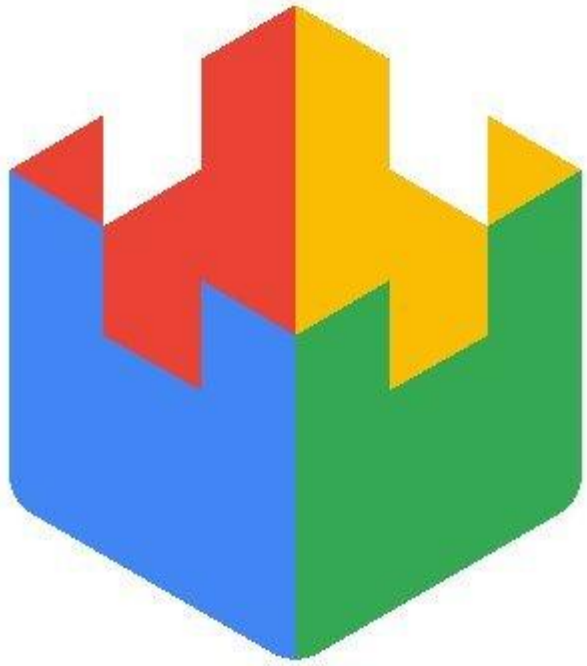
Archetypes for Reliable Systems

Steve McGhee
Reliability Advocate, SRE
Google



Sabre Disclaimer

The purpose of this workshop is to educate and share best practices.

Sabre has chosen and implemented a unique chain of tooling for GCP Cloud Foundations and the services demonstrated here may or may not yet fulfill Sabre's enterprise requirements. Please refer back to the Sabre Cloud foundations team for legitimate use cases for an unenabled service or if you have any questions.

The products mentioned during the workshop can only be used once approved by your Cloud Foundations team.

Please don't expect an accelerated evaluation of new services demonstrated in this workshop.

If it's in preview, it may be longer than normal to have access in sandbox or higher environments.

GCP enabled services list at Sabre:

https://sabrenow.sharepoint.com/teams/cloud-coe/Lists/GCP%20Vetted%20Services/AllItems.aspx?env=WebViewList

Who are we?

Steve McGhee

Reliability Advocate

Google

Ameer Abbas

Product Manager

Google

Agenda

01 Reliability Terms

02 Application Archetypes

03 SLO Math

04 Reliable Architectures

Can you build

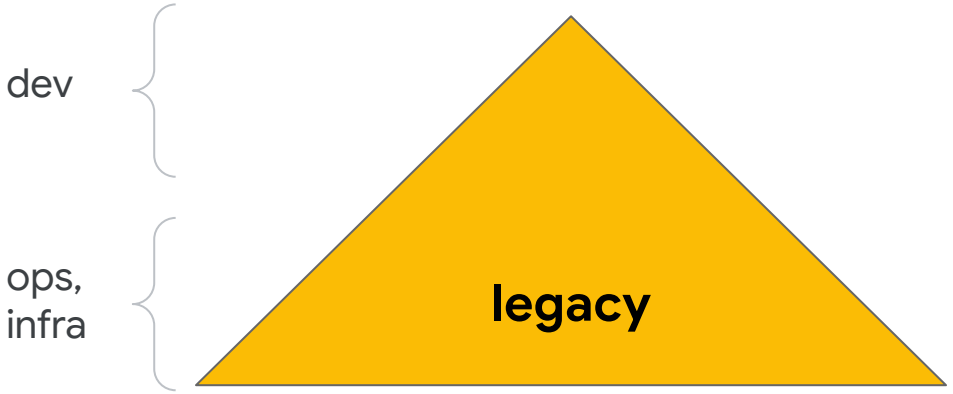
99.99 services

on

99.9

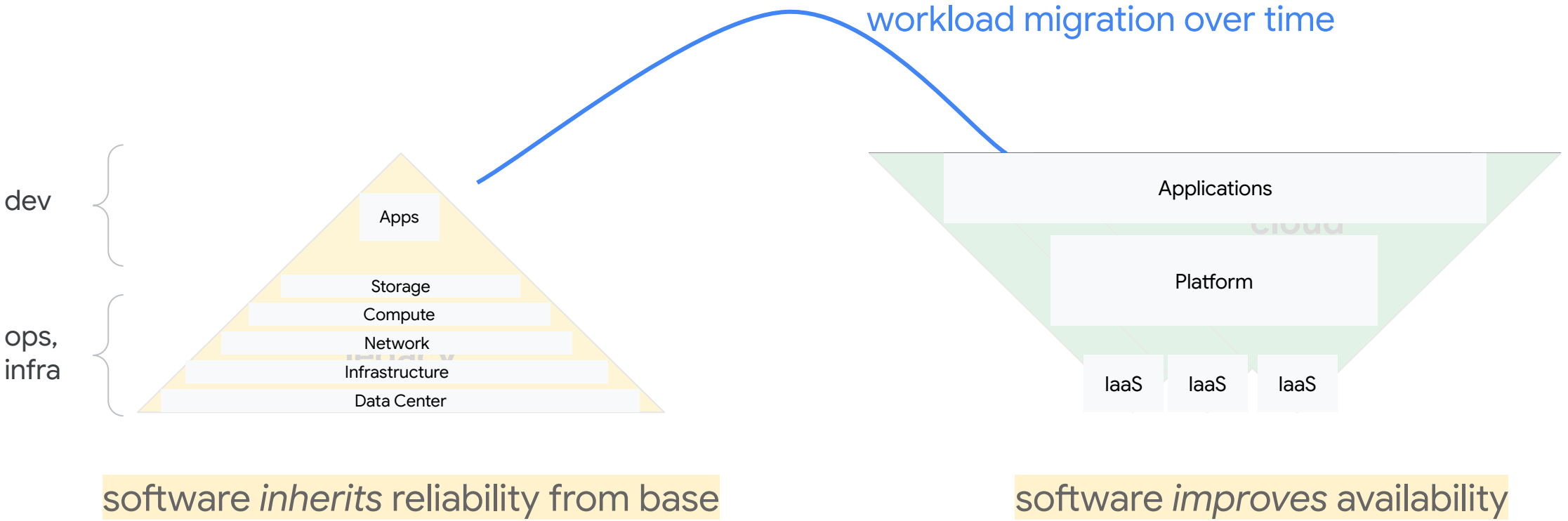
infrastructure?

Pyramids of Reliability



software *inherits* reliability from base

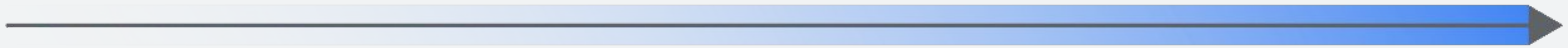
software *improves* availability



software *inherits* reliability from base

software *improves* availability

Application Archetypes



Archetypes to Reliability

- **Archetype** - Abstract model

  Replication, redundancy, RTO/RPO, DR, cost

- **Architecture** - Products and Service design

  K8s, Mesh, CICD, DBs, Storage and backup

- **App/Service** & Footprint - *always changing*

- **SLOs** - expectations, guardrails

Platforms and Applications

Supports N
Application Archetypes

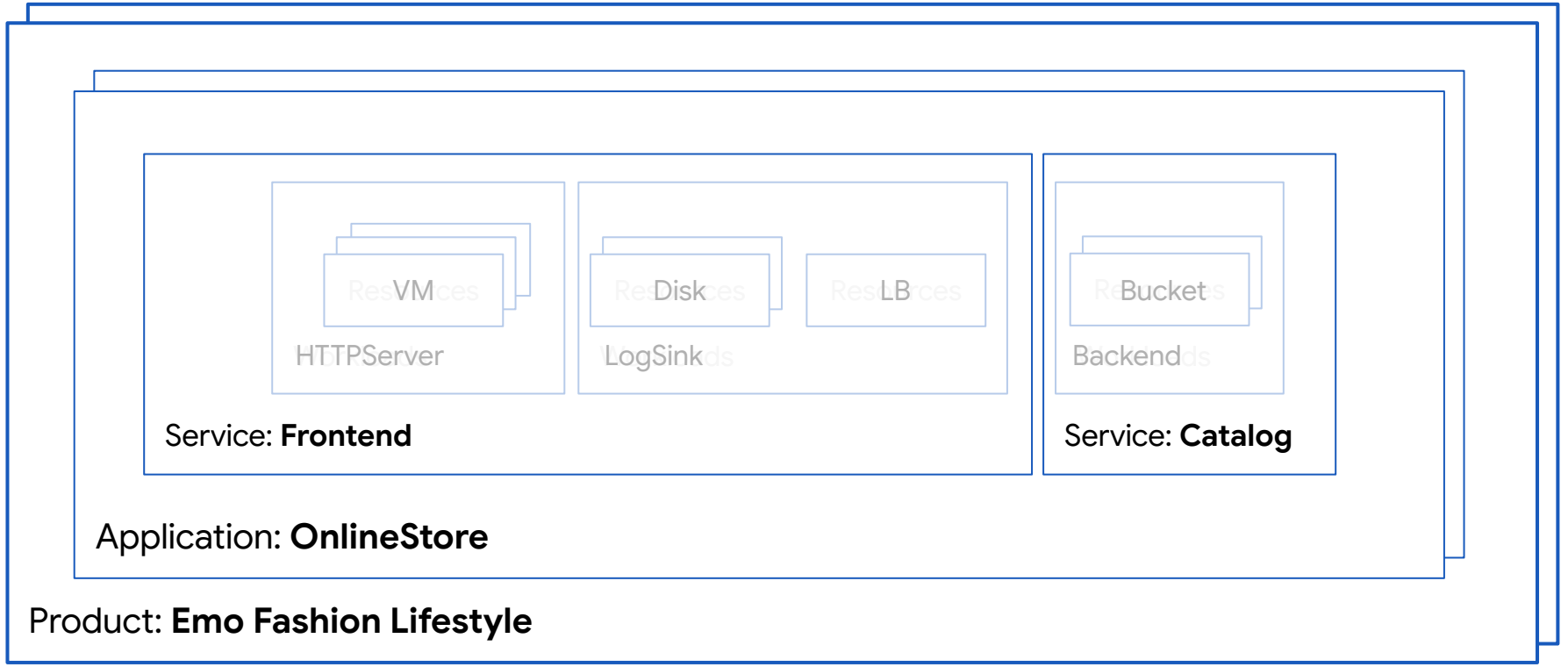
Platform: **Cylon**

Container Orchestration

CI/CD

Observability

Analytics



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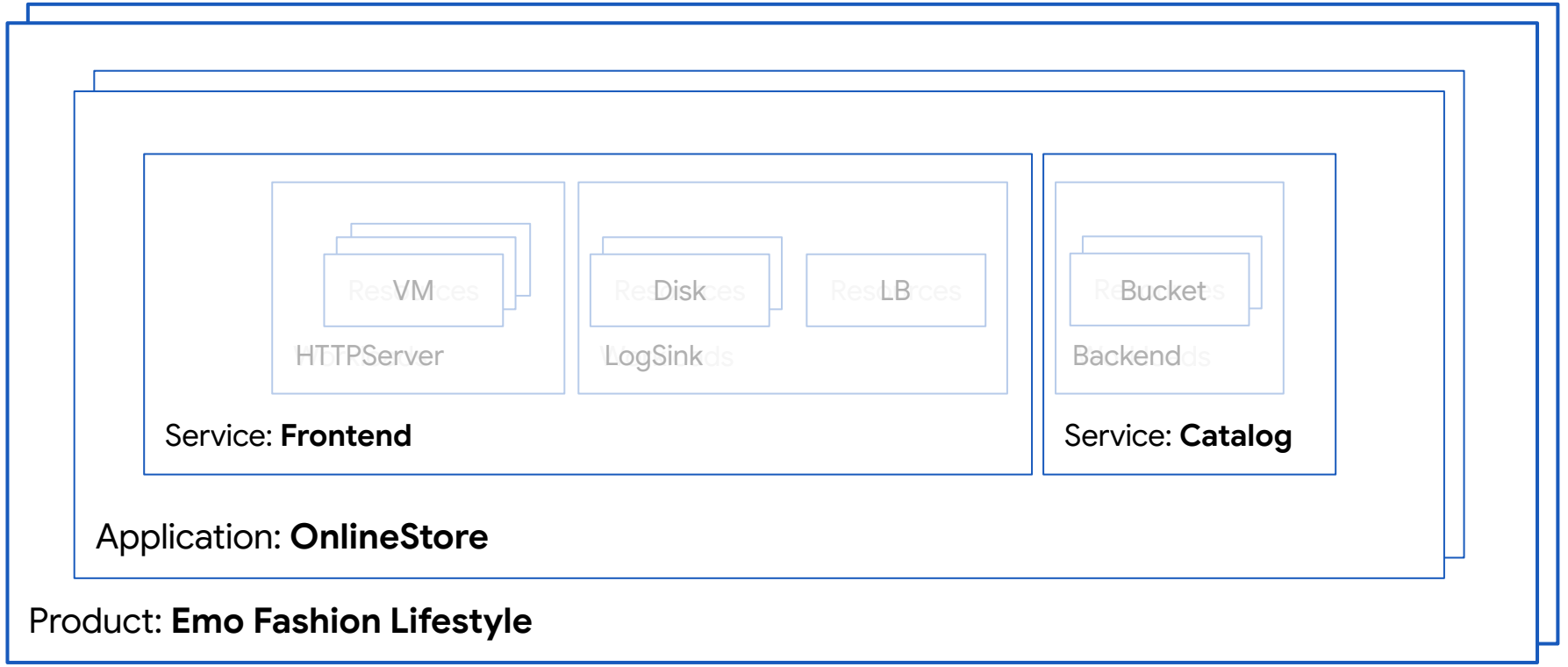

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Platform: **Cylon**

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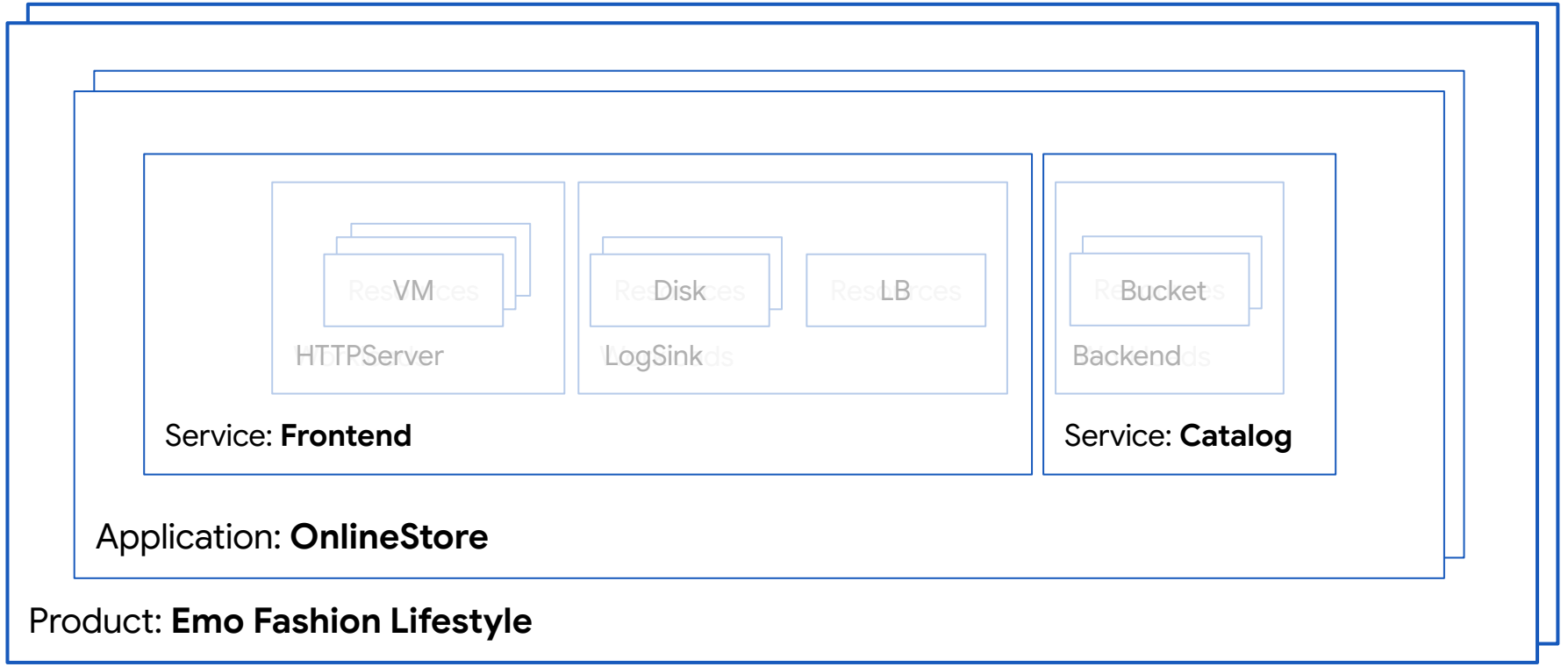
- **CI/CD**
- **Observability**
- **Analytics**

