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Circuit Breaking and Dynamic Routing Deep Dive

Flynn, Technical Evangelist for Linkerd

flynn@buoyant.io | @flynn on slack.linkerd.io

What do you need for the workshop?

- A Kubernetes cluster. I'll be using `civo`, but the type of cluster doesn't much matter.
- To follow along, you'll also need `kubectl`, `bat`, and the `linkerd CLI`.
- Check out the workshop source at

  https://github.com/BuoyantIO/service-mesh-academy/tree/main/dynamic-routing-and-circuit-breaking

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What do you need for the workshop?

- Clone the workshop repo and **MAKE SURE YOU'RE USING AN EMPTY CLUSTER.**

  cd dynamic-routing-and-circuit-breaking
  `bash setup-demo.sh`

- Using k3d or the like?

  ```
  OVERRIDE_EMISSARY_IP=127.0.0.1 \
  bash setup-demo.sh
  ```

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What's on the agenda?

- Brief description of circuit breaking and dynamic request routing!
- **Workshop: dynamic request routing!**
- **Workshop: circuit breaking!**
- Gotchas for both!
- **Workshop: debugging!**

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Dynamic Request Routing

Dynamic request routing

In 2.12 and earlier...

- TrafficSplits (via SMI extension) are the primary way of dynamically controlling routing
- These allow coarse-grained routing behavior, based on the service name and percentage of traffic to split

Examples:

- Route 1% of traffic to `Foo` to `Foo-new`, and 99% to `Foo-orig` (progressive delivery)
- Route 100% of traffic to `Foo` to `Foo-west` (multi-cluster / failover)

Dynamic request routing

- In 2.13, route traffic based on (almost) any attribute of the request:
  - Headers!
  - Verbs!
  - (But not body)
- Examples:
  - Progressive delivery anywhere in the call graph
  - A/B testing anywhere in the call graph
  - Per-user canaries
  - etc.

Dynamic request routing

- Configured with the Gateway API HTTPRoute resource
  - Same resource introduced in Linkerd 2.12 for route-based auth
  - New capabilities for dynamic request routing:
    - use `parentRef` to associate the HTTPRoute with the Service you want to affect
    - use `backendRefs` to describe where you want the traffic to go

Gateway API and GAMMA

- The Gateway API (https://gateway-api.sigs.k8s.io/) is a project within Kubernetes' SIG-Networking
  - Started in 2020 primarily focused on tackling the "annotations wild West" of the Ingress resource
  - Now at version 0.7.0 and looking to reach 1.0.0 this year
- The GAMMA initiative is part of the Gateway API
  - Started in 2022 to sort out how to use Gateway API for meshes
  - Linkerd is quite active in GAMMA

Gateway API and GAMMA

- Linkerd started to use the Gateway API in 2.12
  - Goal is Gateway API for talking about "classes of HTTP traffic" (including gRPC)
    - traffic shaping, retries, timeouts, auth policy, dynamic request routing, etc.
- Things we like about Gateway API:
  - powerful
  - flexible
  - good path to have it included in Kubernetes by default
  - someone else maintains the CRDs 😇

Gateway API and GAMMA

- Things we're actively working on within Gateway API/GAMMA:
  - Many things you can't currently do!
    - e.g. you can't yet configure retries; this is kind of important!
  - We can't yet pass Gateway API conformance tests
    - tests originally required being an ingress controller to pass, and we're not
    - this is why we use the `policy.linkerd.io` APIGroup at the moment
    - this is changing very quickly, so it'll likely be a nonissue soon

Circuit Breaking

Circuit Breaking

- Even newer than dynamic routing, but oft-requested!
- Don't hammer a failing workload endpoint with yet more traffic
  - When failure is detected, stop delivering requests to the failing endpoint (open the circuit breaker)
  - After a little while, try another request
  - If that succeeds, start delivering requests again (close the breaker)

Circuit Breaking in 2.13

- **Limited implementation**:
  - 2.13 can only open breakers when too many consecutive failures happen
  - “Failure” means HTTP 5yz responses
  - 2.13 configures circuit breakers with annotations on a Service
  - All the annotations have “failure-accrual” in their name
  - Docs: https://linkerd.io/2.13/tasks/circuit-breakers/
- This will be changing in future releases.

