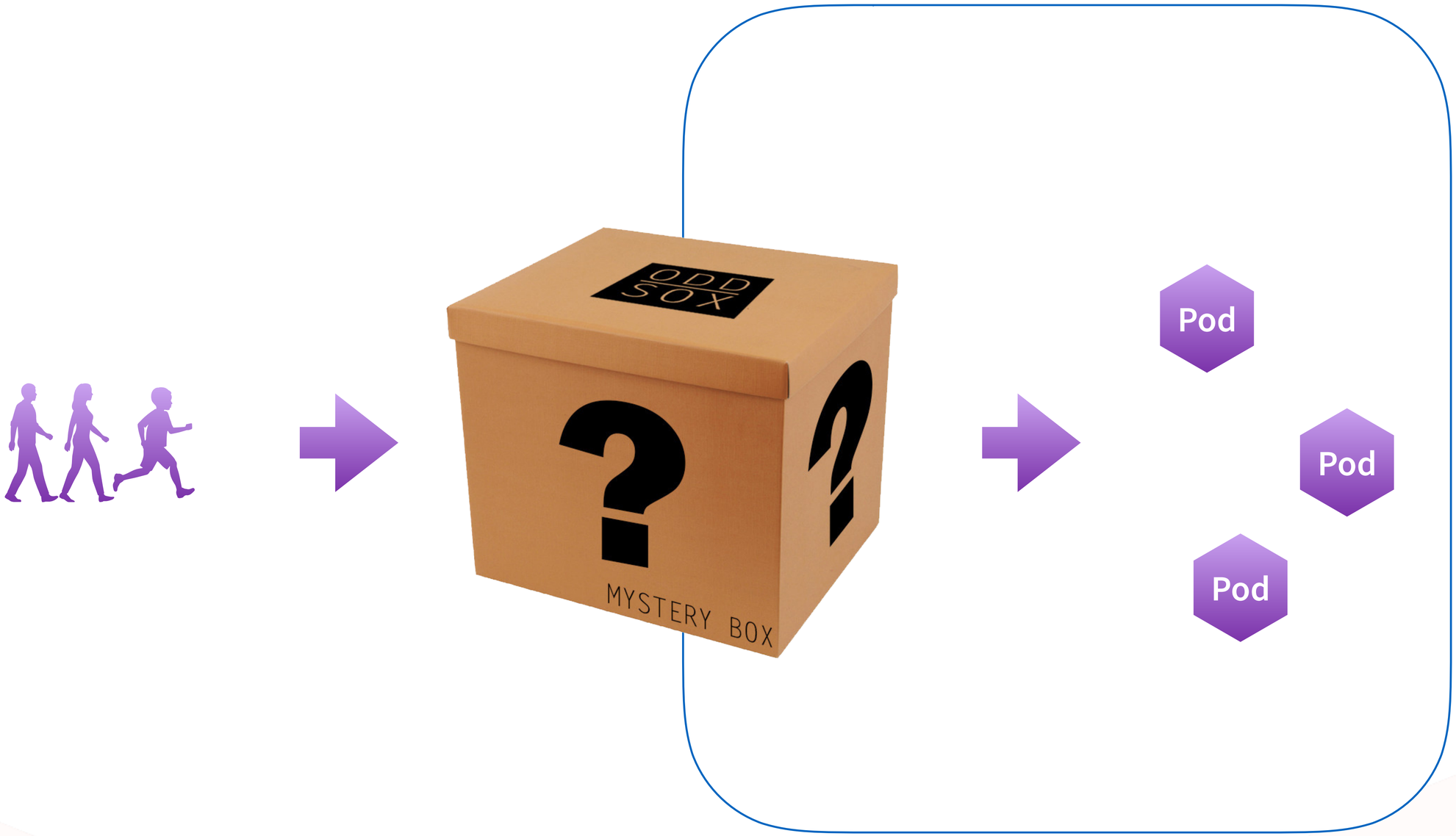
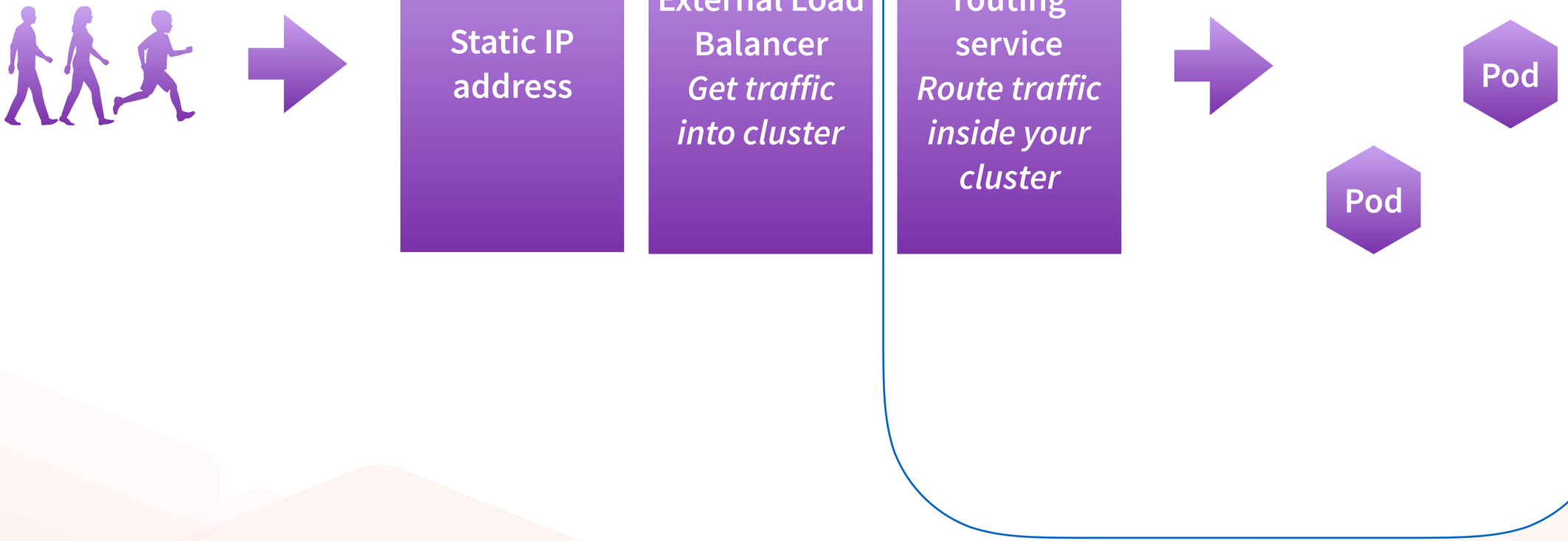
