army Knife of Cloud-Native Networking

Speaker: **Raymond de Jong**

Introduction

Raymond de Jong
Field CTO EMEA

ISOVALENT
now part of CISCO

Switzerland Tourism.

eBPF

cilium

Tetragon

- Open Source Projects

ISOVALENT

now part of CISCO

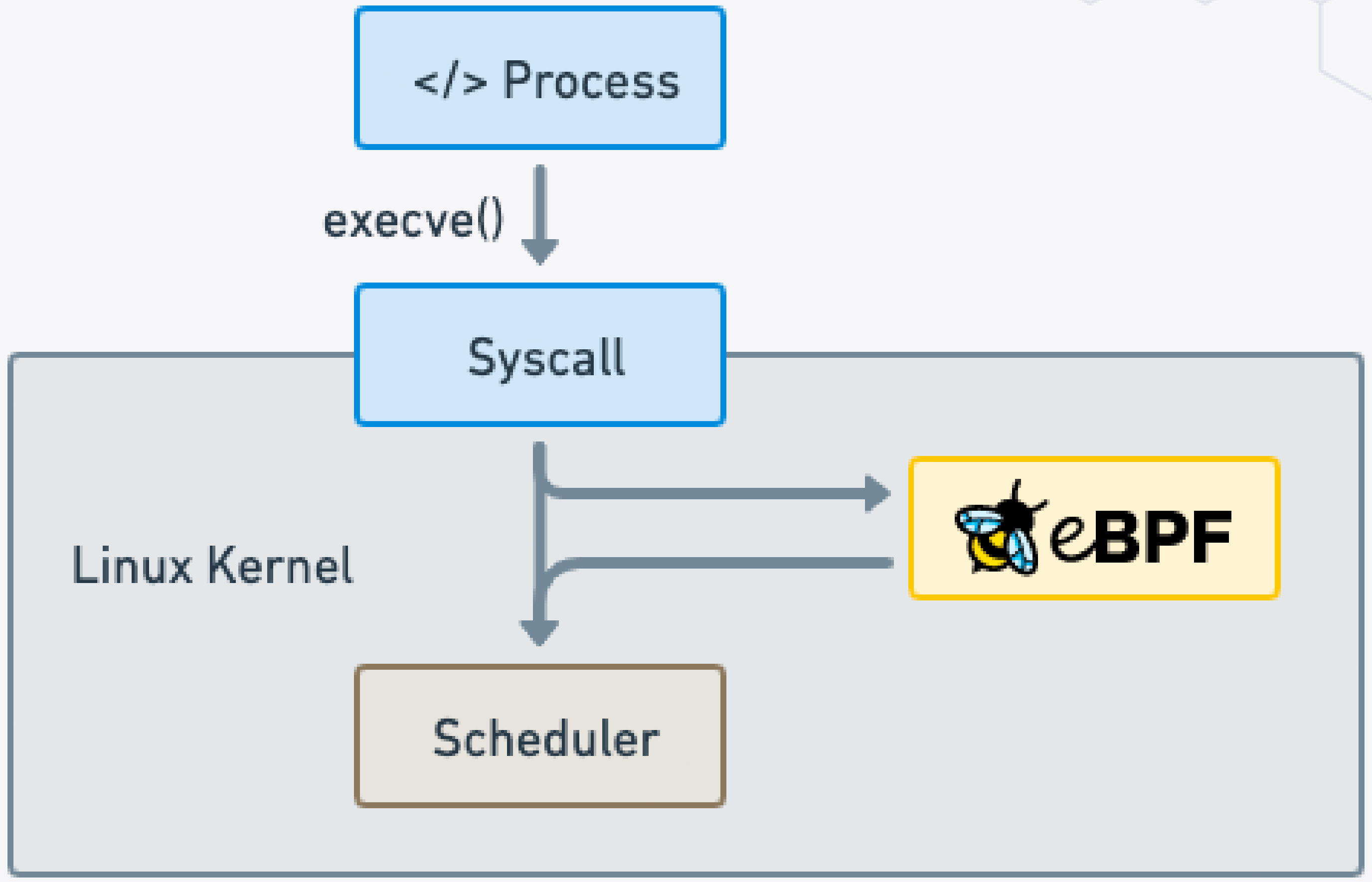
- Company behind Cilium & Tetragon
- Provides Cilium Enterprise & Tetragon Enterprise

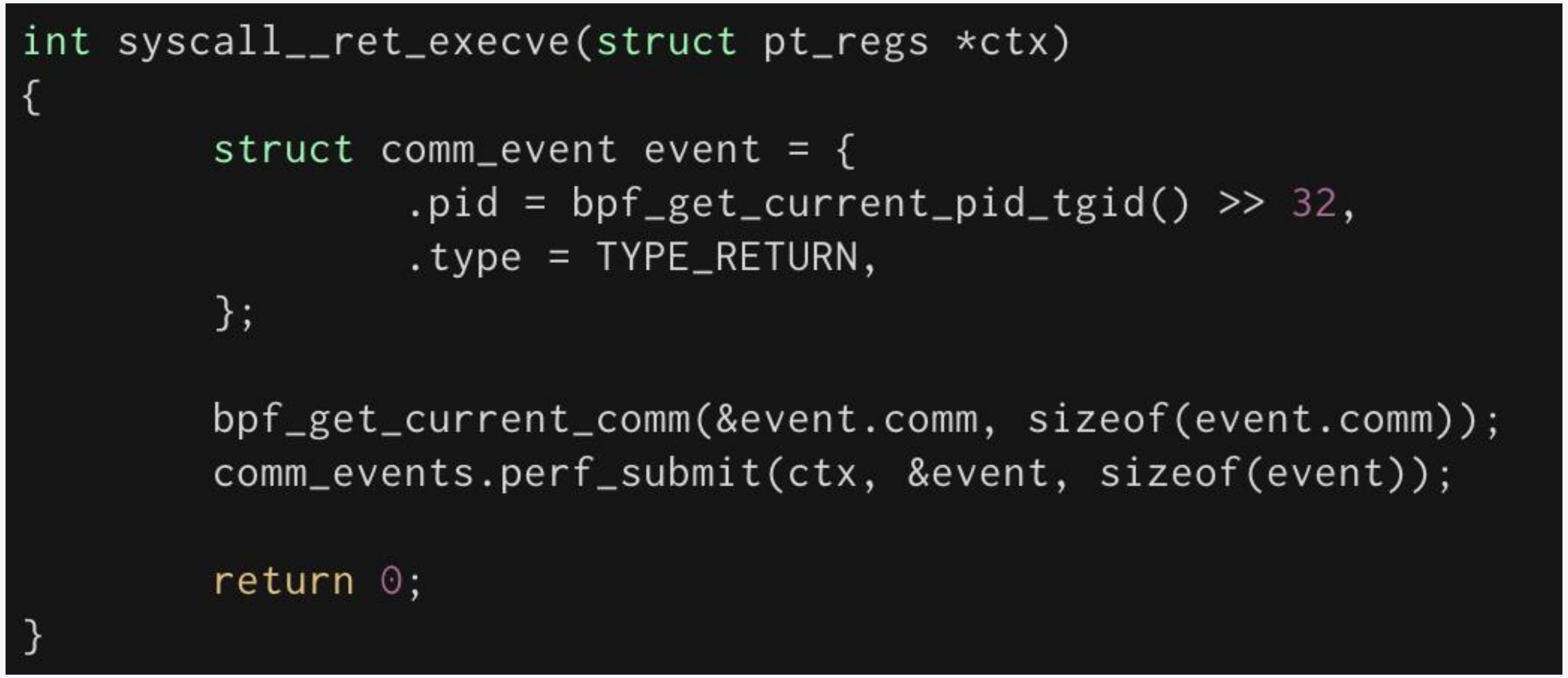
eBPF

eBPF

Makes the Linux kernel programmable in a secure and efficient way.

“What JavaScript is to the browser, eBPF is to the Linux Kernel”



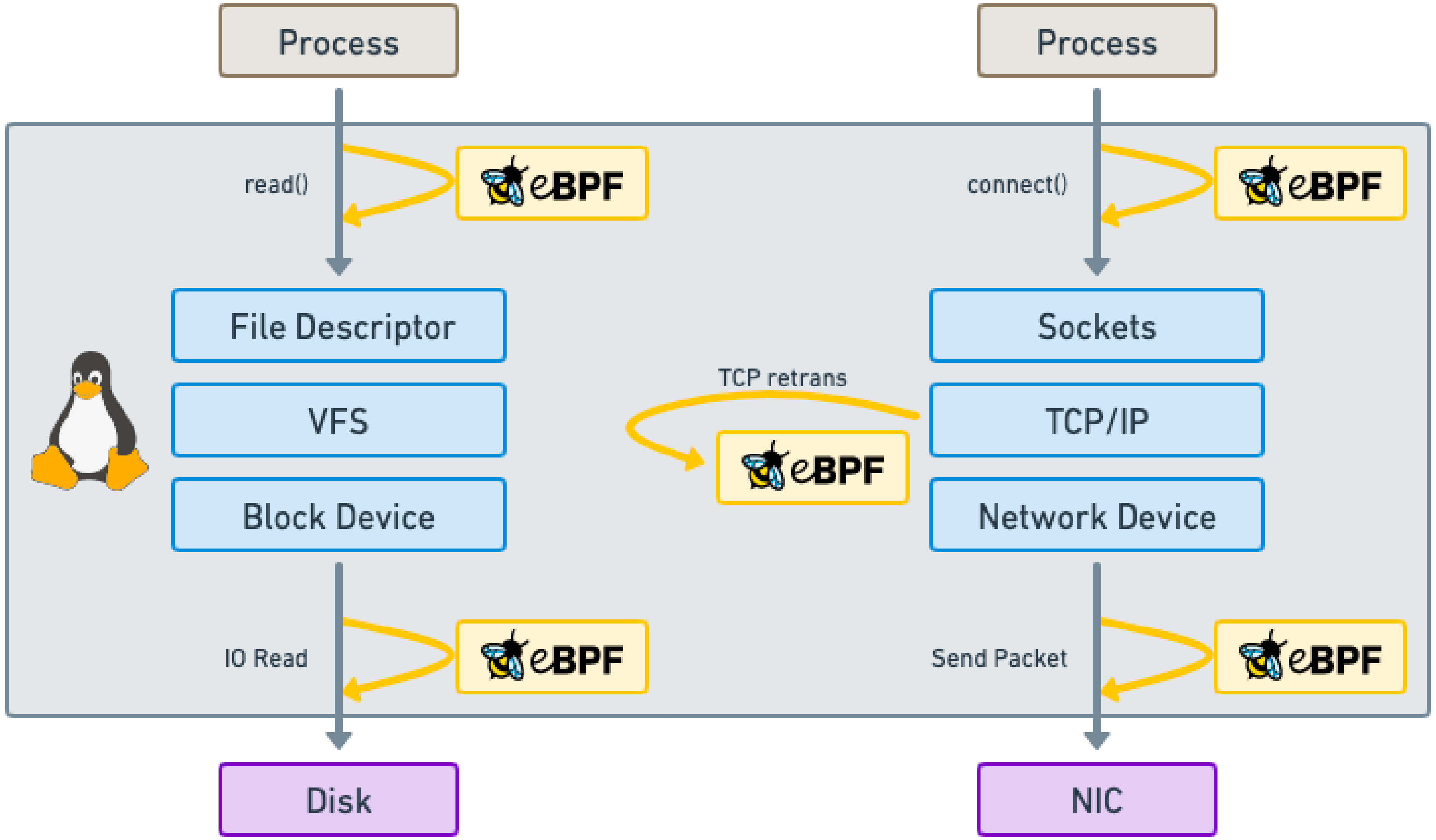


```
int syscall__ret_execve(struct pt_regs *ctx)
{
        struct comm_event event = {
                .pid = bpf_get_current_pid_tgid() >> 32,
                .type = TYPE_RETURN,
        };

        bpf_get_current_comm(&event.comm, sizeof(event.comm));
        comm_events.perf_submit(ctx, &event, sizeof(event));

        return 0;
}
```