Circuit breaking in 2.13:

- Break the circuit after four consecutive request failures:

```
balancer.linkerd.io/failure-accrual: consecutive
balancer.linkerd.io/failure-accrual-consecutive-max-failures: 4
```

- Try reenabling traffic after 30 seconds:

```
balancer.linkerd.io/failure-accrual-consecutive-min-penalty: 30s
```

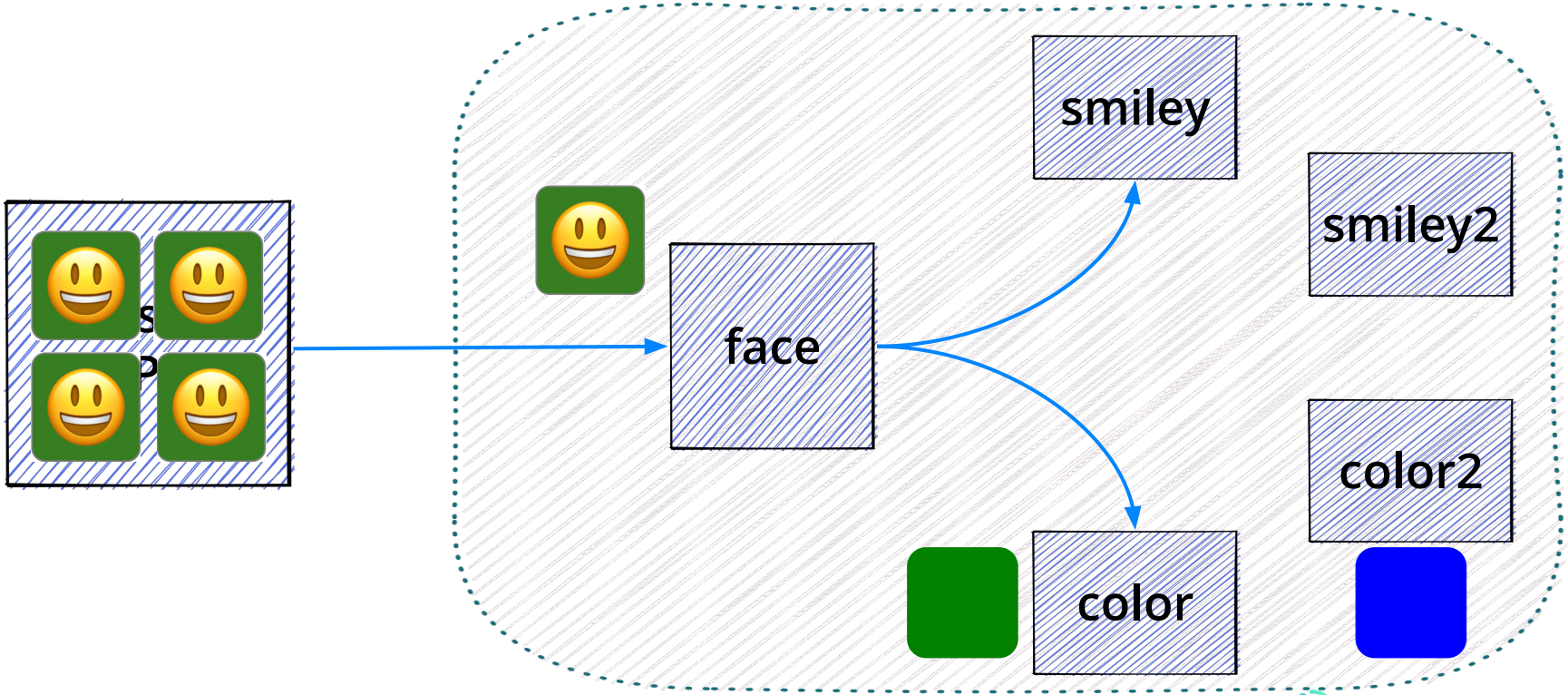
(This is for the first attempt. After that, the delay grows exponentially.)