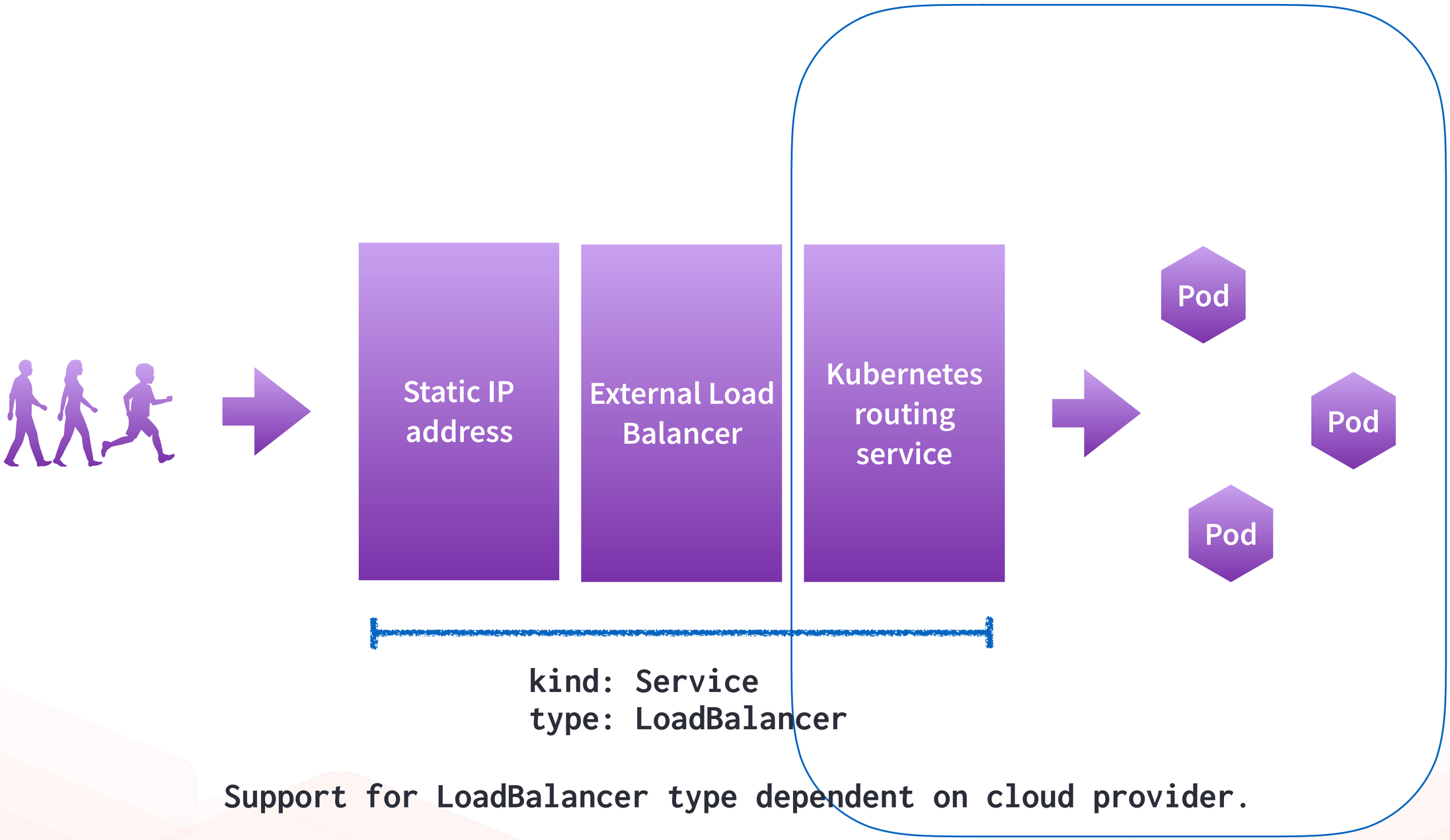
SIMPLY COMPLEX TASK OF KUBERNETES INGRESS

