
KubeCon
CloudNativeCon
Europe 2023
TiKV


# Recovering from Regional Failures at Cloud Native Speeds

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# Speakers

KubeCon CloudNativeCon Europe 2023

## Creator

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Upbound

Principal Solutions Architect

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Millennium bcp

Cloud Compute Lead

https://www.linkedin.com/in/nunoguedes/

# Show of hands



✋ Have you ever heard of K8GB?

# What is K8GB



K8GB (Kubernetes Global Balancer) is an open-source project that provides a global traffic management solution for Kubernetes clusters. It is designed to simplify the configuration and management of DNS-based traffic routing for multi-cluster and multi-region Kubernetes deployments.

- ✅ Open Source CNCF Sandbox project https://www.k8gb.io/
- ✅ Running on Kubernetes Clusters (GSLB CRD)
- ✅ No Management Cluster needed
- ✅ No Single Point Of Failure (using DNS protocol, distributed by design)
- ✅ Multiple load balancing strategies

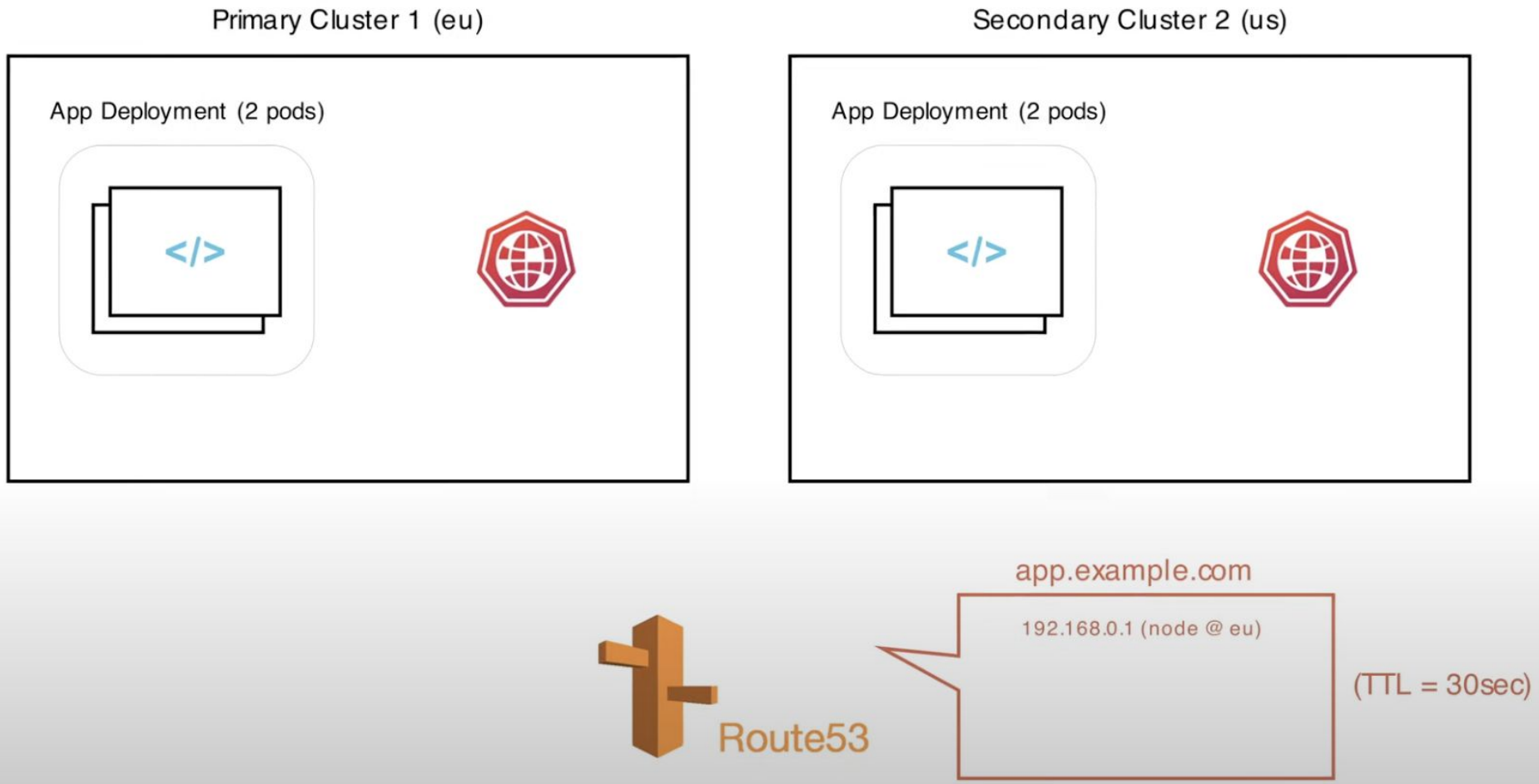
# Project History



- ✅ Originated in Absa where there was a need for cloud native GSLB solution
- ✅ Ability to route traffic to geographically dispersed clusters
- ✅ Response to workload state on a pod health level
- ✅ Designed to replace proprietary vendor solutions
- ✅ K8GB was started in the end of 2019 as OSS project from day 0

