
KubeCon
CloudNativeCon
North America 2022
BUILDING FOR THE ROAD AHEAD
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BUILDING FOR THE ROAD AHEAD

DETROIT 2022

SIG-NETWORK:
Intro and Deep Dive

Andrew Stoycos, Red Hat
Bowei Du, Google
Rob Scott, Google
Surya Seetharaman, Red Hat

Outline

- Networking APIs
  - Service, Endpoint(Slice), Ingress, Gateway API, DNS - Rob Scott
  - NetworkPolicy, Admin Network Policy, Multi Network - Surya
- Networking Components (Kube-Proxy, KPNG) - Andrew
- Features in development - Bowei
  - Topology
  - Terminating Endpoints
  - NetworkPolicy Status
  - InternalTrafficPolicy

Networking APIs

Services

- Enables grouping Pods together and exposing as a network Service
- Services are assigned IP address(es) they can be reached on
- Requests to those addresses will be routed to one of the associated Pods (endpoints)

```yaml
apiVersion: v1
kind: Service
metadata:
  name: store
spec:
  selector:
    app: store
  ports:
  - name: tcp
    protocol: TCP
    port: 80
    targetPort: 8080
```

Services

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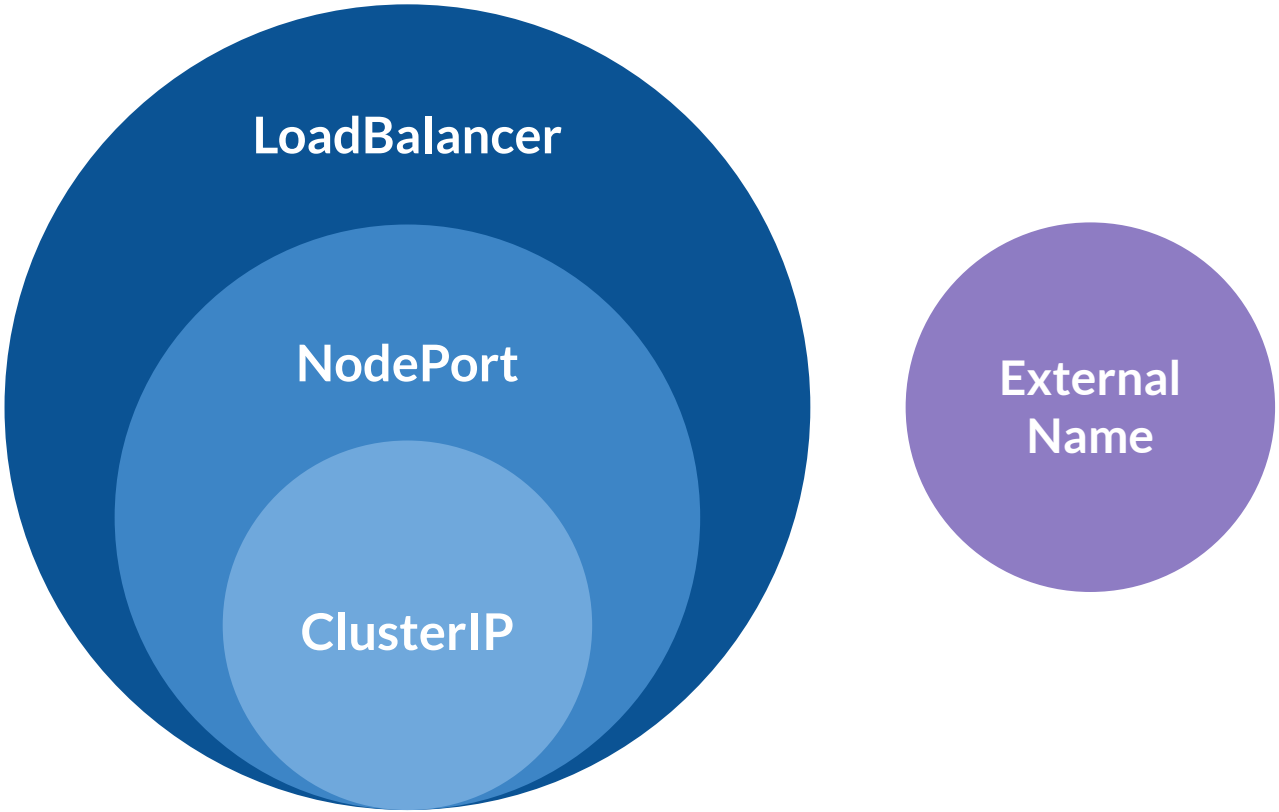
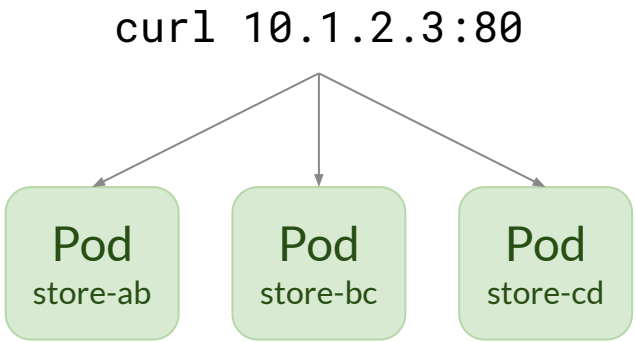
```

Service Types

- ClusterIP
- NodePort
- LoadBalancer
- ExternalName



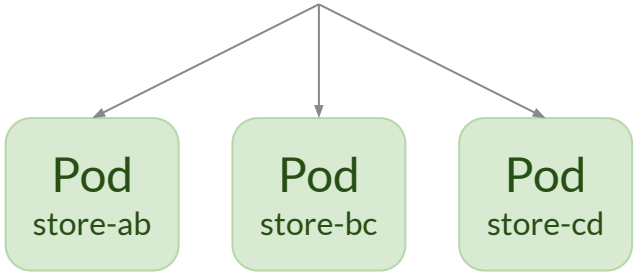
Reaching a Service