Richard Li


WHAT IS INGRESS?
DATAWIRE

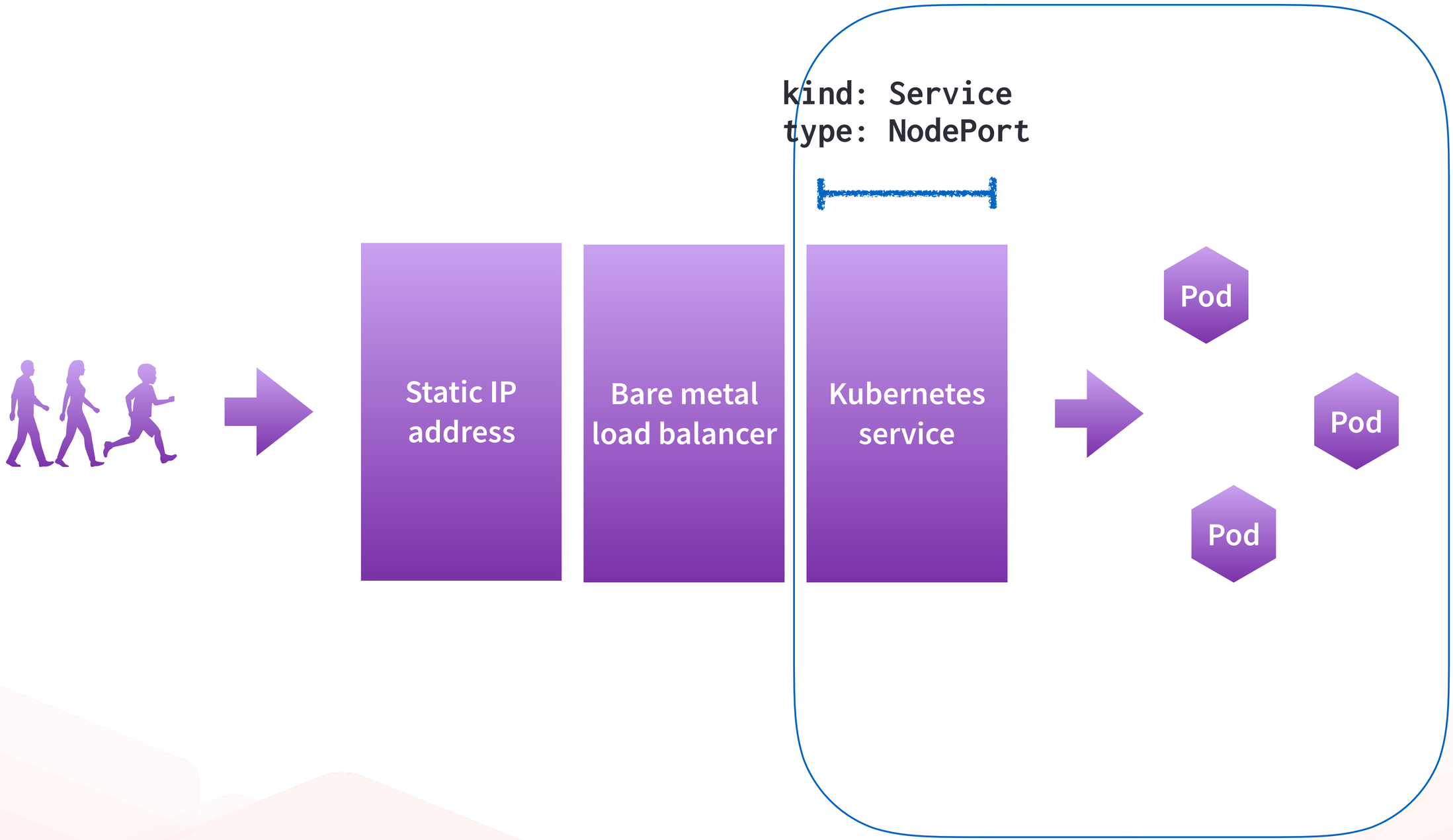

ODD SOX
MYSTERY BOX
Pod
Pod
Pod


Static IP address
External Load Balancer
Get traffic into cluster
Kubernetes routing service
Route traffic inside your cluster
Pod
Pod
Pod



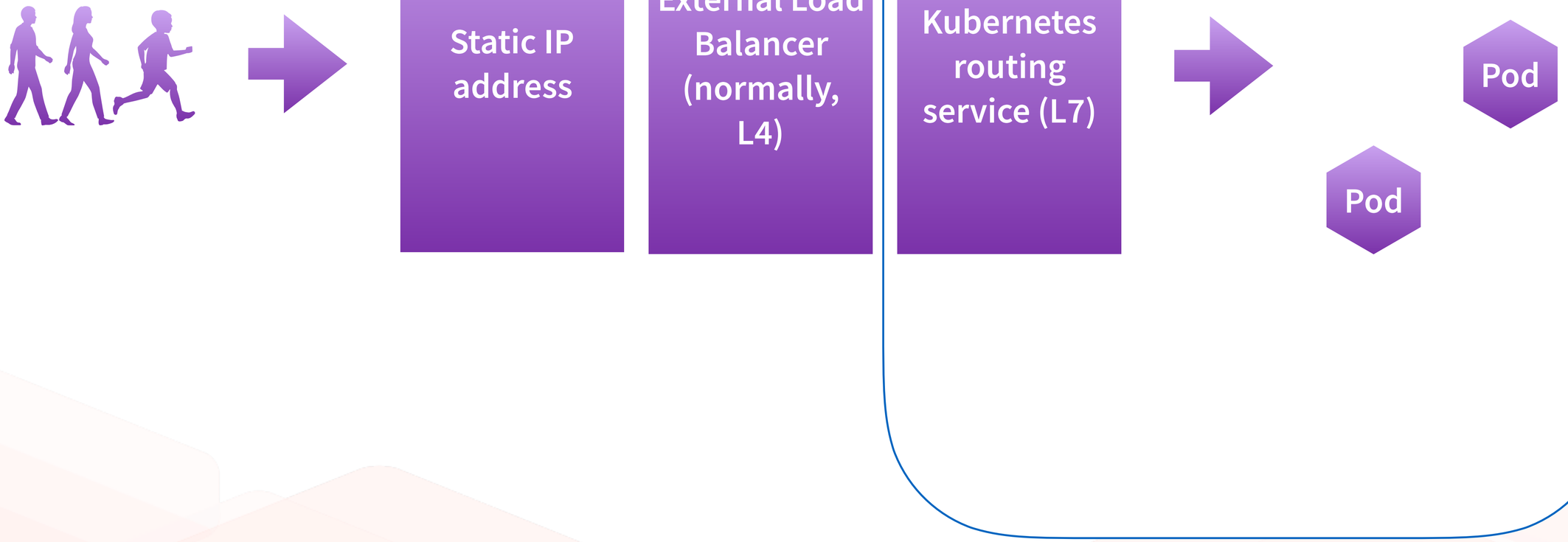

```
kind: Service
type: LoadBalancer
```