- Don't ever wait more than 120 seconds between retries:

```
balancer.linkerd.io/failure-accrual-consecutive-max-penalty: 120s
```

Demo Architecture

Demo Architecture



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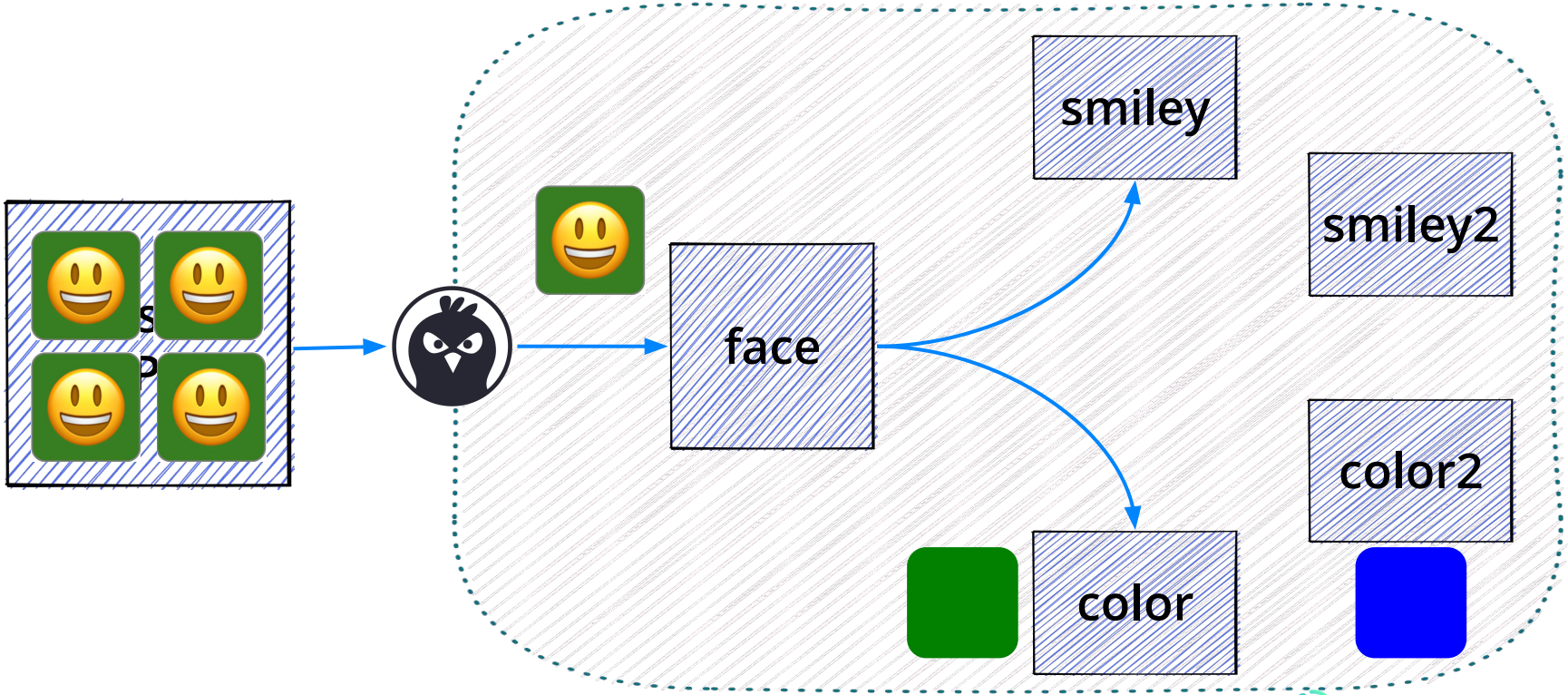
Demo Architecture