```yaml
apiVersion: v1
kind: Service
metadata:
  name: store
spec:
  clusterIP: 10.1.2.3
  selector:
    app: store
  ports:
  - name: tcp
    protocol: TCP
    port: 80
    targetPort: tcp
```

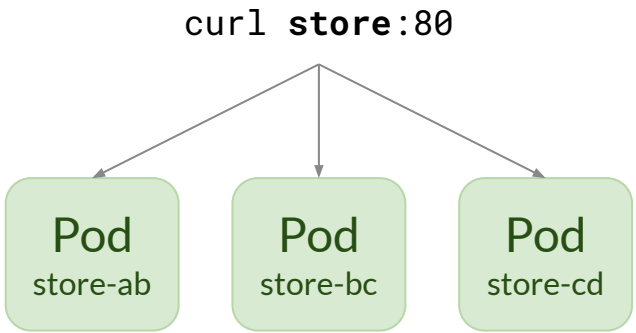
Reaching a Service

`curl` **`store.prod.svc.cluster.local`**`:80`




```yaml
apiVersion: v1
kind: Service
metadata:
  name: store
  namespace: prod
spec:
  clusterIP: 10.1.2.3
  selector:
    app: store
  ports:
  - name: tcp
    protocol: TCP
    port: 80
    targetPort: tcp
```

Reaching a Service




```yaml
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kind: Service
metadata:
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spec:
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  selector:
    app: store
  ports:
  - name: tcp
    protocol: TCP
    port: 80
    targetPort: tcp
```
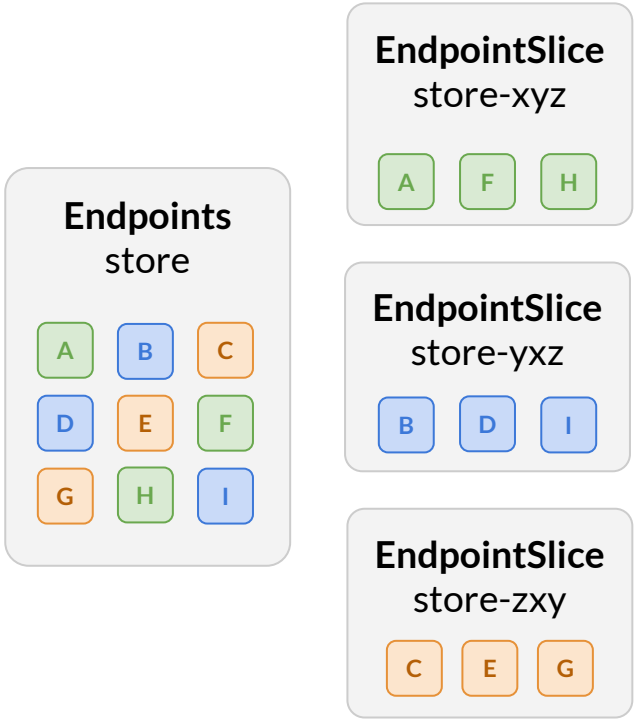

Endpoints and EndpointSlices

- Track IPs and Ports for Pods backing a Service
- Endpoints limited to 1000 Pods per Service
- EndpointSlices are sharded Endpoints, much more scalable
- New features enabled by EndpointSlices:
  - Dual Stack
  - Topology
  - Terminating Endpoints



Gateway and Ingress

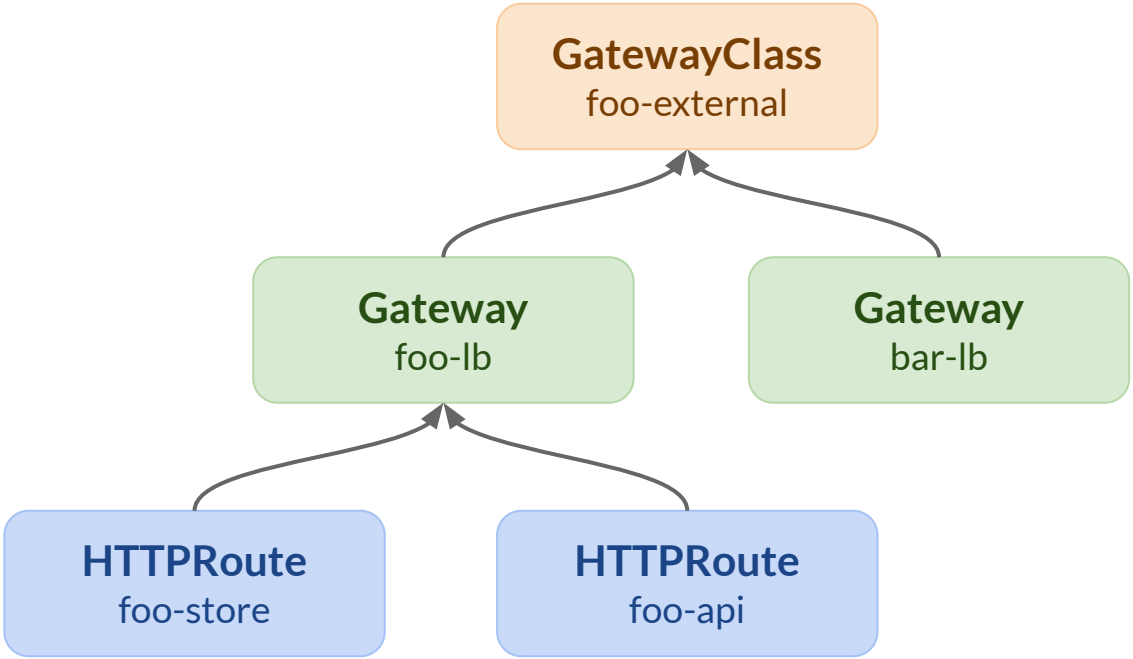
The Ingress API

- Host and Path Matching
- Forward to Service
- TLS Configuration
- Stable for 5 years
- **Simple and broadly implementable**