# K8GB Makes Your App Globally Available

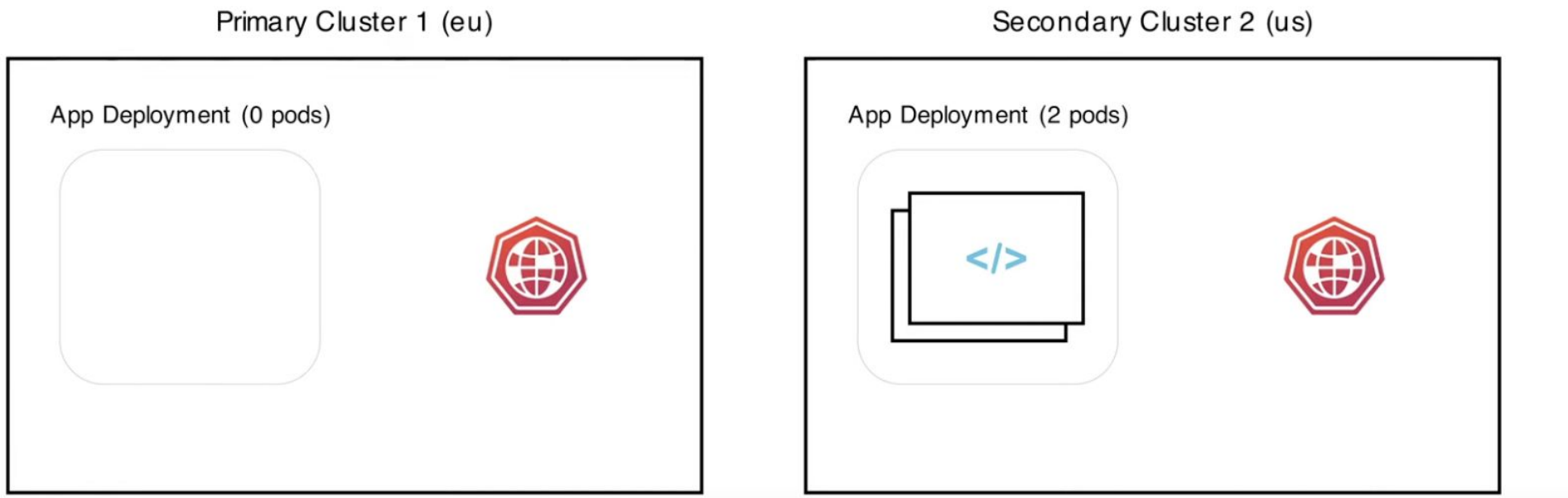





Video

Source

# K8GB Makes Your App Globally Available





Video

Source

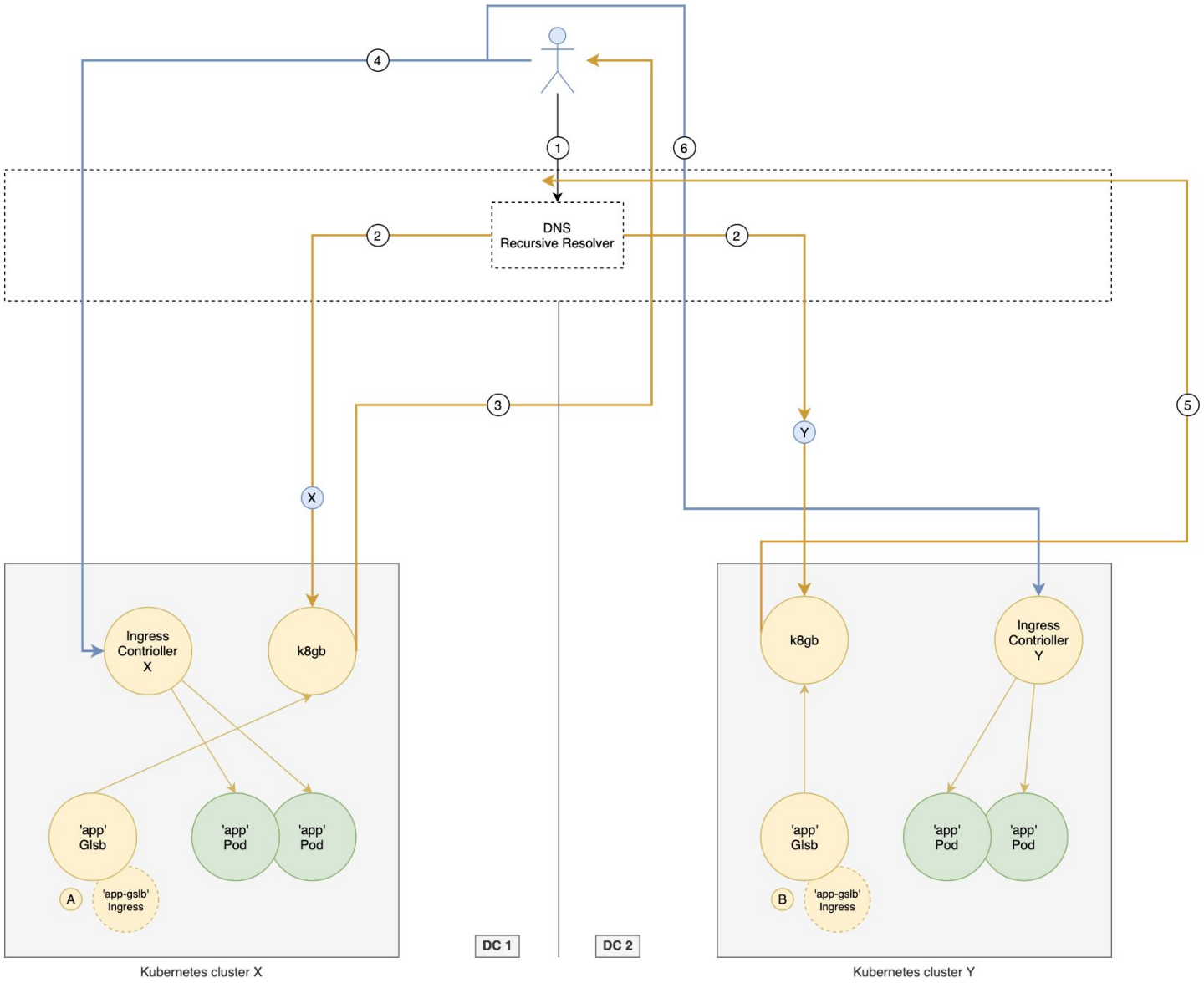
# K8GB Core Principles



- ✅ Kubernetes native
- ✅ Single Gslb CRD / Ingress
- ✅ No control cluster
- ✅ Based on DNS
- ✅ Environment agnostic

Donovan Muller
donovanmuller

Thanks @donovanmuller!



# Simple Way to Control Global Traffic

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### Gslb custom resource

```yaml
apiVersion: k8gb.absa.oss/v1beta1
kind: Gslb
metadata:
  name: hello-kubernetes
  namespace: hello-kubernetes
spec:
  ingress:
    ingressClassName: nginx
    rules:
    - host: hello.demo.k8gb-kubeconeu2023.com
      http:
        paths:
        - backend:
            service:
              name: hello-kubernetes-hello-kubernetes
              port:
                name: http
          path: /
          pathType: Prefix
  strategy:
    dnsTtlSeconds: 30
    primaryGeoTag: northeurope
    splitBrainThresholdSeconds: 300
    type: failover
```

### or standard Ingress annotations

```yaml
apiVersion: networking.k8s.io/v1
kind: Ingress
metadata:
  annotations:
    k8gb.io/primary-geotag: northeurope
    k8gb.io/strategy: failover
  name: hello-kubernetes
  namespace: hello-kubernetes
spec:
  ingressClassName: nginx