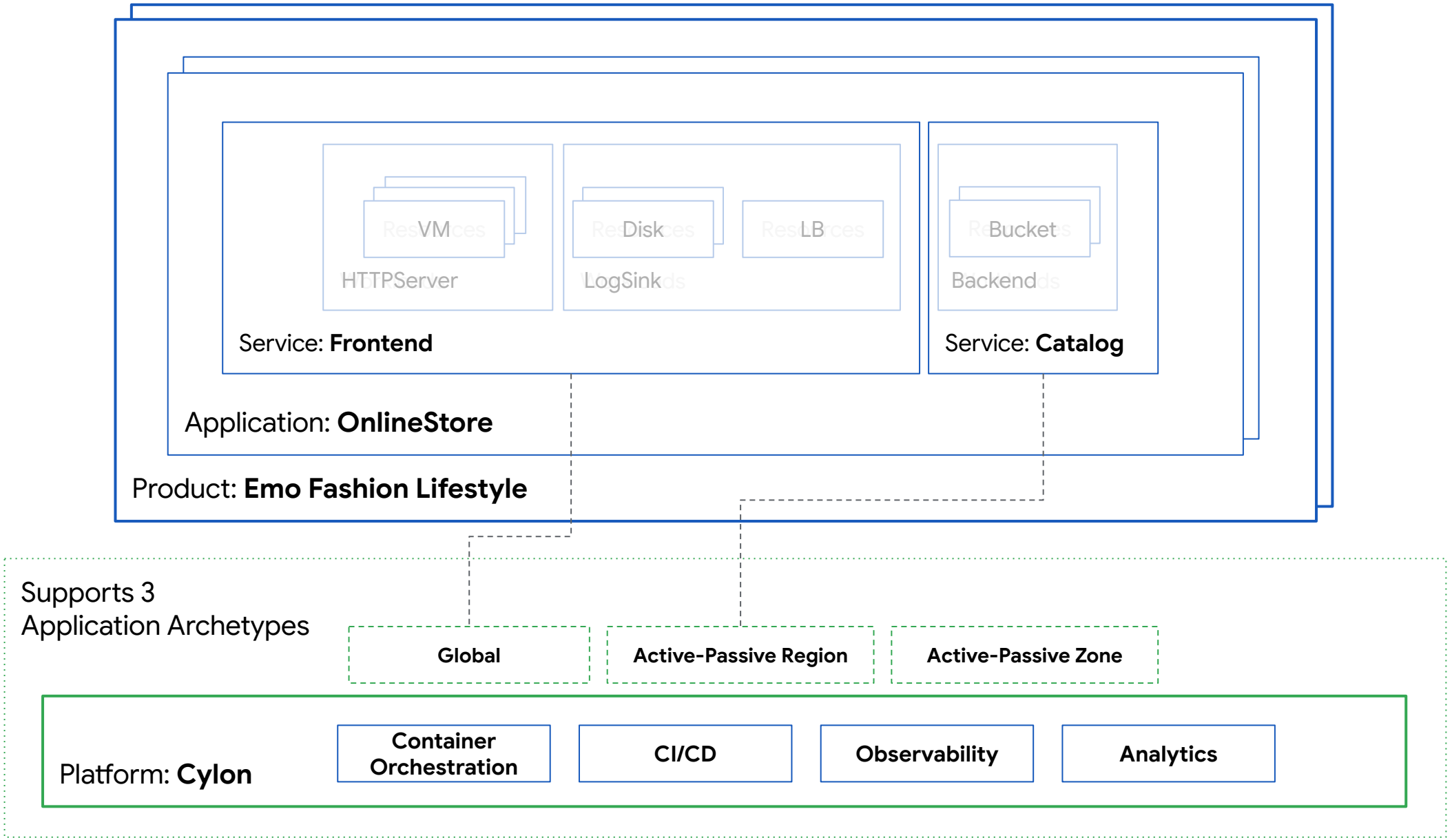


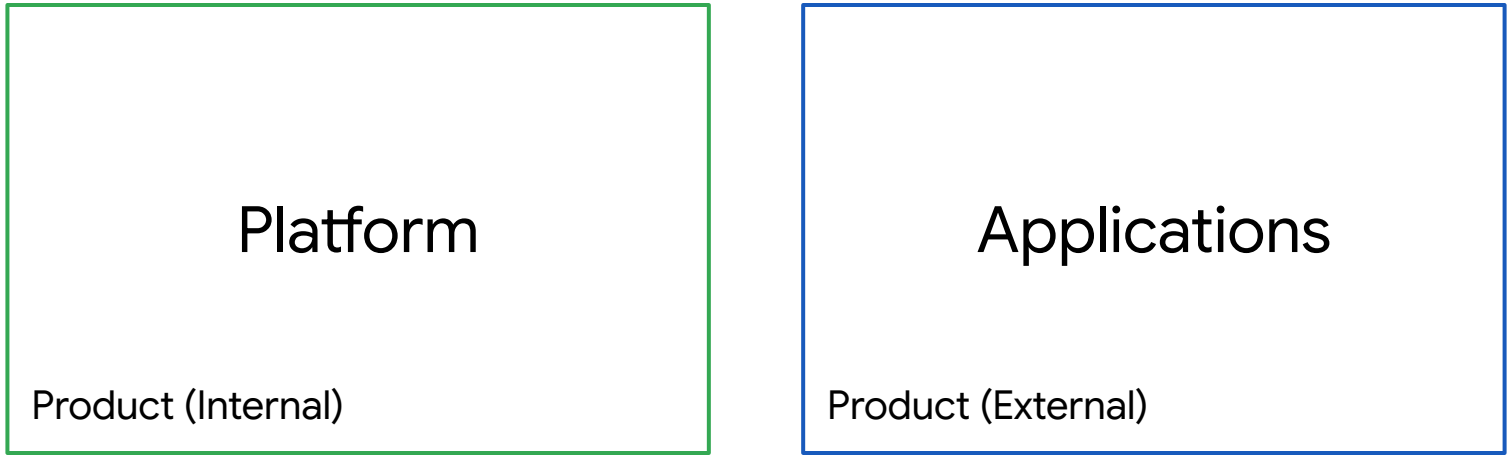
Supports 3
Application Archetypes

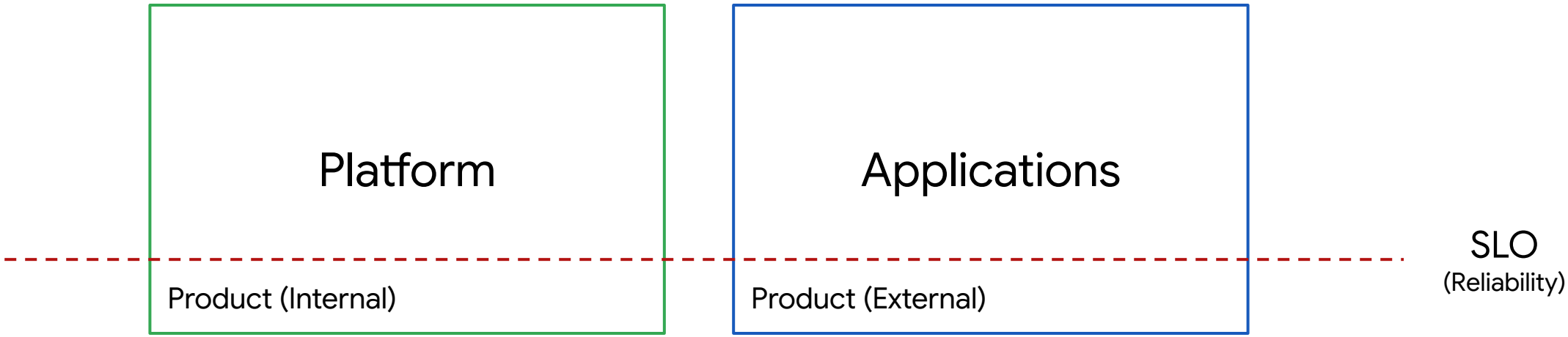
Global | **Active-Passive Region** | **Active-Passive Zone**

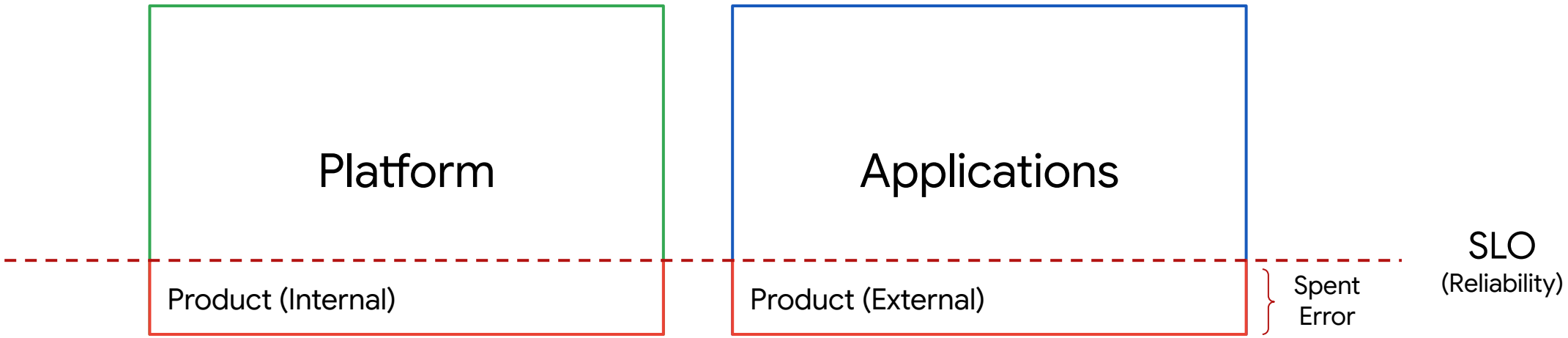
Platform: **Cylon**

Container Orchestration | **CI/CD** | **Observability** | **Analytics**


VM
HTTPServer
Disk
LogSink
LB
Bucket
Backend
Service: Frontend
Service: Catalog
Application: OnlineStore
Product: Emo Fashion Lifestyle
Supports 3
Application Archetypes
Global
Active-Passive Region
Active-Passive Zone
Platform: Cylon
Container Orchestration
CI/CD
Observability
Analytics


Platform
Product (Internal)
Applications
Product (External)


Platform
Applications
SLO
(Reliability)
Product (Internal)
Product (External)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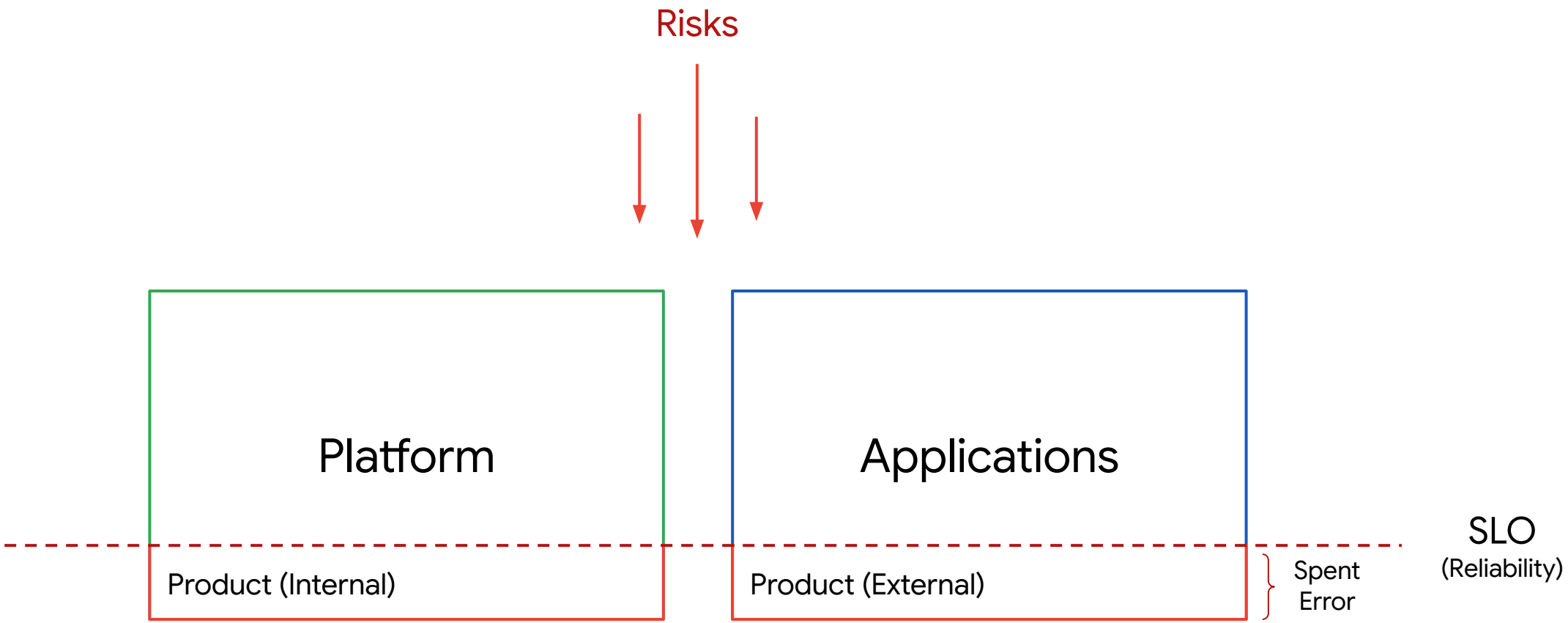
Applications
Product (Internal)
Product (External)
Spent
Error
SLO
(Reliability)


Risks
Platform
Applications
Product (Internal)
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Spent
Error
SLO
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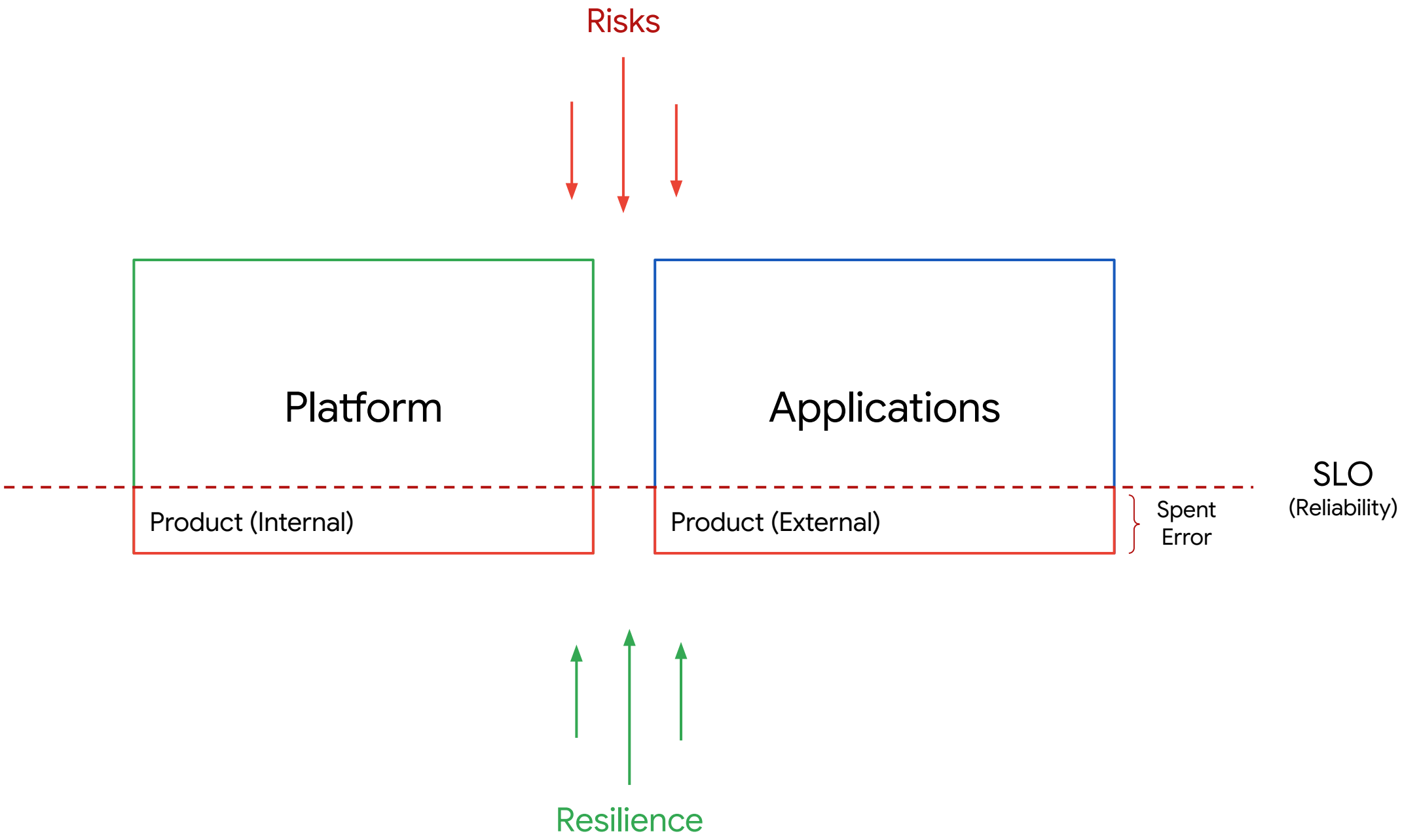
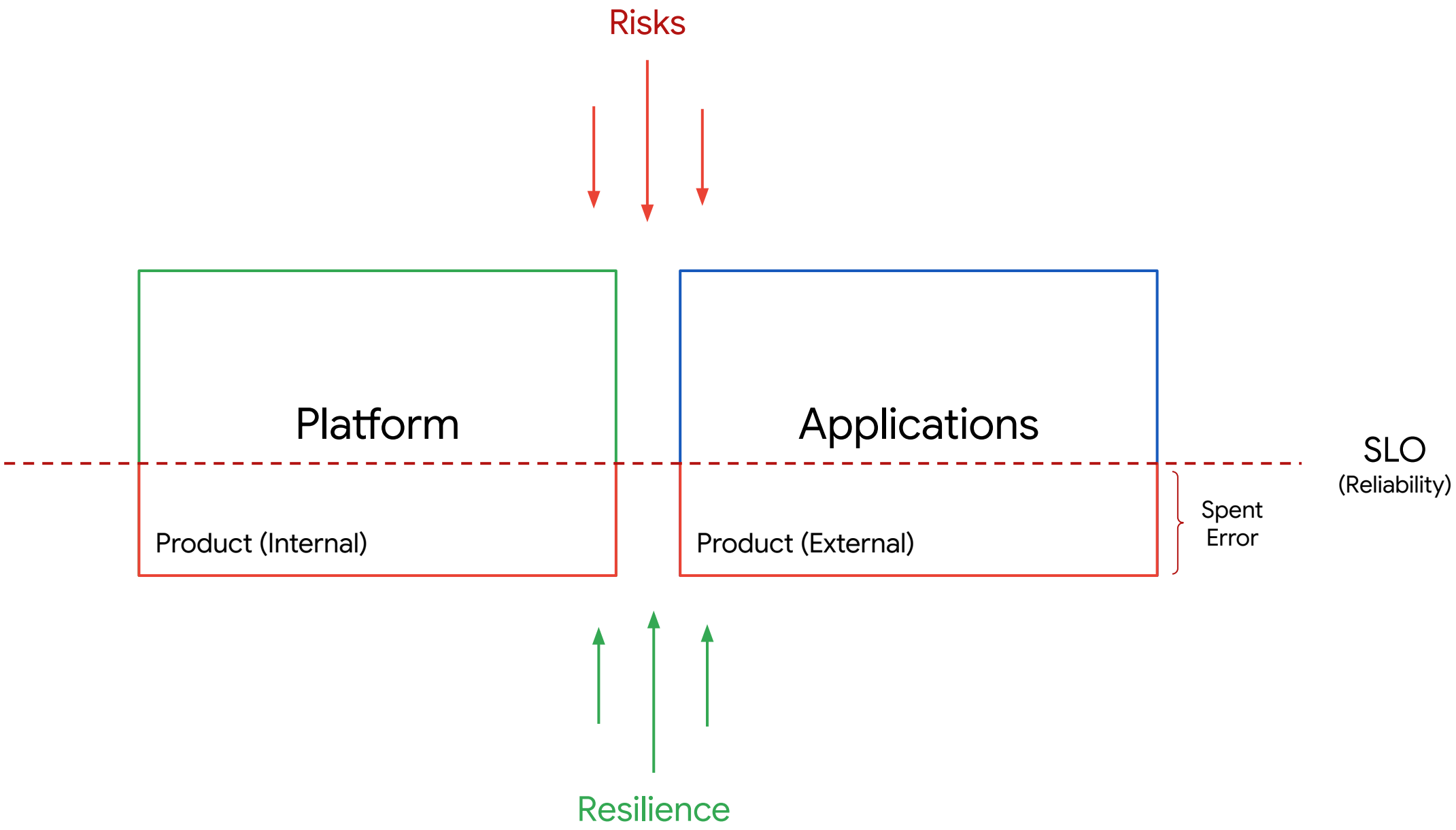