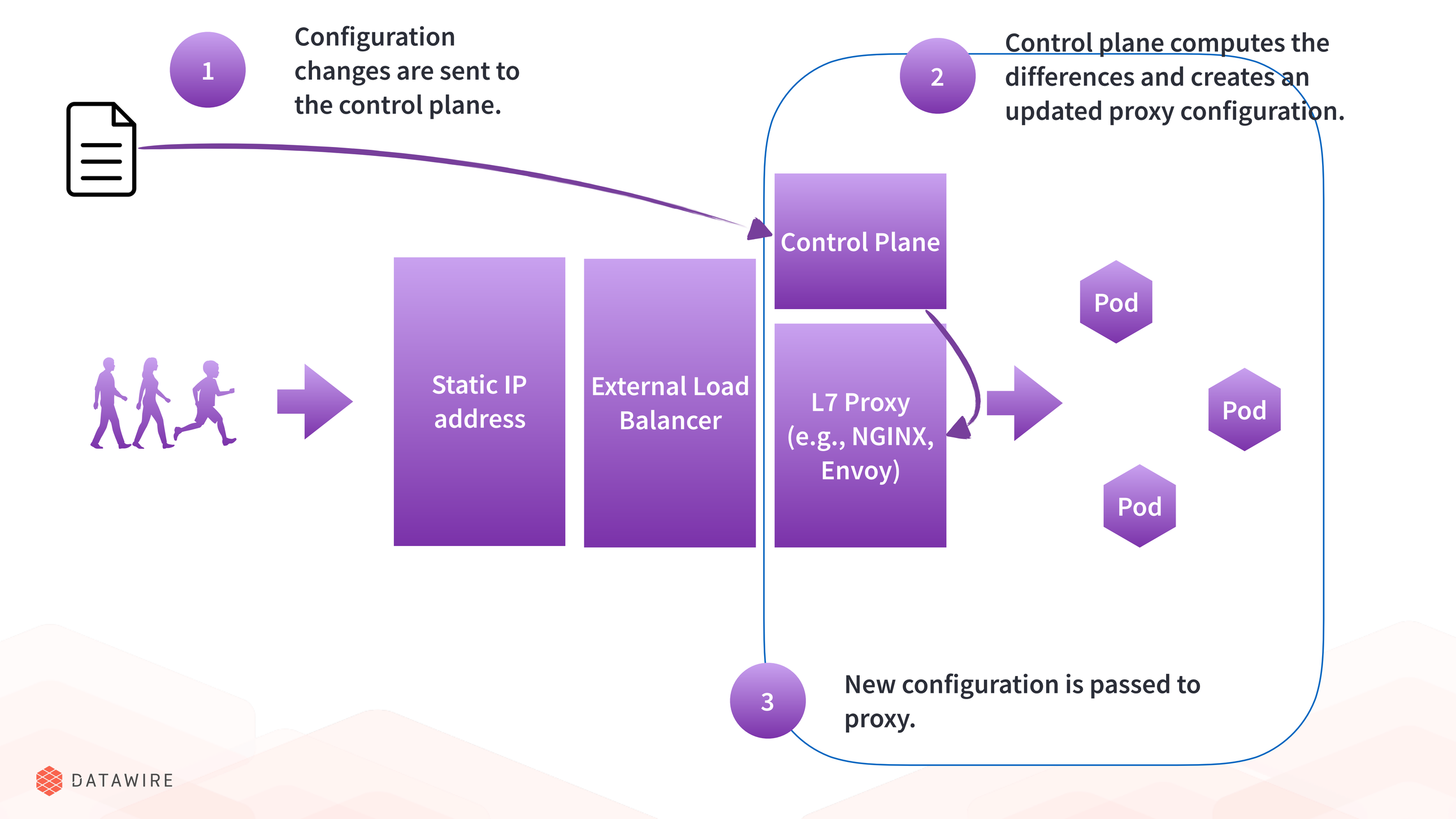
Support for LoadBalancer type dependent on cloud provider.


kind: Service
type: NodePort
Static IP address
Bare metal load balancer
Kubernetes service
Pod
Pod
Pod

TL; DR. Create a Service of type LoadBalancer if you're using AWS, GKE, etc. Otherwise, use type NodePort.

This is all Layer 4. What about Layer 7?


Static IP address
External Load Balancer (normally, L4)
Kubernetes routing service (L7)
Pod
Pod
Pod


1
Configuration changes are sent to the control plane.
2
Control plane computes the differences and creates an updated proxy configuration.
Control Plane
Static IP address
External Load Balancer
L7 Proxy (e.g., NGINX, Envoy)
Pod
Pod
Pod
3
New configuration is passed to proxy.

CONFIGURING L7

Decentralized, declarative configuration.

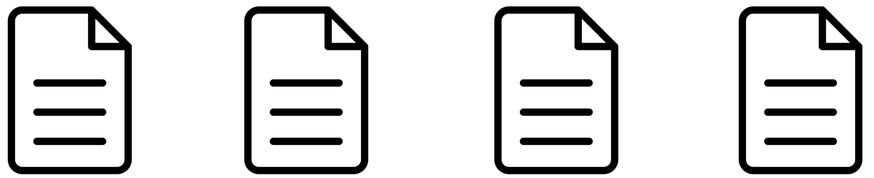
SILOED TEAMS

PM Dev QA Ops

Imperative, API-driven configuration

DECENTRALIZED, FULL-LIFECYCLE TEAMS

Users Ads Catalog Search



Declarative configuration

You can configure routing via ingress resources (e.g., use an ingress controller).

```
apiVersion: extensions/v1beta1
kind: Ingress
metadata:
  name: test-ingress
  annotations:
    nginx.ingress.kubernetes.io/rewrite-target: /
spec:
  rules:
  - http:
      paths:
      - path: /testpath
        backend:
          serviceName: test
          servicePort: 80
```

```yaml
---
apiVersion: v1
kind: Service
metadata:
  name: httpbin
  annotations:
    getambassador.io/config: |
      ---
      apiVersion: ambassador/v0
      kind:  Mapping
      name:  httpbin_mapping
      prefix: /httpbin/
      service: httpbin.org:80
      host_rewrite: httpbin.org
spec:
  ports:
  - name: httpbin
    port: 80
```

You can configure routing via annotations (e.g., Ambassador API Gateway).

Ingress provides portability between different controllers …

How many NGINX ingress controllers exist on Kubernetes?

Ingress provides portability between different controllers …

- → ingress-nginx (Google)
- → kubernetes-ingress (NGINX)
- → kubernetes-ingress with NGINX Plus (NGINX)
- → …

Except ingress isn't actually portable.