  rules:
  - host: hello.demo.k8gb-kubeconeu2023.com
    http:
      paths:
      - backend:
          service:
            name: hello-kubernetes-hello-kubernetes
            port:
              name: http
        path: /
        pathType: Prefix
```

Gateway support is on the roadmap!

# Load Balancing Strategies



### ✅ roundRobin

Returns both cluster endpoints in round-robin manner.

### ✅ weightedRoundRobin

While roundRobin is fair for all regions, with WeightRoundRobin we can set explicitly how the regions should be loaded with traffic. For example, we can set one region to handle 80% of the traffic, another 20% and a third 0%, so that the last region is practically disabled.

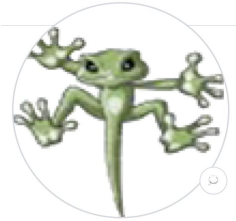

Thanks @kuritka!

### ✅ failover

Pinned to a specified primary cluster until workload on that cluster has no available Pods, upon which the next available cluster's Ingress node IPs will be resolved. When Pods are again available on the primary cluster, the primary cluster will once again be the only eligible cluster for which cluster Ingress node IPs will be resolved

### ✅ geoip

Similar to failover mode, but returns "closest" cluster to the client initiating request. This requires a specially crafted GeoIP database and DNS resolver to support EDNS0 extension (CLIENT-SUBNET in particular).




Thanks @k0da!