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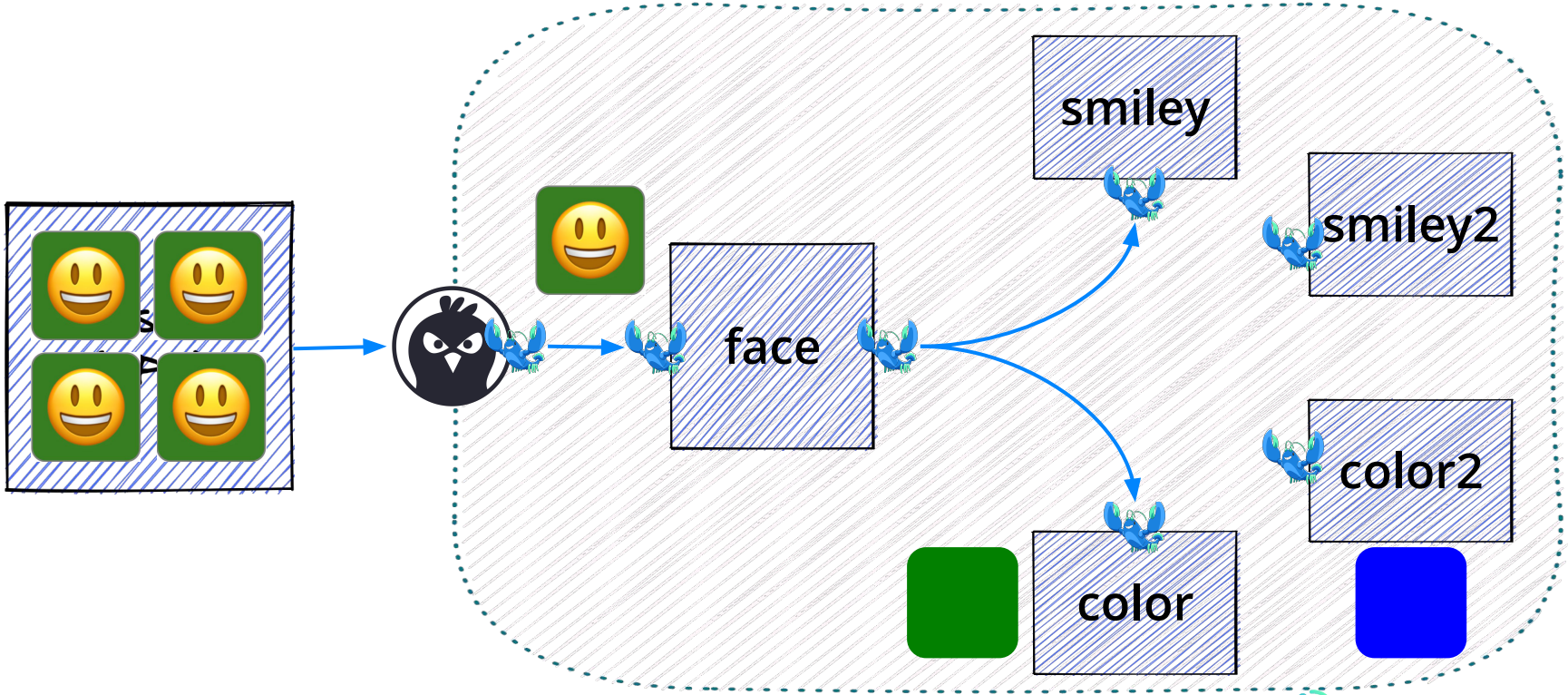