Run eBPF programs on events



Attachment points

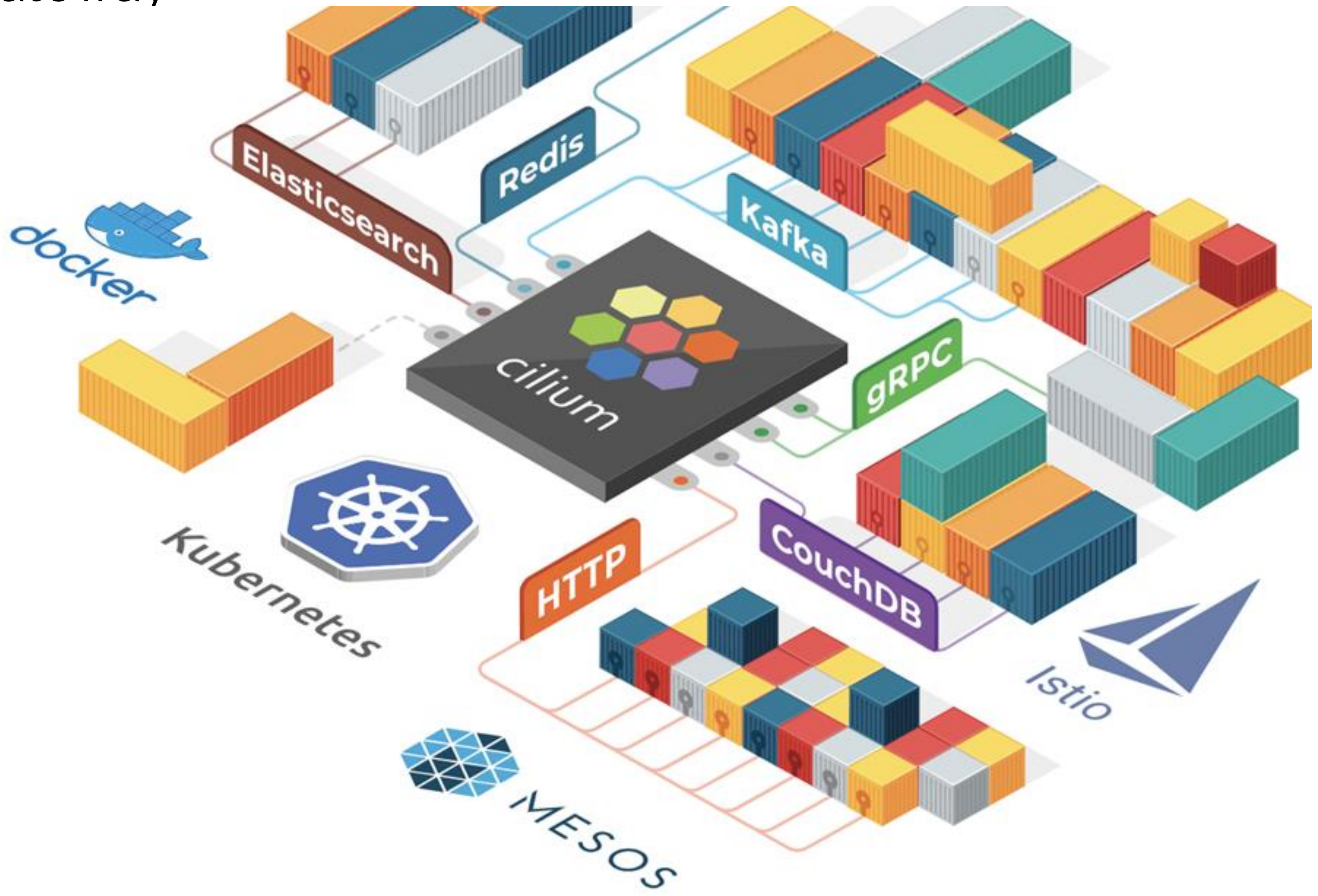
- Kernel functions (kprobes)
- Userspace functions (uprobe)
- System calls
- Tracepoints
- Sockets (data level)
- Network devices (packet level)
- Network device (DMA level) [XDP]
- ...

What is Cilium?

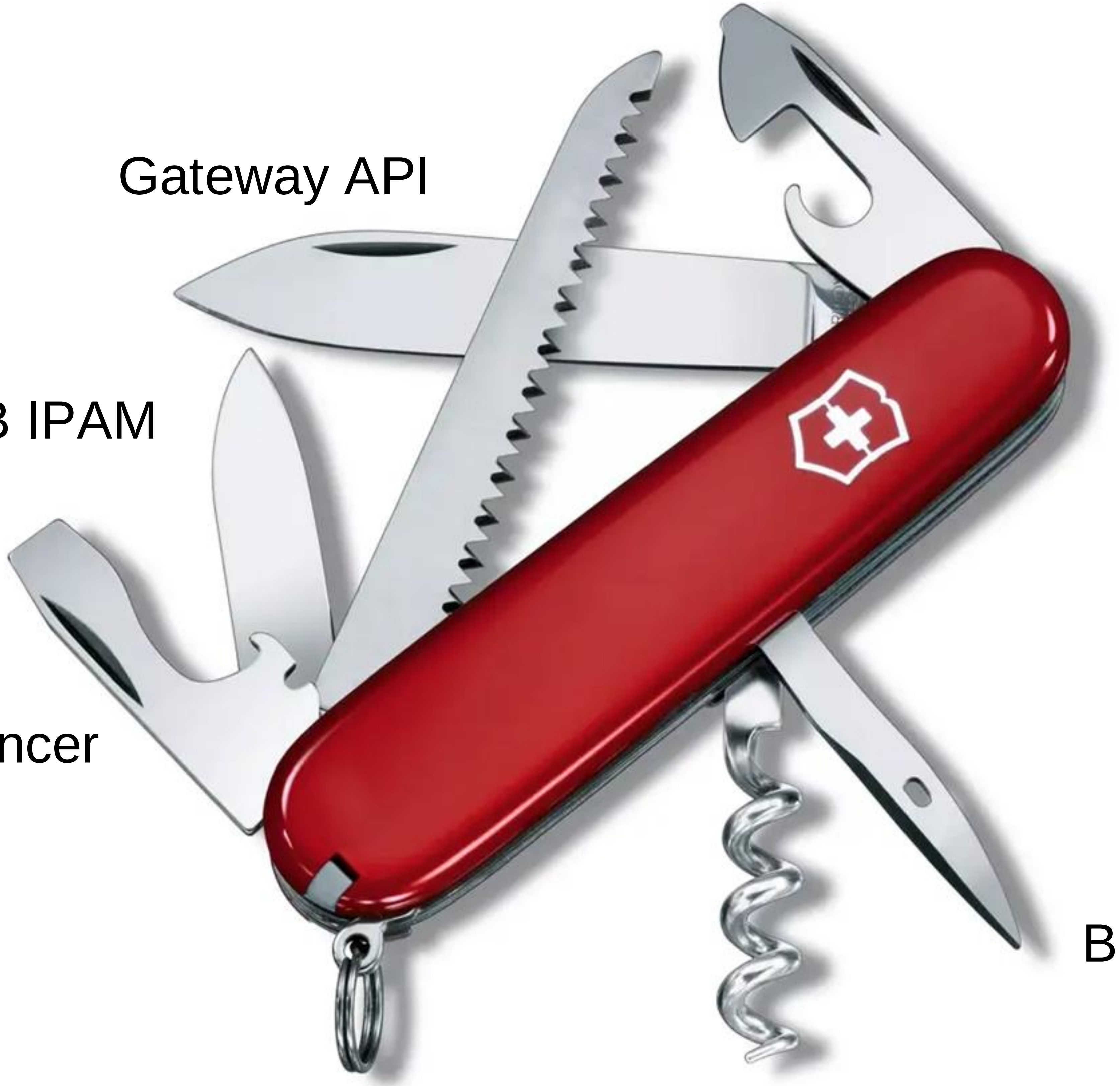
- **Networking & Load-Balancing**
  - CNI, Kubernetes Services, Multi-cluster, VM Gateway
- **Network Security**
  - Network Policy, Identity-based, Encryption
- **Observability**
  - Metrics, Flow Visibility, Service Dependency

At the foundation of Cilium is the new Linux kernel technology eBPF, which enables the dynamic insertion of powerful security, visibility, and networking control logic within Linux itself. Besides providing traditional network level security, the flexibility of BPF enables security on API and process level to secure communication within a container or pod.