Aspect or Feature	kubernetes/ingress-nginx	nginxinc/kubernetes-ingress with NGINX	nginxinc/kubernetes-ingress with NGINX Plus
Fundamental			
Authors	Kubernetes community	NGINX Inc and community	NGINX Inc and community
NGINX version	Custom NGINX build that includes several third-party modules	NGINX official mainline build	NGINX Plus
Commercial support	N/A	N/A	Included
Load balancing configuration			
Merging Ingress rules with the same host	Supported	Supported	Supported
HTTP load balancing extensions - Annotations	See the supported annotations	See the supported annotations	See the supported annotations
HTTP load balancing extensions -- ConfigMap	See the supported ConfigMap keys	See the supported ConfigMap keys	See the supported ConfigMap keys
TCP/UDP	Supported via a ConfigMap	Supported via a ConfigMap with native NGINX configuration	Supported via a ConfigMap with native NGINX configuration
Websocket	Supported	Supported via an annotation	Supported via an annotation

- Each controller does custom extensions to the ingress specification for features.
- Each controller has different features.
- The "solution" to this conundrum is to keep Ingress in beta (since Kube 1.1)

https://github.com/nginxinc/kubernetes-ingress/blob/master/docs/nginx-ingress-controllers.md

Ingress controller / resources ≠ ingress
Ingress controller / resources = routing

```yaml
kind: Service
apiVersion: v1
metadata:
  name: ingress-nginx
  namespace: ingress-nginx
  labels:
    app.kubernetes.io/name: ingress-nginx
    app.kubernetes.io/part-of: ingress-nginx
  annotations:
spec:
  type: LoadBalancer
  selector:
    app.kubernetes.io/name: ingress-nginx
    app.kubernetes.io/part-of: ingress-nginx
  ports:
  - name: http
    port: 80
    targetPort: http
  - name: https
    port: 443
    targetPort: http
```

The NGINX ingress controller is a Service of type LoadBalancer!

TL; DR.

- Most ingress models on Kubernetes use a decentralized, declarative configuration model.
- This configuration occurs through Kubernetes manifests.
- Ingress is one format for routing configuration, but there are others.
- Decide on ingress solutions based on features/functionality/robustness.

REAL-WORLD INGRESS

Ingress isn’t just about routing.

- **Protocols.** gRPC, HTTP/2, WebSockets.
- **Resilience.** Timeouts, rate limiting, circuit breakers.
- **Testing.** Canary releases, traffic shadowing.
- **Observability.** Distributed tracing, metrics.
- **TLS.** Redirect from cleartext, SNI.
- **Load balancing.** Round robin, sticky sessions, maglev …

And there are operational concerns, too!

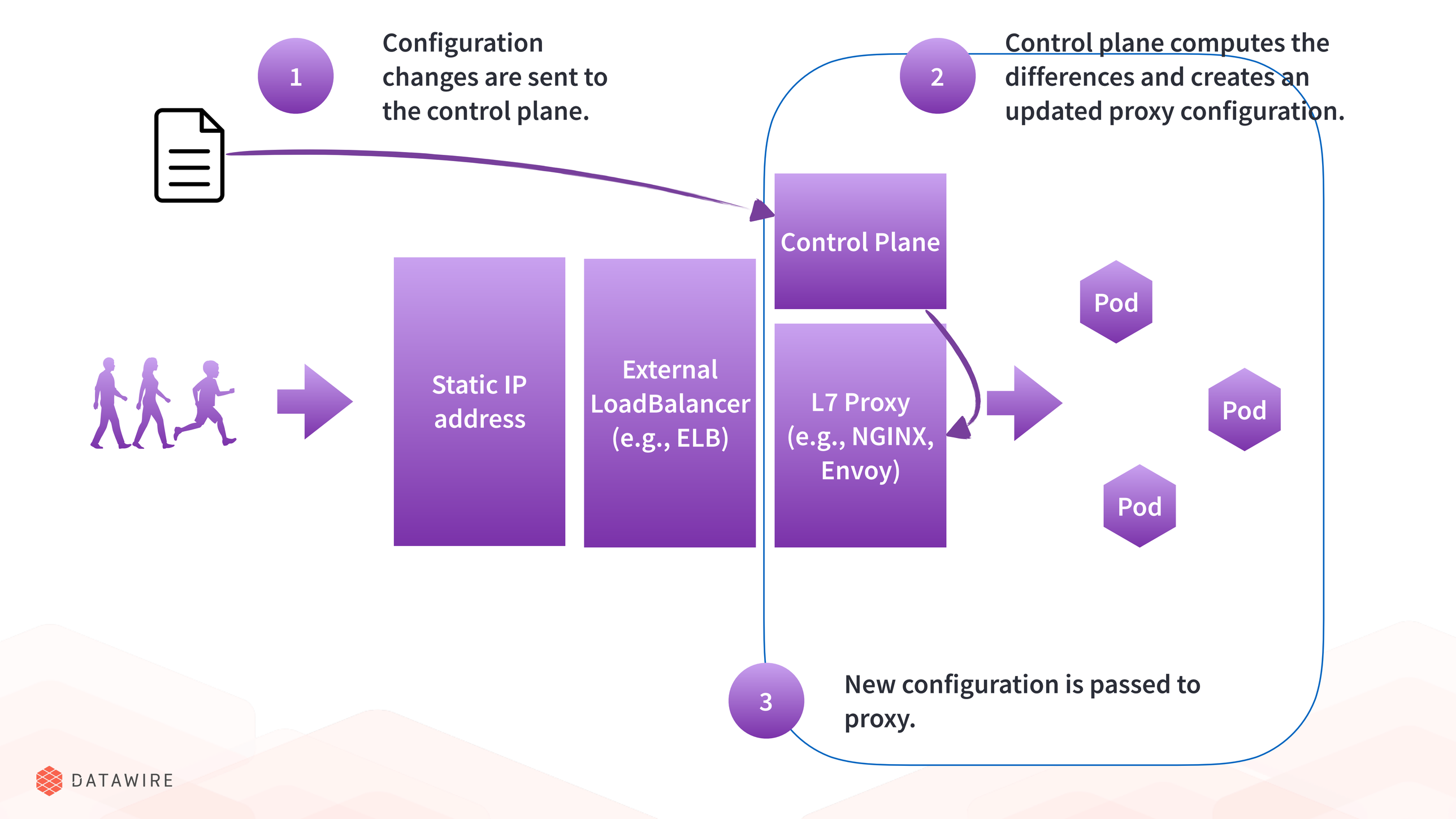
- **Upgrades.** How do you upgrade and test your ingress solution?
- **Hitless reloads.** How do you avoid impacting your users during configuration changes?
- **Endpoint vs service routing.** Do you need to route to Kubernetes services or pods?