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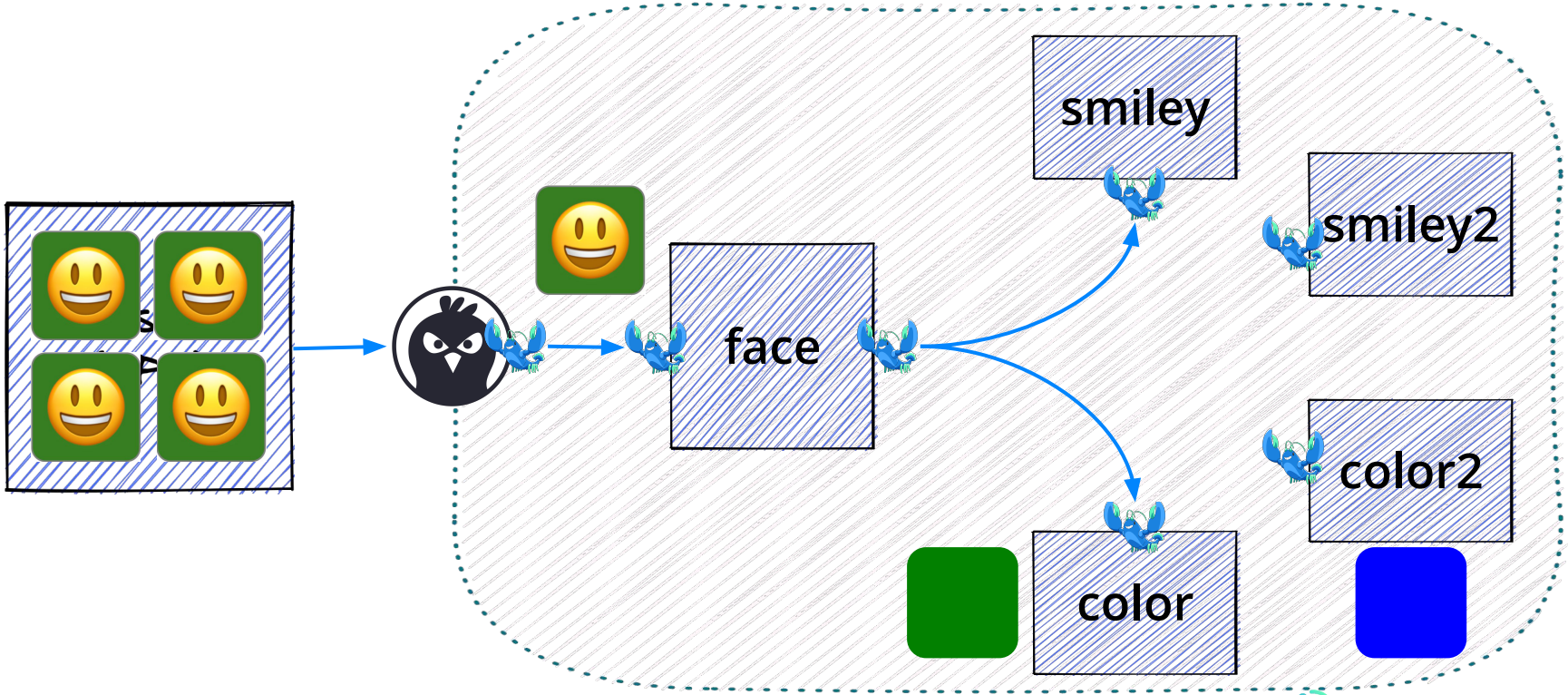
Demo Time

Demo Architecture



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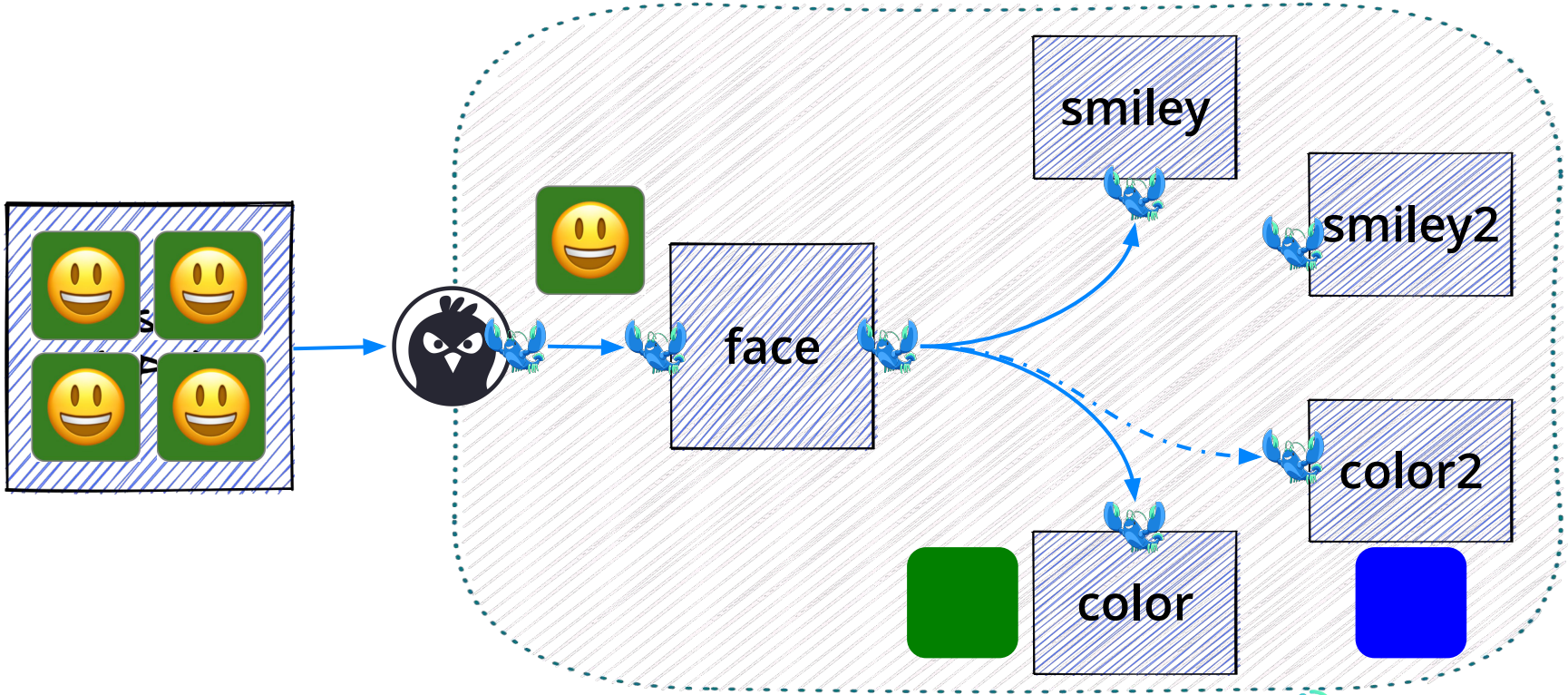
Demo Architecture