```yaml
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  name: minimal-ingress
spec:
  ingressClassName: nginx-example
  rules:
  - http:
      paths:
      - path: /testpath
        pathType: Prefix
        backend:
          service:
            name: test
            port:
              number: 80
```

Gateway API

- Next generation of Kubernetes routing and load balancing APIs
- Designed to be expressive and extensible
- Role oriented resource model
- 15 implementations
- Graduated to beta in July



Simple Path Match

Ingress

```yaml
ingressClassName: nginx
rules:
- http:
    paths:
    - path: /login
      pathType: Prefix
      backend:
        service:
          name: auth-svc
          port:
            number: 8080
```

HTTPRoute

```yaml
parentRefs:
- name: nginx
rules:
- matches:
  - path:
      type: PathPrefix
      value: /login
  backendRefs:
  - name: auth-svc
    port: 8080
```

Get Involved

- Focus Areas: Mesh, L4, L7 -> GA, Conformance
- Weekly community meetings on Mondays
- Weekly GAMMA meetings on Tuesdays
- Contributors from all backgrounds welcome

gateway-api.sigs.k8s.io

#sig-network-gateway-api

kubernetes-sigs/gateway-api

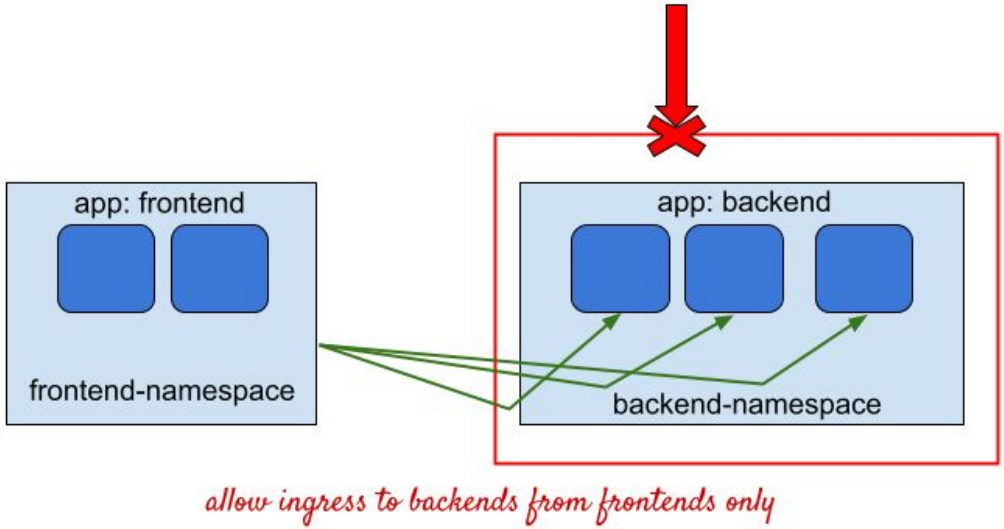
Network Policy

Contributions welcome! Stable for over 5 years.

network-policy-api && https://kubernetes.io/docs/concepts/services-networking/network-policies/

Network Policy (NP)

- How can app owners control traffic to/from their workloads?
    - example; backends can get traffic only from frontends, databases can only get traffic from backends etc..



Network Policy (NP)

- How can app owners control traffic to/from their workloads?
    - example; backends can get traffic only from frontends, databases can only get traffic from backends etc..
- An API that let's users define simple ingress/egress rules
- API design is implicit in nature
- Network policy peers
    - pod, namespace, ipBlock