Read More



In this Session



Gateway API

LB IPAM

Load Balancer

BGP

L2 Announcements

Cilium Features Deep Dive

BGP Control Plane

BGP

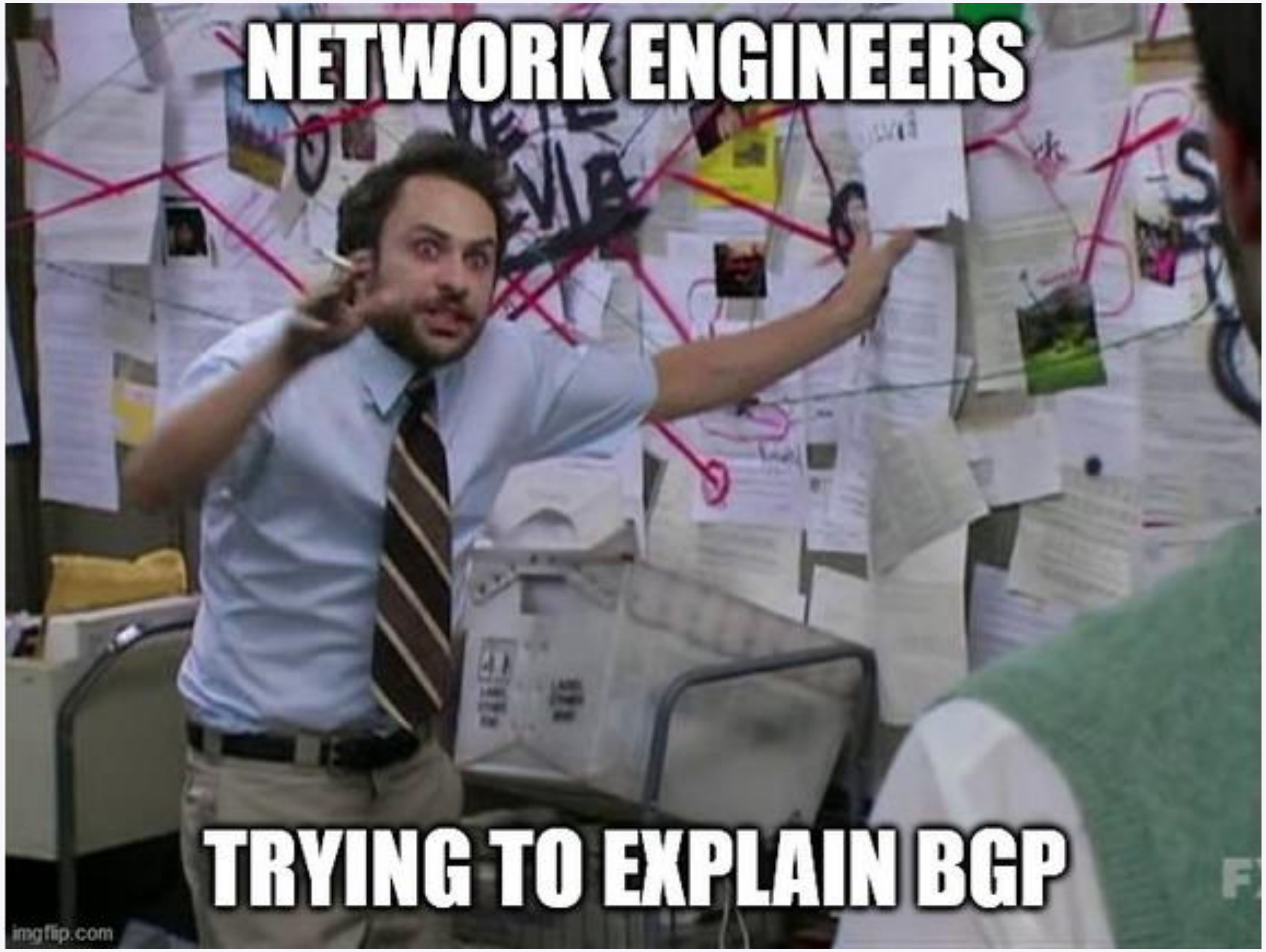
BGP

Use Cases

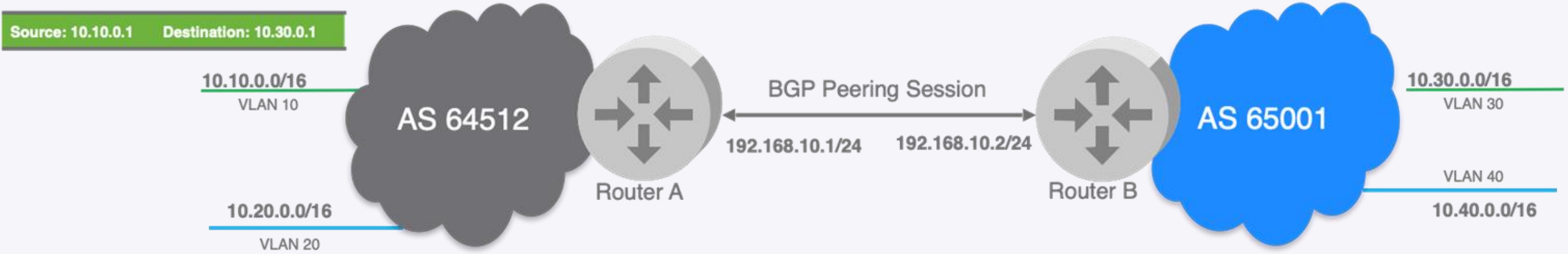
- External Network Connectivity
  - Ingress
  - Egress
- Automation
- Availability
- Recoverability
- Traffic Engineering

Challenges

- Multi-Tenancy
- Security
- Traffic Optimization


NETWORK ENGINEERS
TRYING TO EXPLAIN BGP
imgflip.com

BGP Introduction



- BGP is a dynamic routing protocol. It uses TCP port 179.
- BGP neighbours exchange routing information over a peering session.
- A given router can build a BGP peering session with one or multiple other routers.

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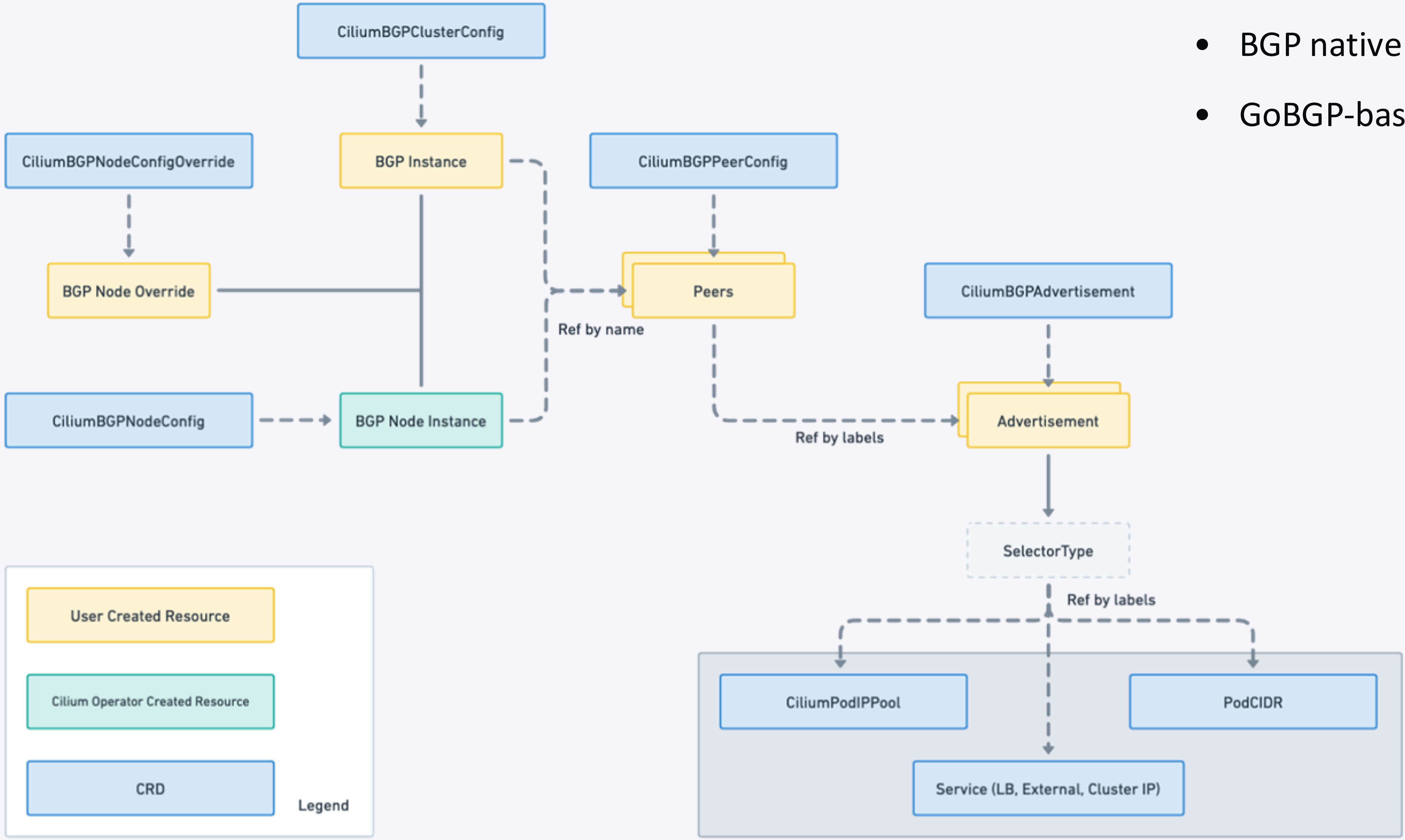
Cilium BGP Control Plane v2

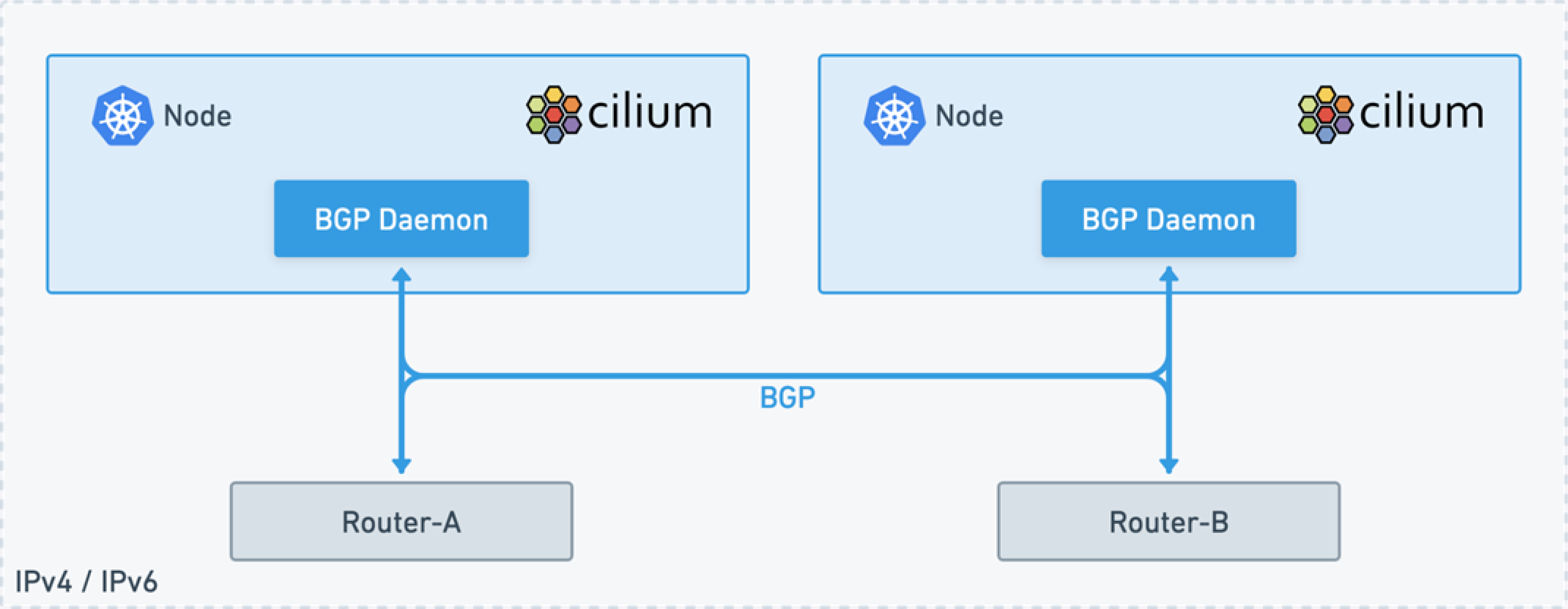
- BGP natively supported in Cilium
- GoBGP-based