Upgrades

→ Ingress has a new release (v0.35 —> v0.36)

→ Run a “full stack canary” of new ingress versions

- Route most of traffic through v0.35
- Route some traffic through v0.36 (for some services, for 1% traffic, …)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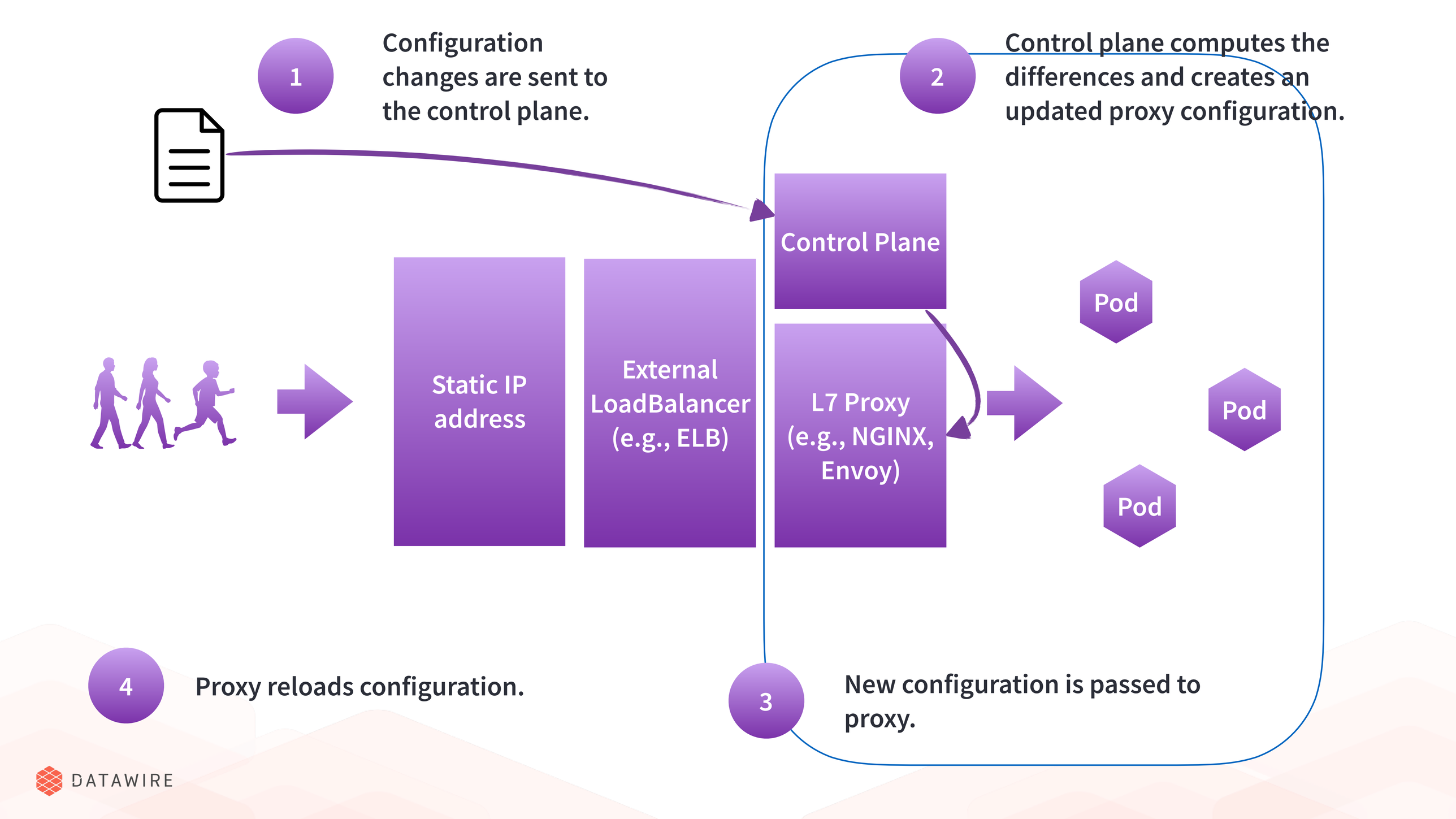
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L7 Proxy (e.g., NGINX, Envoy)
Pod
Pod
Pod
4
Proxy reloads configuration.
3
New configuration is passed to proxy.

In Kubernetes, configurations can change frequently (“microservices”), triggering proxy reloads.

→ Existing connections can drop

→ Response latency increases

→ Load balancing quality goes down

Strategies for mitigating reloads

- Don’t trigger reload when there is no change in state
- Do “hot reloads” (aka “hitless reloads” aka “hot restart”): HAProxy 1.8, NGINX, Envoy Proxy
- Use APIs to manage configuration (if available): NGINX Plus, Envoy Proxy, NGINX Lua handler, HAProxy 1.8

envoy

- Istio announces in May; will use Envoy

- Netflix announces Hystrix

NGINX

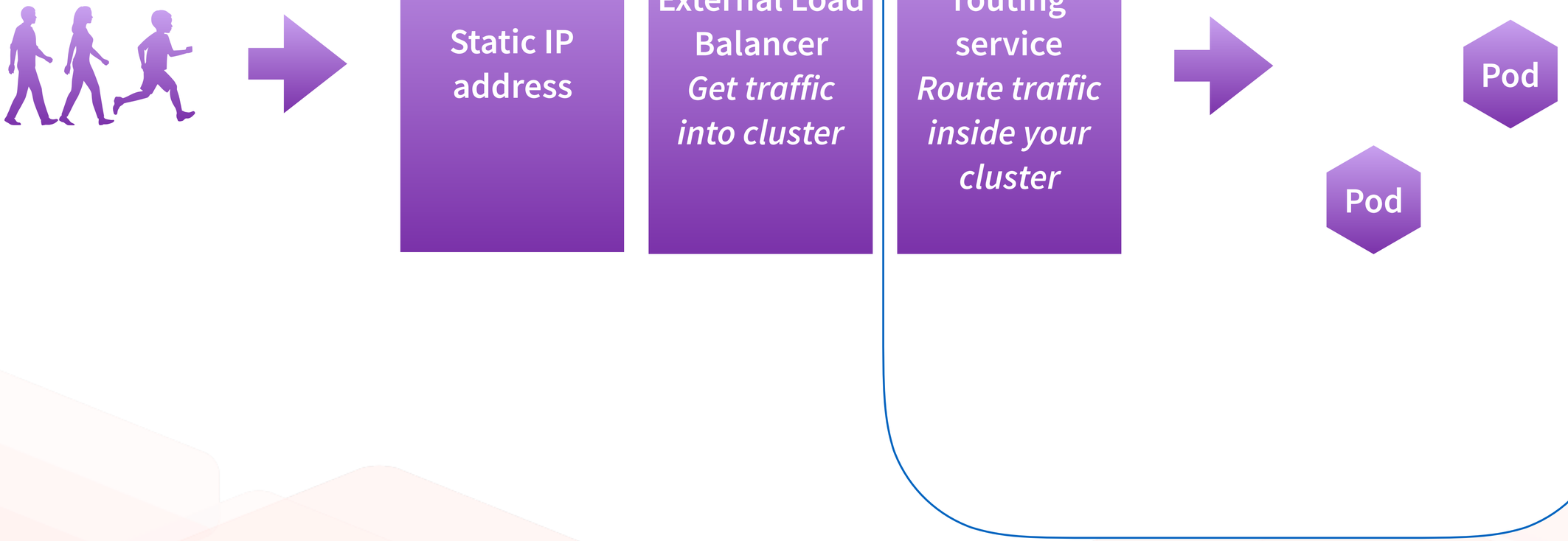
- NGINX Plus R13 (Aug 2017)
- Runtime API
- Shadowing