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Gotchas

The Biggest Gotcha Of Them All

ServiceProfiles don’t compose with the shiny new features.

ServiceProfiles Don’t Compose With New Stuff

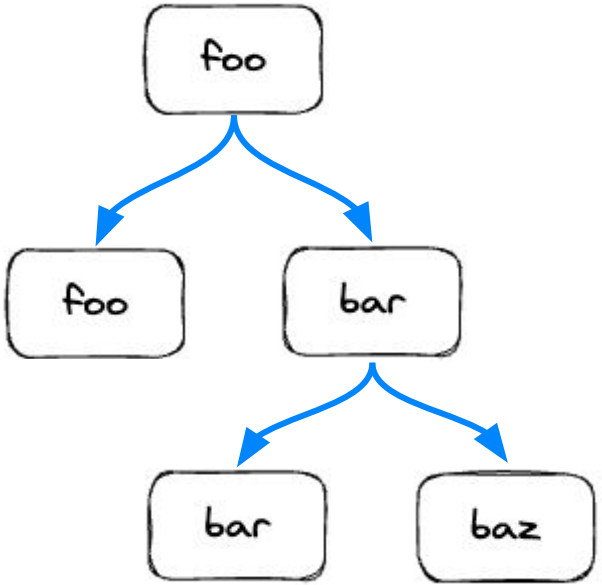
- If you have a ServiceProfile that defines routes, it will **take precedence** over
  - HTTPRoutes with conflicting routes
  - circuit breakers for workloads the ServiceProfile uses
- **This will be the case for the foreseeable future**
  - Doing it the other way around could yield too many surprising things when you upgrade
- There are still several things in 2.13 that you must do with ServiceProfile
  - Retries, timeouts, etc.
  - We are **actively working** on making all of this better. Quickly.

ServiceProfiles Don’t Compose With New Stuff

- Rules of thumb for debugging:
  - If your routes or breakers aren’t working, make sure you have no ServiceProfiles
  - If you have ServiceProfiles and remove them, you might need to restart Pods
    - Basically, the Linkerd proxy needs to decide if it’s running in 2.12 mode or 2.13 mode, and it might not switch cleanly.
  - The new `linkerd diagnostics policy` command can help when debugging routing issues.
- Back to the demo for a moment…

Dynamic Request Routing Gotchas

- HTTPRoutes don't stack
  - One HTTPRoute splits `foo` traffic 50/50 between `foo` and `bar`
  - Another HTTPRoute splits `bar` traffic 50/50 between `bar` and `baz`