Risks
Platform
Applications
Product (Internal)
Product (External)
Spent
Error
SLO
(Reliability)
Resilience


Risks
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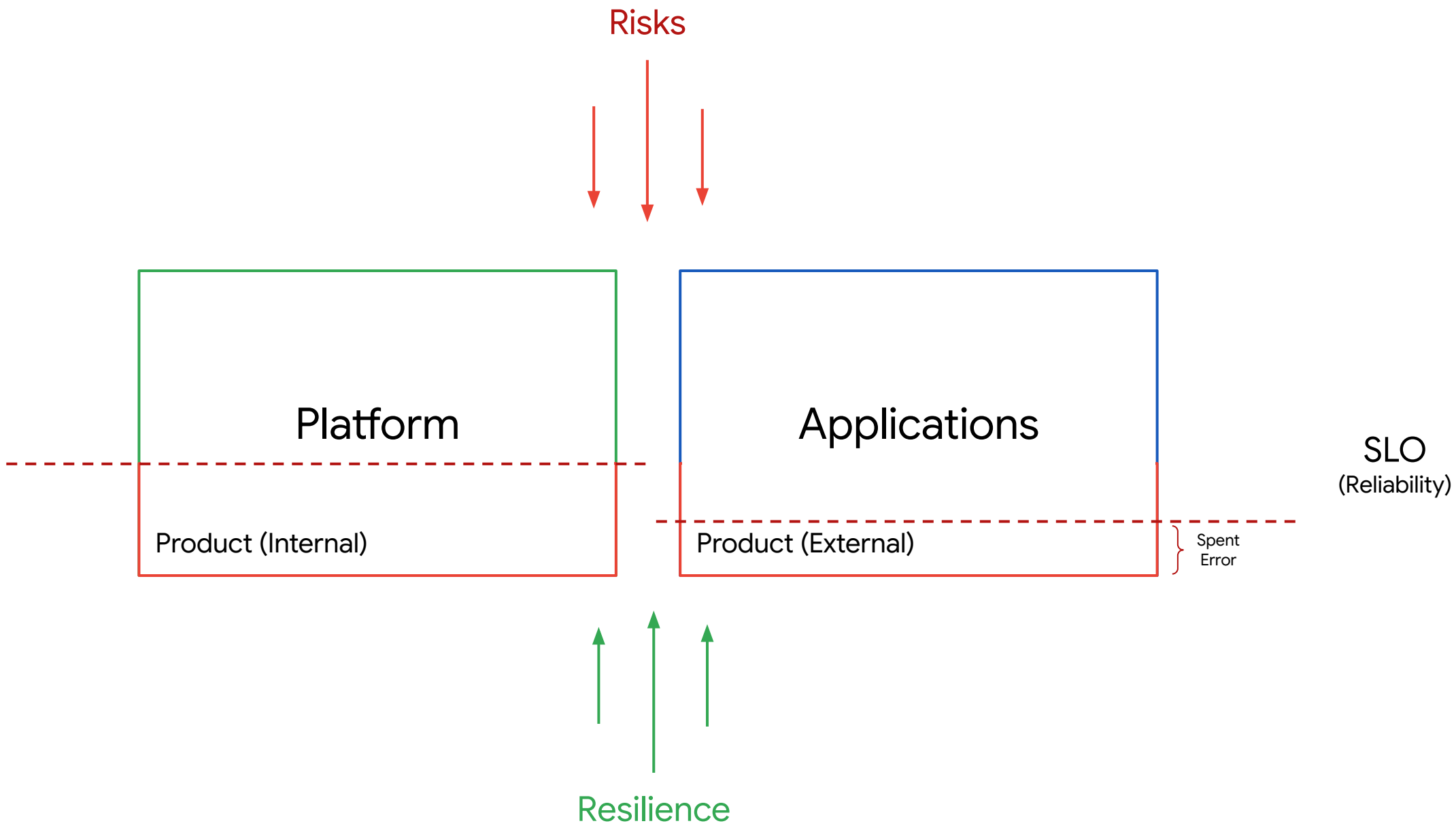
Risks
Platform
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Spent
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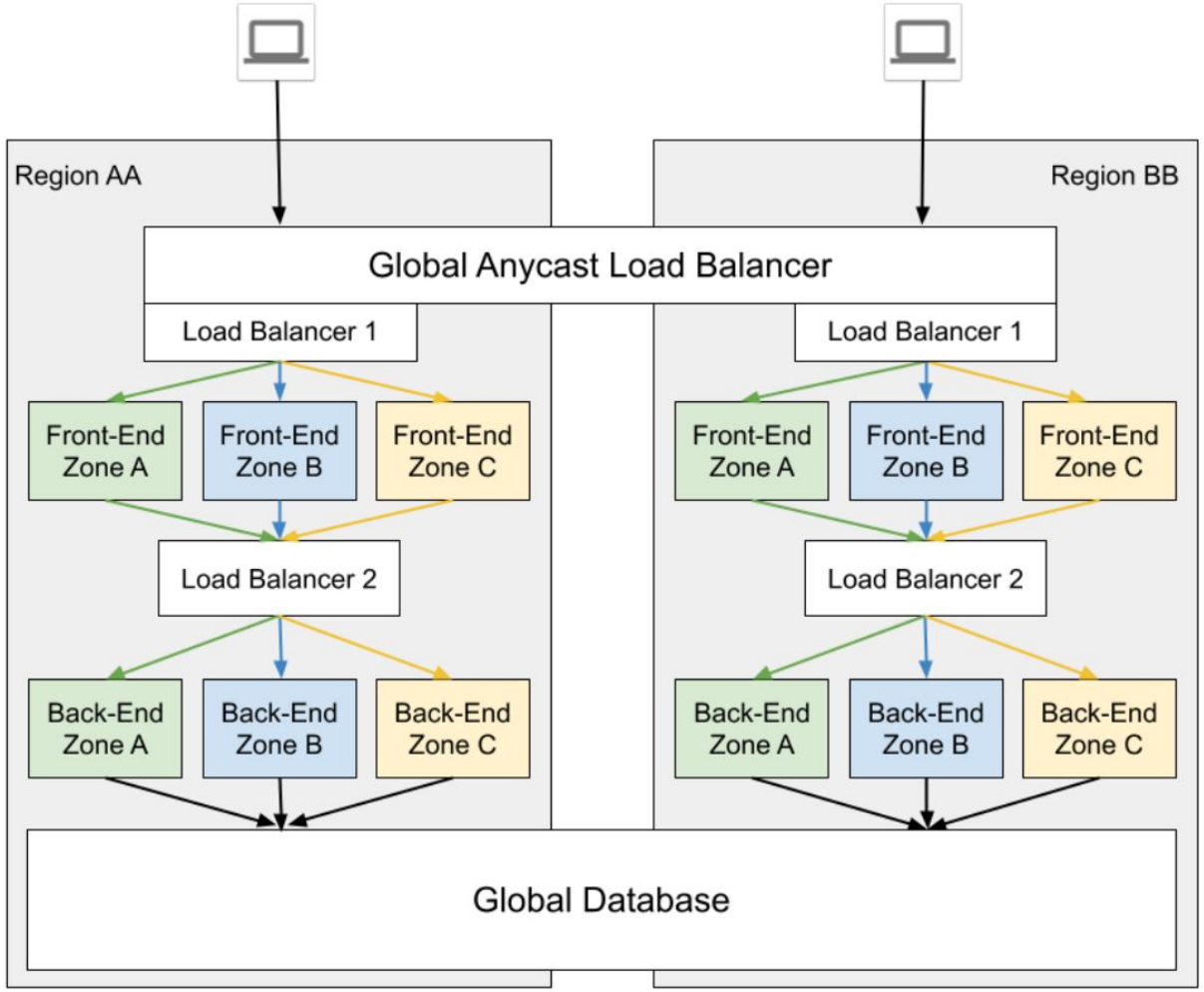
5 Application Archetypes

5 Application Archetypes

bit.ly/cloudarchetypes

Anna Berenberg, Brad Calder

ACM Computing Surveys, vol. 55 (2022), pp. 1-48

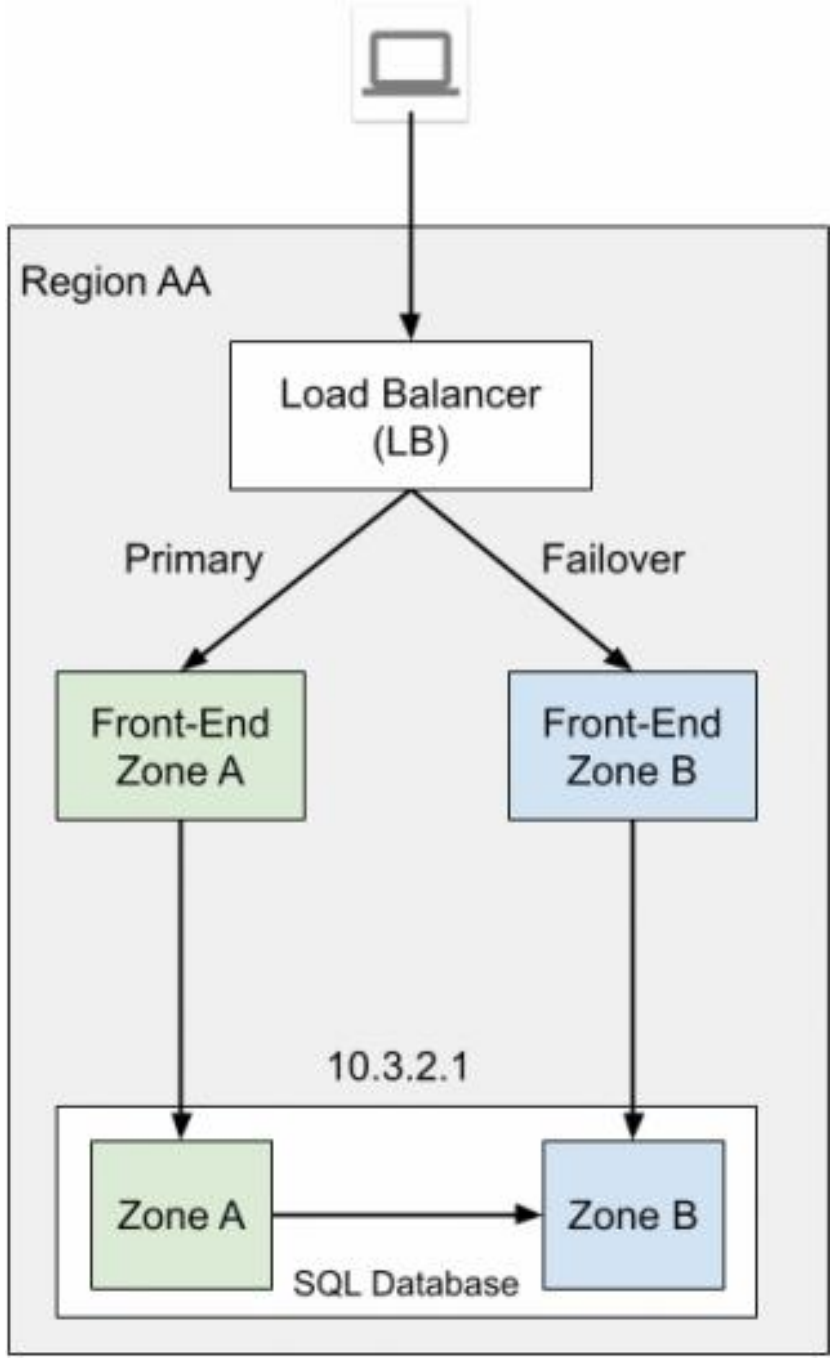


Archetype 5.2: Global Anycast with regional isolated stacks and global database deployment model

Archetype 2.2

Active Passive Zones

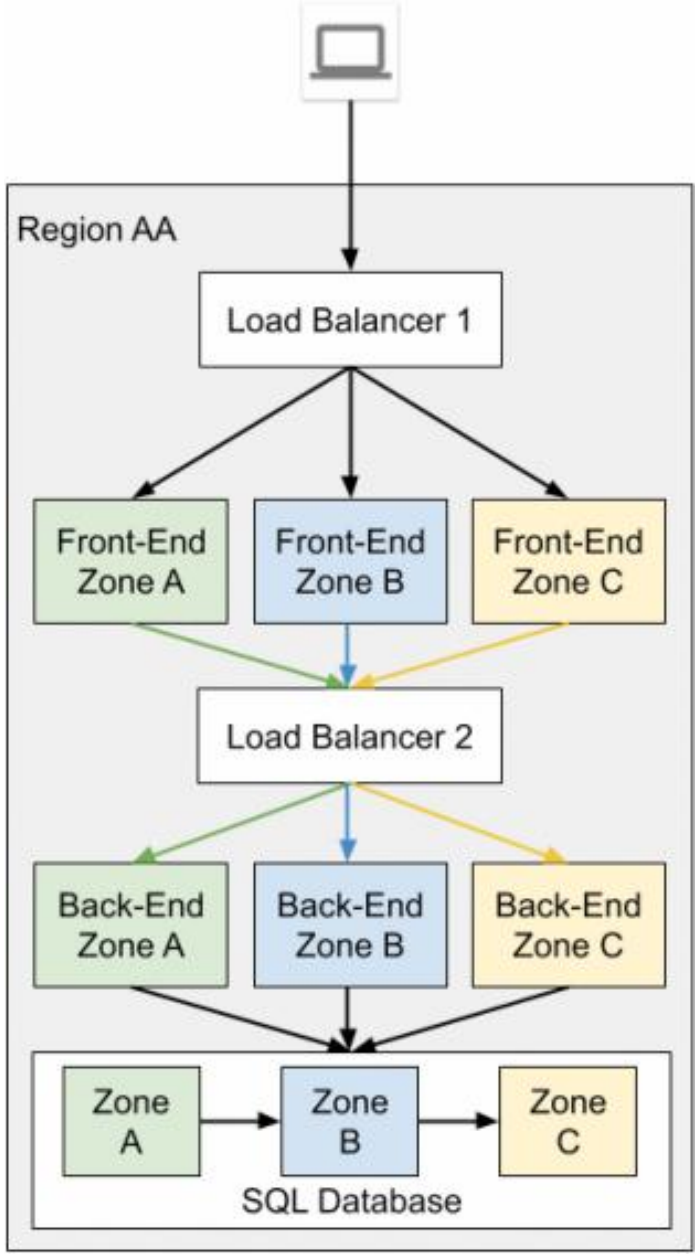
- **Deploy** all services of app to two zones in one region
- **Data** in SQL with a read replica
- **L4 LB** with one backend group
- **Survives zone** failure. Does not survive region failure.
- **Fail-Ops**: Change LB backend, promote read replica
- **Cost**: 2x serving + 2x data (1 replica)
- **Complexity**: Low
- **App Refactoring**: None (lift and shift)
- **Type**: COTS, licensing