https://isovalent.com/blog/post/isovalent-enterprise-for-cilium-1-16/#h-bgpv2

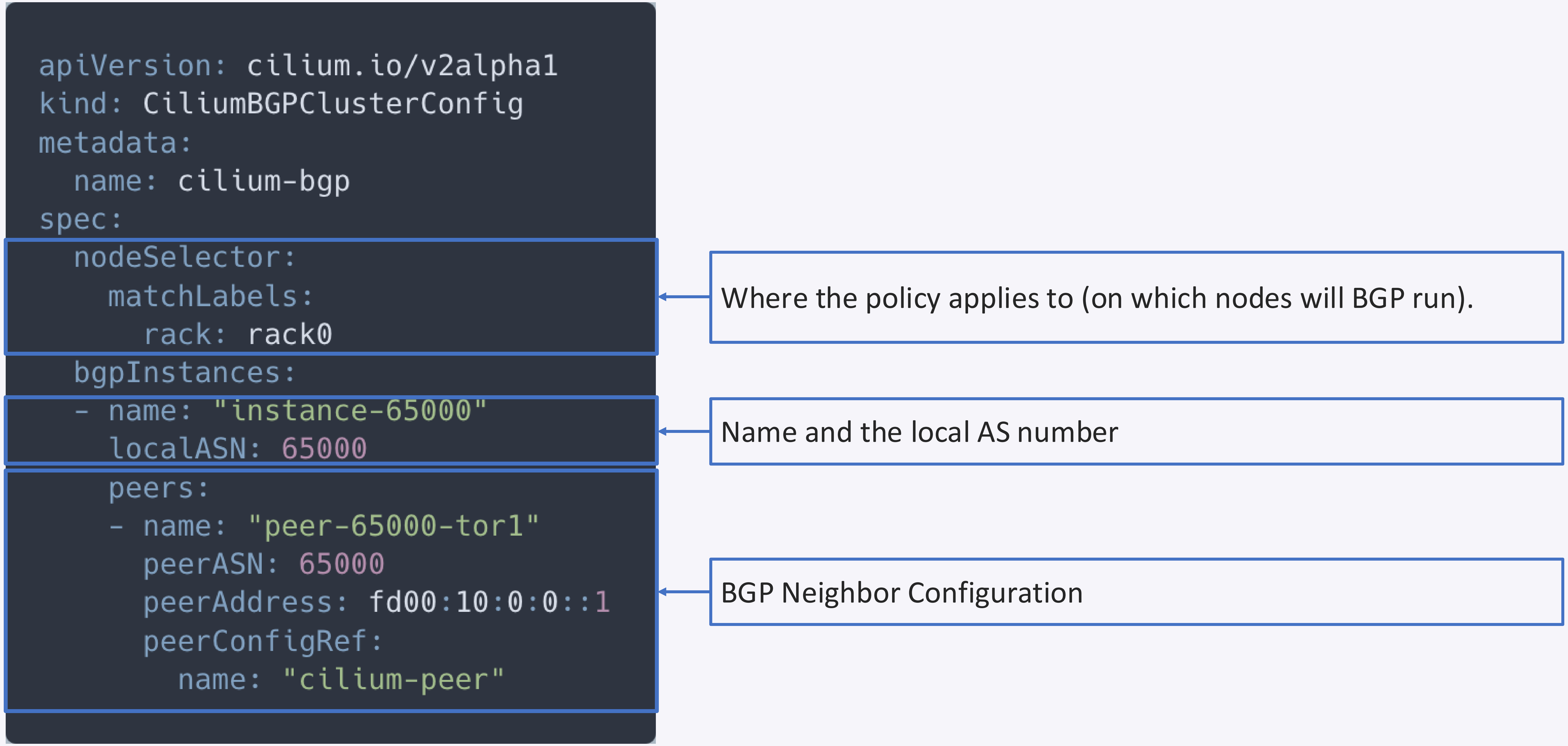
Cilium BGP Features

- IPv4 & IPv6
- PodCIDR, ClusterIP, ExternalIP, LoadBalancerIP Advertisements
- Hold/Keepalive Timers
- MD5 Password
- Graceful Restart
- Multihop
- Communities
- BFD
- BGP Operational Tooling



https://isovalent.com/blog/post/connecting-your-kubernetes-island-to-your-network-with-cilium-bgp/

CiliumBGPClusterConfig CRD



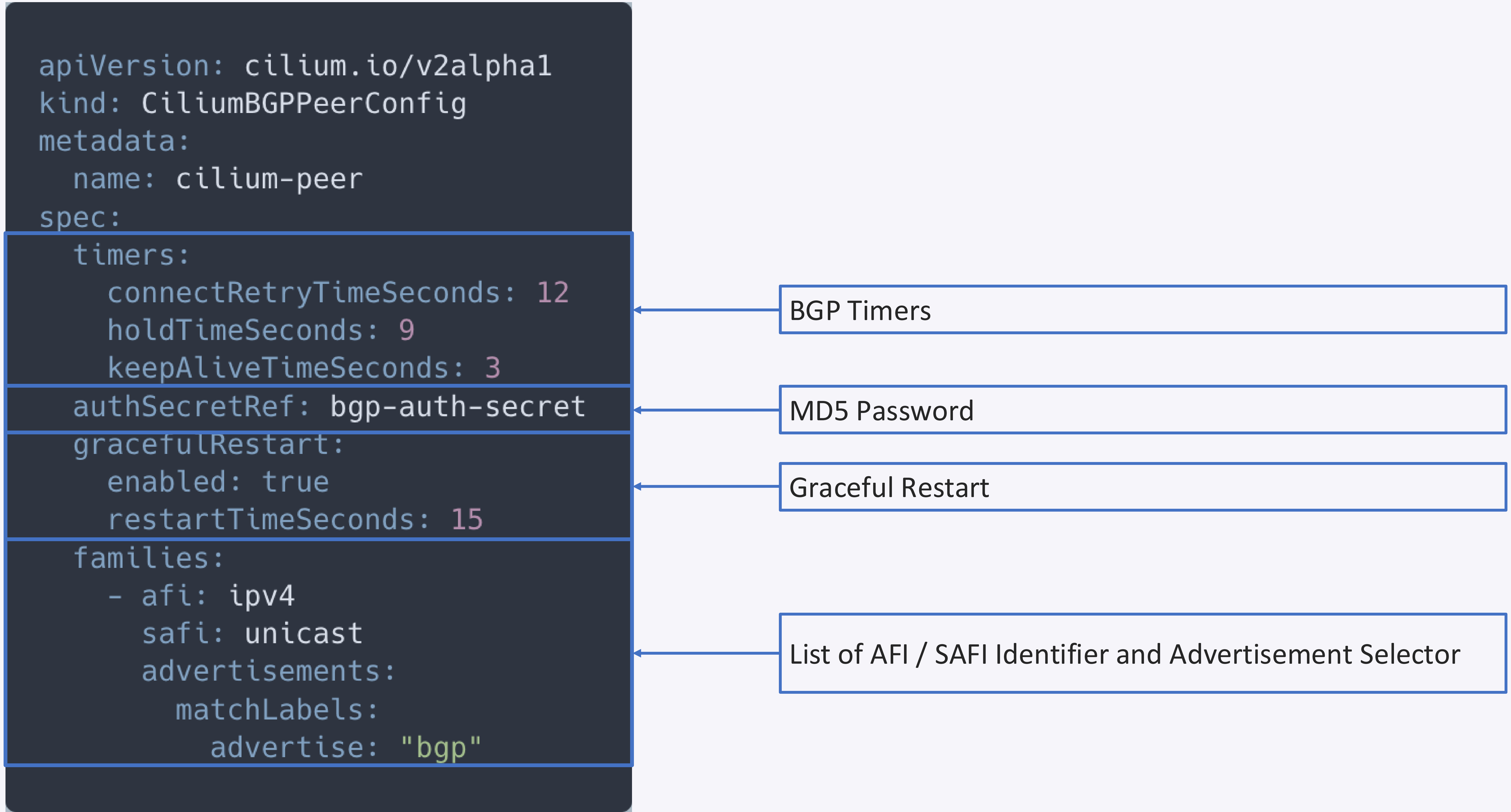
```yaml
apiVersion: cilium.io/v2alpha1
kind: CiliumBGPClusterConfig
metadata:
  name: cilium-bgp
spec:
  nodeSelector:
    matchLabels:
      rack: rack0
  bgpInstances:
  - name: "instance-65000"
    localASN: 65000
    peers:
    - name: "peer-65000-tor1"
      peerASN: 65000
      peerAddress: fd00:10:0:0::1
      peerConfigRef:
        name: "cilium-peer"
```

Where the policy applies to (on which nodes will BGP run).

Name and the local AS number

BGP Neighbor Configuration

CiliumBGPPeerConfig CRD



```yaml
apiVersion: cilium.io/v2alpha1
kind: CiliumBGPPeerConfig
metadata:
  name: cilium-peer
spec:
  timers:
    connectRetryTimeSeconds: 12
    holdTimeSeconds: 9
    keepAliveTimeSeconds: 3
  authSecretRef: bgp-auth-secret
  gracefulRestart:
    enabled: true
    restartTimeSeconds: 15
  families:
    - afi: ipv4
      safi: unicast
      advertisements:
        matchLabels:
          advertise: "bgp"
```

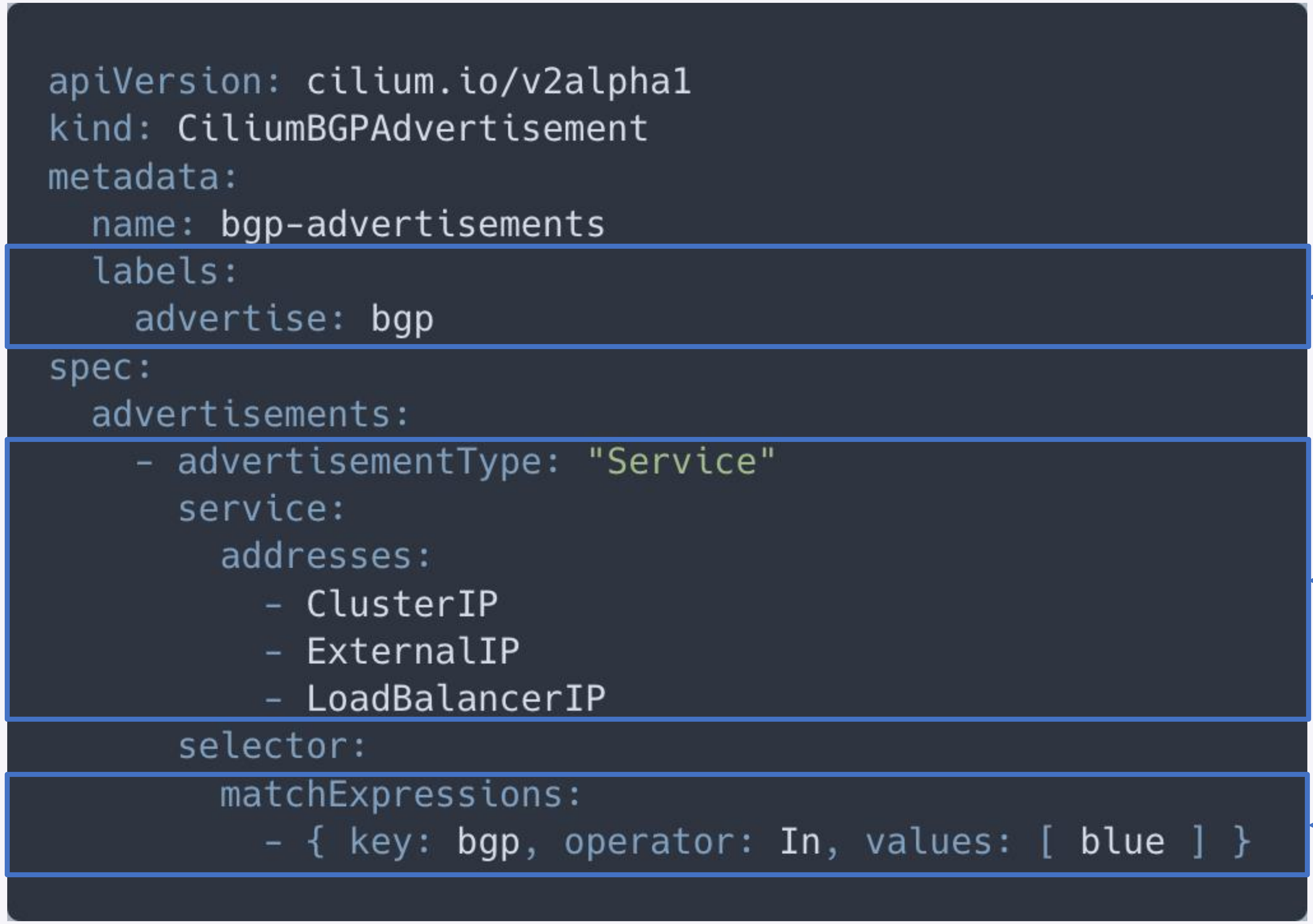
BGP Timers

MD5 Password

Graceful Restart

List of AFI / SAFI Identifier and Advertisement Selector

CiliumBGPAdvertisement CRD



```yaml
apiVersion: cilium.io/v2alpha1
kind: CiliumBGPAdvertisement
metadata:
  name: bgp-advertisements
  labels:
    advertise: bgp
spec:
  advertisements:
    - advertisementType: "Service"
      service:
        addresses:
          - ClusterIP
          - ExternalIP
          - LoadBalancerIP
      selector:
        matchExpressions:
          - { key: bgp, operator: In, values: [ blue ] }
```