# Supported Integrations



✅ K8GB is architected to run on top of any CNCF-conformant K8s cluster and Ingress controller

✅ Supported external DNS providers:

- ✅ Infoblox
- ✅ Route53
- ✅ NS1
- ✅ RFC2136 implementations (such as Bind and Windows DNS)
- ✅ Azure Public DNS* (to be released soon)

# Observability

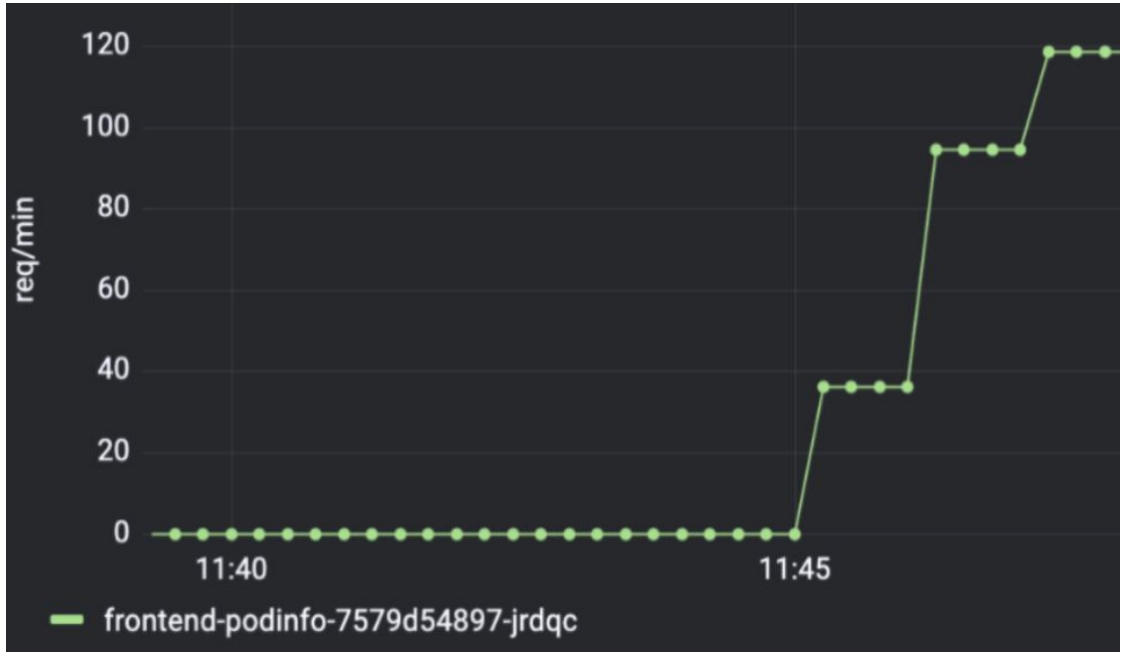


Jirka Kremser
jkremser

Thanks @jkremser!