Archetype 3.1

Multi Zonal

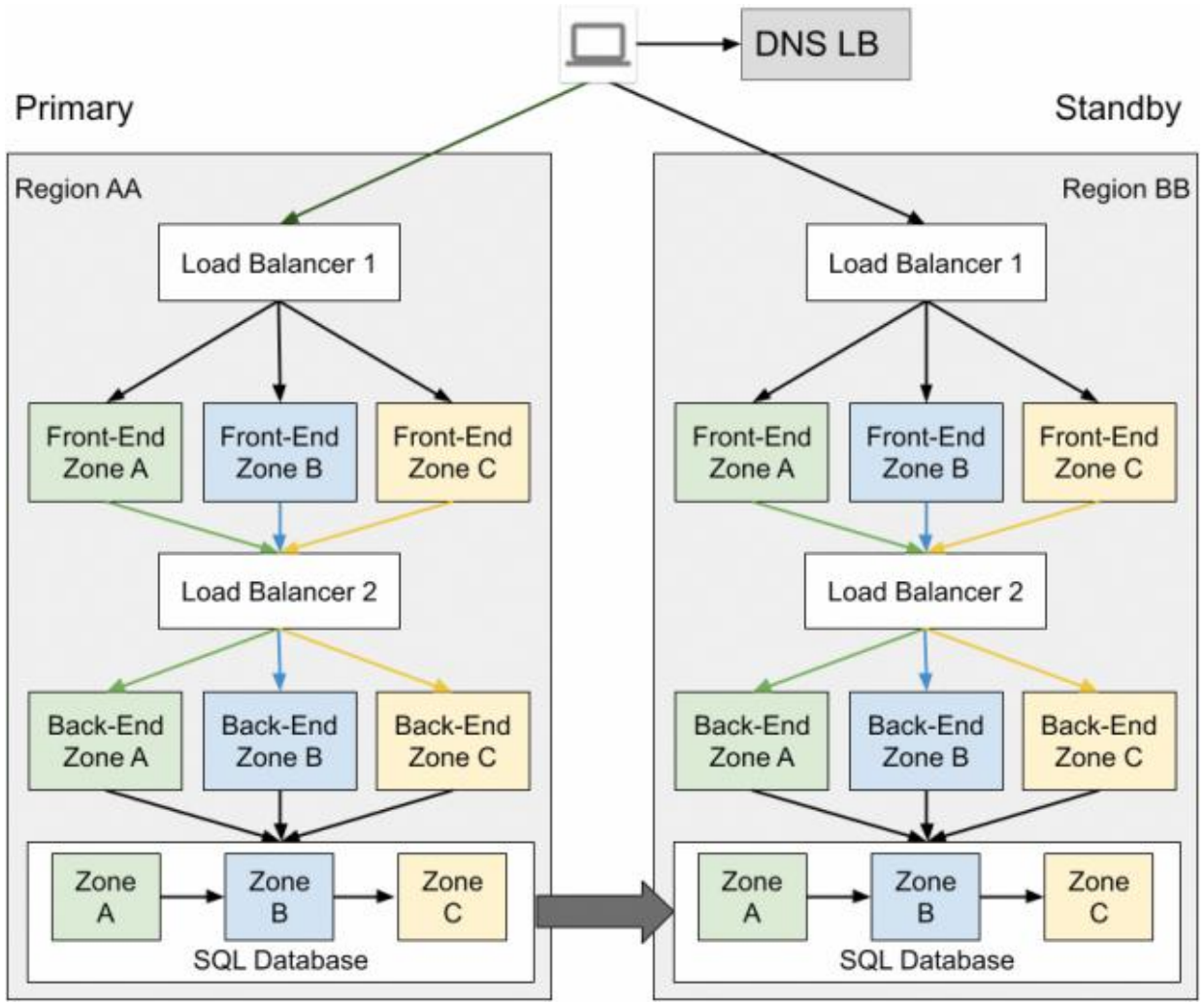
- **Deploy** all services of app to all three zones in one region
- **Data:** Use HA SQL
- Use **Global LB or Reg LB** with 3 backend groups
- **Survives zone** failure. Does not survive region failure.
- **Fail-Ops**: Initiate DB failover
- **Cost**: 1.5x serving + 2x data (HA SQL)
- **Complexity**: Medium
- **App Refactoring**: Low (multi instance)
- **Type**: Web services



Archetype 3.2

Active Passive Region

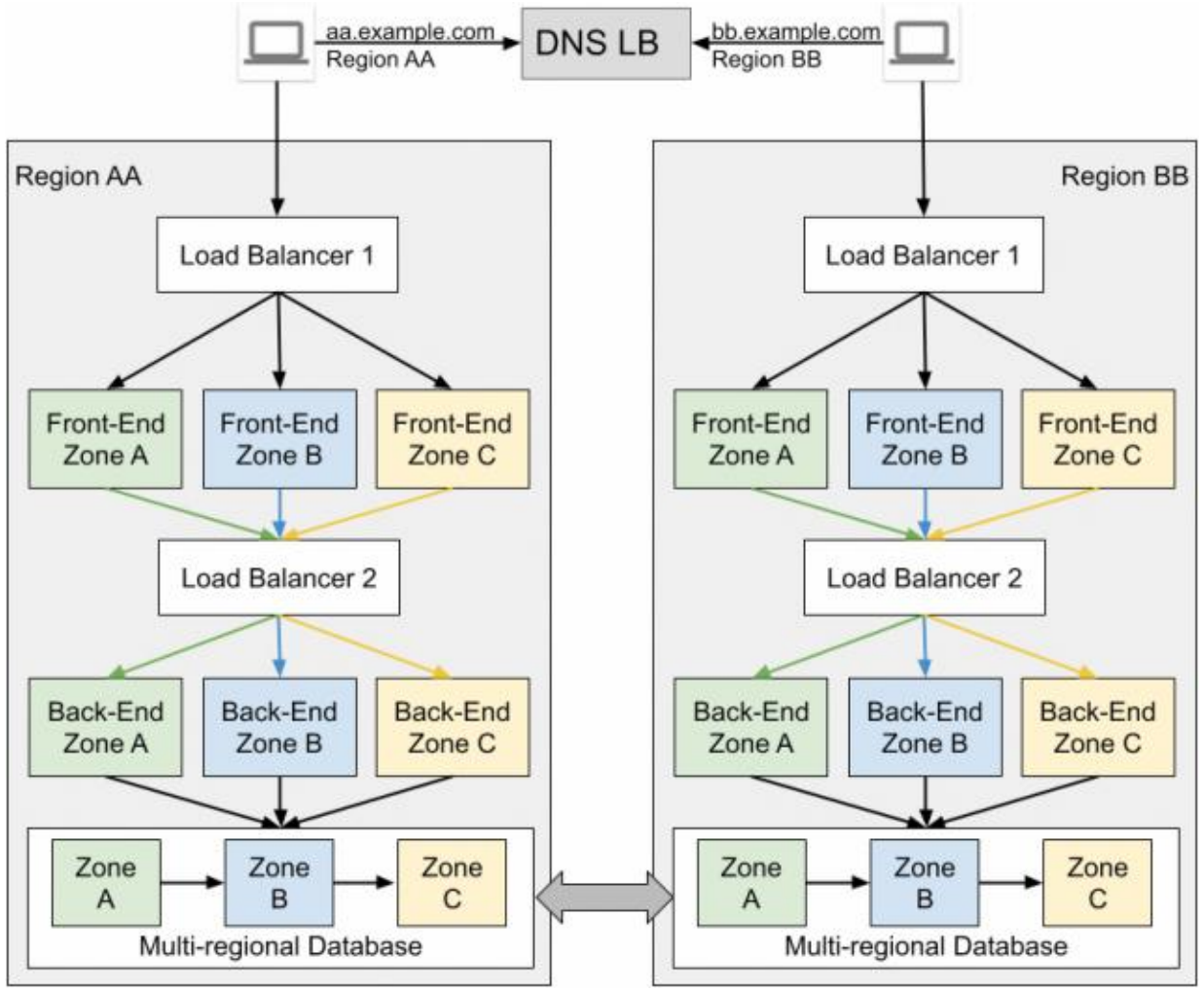
- **Deploy** all services of app to all three zones in each of two regions
- **Data:** SQL with cross-region replication
- **DNS** points at one LB (until disaster)
- **Survives zone and region** failures
- **Fail-Ops**: No action for zone failure.
  - Update DNS to point at standby LB
  - Cross region DR failover process for DB
- **Cost**: 3x serving + 2x data (HA SQL)
- **Complexity**: Medium
- **App Refactoring**: Medium (multi instance, multi regional data)
- **Type**: HA web services



Archetype 4.3

Isolated Regions

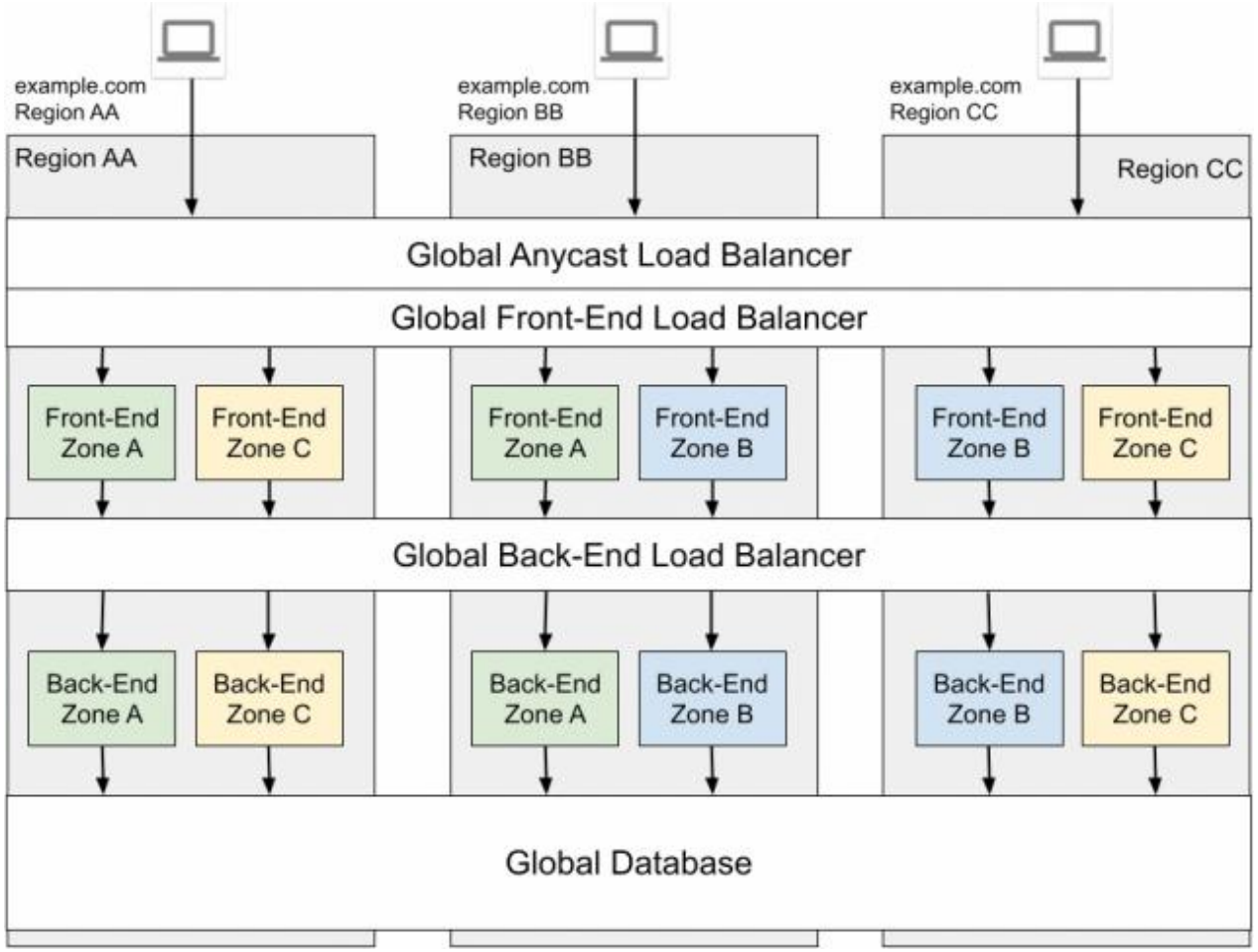
- **Deploy** all services of app to all three zones in each of two regions
- **Data:** Spanner or CockroachDB
- **DNS** points at two Regional LBs
- **Survives zone and region** failures. No impact for ½ consumers. Possible manual failover
- **Fail-Ops**: No action for zone failure. Optional regional failover like Arch 3.2
- **Cost**: 1.5 cost per region for zone failure
- **Complexity**: Medium/High
- **App Refactoring**: Medium (multi instance, multi regional data)
- **Type**: Regulated HA services



Archetype 5.2

Global

- **Deploy** all services of app to all three zones in each of two or more regions
- **Data:** Spanner or CockroachDB
- **Global LB** points at regional backend groups
- **Survives zone and region** failures
- **Fail-Ops**: None
- **Cost**: N+m cost modelling. Global DBs are more expensive
- **Complexity**: High
- **App Refactoring**: High (multi instance, global DBs)
- **Type**: Global consumer services



How to use Archetypes?

01

Services can be deployed to a **single archetype**

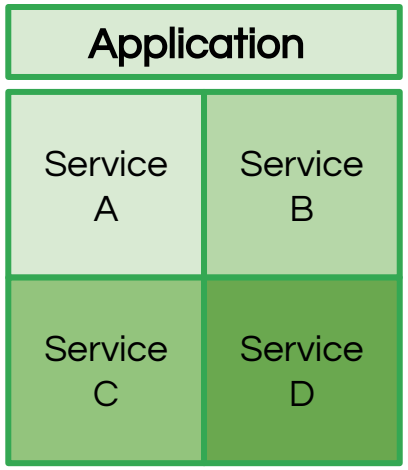
How to use Archetypes?

01

Services can be deployed to a **single archetype**

02

Application can use services across **multiple archetypes**



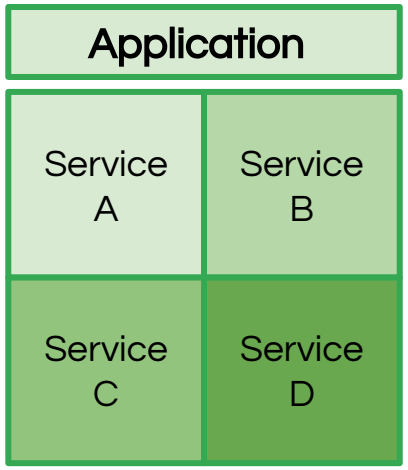
How to use Archetypes?

01

Services can be deployed to a **single archetype**

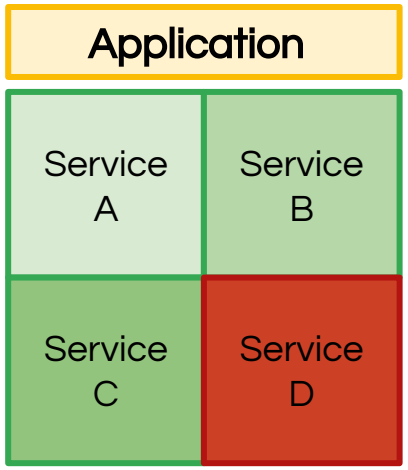
02

Application can use services across **multiple archetypes**



03

Applications should be designed for **graceful degradation**



SLOs and SLIs

SLOs in one slide

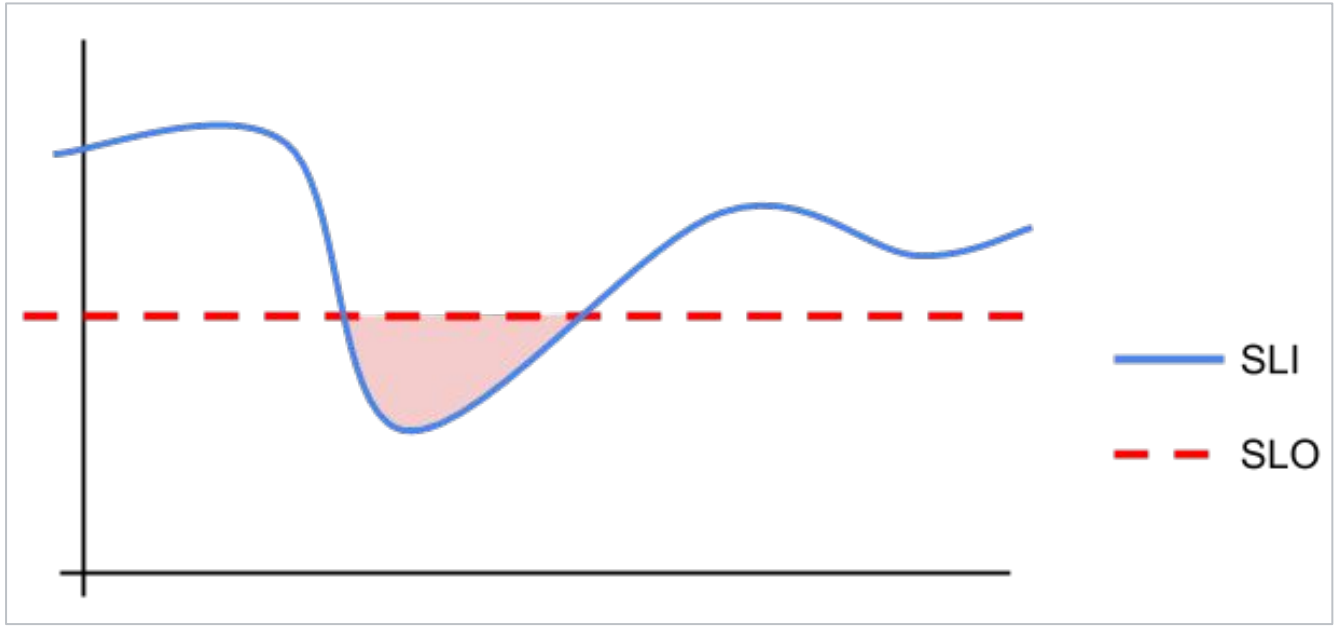
A **ratio-rate** of good/total, measured over a time duration.

If too much non-good, for too long, tell a human.