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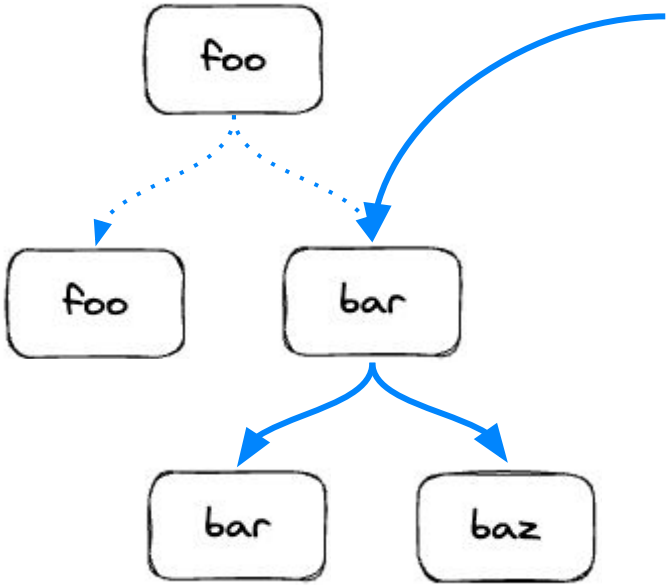

Dynamic Request Routing Gotchas

- HTTPRoutes don't stack
  - One HTTPRoute splits `foo` traffic 50/50 between `foo` and `bar`
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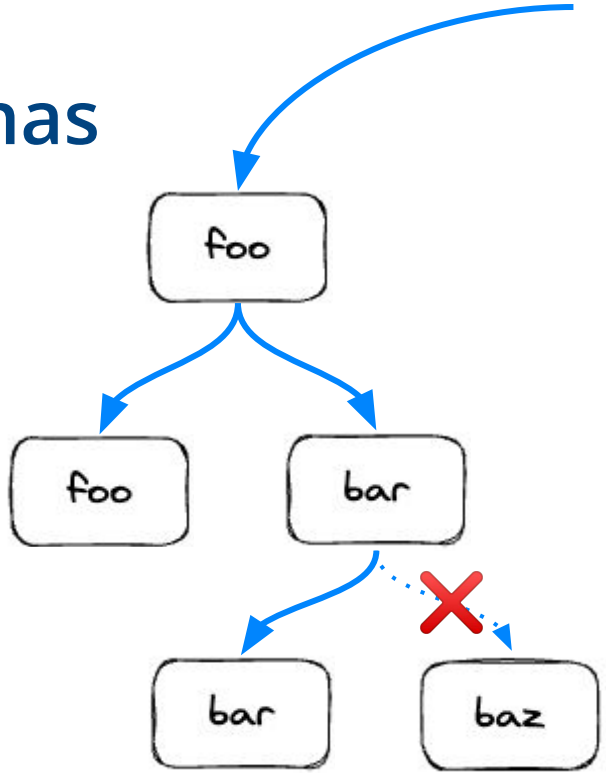
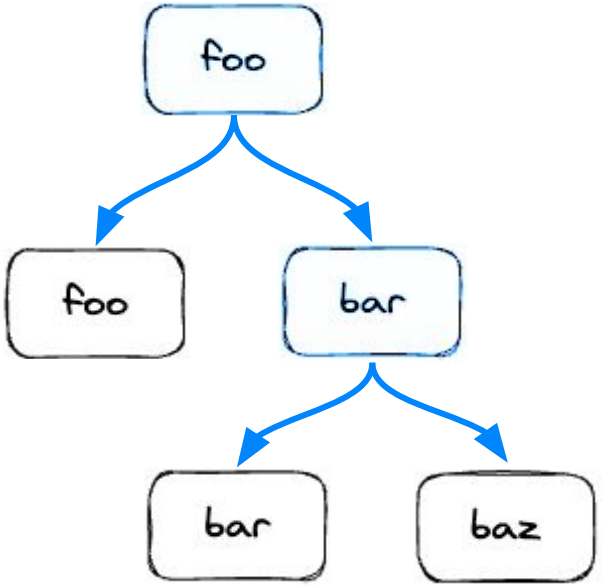
  - Traffic sent directly to `bar` will get split between `bar` and `baz`
  - Traffic sent to `foo` will never get sent to `baz`