envoy

CLOUD NATIVE COMPUTING FOUNDATION

HAPROXY

- 1.8 released
- Finally supports hitless reloads, runtime API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External Load Balancer
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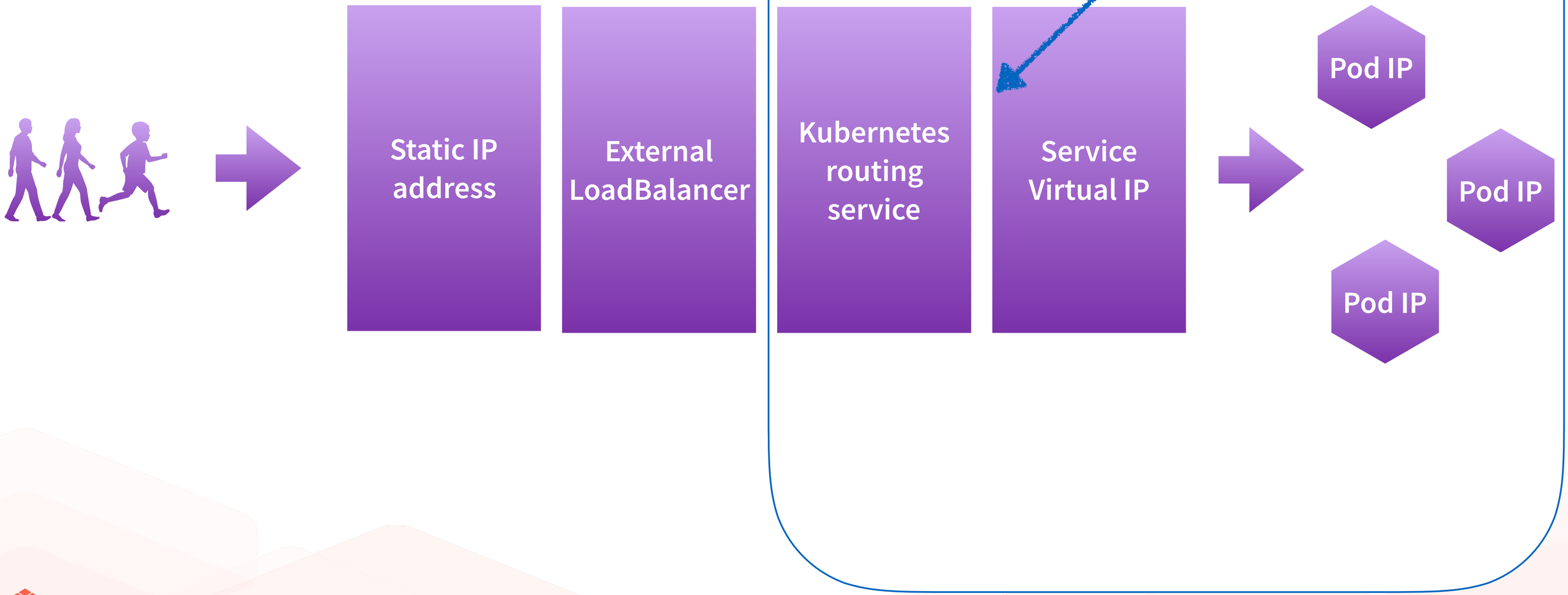
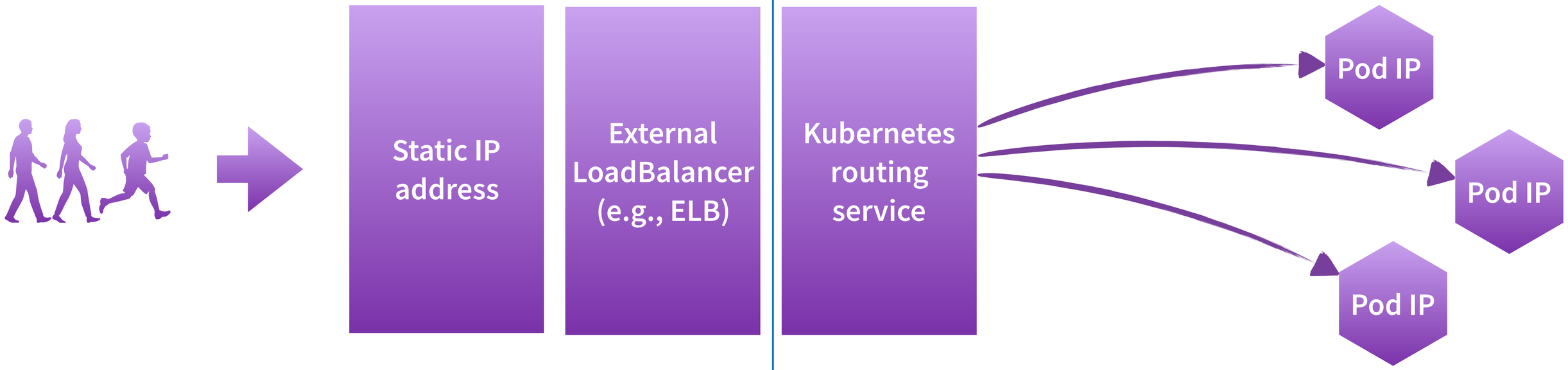
By default, Kubernetes does round-robin load balancing.