SLI is the squiggly line

SLO is the straight one

Area is time **exceeding SLO**



SLI

Quantitative measure of some aspect of the level of service

aka

latency, throughput, availability

from Google SRE Handbook

SLI

Quantitative measure of some aspect of the level of service

aka

latency, throughput, availability

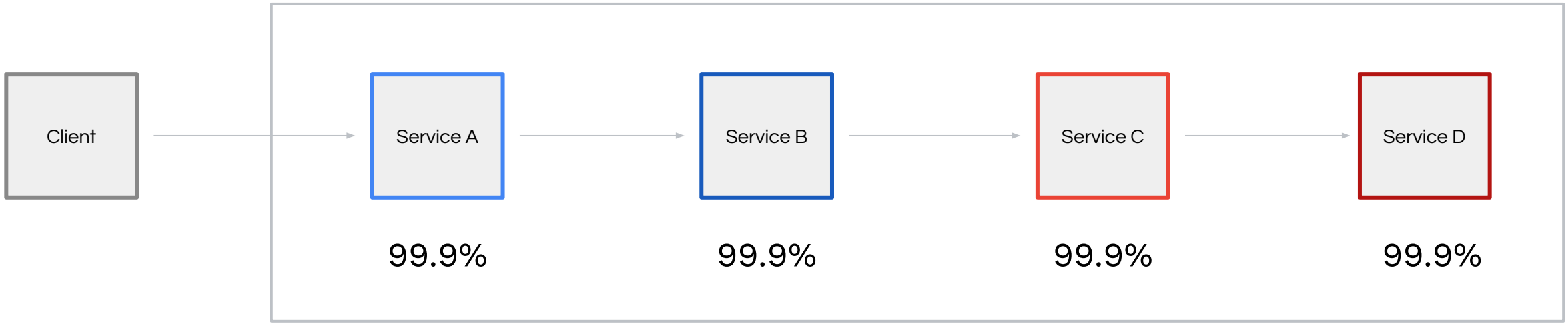
SLO

a target value or range of values for a service level that is measured by an SLI

aka

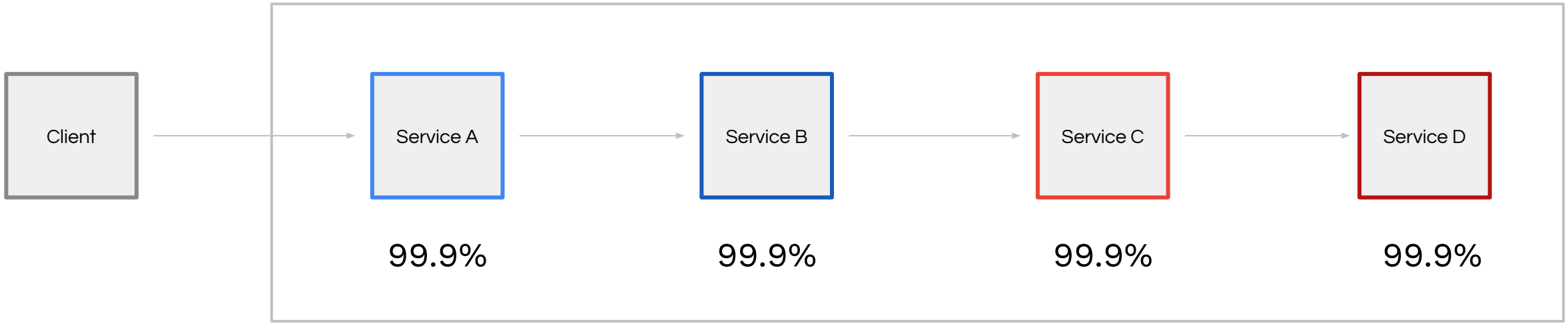
99% of Get RPC calls will complete in less than 100 ms

from Google SRE Handbook



from Steve McGhee's SLO Conf 2021 Talk

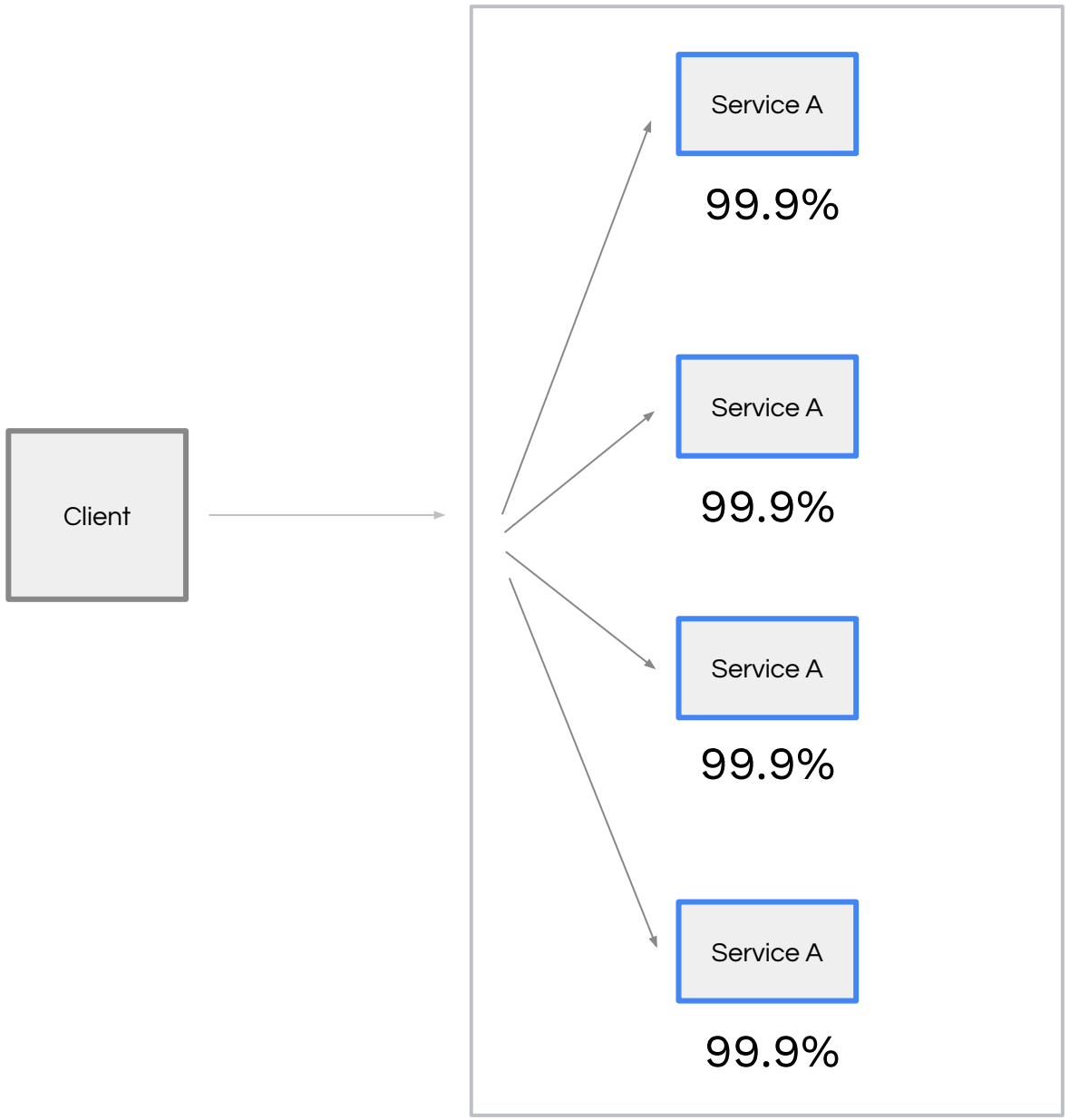
Intersection (or serial)



0.999 x 0.999 x 0.999 x 0.999

99.6% SLO

from Steve McGhee's SLO Conf 2021 Talk



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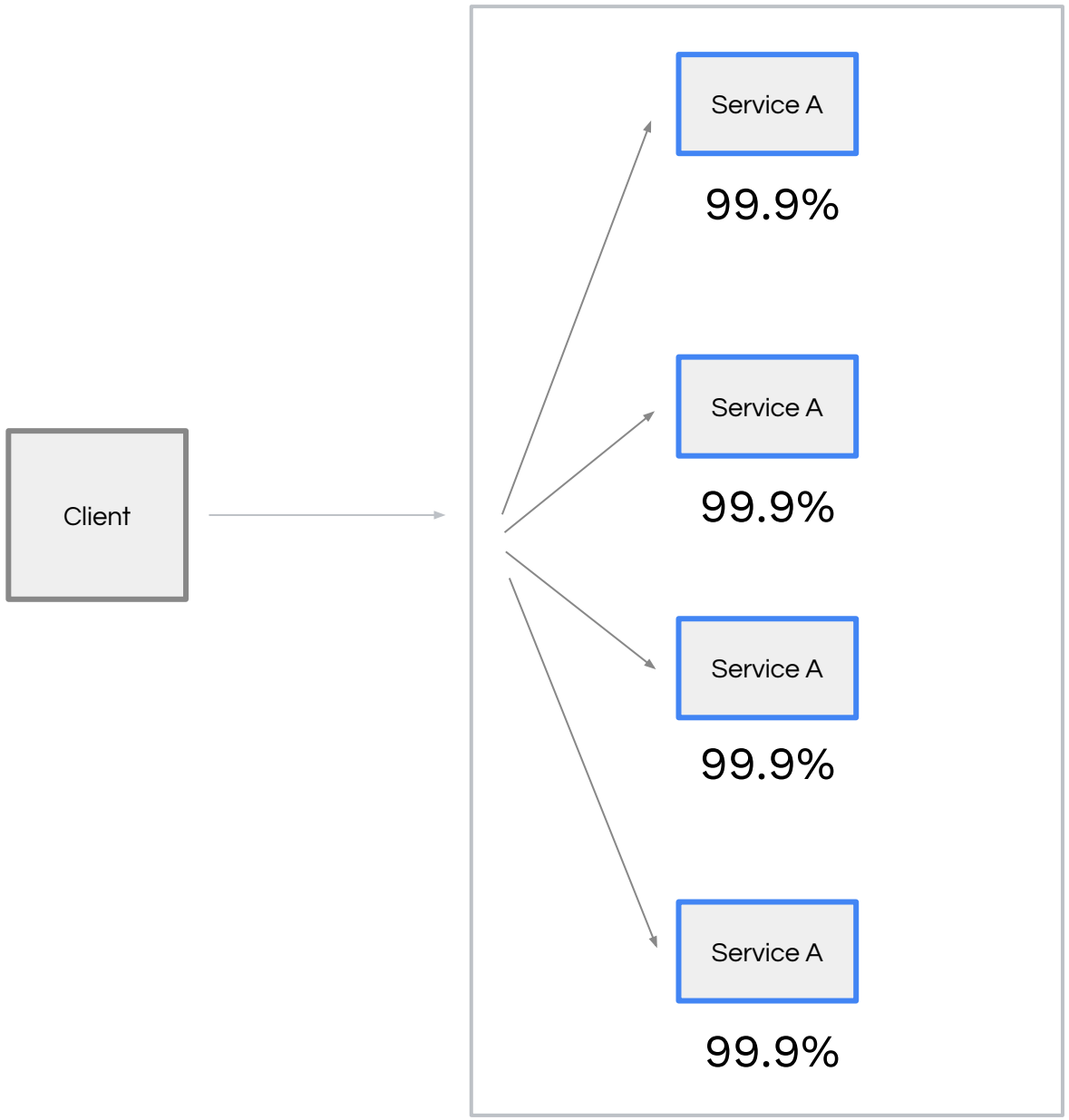


Union (aka parallel)

$1 - (0.001)^{4}$

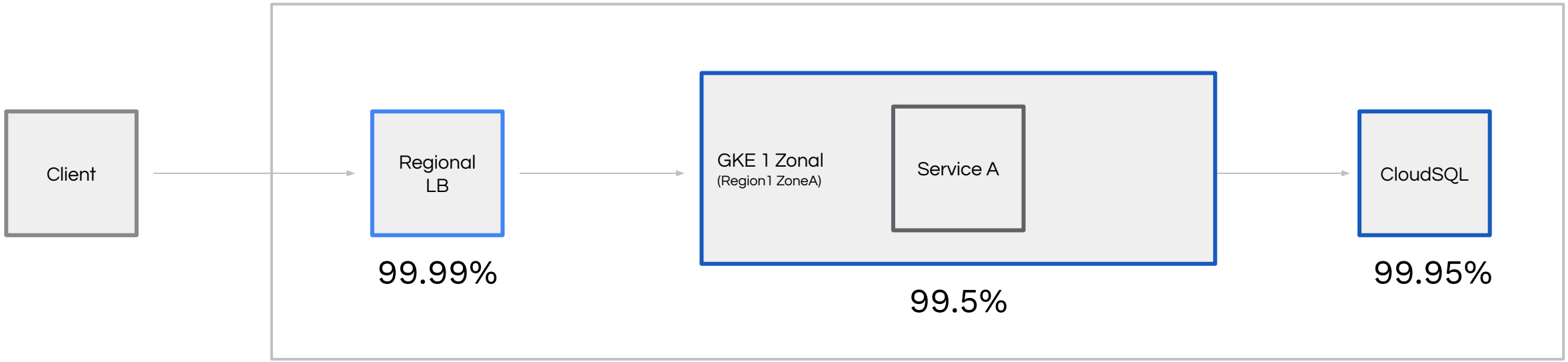
99.999999999% SLO

or 11 nines

This is strictly mathematical and does not include any dependent variables like network, LBs, capacity planning, connectivity, and other dependent services

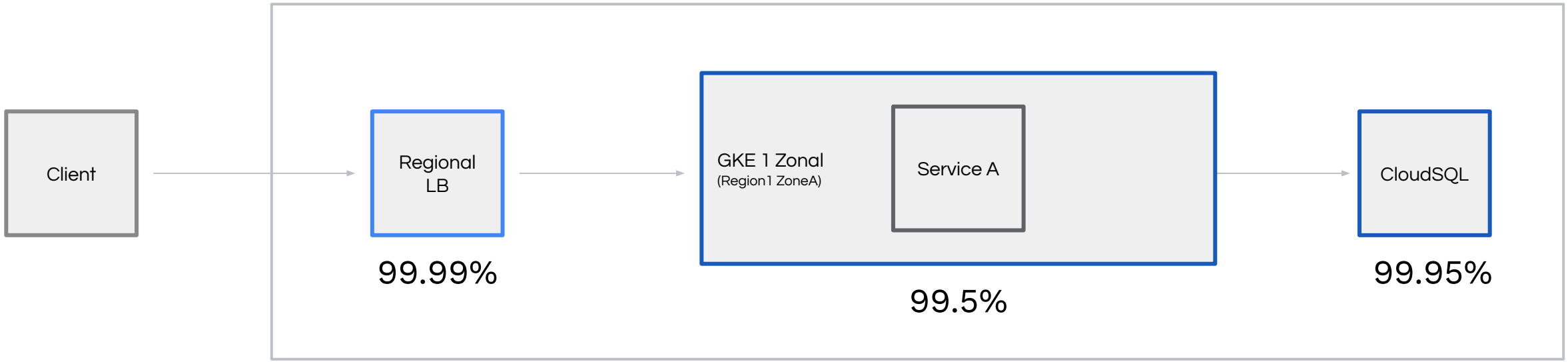
Building Reliable Platforms on Kubernetes