Labels referenced by CiliumBGPPeerConfig

Advertisement Type and Address to Advertise:

- Pod CIDR ranges
- ClusterIP, ExternalIP, LoadBalancerIP
- Pod IP Pool (MultiPool IPAM)

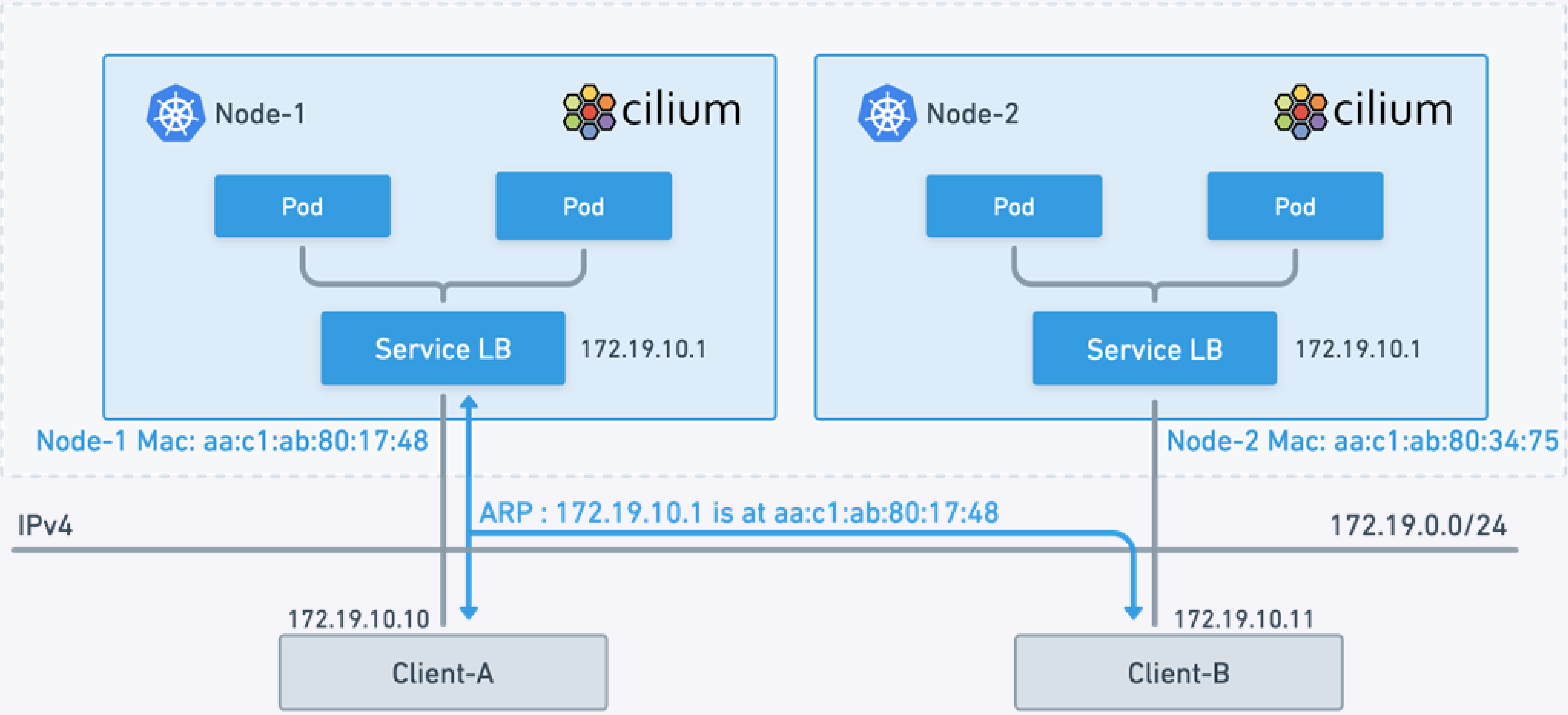
Selector for Advertisement

L2 Announcements

L2 Announcements

L2 Announcements

- Cilium responds to ARP queries from local clients for ExternalIPs and/or LoadBalancer IPs.
- Virtual IPs on multiple nodes, however only one Node will respond at a time and will act as a North-South LoadBalancer.



https://docs.cilium.io/en/stable/network/l2-announcements/#l2-announcements

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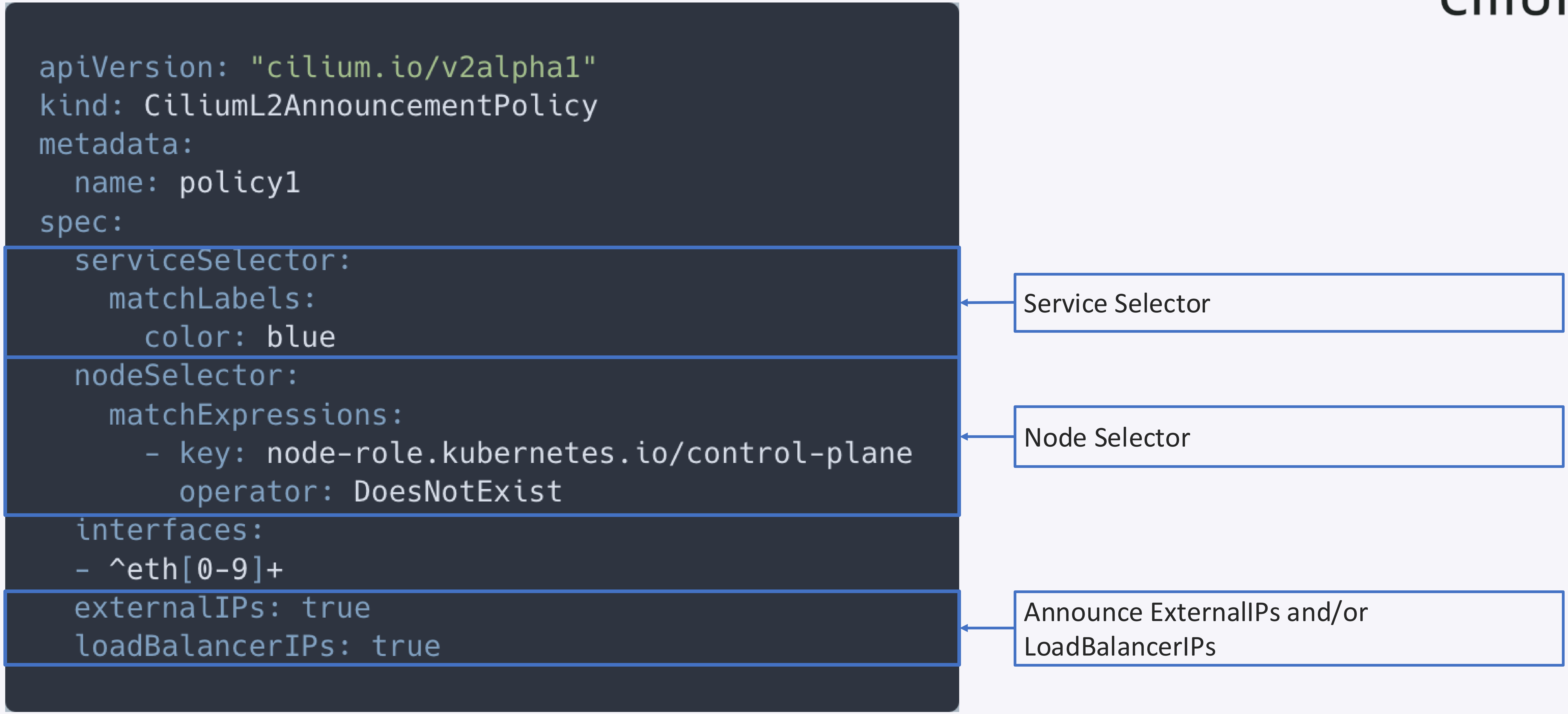
CiliumL2AnnouncementPolicy



```yaml
apiVersion: "cilium.io/v2alpha1"
kind: CiliumL2AnnouncementPolicy
metadata:
  name: policy1
spec:
  serviceSelector:
    matchLabels:
      color: blue
  nodeSelector:
    matchExpressions:
      - key: node-role.kubernetes.io/control-plane
        operator: DoesNotExist
  interfaces:
  - ^eth[0-9]+
  externalIPs: true
  loadBalancerIPs: true
```