✅ Metrics: Prometheus-compatible metrics for health

✅ Traces: Supports Jaeger or any other OTEL compliant solution

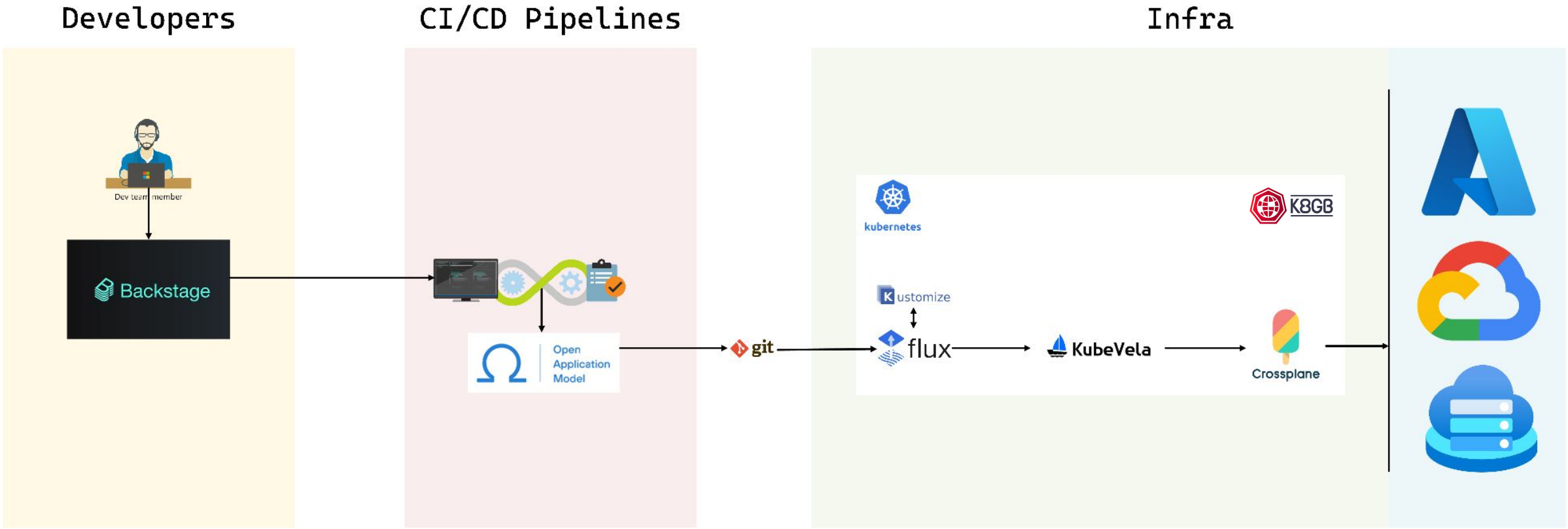
# MBCP Use Case



- ✅ 5 regions across Europe, including:
  - ✅ Azure
  - ✅ GCP
  - ✅ On-prem
- ✅ Everything is IaC (hopefully using a control plane for lifecycle management)
- ✅ Everything is GitOps

# MBCP Use Case






Millennium bcp

# MBCP Use Case



✅ K8s typical deployment pattern:

**Management cluster A**
99.5% SLO
Multi-zone
Single region
DR using IaC + GitOps + state restore

**Run cluster B**
99.95% SLO
Multi-zone
Multi-region
DR using IaC + GitOps

**Cluster B-x**
Hot cluster
Multi-zone
Region “A”

**Cluster B-y**
Warm cluster
Multi-zone
Region “B”

Millennium bcp

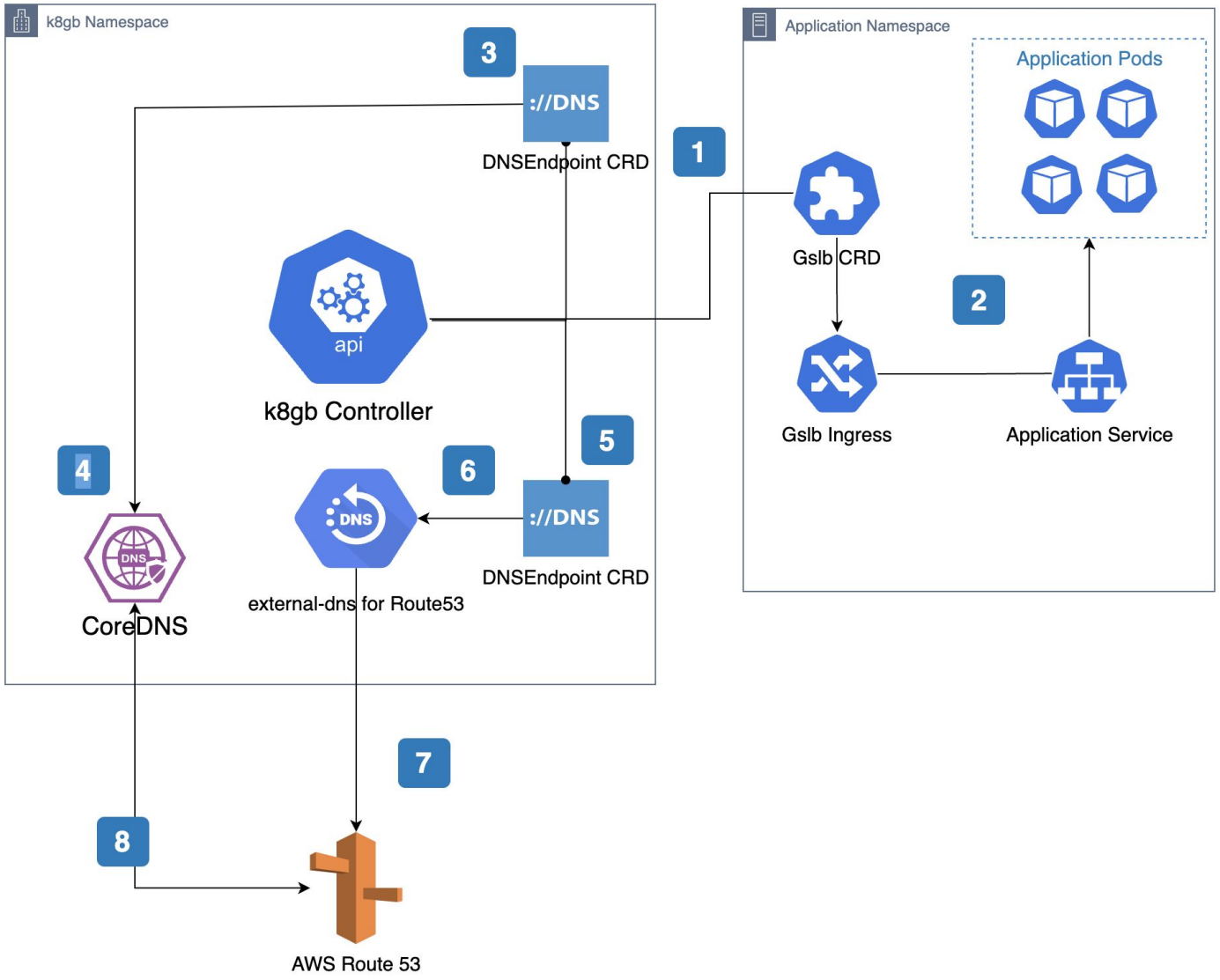
# Demo



http://hello.demo.k8gb-kubeconeu2023.com

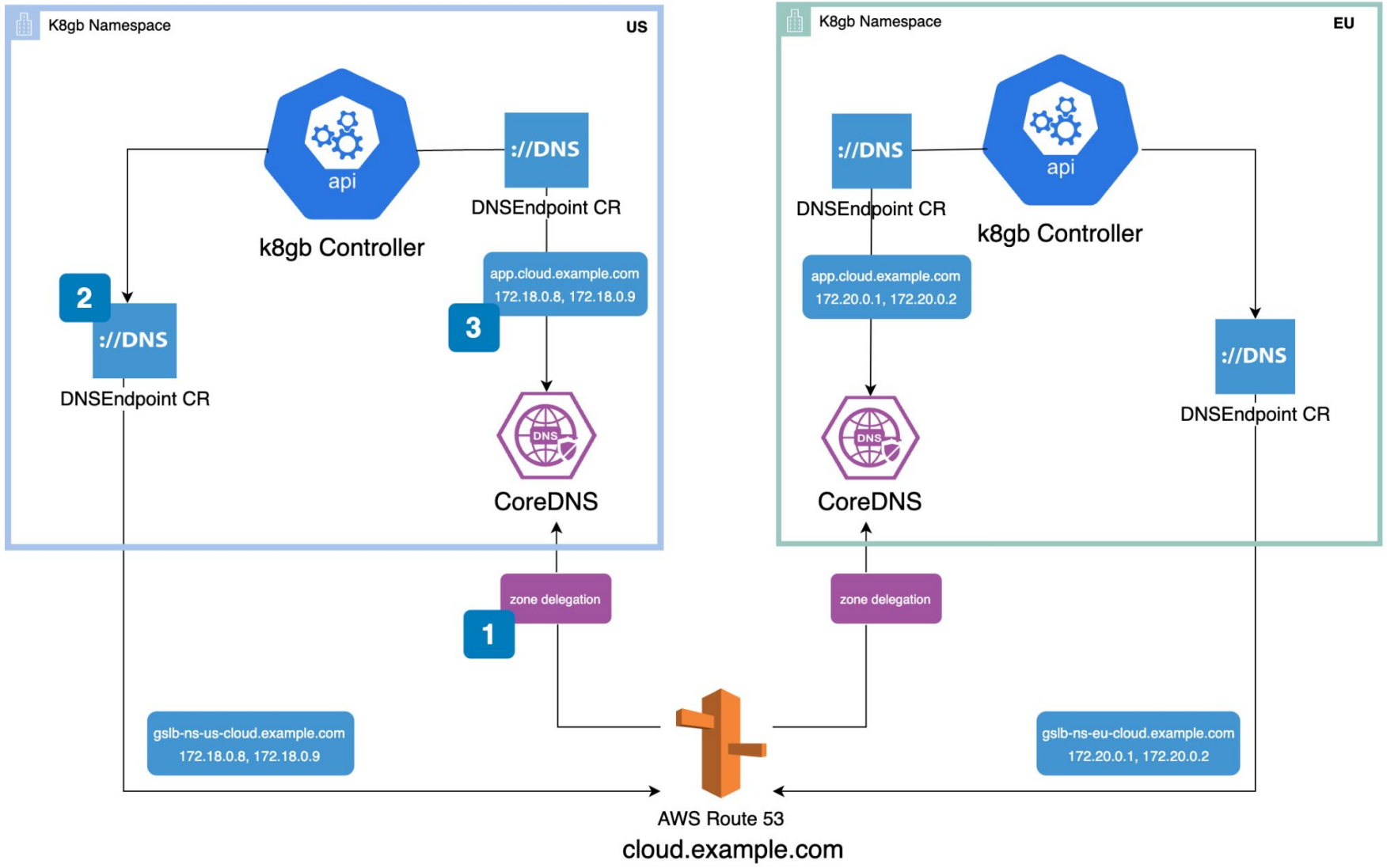
Code: https://dev.azure.com/infbase/k8gb-kubeconeu2023/