```yaml
---
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: allow-ingress-to-backend-from-frontend
  namespace: foo
spec:
  podSelector:
    matchLabels:
      app: backend
  policyTypes:
    - Ingress
  ingress:
  - from:
    - namespaceSelector:
        matchLabels:
          app: frontend
```

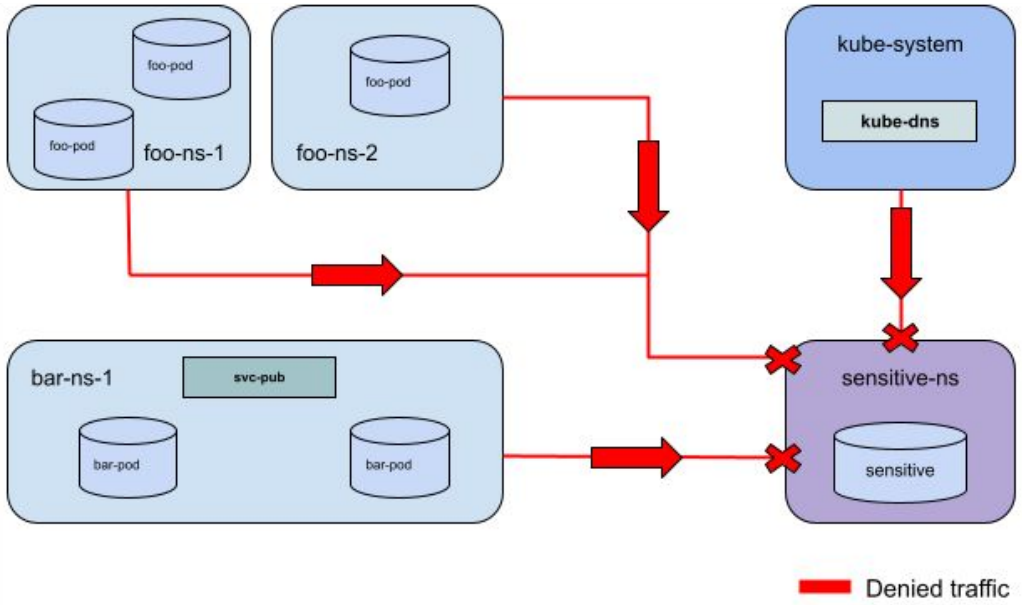
Admin Network Policy

Contributions welcome! Under active development!

https://github.com/kubernetes-sigs/network-policy-api && https://network-policy-api.sigs.k8s.io/

Admin Network Policy (ANP)

- Network Policies were designed for app owners…
- How can admins enforce policies cluster-wide??



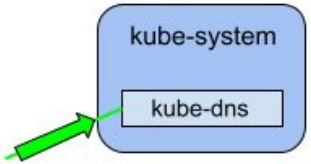
Admin Network Policy (ANP)

- Network Policies were designed for app owners…
- How can admins enforce policies cluster-wide??
- Cluster-scoped policy API
  - AdminNetworkPolicy
  - BaselineAdminNetworkPolicy
- API design is explicit in nature

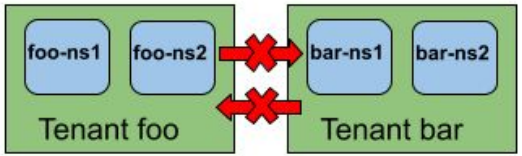
```yaml
apiVersion: policy.networking.k8s.io/v1alpha1
kind: AdminNetworkPolicy
metadata:
  name: cluster-wide-deny-example