Service Selector

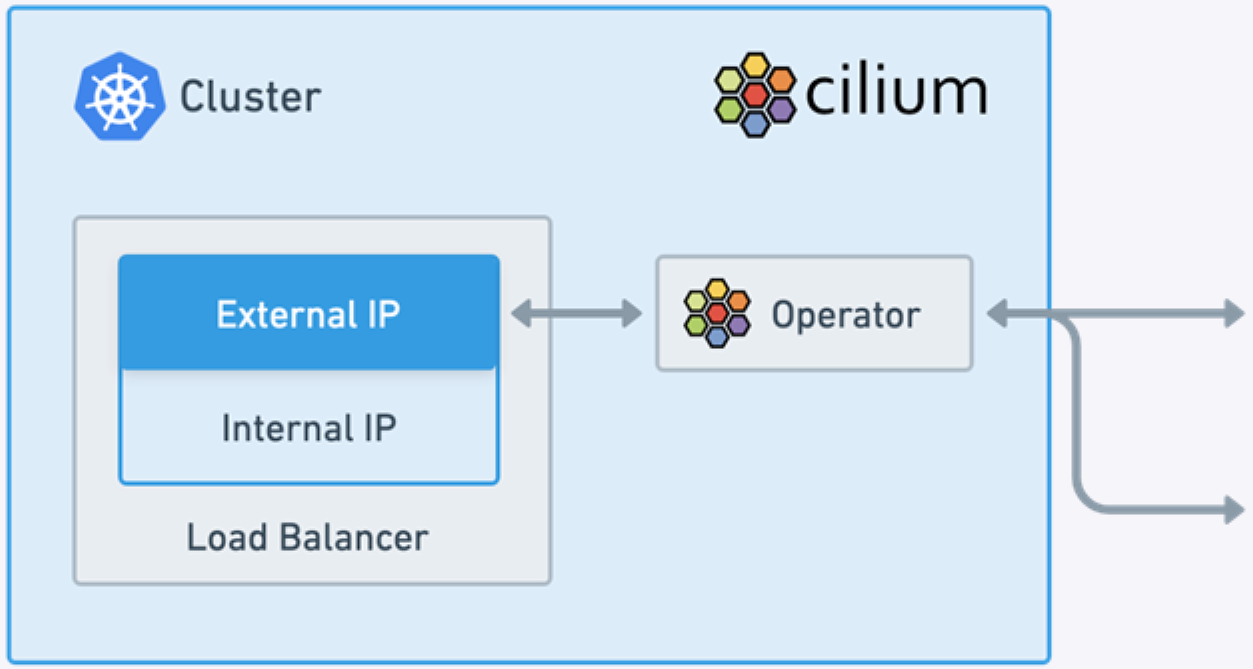
Node Selector

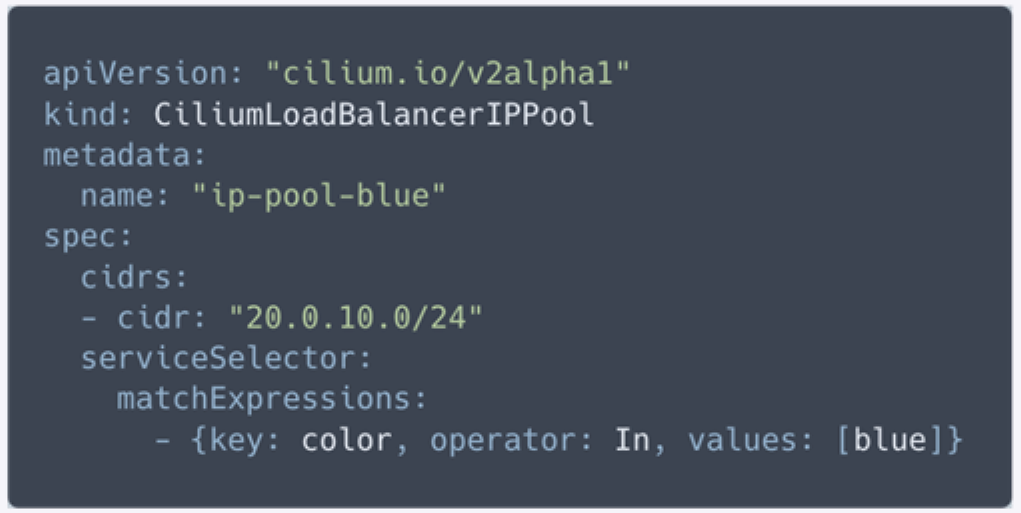
Announce ExternalIPs and/or LoadBalancerIPs

LB IPAM

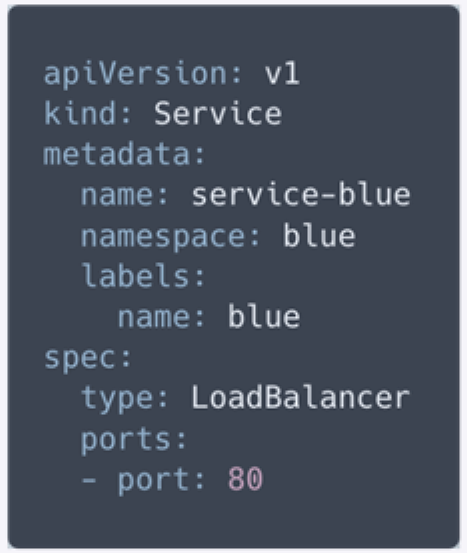
LoadBalancer IP Address Management (LB IPAM)

- Automatically assign IP addresses to Kubernetes Services of the type LoadBalancer
- Define which services can get IPs from which pools using a label selector or based on the service name or the service namespace.
- Assigned IP addresses can then be advertised to BGP neighbors.





```yaml
apiVersion: "cilium.io/v2alpha1"
kind: CiliumLoadBalancerIPPool
metadata:
  name: "ip-pool-blue"
spec:
  cidrs:
  - cidr: "20.0.10.0/24"
  serviceSelector:
    matchExpressions:
      - {key: color, operator: In, values: [blue]}
```

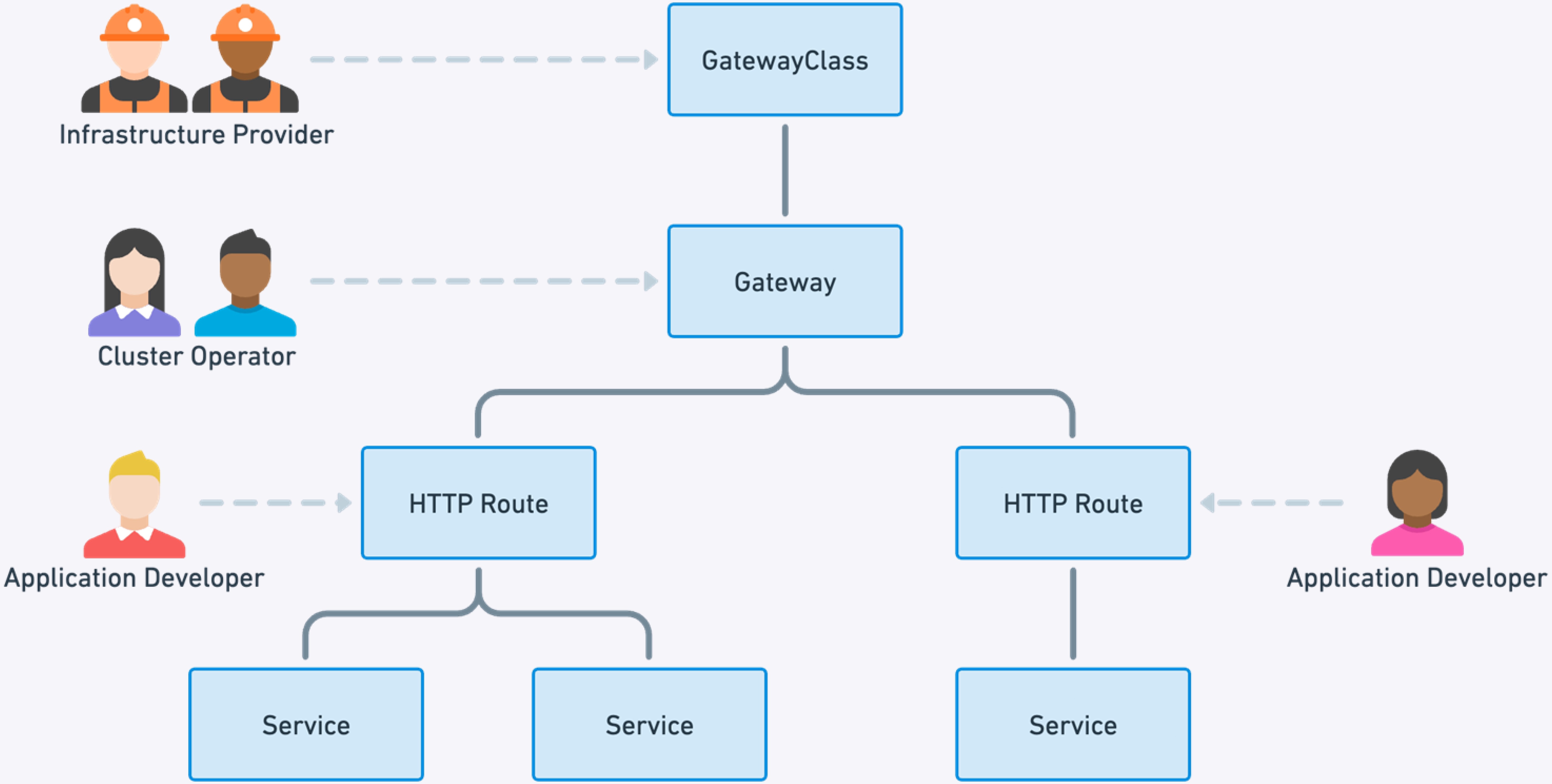


```yaml
apiVersion: v1
kind: Service
metadata:
  name: service-blue
  namespace: blue
  labels:
    name: blue
spec:
  type: LoadBalancer
  ports:
  - port: 80
```

Gateway API

Gateway API

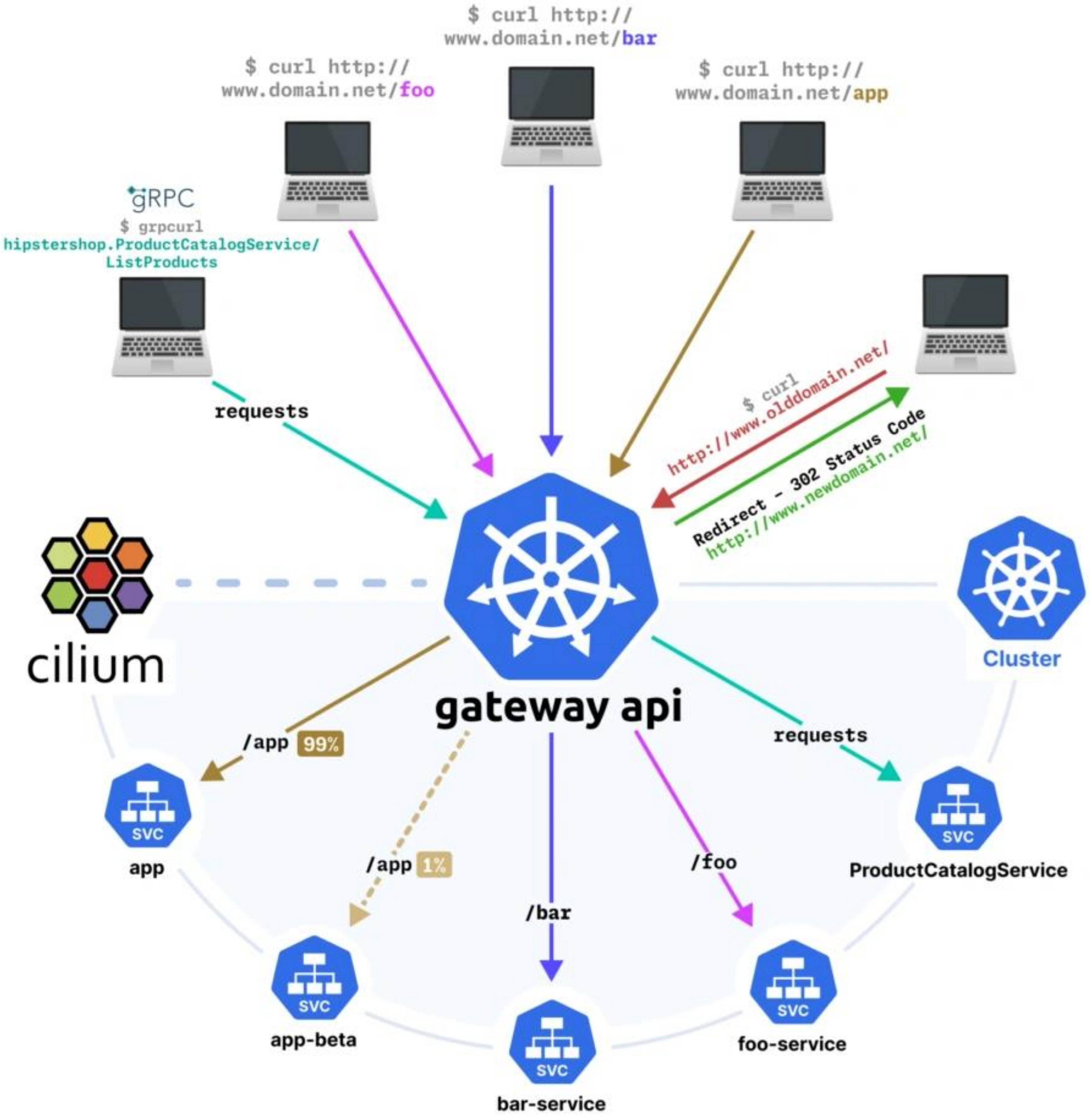
Introduction



Gateway API

Use Cases

- Traffic Management
  - Rolling deployments
  - A/B Testing
  - Traffic Splitting
  - Canary
  - Blue-Green
- Scalability
- Golden Signals



```
$ curl http://www.domain.net/bar
```

```
$ curl http://www.domain.net/foo
```

```
$ curl http://www.domain.net/app
```

```
$ grpcurl hipstershop.ProductCatalogService/ListProducts
```