Archetype 2.1 Single zonal GKE cluster with Cloud SQL



GCP SLAs

Archetype 2.1 Single zonal GKE cluster with Cloud SQL



0.9999 x 0.995 x 0.9995

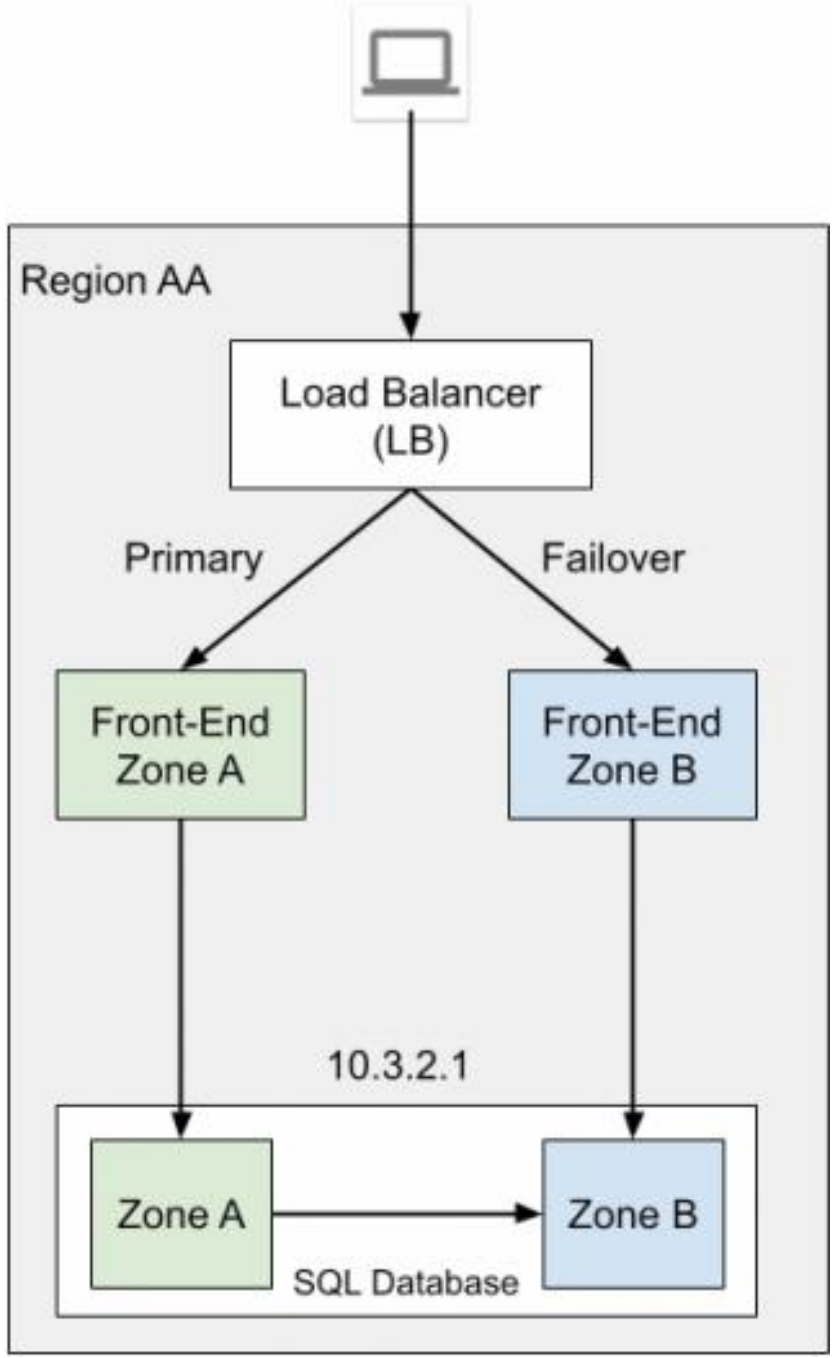
99.44% LIMIT

GCP SLAs

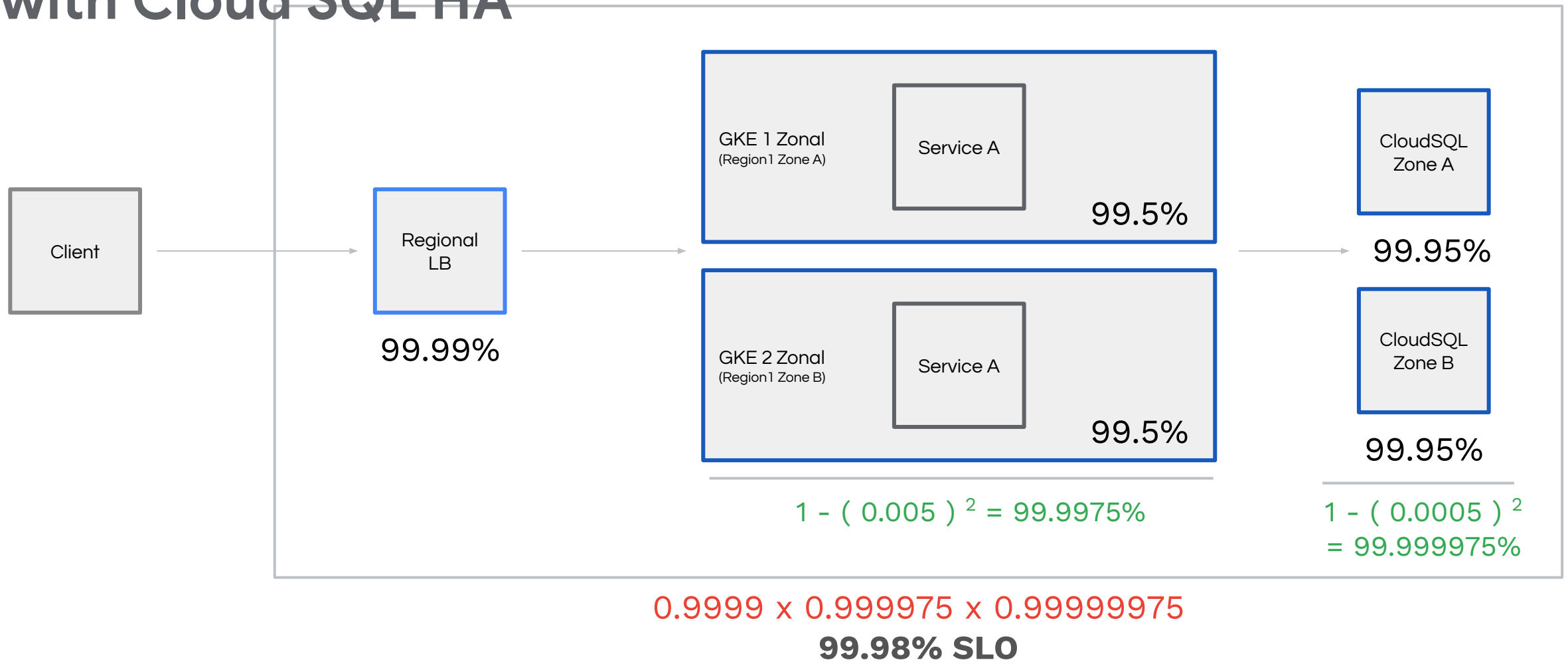
Archetype 2.2

Active Passive Zones

- **Deploy** all services of app to two zones in one region
- **Data** in Cloud SQL with a read replica
- **L4 LB** with one backend group
- **Survives zone** failure. Does not survive region failure.
- **Fail-Ops**: Change LB backend, promote read replica
- **Cost**: 2x serving + 2x data (1 replica)

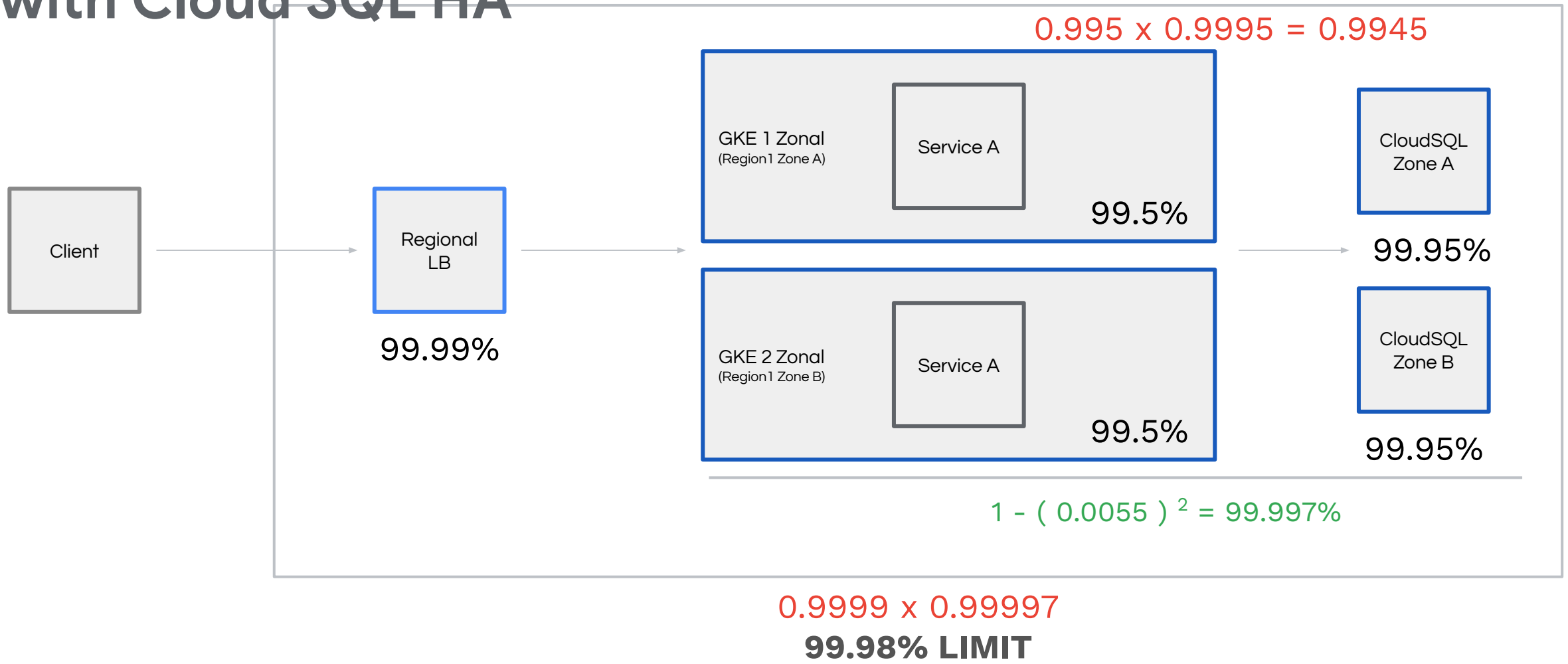


Archetype 2.2 Active Passive Zone with Cloud SQL HA



GCP SLAs

Archetype 2.2 Active Passive Zone with Cloud SQL HA

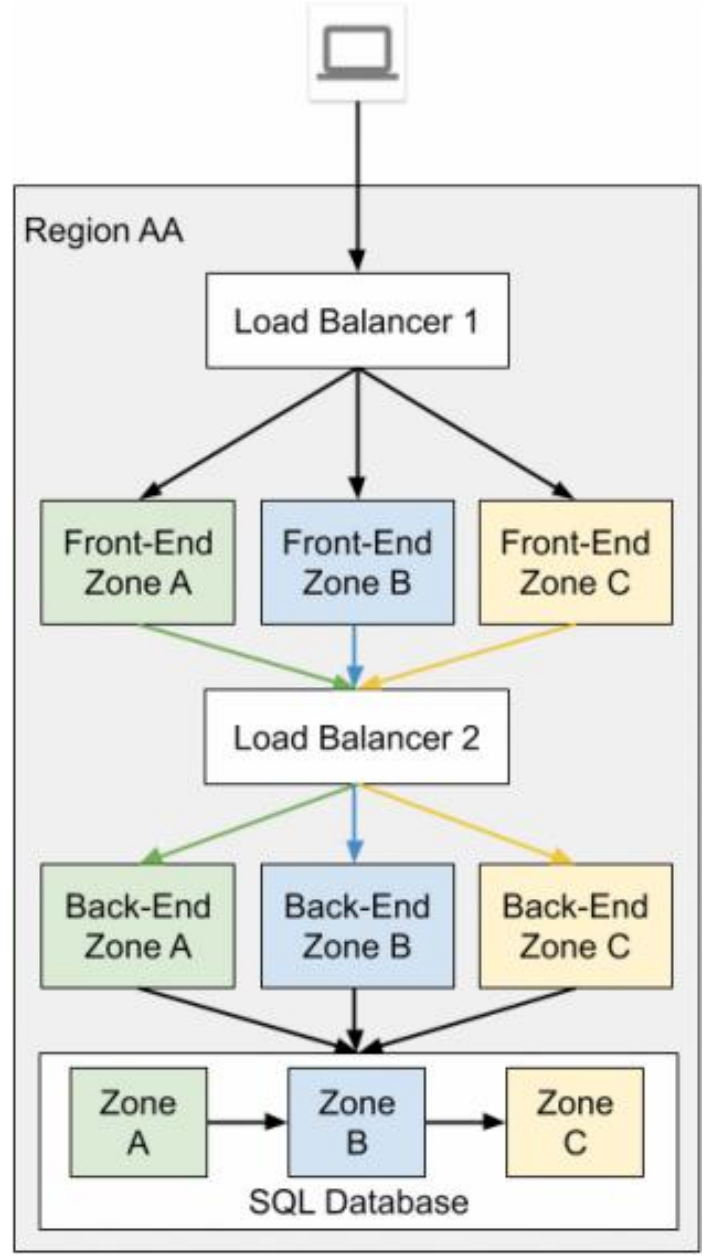


GCP SLAs

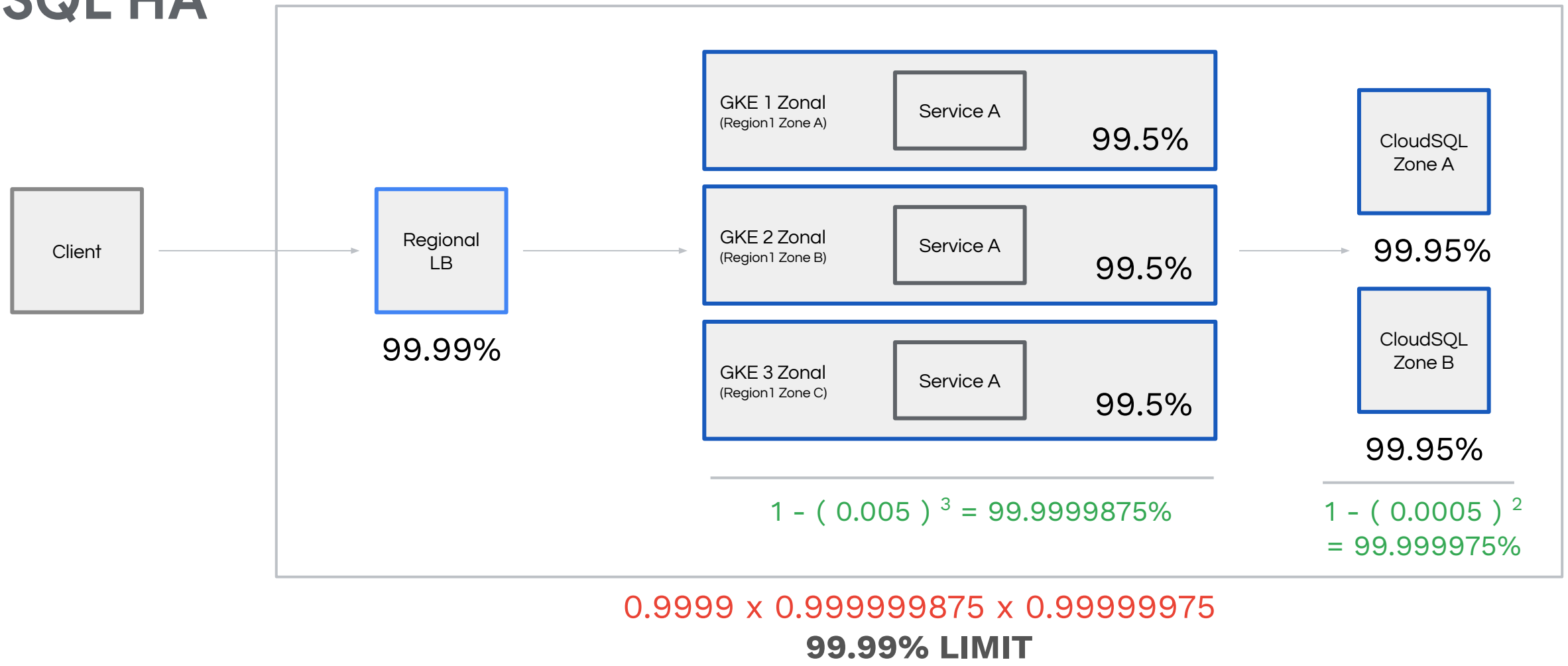
Archetype 3.1

Multi Zonal

- **Deploy** all services of app to all three zones in one region
- **Data:** Use HA Cloud SQL
- Use **GLB or RLB** with 3 backend groups
- **Survives zone** failure. Does not survive region failure.
- **Fail-Ops**: Initiate DB failover (testable)
- **Cost**: 1.5x serving + 2x data (SQL HA)