spec:
  priority: 1
  subject:
    namespaces:
      matchLabels:
        kubernetes.io/metadata.name: sensitive-ns
  ingress:
  - name: "default-deny-to-sensitive-ns"
    action: "Deny"
    from:
    - namespaces:
        related: "NotSelf"
```

Admin Network Policy (ANP)

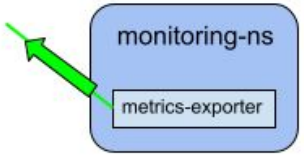
- Network Policies were designed for app owners…
- How can admins enforce policies cluster-wide??
- Cluster-scoped policy API
  - AdminNetworkPolicy
  - BaselineAdminNetworkPolicy
- API design is explicit in nature
- v1alpha1 supports east-west traffic
- TBD: north-south traffic support
- Next Steps: Implementations!



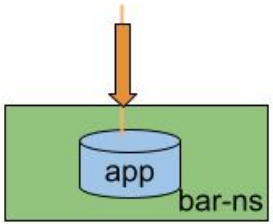
always ingress to dns namespace



isolate multi-tenants



always egress from monitoring namespace



explicitly delegate to network policy rules in an app namespace

Get Involved

- Focus Areas: Network Policies, Admin Network Policies
- Bi-Weekly community meetings on Monday at 4pm EDT/1pm PDT
- All are Welcome!

#sig-network-policy-api

kubernetes-sigs/network-policy-api

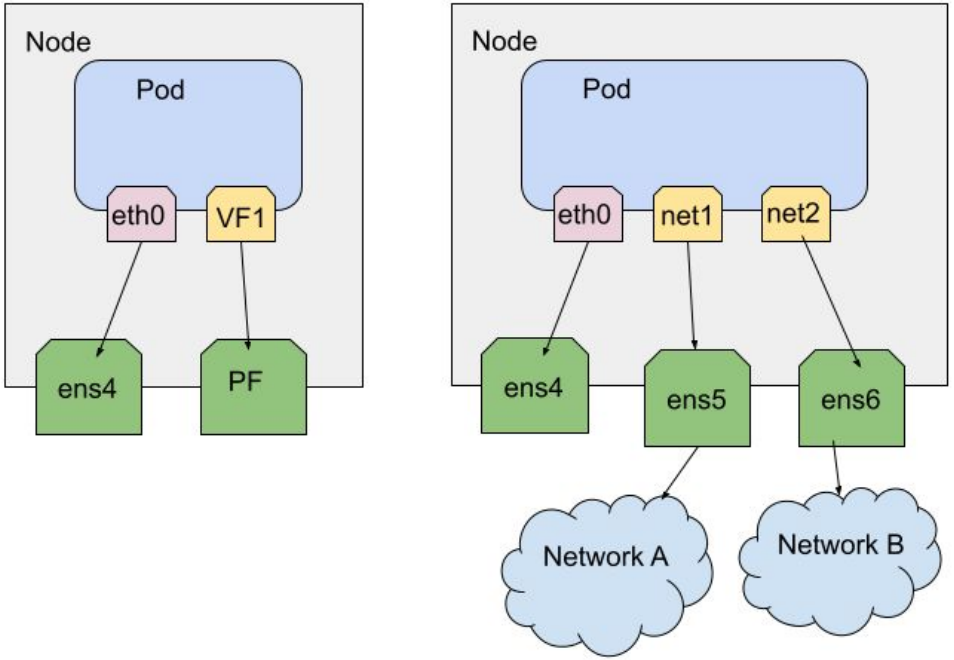