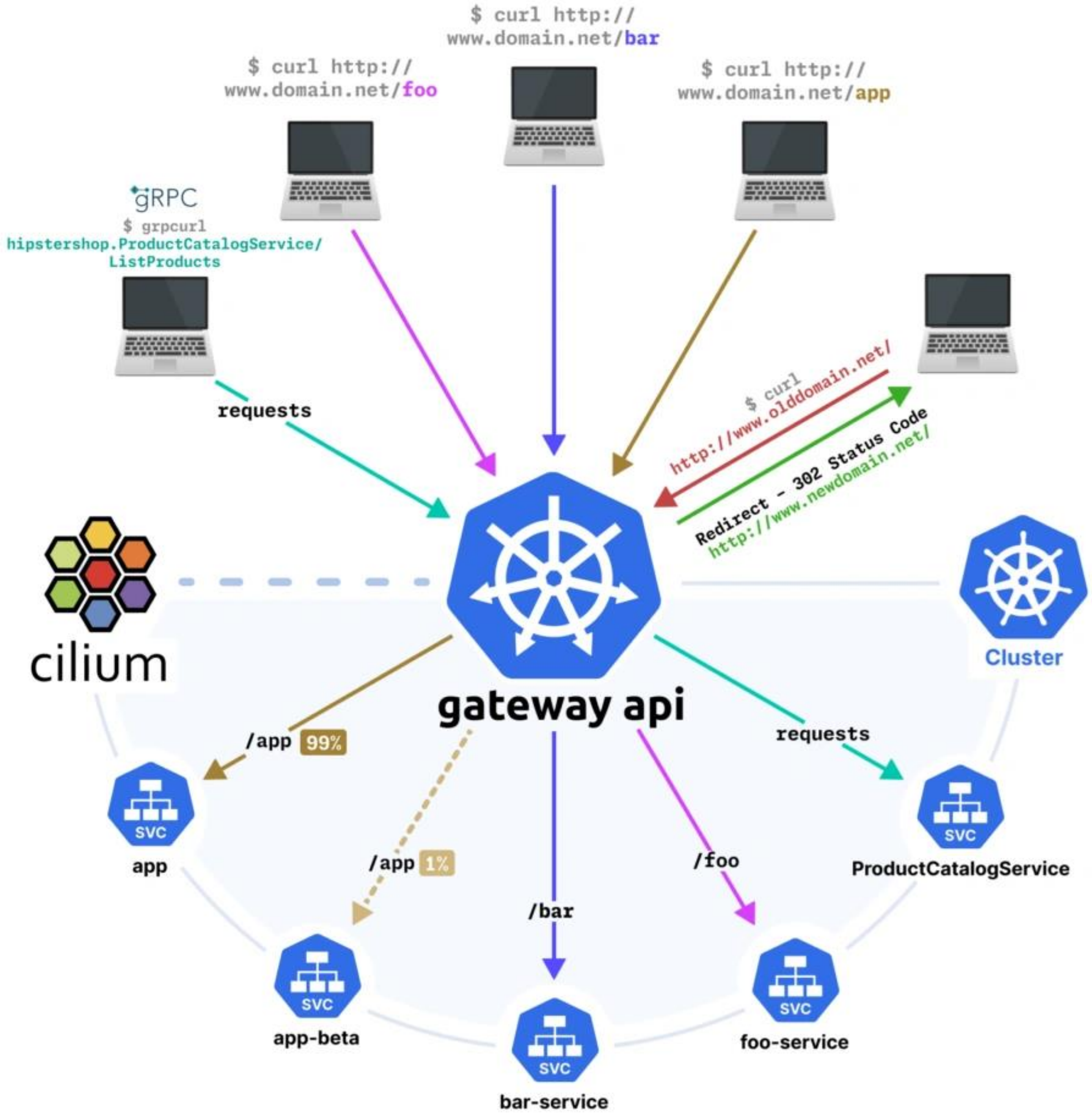
```
$ curl http://www.olddomain.net/
```

Gateway API

Cilium Supports Gateway API 1.1

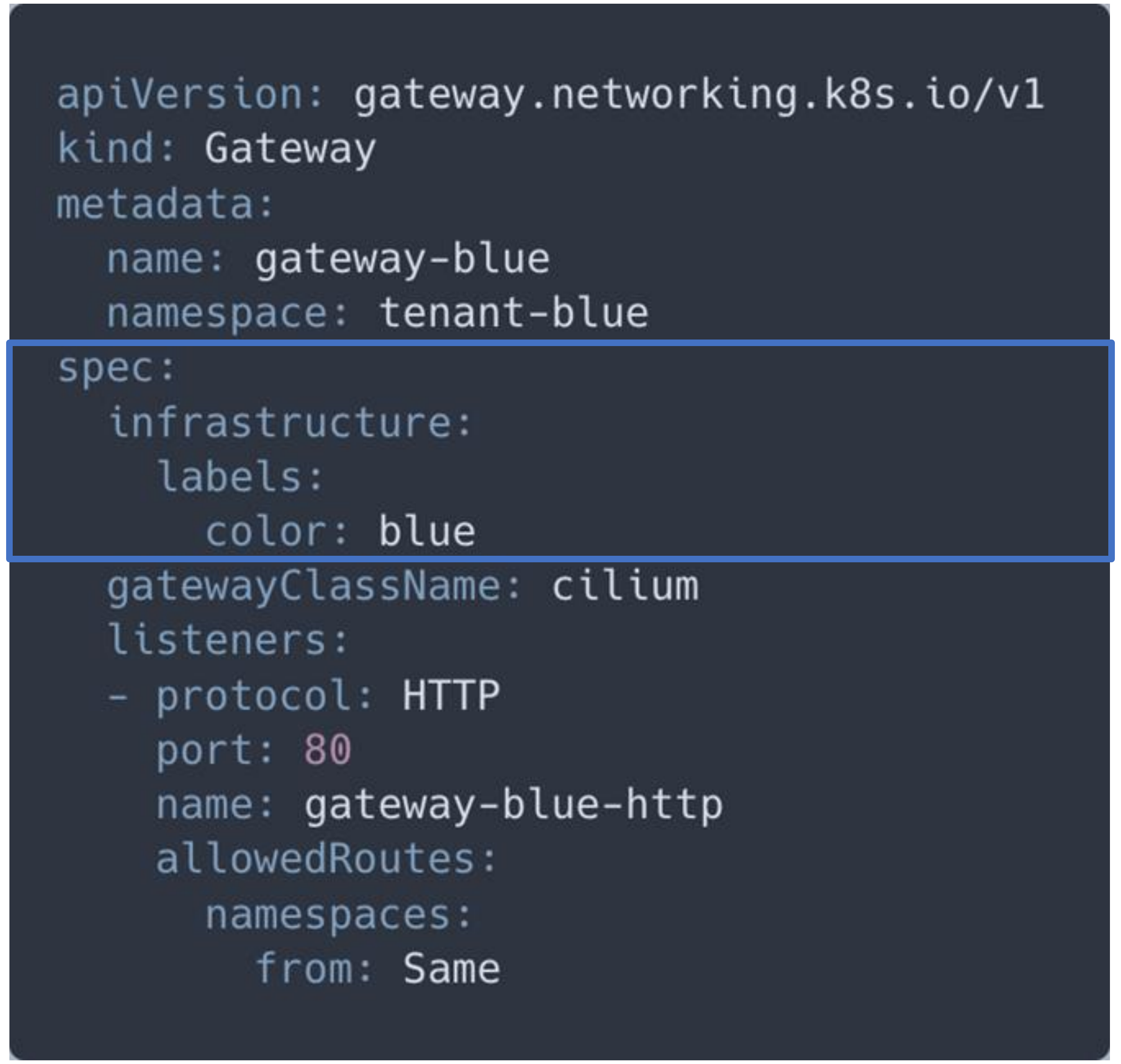
Latest New Features

- GAMMA support
- gRPC routing
- proxyProtocol, ALPN, appProtocol support
- Local ExternalTrafficPolicy
- Envoy Proxy as dedicated DaemonSet
- Host Network Mode & Envoy listeners on subset of nodes.