# K8GB Internal Machinery




1. k8gb controller watches all namespaces for Gslb custom resource creation and reacts accordingly
2. Gslb Ingress is getting automatically created from Gslb CR spec. k8gb controller is transitively aware of application pod health status through association of Gslb Ingress with Application Service
3. k8gb controller creates DNSEndpoint Custom Resource which is populated with information from Gslb Ingress status - specifically desired application FQDN and active IP addresses to dynamically compose A record.
4. CoreDNS instance with enabled k8s_crd plugin reacts to DNSEndpoint creation and reads data from the CR object and becomes ready to serve external DNS requests
5. k8gb controller also creates special DNSEndpoint to configure DNS zone delegation in external DNS provider
6. Dedicated External DNS instance which is configured to talk to Route 53 is reading data from DNSEndpoint CR
7. External DNS for Route53 makes API calls to configure NS and glue A records in Route53
8. Zone delegation is configured on Route53 and k8gb is now authoritative for the application DNS zone. CoreDNS is serving external DNS requests with dynamically constructed DNS responses

# K8GB Multi-Cluster Interoperability 1/2

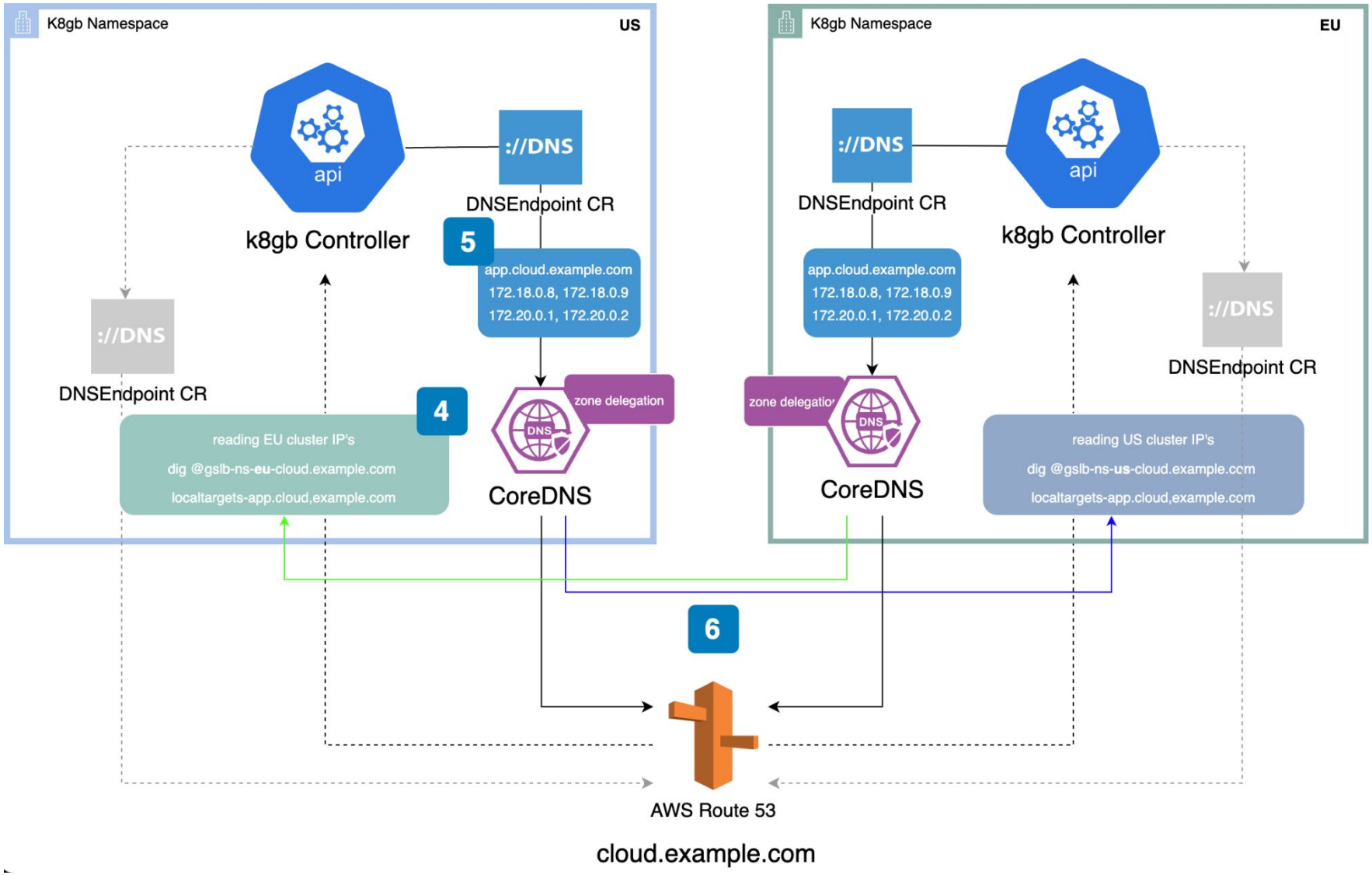



1. Zone-delegation for all regions involved is set in the k8s_crd plugin instance. In our example, we delegate the zone *cloud.example.com.*

2. k8gb controller creates new records in edgeDNS via externalDNS. These records contain the host network ingress addresses of the cluster or CoreDNS Service addresses. The new record is for our domain in the format *gslb-ns-<region>-cloud.example.com* .