Multi Network

Contributions welcome! Ongoing design! New SIG!

https://docs.google.com/document/d/1ztx9TOQ9Hiyj9PG9aPv6jyDLhe_FB7haV_yjJIcb-0Y/edit#heading=h.5t6qeinm4208

Multi-Network

- Apps might need to access different isolated networks via performance oriented interfaces like SR-IOV
- Represent more complex networking solutions via an API
- In early stages (design phase)



Get Involved

KubeCon CloudNativeCon North America 2022

- Focus Areas: Multi Network (intro slide deck)
- Bi-Weekly community meetings on Wednesday at 8am PST/ 5pm CEST
- Welcome!

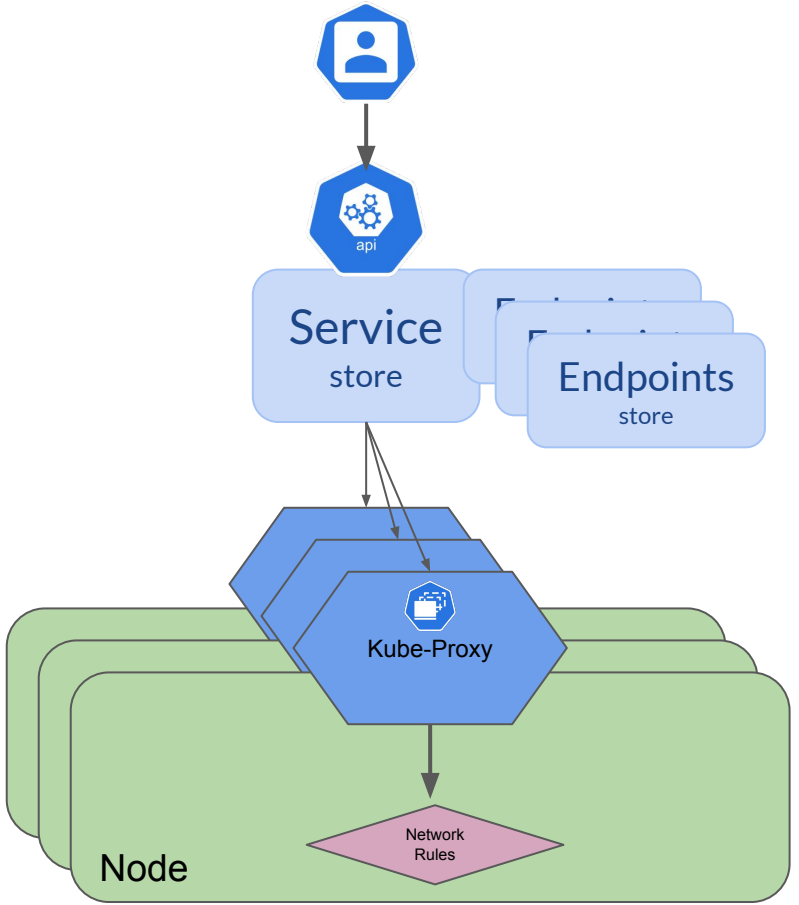
#sig-network-multi-network

Networking Components

Kube-Proxy

Kube-Proxy

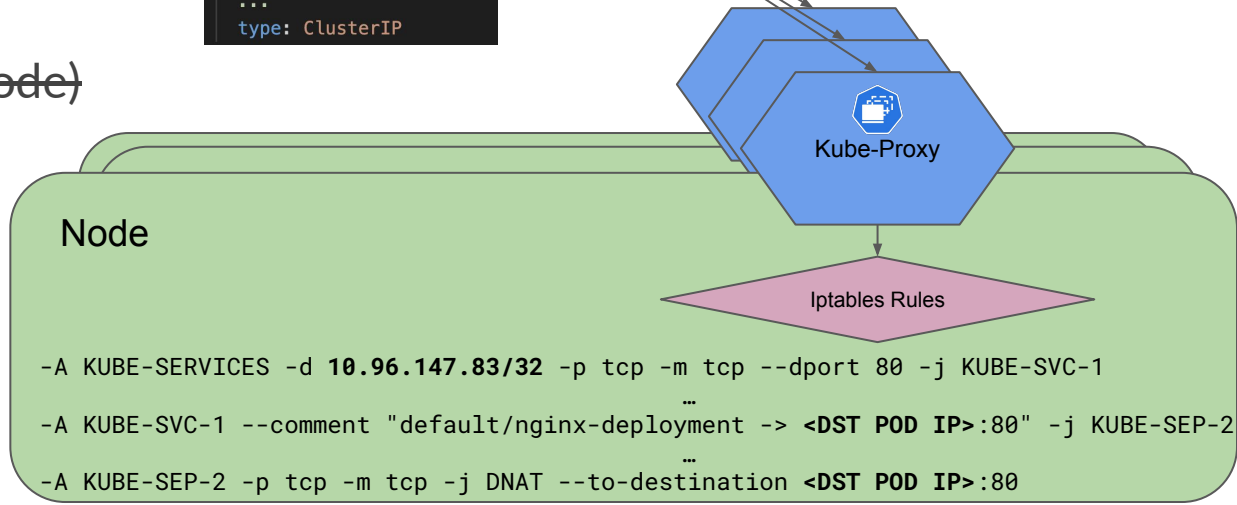
- We talked about some great K8s Networking APIs including **Services** and **Endpoints**
- Kube-Proxy implements the Services API
- Node agent which resolves K8s Networking Objects into datapath rules



Kube-Proxy

- Implemented in core Kubernetes
- Can program datapath rules in three different modes
  - iptables (default)
  - ipvs
  - ~~userspace ("legacy" mode)~~