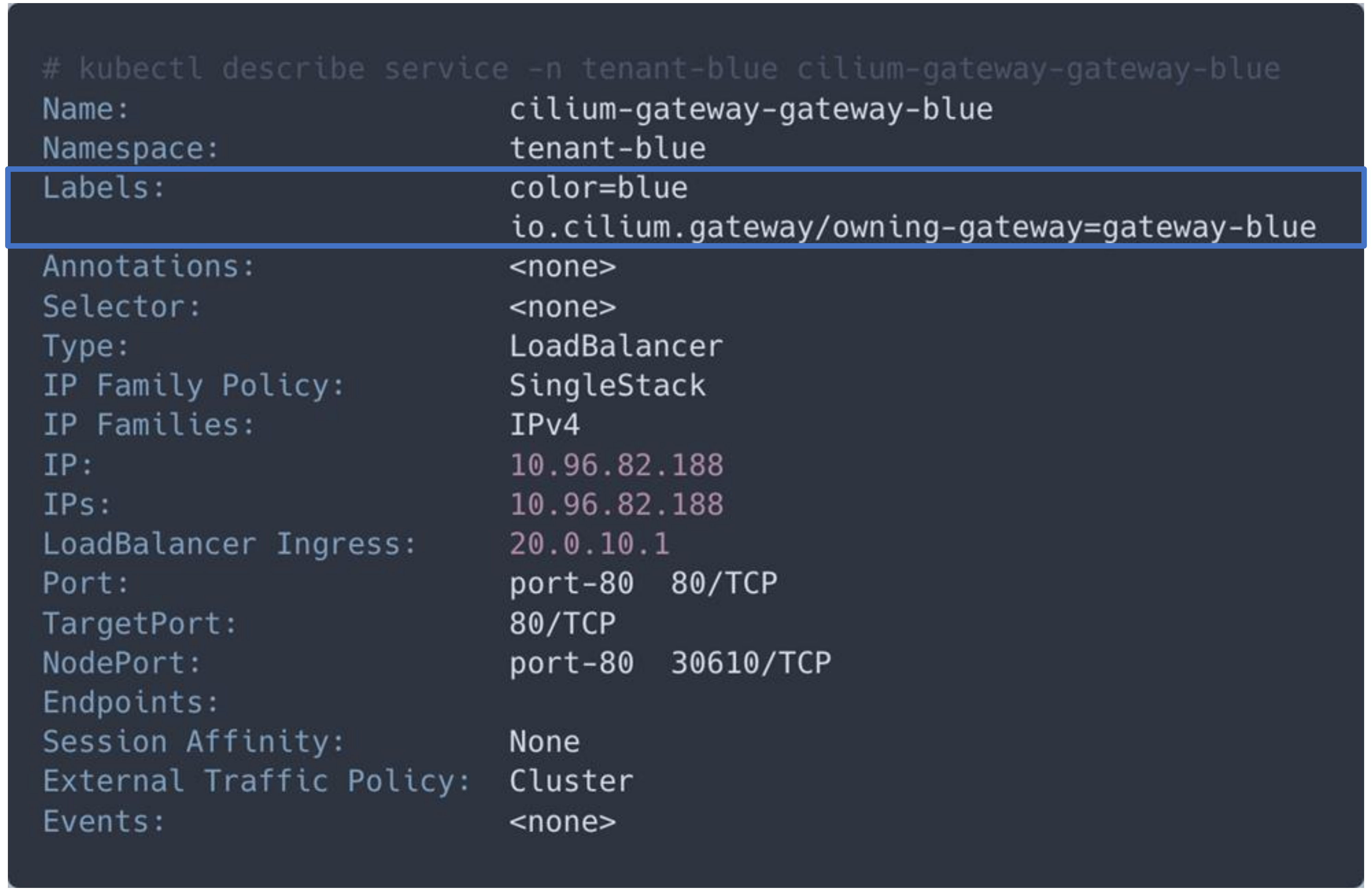

$ curl http://www.domain.net/bar
$ curl http://www.domain.net/foo
$ curl http://www.domain.net/app
gRPC
$ grpcurl hipstershop.ProductCatalogService/ListProducts
requests
$ curl http://www.olddomain.net/
Redirect - 302 Status Code http://www.newdomain.net/
cilium
gateway api
Cluster
/app 99%
/app 1%
/bar
/foo
requests
SVC
app
SVC
app-beta
SVC
bar-service
SVC
foo-service
SVC
ProductCatalogService

Gateway API

Annotation Propagation from the Gateway to the LoadBalancer Service



```yaml
apiVersion: gateway.networking.k8s.io/v1
kind: Gateway
metadata:
  name: gateway-blue
  namespace: tenant-blue
spec:
  infrastructure:
    labels:
      color: blue
  gatewayClassName: cilium
  listeners:
  - protocol: HTTP
    port: 80
    name: gateway-blue-http
    allowedRoutes:
      namespaces:
        from: Same
```



```
# kubectl describe service -n tenant-blue cilium-gateway-gateway-blue
Name:                     cilium-gateway-gateway-blue
Namespace:                tenant-blue
Labels:                   color=blue
                          io.cilium.gateway/owning-gateway=gateway-blue
Annotations:              <none>
Selector:                 <none>
Type:                     LoadBalancer
IP Family Policy:         SingleStack
IP Families:              IPv4
IP:                       10.96.82.188
IPs:                      10.96.82.188
LoadBalancer Ingress:     20.0.10.1
Port:                     port-80  80/TCP
TargetPort:               80/TCP
NodePort:                 port-80  30610/TCP
Endpoints:
Session Affinity:         None
External Traffic Policy:  Cluster
Events:                   <none>
```

Demo

NetworkPolicies

Gateway API

LB IPAM

Load Balancer

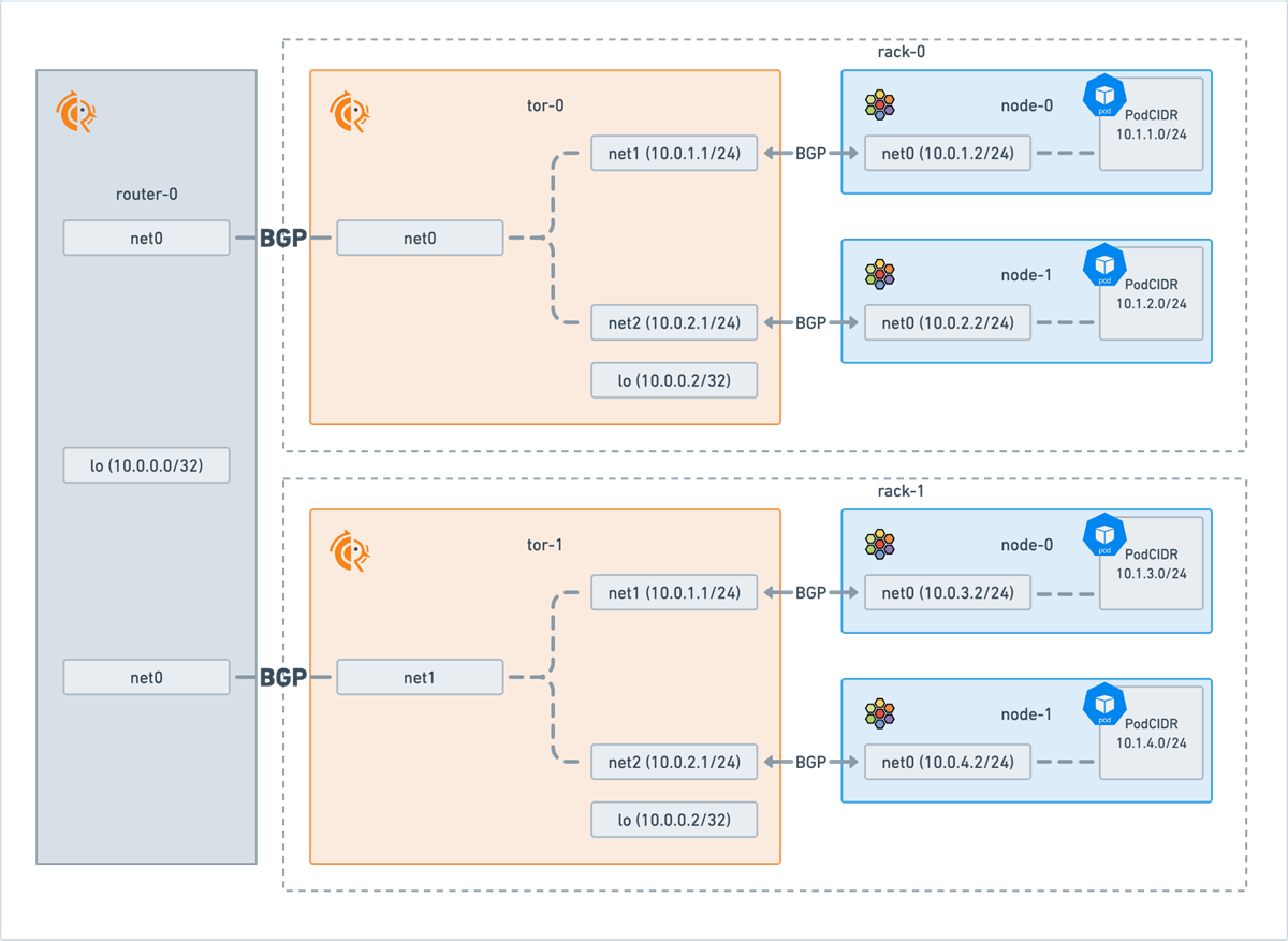
BGP

Demo

As a Platform Engineer I want to:

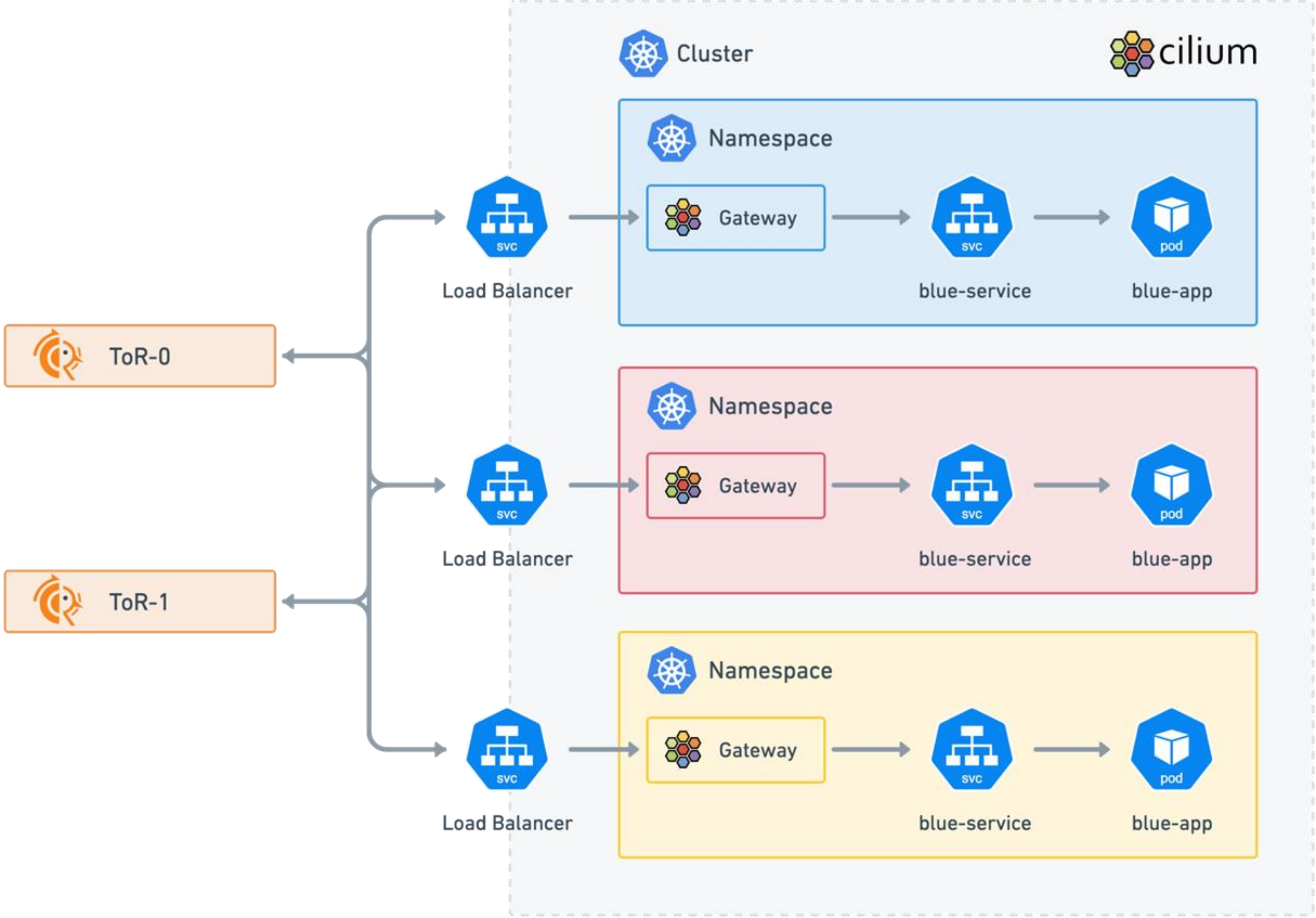
- Support a multi-tenant Kubernetes platform
- Provide separation and segmentation for each tenant
    - Using unique Ingress IPs per tenant
    - Using Network Policies for isolation
- Provide L7 Routing and Filtering capabilities
- Advertise LoadBalancer IPs to the external network using BGP

Demo Topology



cilium

Demo Topology



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Thank you!