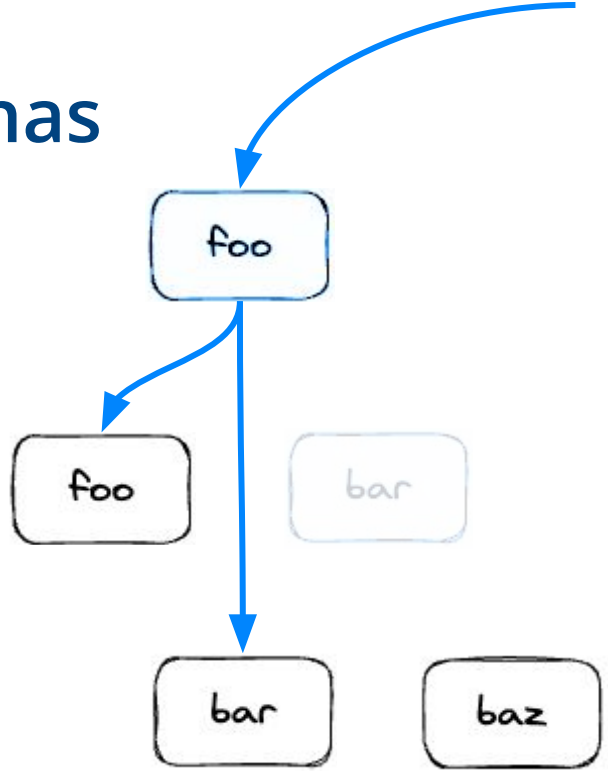
Dynamic Request Routing Gotchas

- HTTPRoutes distinguish between the “front end” of a Service and the “back ends”
- Routing only happens at the Service frontend (a ClusterIP)



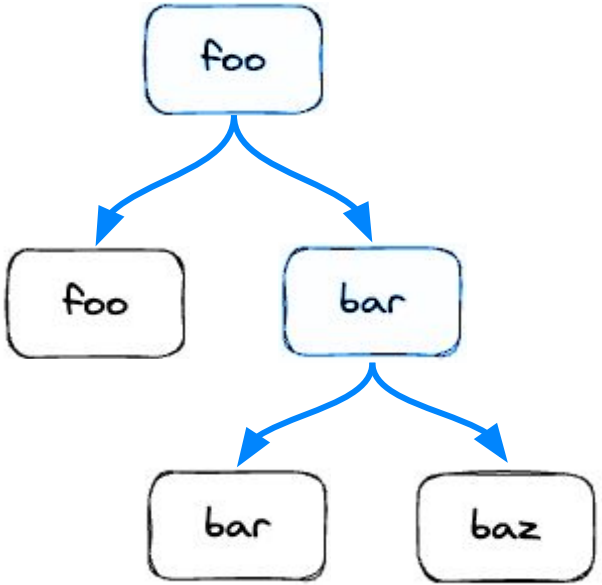
Dynamic Request Routing Gotchas

- HTTPRoutes distinguish between the “front end” of a Service and the “back ends”
- Routing only happens at the Service frontend (a ClusterIP)…
- …but once a routing decision is made, we go direct to a backend (an endpoint IP)



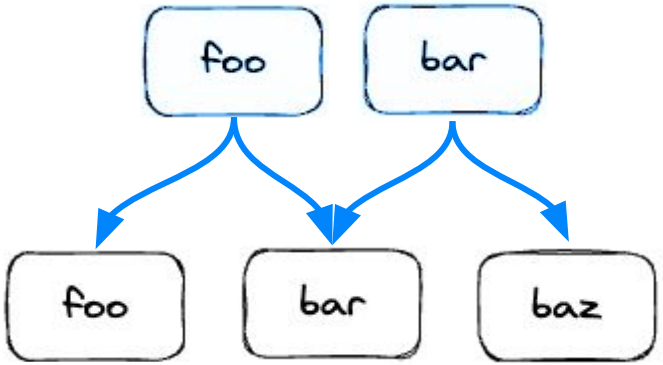
Dynamic Request Routing Gotchas

- So rather than setting up this…



Dynamic Request Routing Gotchas

- So rather than setting up this…
- …you were actually setting up this.



Q&A

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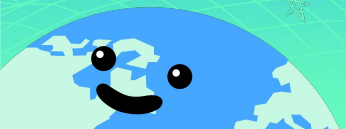

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Thanks much!

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