```yaml
apiVersion: v1
kind: Service
metadata:
  name: nginx-deployment
  namespace: default
  ...
spec:
  clusterIP: 10.96.147.83
  ...
  - port: 80
    protocol: TCP
    targetPort: 80
  selector:
    app: nginx
  ...
  type: ClusterIP
```



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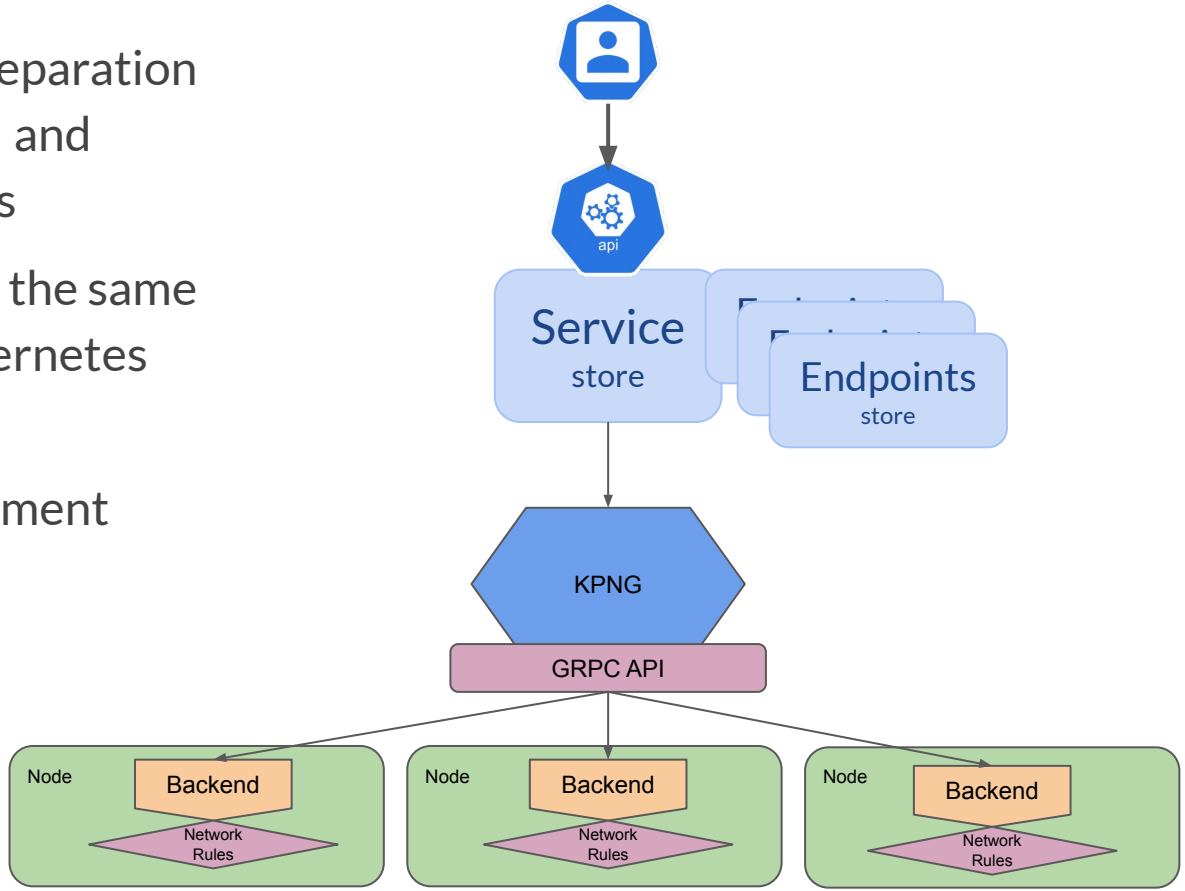
KPNG

(Kube-Proxy Next Generation)

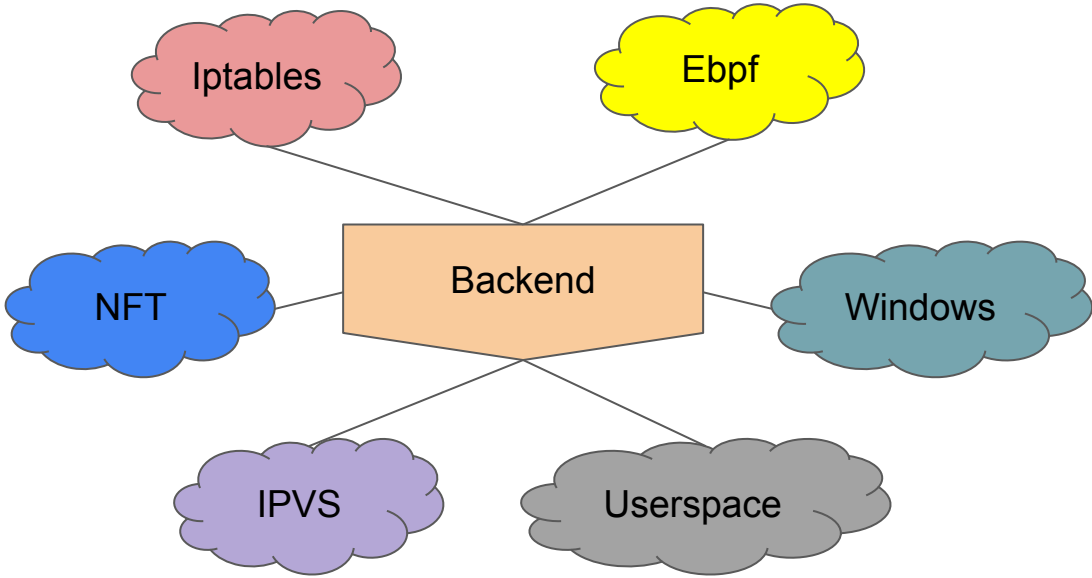
KPNG

- Provides a fundamental separation between the Services API and Backend Implementations
- Allows backends to reuse the same bits which watch the kubernetes API
- Extremely flexible deployment model



KPNG

- Current Backends
  - Iptables
  - NFT
  - Ipvs
  - Userspace
  - Windows
  - Ebpf (POC)
- More to come from Viewers like You!



Networking Components: Get Involved

- Now that you know a bit more….Get involved!
  - So You Want To Write A Service Proxy…
  - Kube-Proxy good-first-issues
  - KPNG good-first-issues

Features in Development

Topology Aware Hints

Pods

Zone A

A A A A

Zone B

B B B

Zone C

C C

EndpointSlices

Original

For: All Zones

A A A
A B B
B C C

Allocate proportional endpoints to each zone

Topology Hints

For: Zone A

A A A

For: Zone B

B B B

For: Zone C

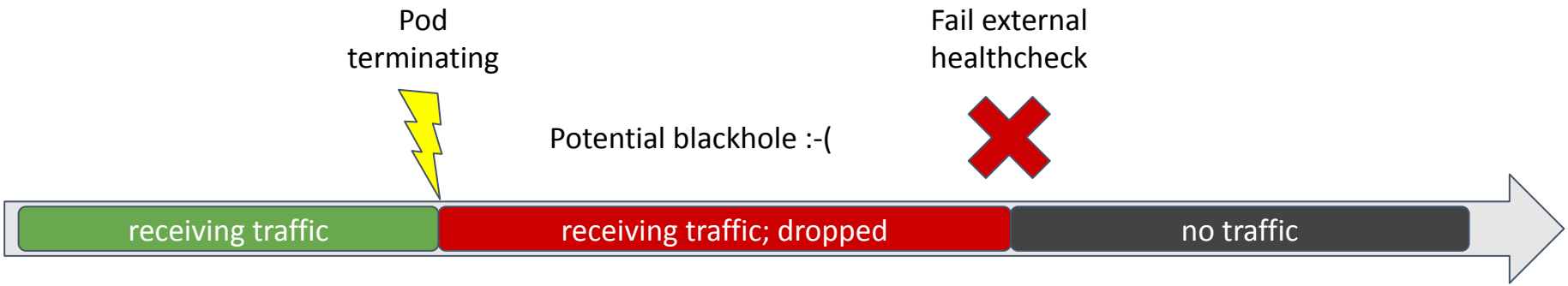