Archetype 3.1 Multi Zonal with Cloud SQL HA

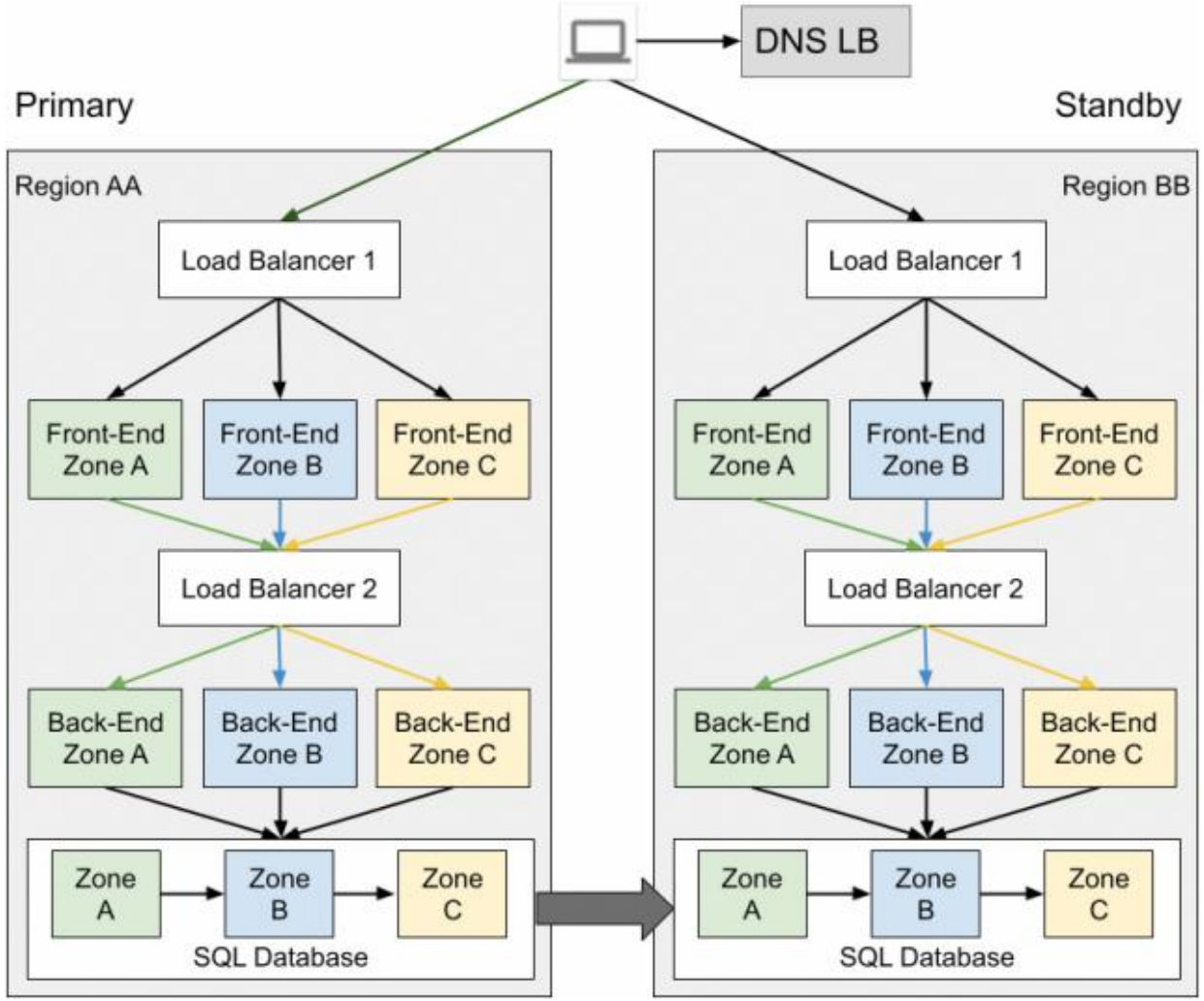


GCP SLAs

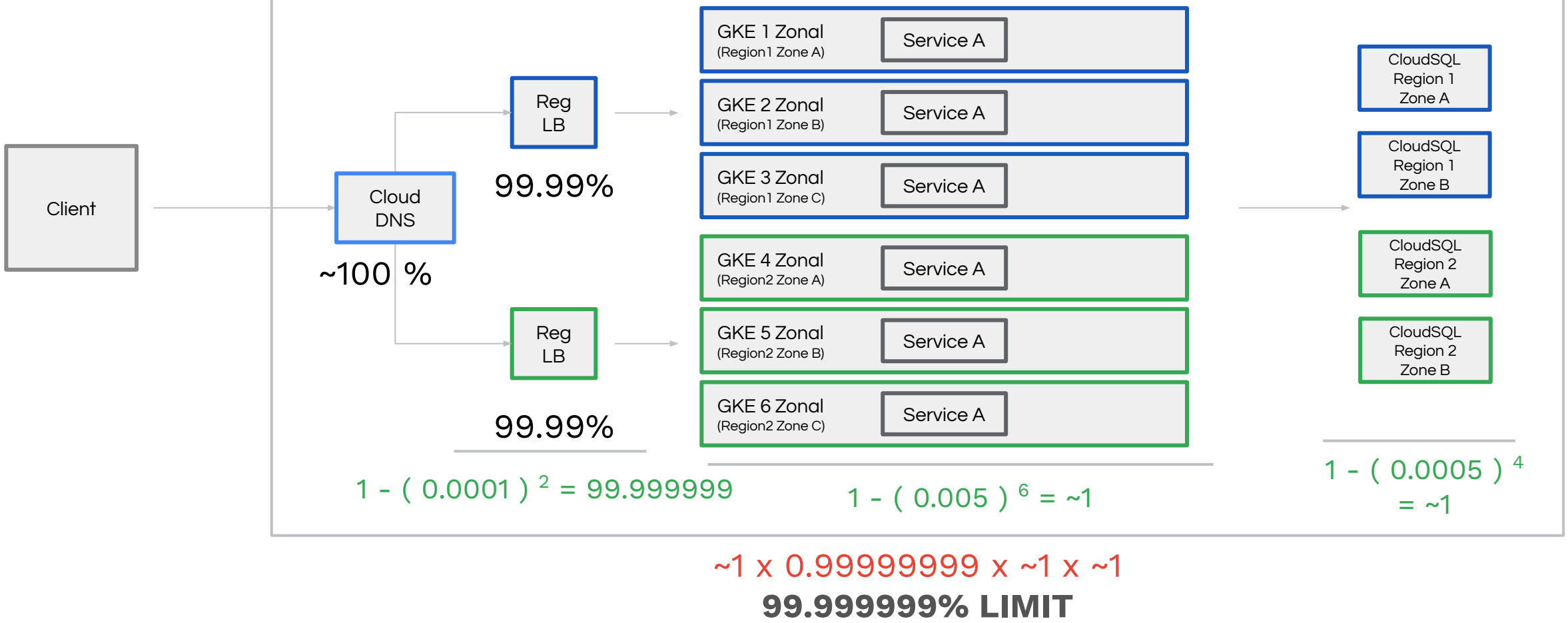
Archetype 3.2

Active Passive Region

- **Deploy** all services of app to all three zones in each of two regions
- **Data:** Cloud SQL with cross-region replication
- **Cloud DNS** points at one LB (until disaster)
- **Survives zone and region** failures
- **Fail-Ops**: No action for zone failure.
  - Update DNS to point at standby LB
  - Cross region DR failover



Archetype 3.2 Active Passive Regions with Cloud SQL HA



~1 x 0.99999999 x ~1 x ~1

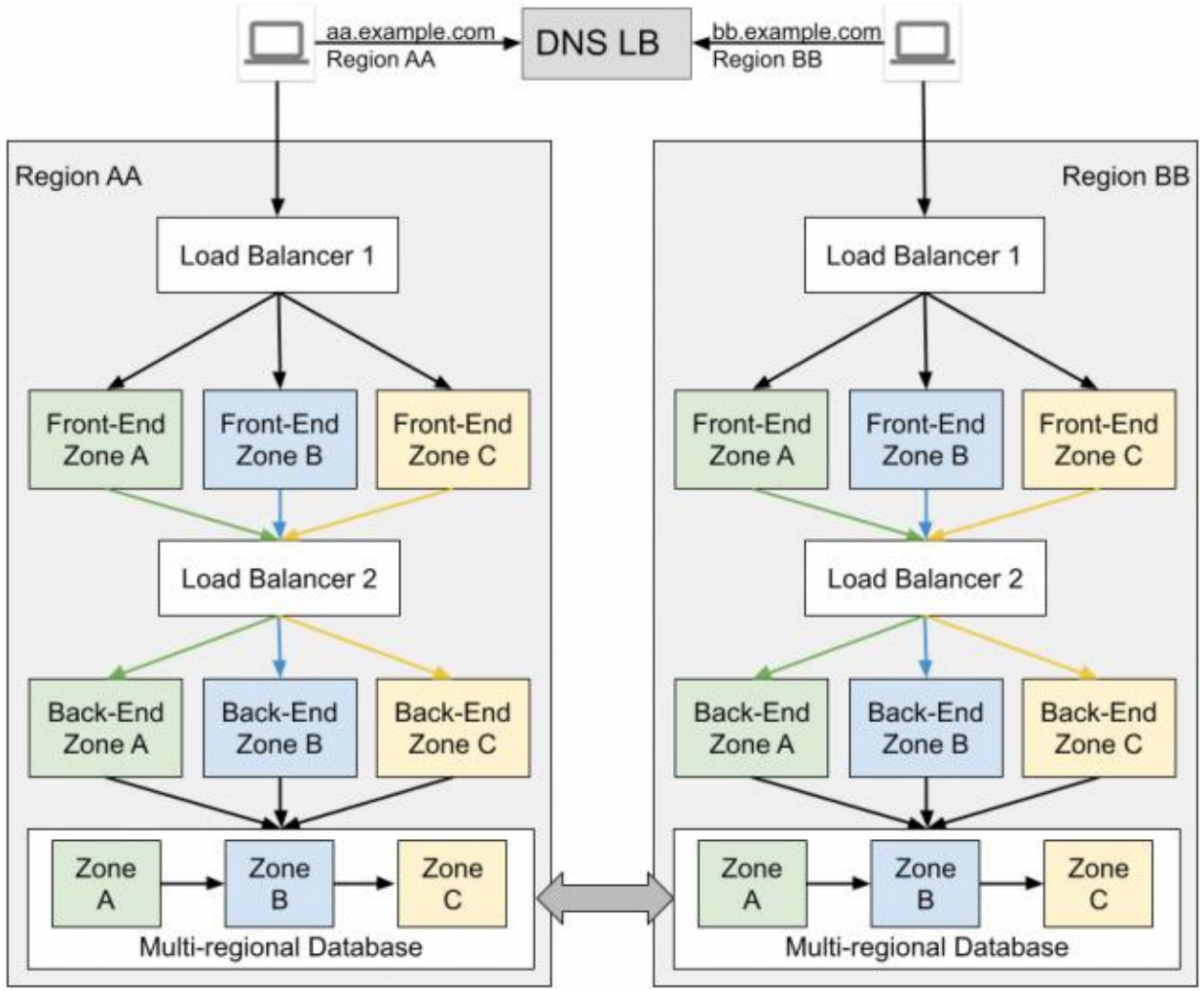
99.999999% LIMIT

GCP SLAs

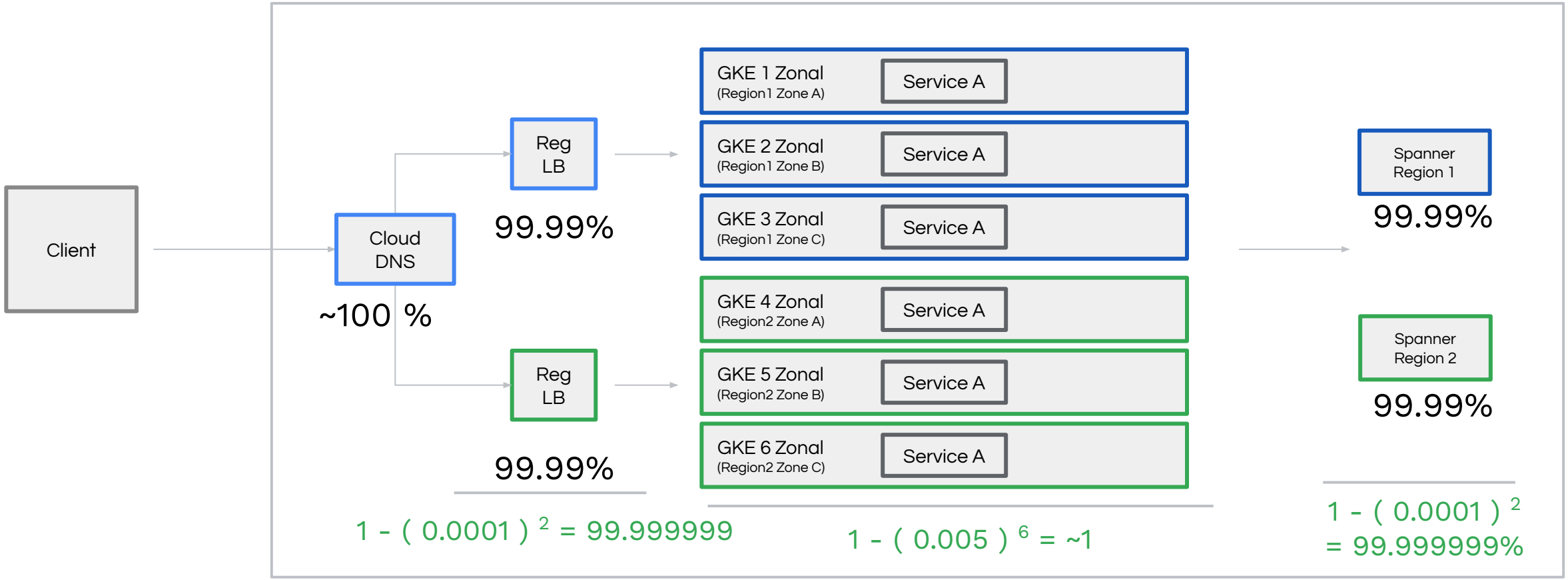
Archetype 4.3

Isolated Regions

- **Deploy** all services of app to all three zones in each of two regions
- **Data:** Spanner or CockroachDB
- **Cloud DNS** points at two Regional LBs
- **Survives zone and region** failures. No impact for ½ consumers. Possible manual failover
- **Fail-Ops**: No action for zone failure. Optional regional failover like Arch 3.2
- **Cost:** 1+½ cost for zone failure



Archetype 4.3 Isolated Regions with Cloud Spanner



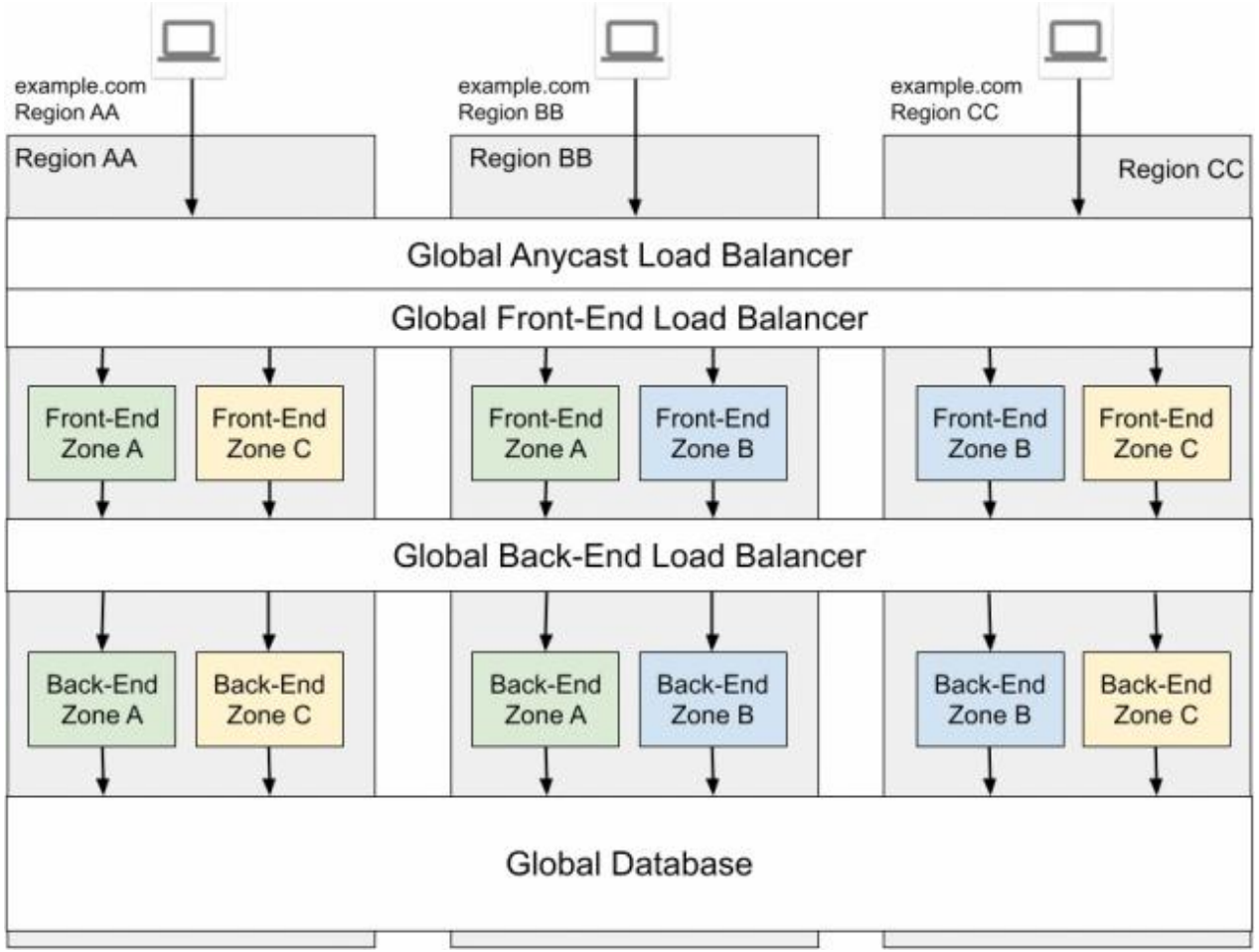
~1 x 0.99999999 x ~1 x 0.99999999

99.999998% LIMIT

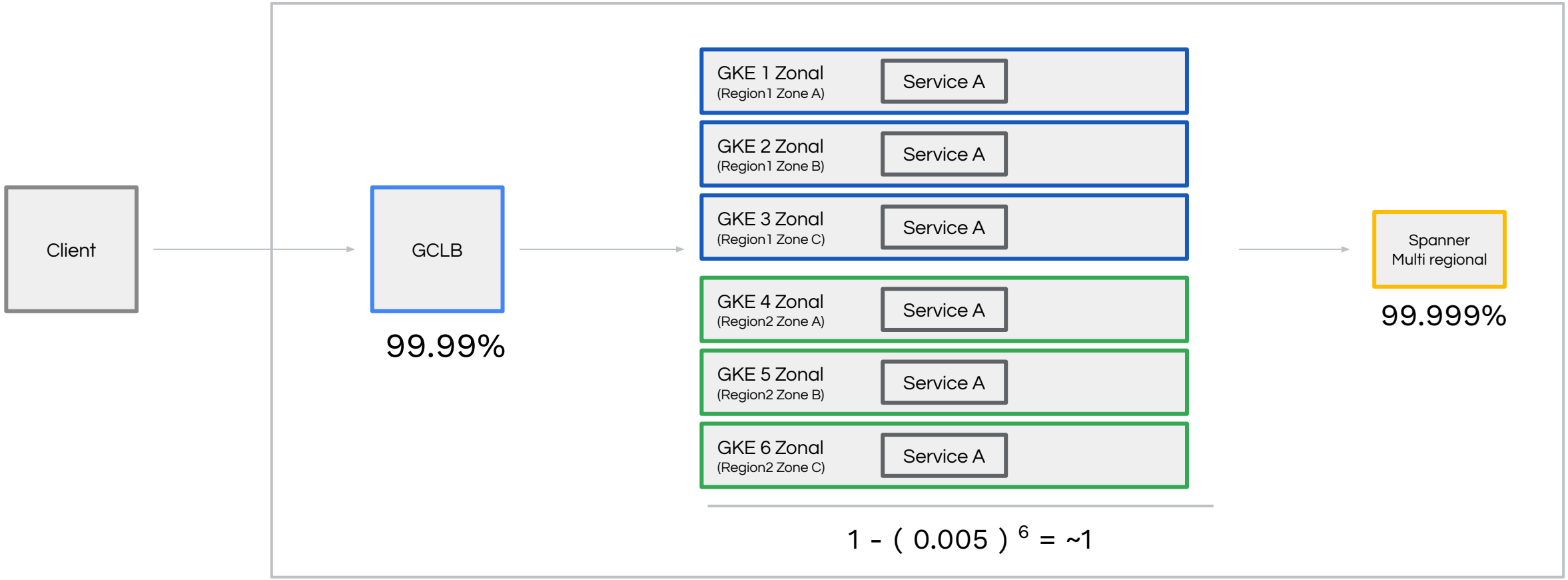
GCP SLAs

Archetype 5.2
Global

- **Deploy** all services of app to all three zones in each of two or more regions
- **Data:** Spanner or CockroachDB
- **Global LB** points at regional backend groups
- **Survives zone and region** failures
- **Fail-Ops**: None
- **Cost**: N+m cost modelling. Global DBs are more expensive
- **Complexity**: High



Archetype 5.2 Global with Cloud Spanner (Multi regional)