You can bypass Kubernetes default with endpoint routing.



(This is how you get sticky sessions, fancier load balancing, etc.)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2-22
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S. Adams
IF THE BOSS USES A BUZZWORD ON YOUR CARD, YOU CHECK IT OFF. THE OBJECTIVE IS TO FILL A ROW.
© 1994 United Feature Syndicate, Inc.
YOU'RE ALL VERY ATTENTIVE TODAY. MY PROACTIVE LEADERSHIP MUST BE WORKING!
BINGO, SIR.

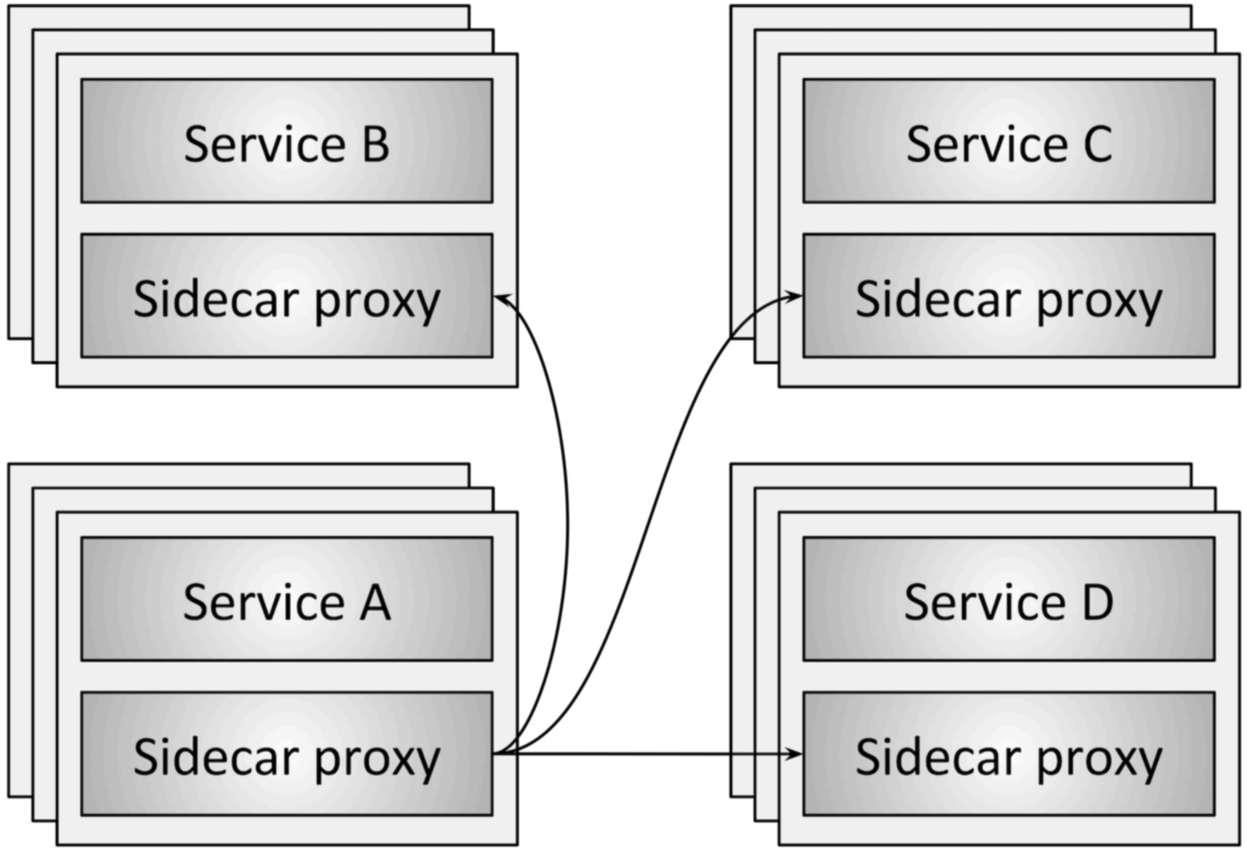
SERVICE MESH.

→ Service mesh facilitates service-to-service communication

- Routing
- Resilience
- Observability
- Security (end-to-end encryption)

→ Grows more important as your topology gets deeper / more complex

“Sidecar” deployment model



Ingress versus service mesh

- → Service meshes frequently include an ingress (e.g., Istio has a “gateway” abstraction)
- → Service meshes assume you have control of the client
- → Ingress assumes you have **no control** of the client
  - HTTP —> HTTPS redirect
  - OAuth / OIDC

TL; DR.

- Think about the functional aspects of ingress, as well as the operational aspects when choosing an ingress.
- The edge and service mesh are different but related use cases.
- If you're looking for a new Kubernetes job, add service mesh to your LinkedIn profile (you'll know more than your hiring manager, anyway).

INGRESS CAN HELP YOU GO FASTER

DATAWIRE

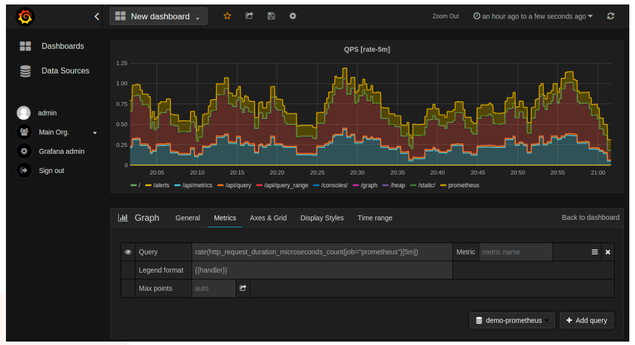
Scenario

Shadow & Routing: Route 100% of prod traffic to 1.0 and 1.1.

Ingress

Stream v1.0

Stream v1.1



Metrics: Compare latency on requests to v1.0 vs v1.1

Summary

- To get traffic into a cluster, you need a service of LoadBalancer or NodePort (and probably a LoadBalancer)
- This service is implemented as a combination of a control plane and a L7 proxy such as NGINX or Envoy Proxy
- Ingress resources are a specific way of controlling routing into your cluster, but not the only way
- When choosing ingress, think about your protocol, resilience, observability, and other requirements

Thank you!

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- Slack: @rdl (On Kubernetes, Envoy, and Ambassador Slack channels)