3. At this moment the individual k8gb does not yet know about the other k8gb. If you hit k8s_crd plugin on the app.cloud.example.com host, you will receive addresses bound only to the cluster whose CoreDNS(with k8s_crd plugin configured) you hit.

# K8GB Multi-Cluster Interoperability 2/2




**4** The k8gb controller knows the DNS Zone and all individual regions. It iterates through them and finds out the addresses for each individual region by discovering glue A record for NS server through EdgeDNS. Then it queries special localtargets-* service FQDN directly from the coredns of the paired k8gb-enabled cluster. The k8gb controllers on all clusters now know about the other endpoints. In a nutshell, clusters cross-polling each other each reconciliation loop utilizing the same DNS protocol for the state sync

**5** The CoreDNS k8s_crd plugin has updated entries and contains a merge of all entries for the app.cloud.example.com in delegated zone *cloud.example.com*. CoreDNS k8s_crd plugin determines the order in which addresses will be returned if hit.

**6** The records are shared between distributed k8gb's cross all regions. All checks repeats cyclically and all changes are gradually propagated to individual clusters. The actually DNS response will be returned according to the configured load balancing strategy. Diagram exposes RoundRobin strategy example when all IP addresses are merged together into the single response.

# CNCF Landscape Stats

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**CNCF** Sandbox Project

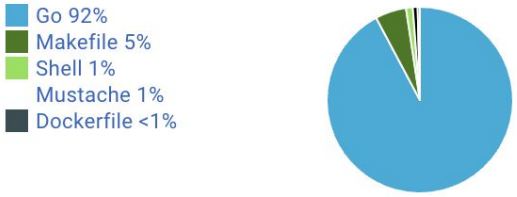
**LF** Project

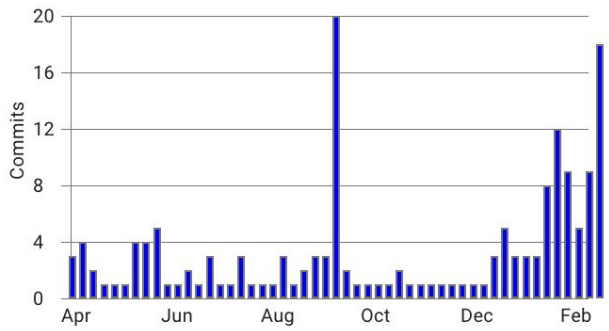
Open Source Software

**License** Apache License 2.0

**OpenSSF Best Practices** ✓

Tweet 1983




# k8gb

**Cloud Native Computing Foundation (CNCF)**

Orchestration & Management · Coordination & Service Discovery

A cloud native Kubernetes Global Balancer

| | | | |
|---|---|---|---|
| Website | k8gb.io | | |
| Repository | github.com/k8gb-io/k8gb ★ 561 | | |
| Crunchbase | crunchbase.com/organization/cloud-native-computing-foundation | | |
| LinkedIn | linkedin.com/company/cloud-native-computing-foundation | | |
| Twitter | @CloudNativeFdn | Latest Tweet | this week |
| First Commit | 3 years ago | Latest Commit | this week |
| Contributors | 19 | Latest Release | 6 months ago |
| Accepted | 2021-03-30 | | |
| Headquarters | San Francisco, California | Headcount | 11-50 |
| Funding | $3M | | |
| Annual Review | 1187 years ago | | |
| Annual Review Date | 11 months ago | | |
| Dev Stats | https://k8gb.devstats.cncf.io/ | | |
| Artwork | https://github.com/cncf/artwork/blob/master/examples/sandbox.md#k8gb-logos | | |
| Slack | https://cloud-native.slack.com/messages/k8gb | | |

# CLO Monitor


- https://clomonitor.io/projects/cncf/k8gb
- Finalist of CNCF Security Slam NA 2022
  https://www.cncf.io/reports/security-slam-north-america-2022/

# Diverse Group of Maintainers



- ✅ 3 maintainers from Absa
- ✅ 1 maintainer from Giant Swarm
- ✅ 1 maintainer from Upbound

# Roadmap



- ✅ Supported Azure integration (already in the demo)
- ✅ Supported GCP integration
- ✅ Gateway support
- ✅ Full detailed Roadmap
https://github.com/orgs/k8gb-io/projects/2/views/1

# Be a part of K8GB

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- ✅ Visit us at www.k8gb.io
- ✅ Try K8GB in your environment
- ✅ Drop any question to #k8gb CNCF slack channel
- ✅ ⭐ Star us in GitHub! :) github.com/k8gb-io/k8gb
- ✅ Add your organization to ADOPTERS.md!
- ✅ Create Issues and PRs!

# Questions?



Ask a question, get a K8GB sticker

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to leave feedback on this session