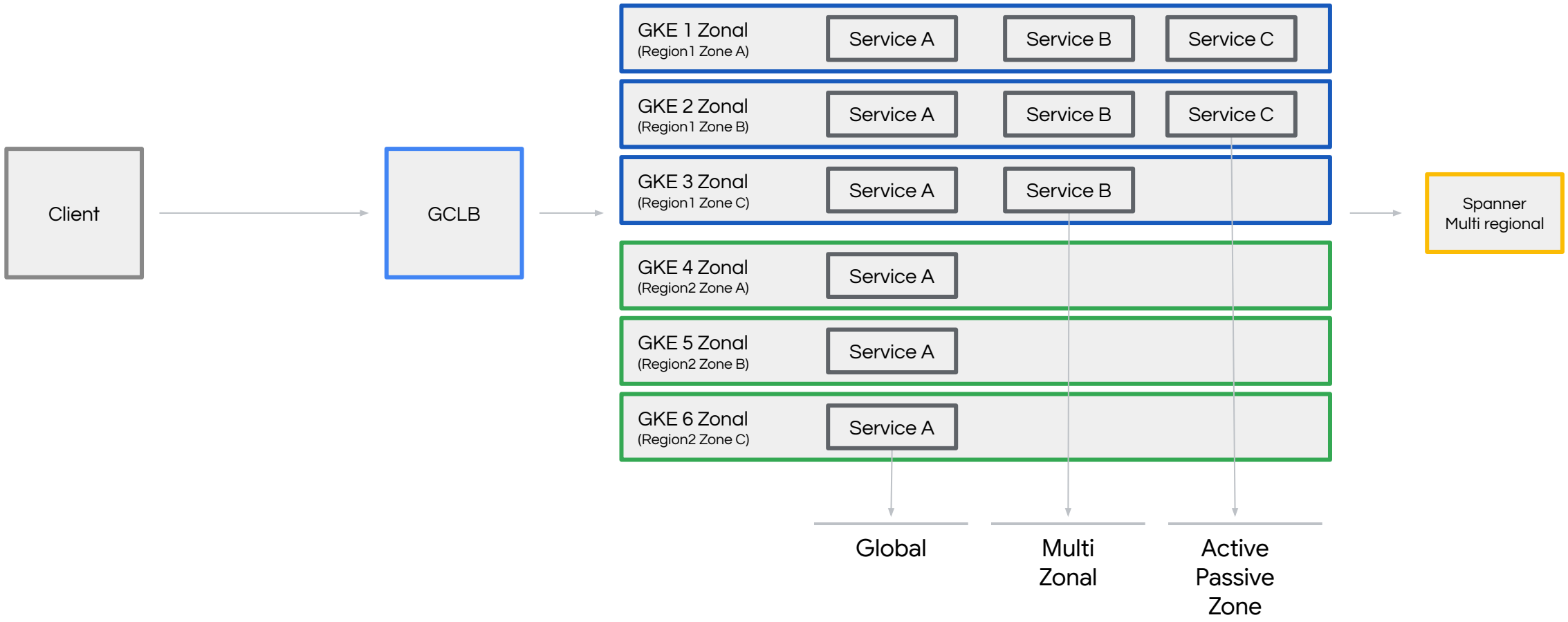


0.9999 x 1 x 0.99999

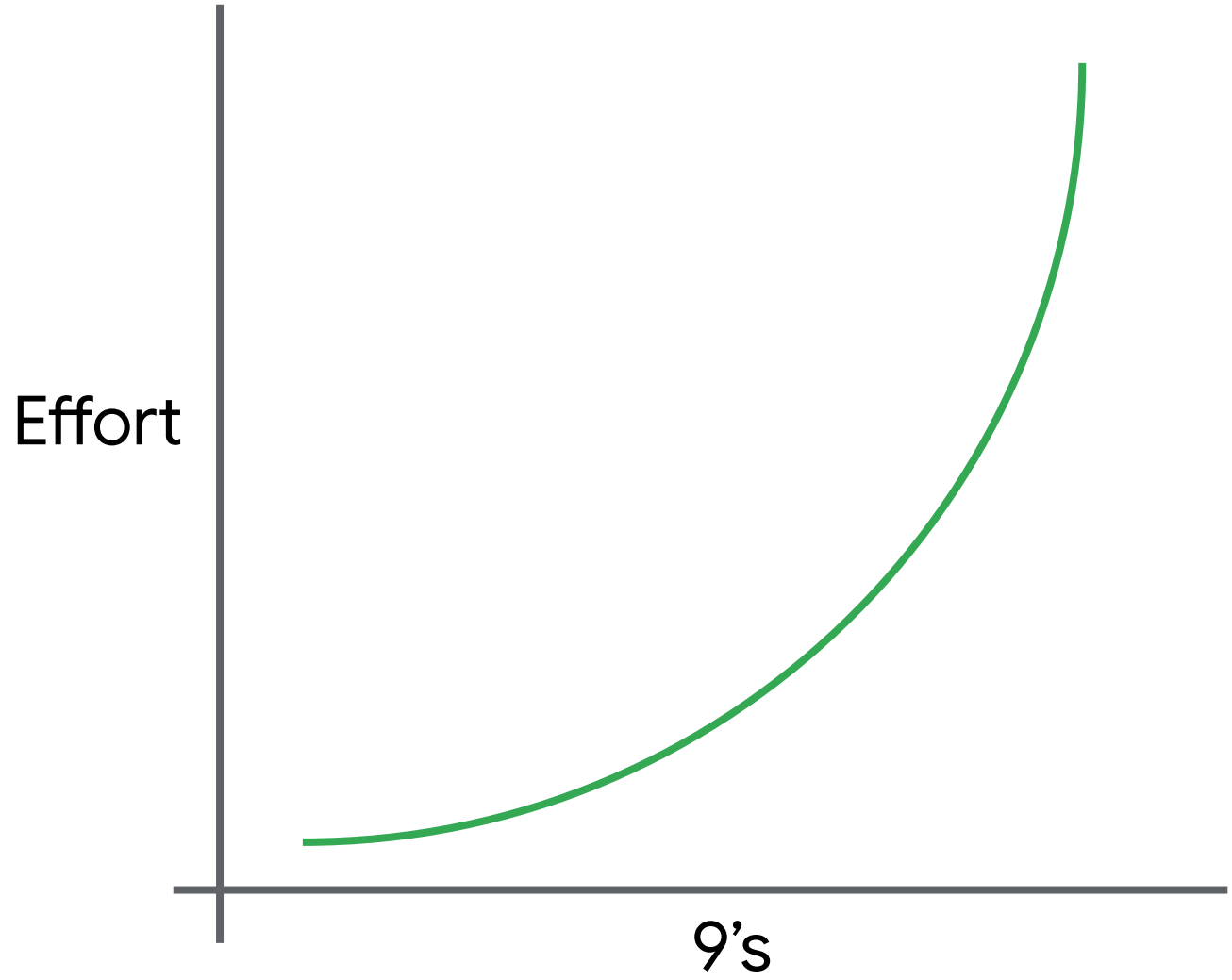
99.99% LIMIT

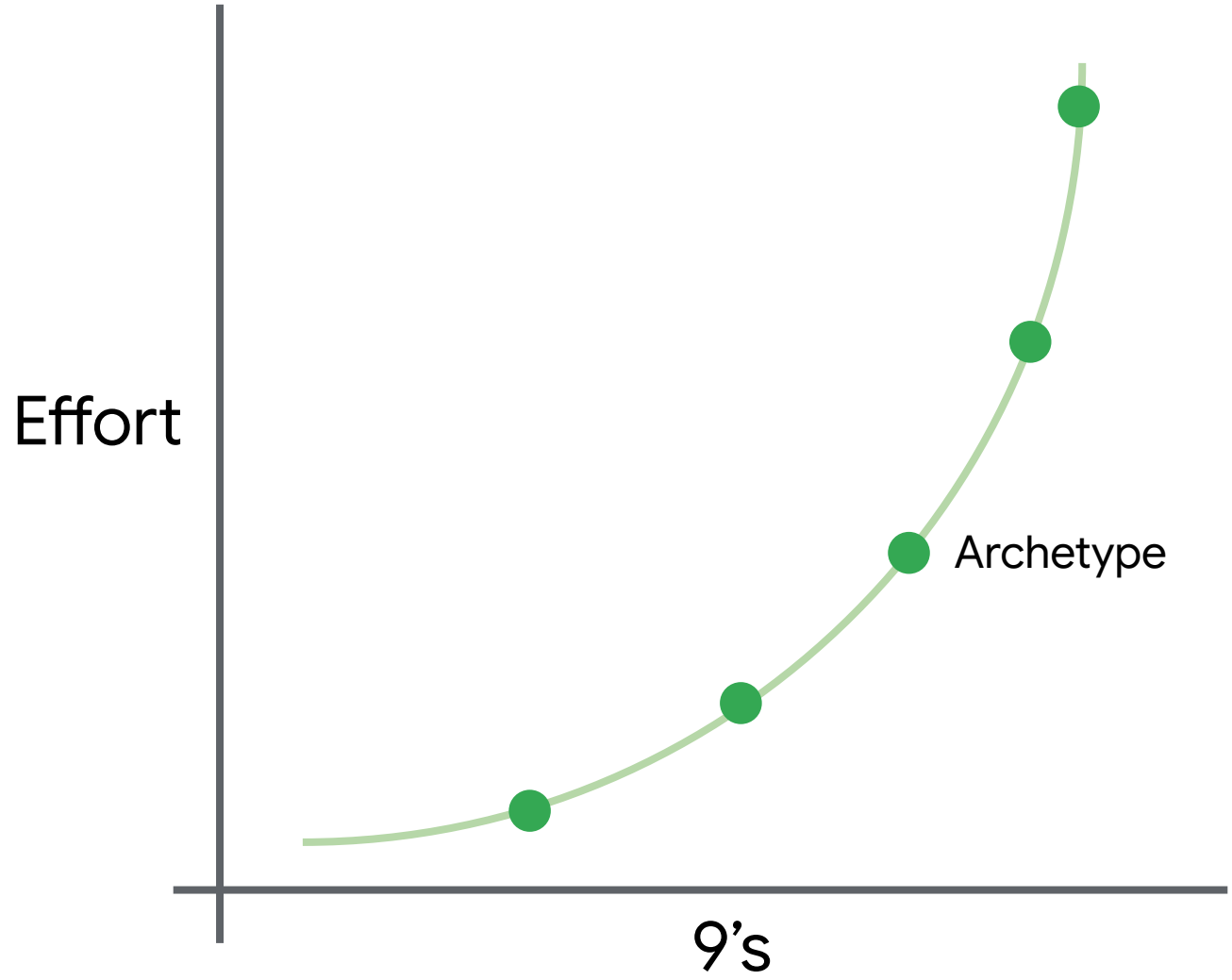
GCP SLAs

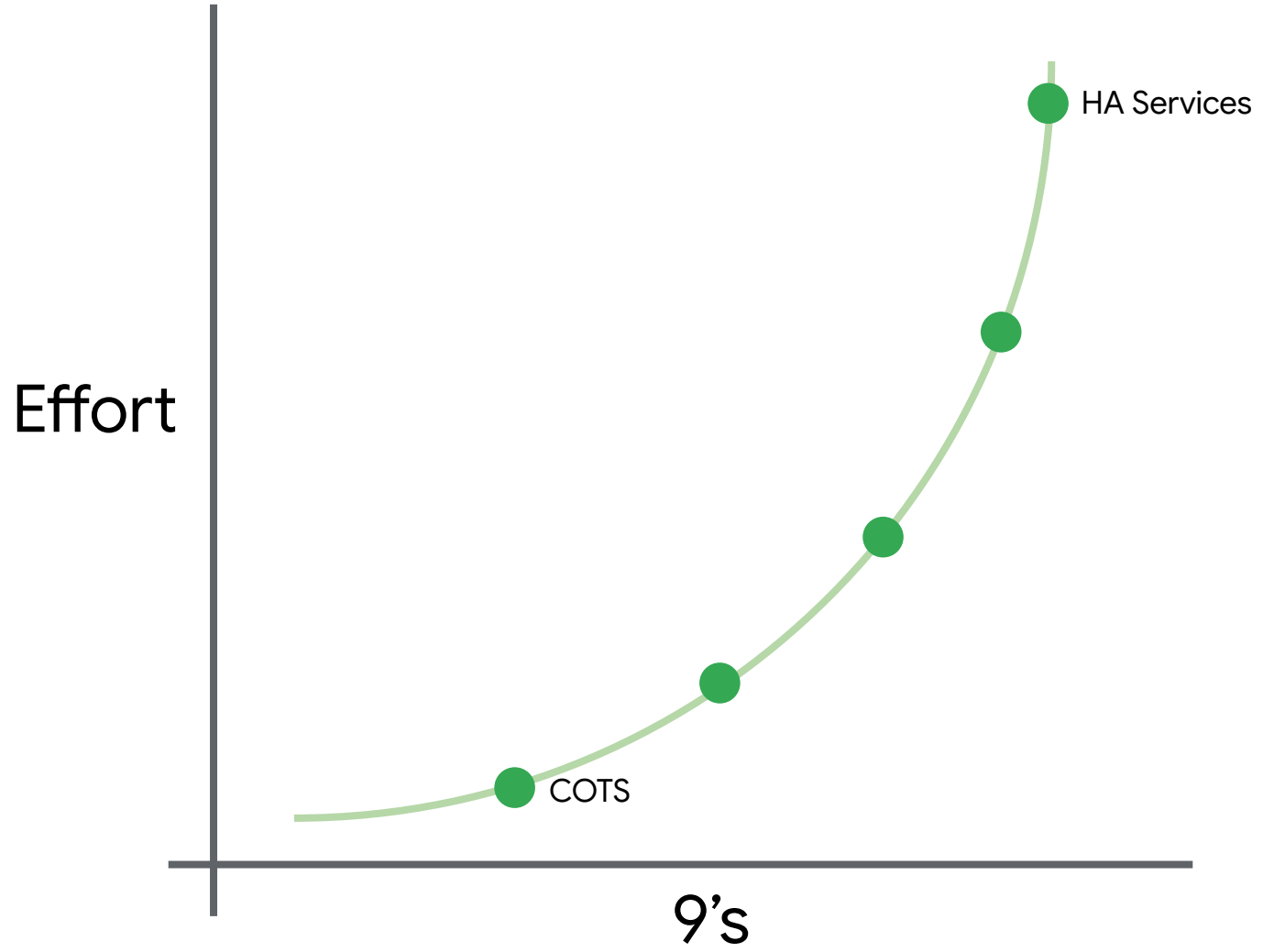
Application with Services using multiple Archetypes

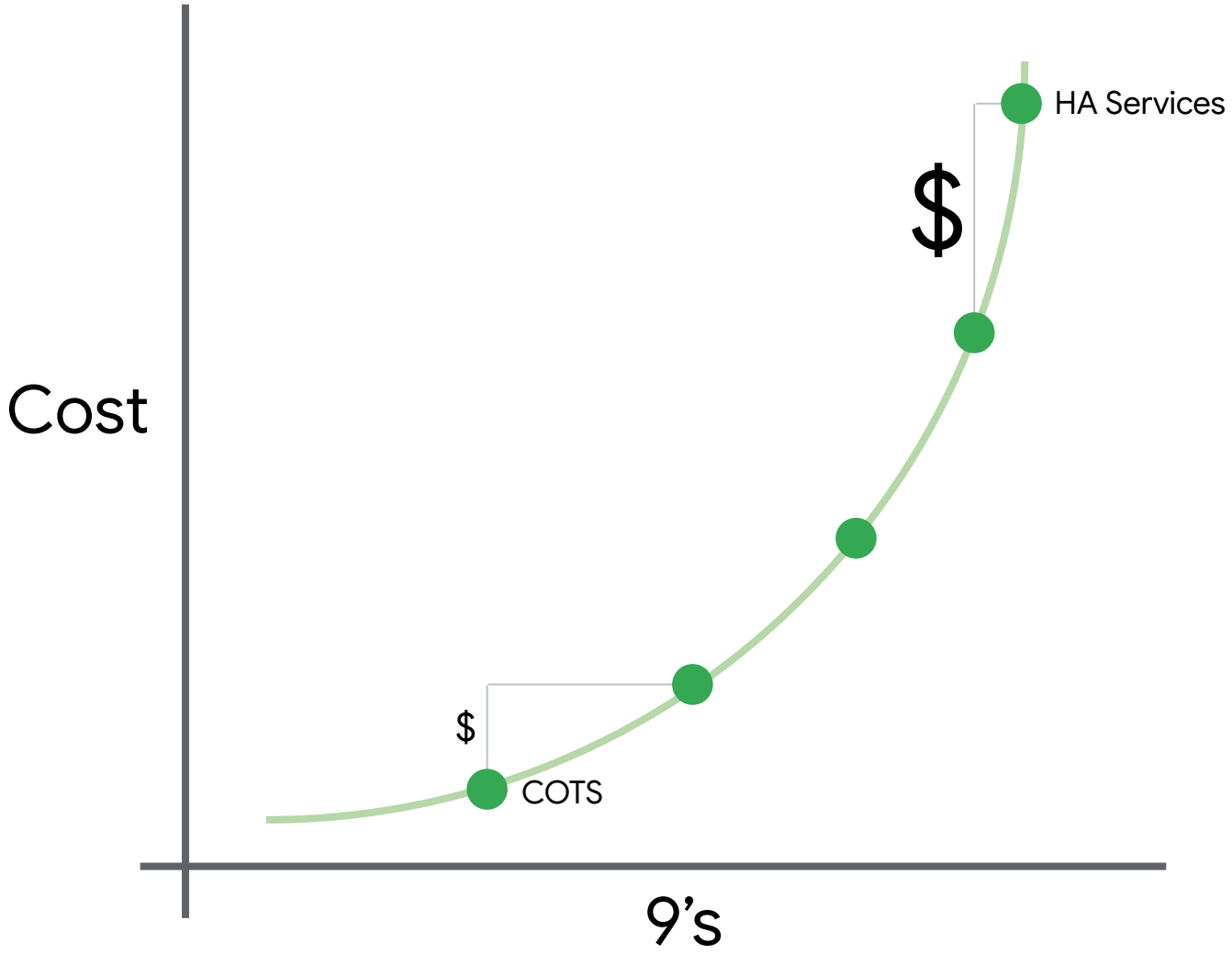


GCP SLAs


Effort
9’s


Effort
Archetype
9’s


Effort
HA Services
COTS
9's


Cost
9's
HA Services
$
$
COTS

Conclusions

- Start with **Archetypes**
- Compose **Services into Applications** that can **degrade gracefully**
- Develop **resilient teams**
  robust platforms
  reliable products

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