C C A

Terminating Endpoints

Tracking terminating endpoints (KEP, KEP)

Gracefully keep sending traffic to an `ExternalTrafficPolicy=local` Pods to include those that are terminating. This avoids a **blackhole** between when the Pods terminate and when the LB notices the Pods are shutting down.

Adds “terminating” state to EndpointSlice.



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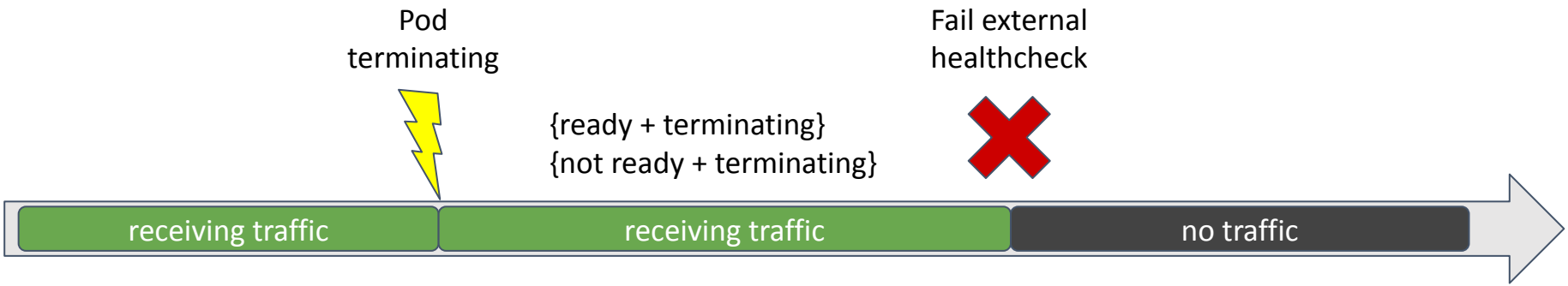

NetworkPolicy Status

NetworkPolicy now has a Status and Conditions fields.

This allows implementations to signal state about your policy:

- Optional feature support such as portRanges.

```
apiVersion: v1
kind: NetworkPolicy
metadata:
  name: my-policy
spec:
  ...
status:
  conditions:
  - ...
```

InternalTrafficPolicy

Makes your service route only to endpoints local to the Node for traffic sent to the Service ClusterIP.

Typical use case: Service backed by a Daemonset for a logging service with traffic that you never want to traverse outside of the node.

```yaml
apiVersion: v1
kind: Service
metadata:
  name: my-service
spec:
  selector:
    app.kubernetes.io/name: MyApp
  ports:
    - protocol: TCP
      port: 80
      targetPort: 9376
  internalTrafficPolicy: Local
```

Questions?