

JESSICA TAI / MARCH 4, 2019 / QCON LONDON

Airbnb's Great Migration: Building Services at Scale



2014



@jessicantai

2015+



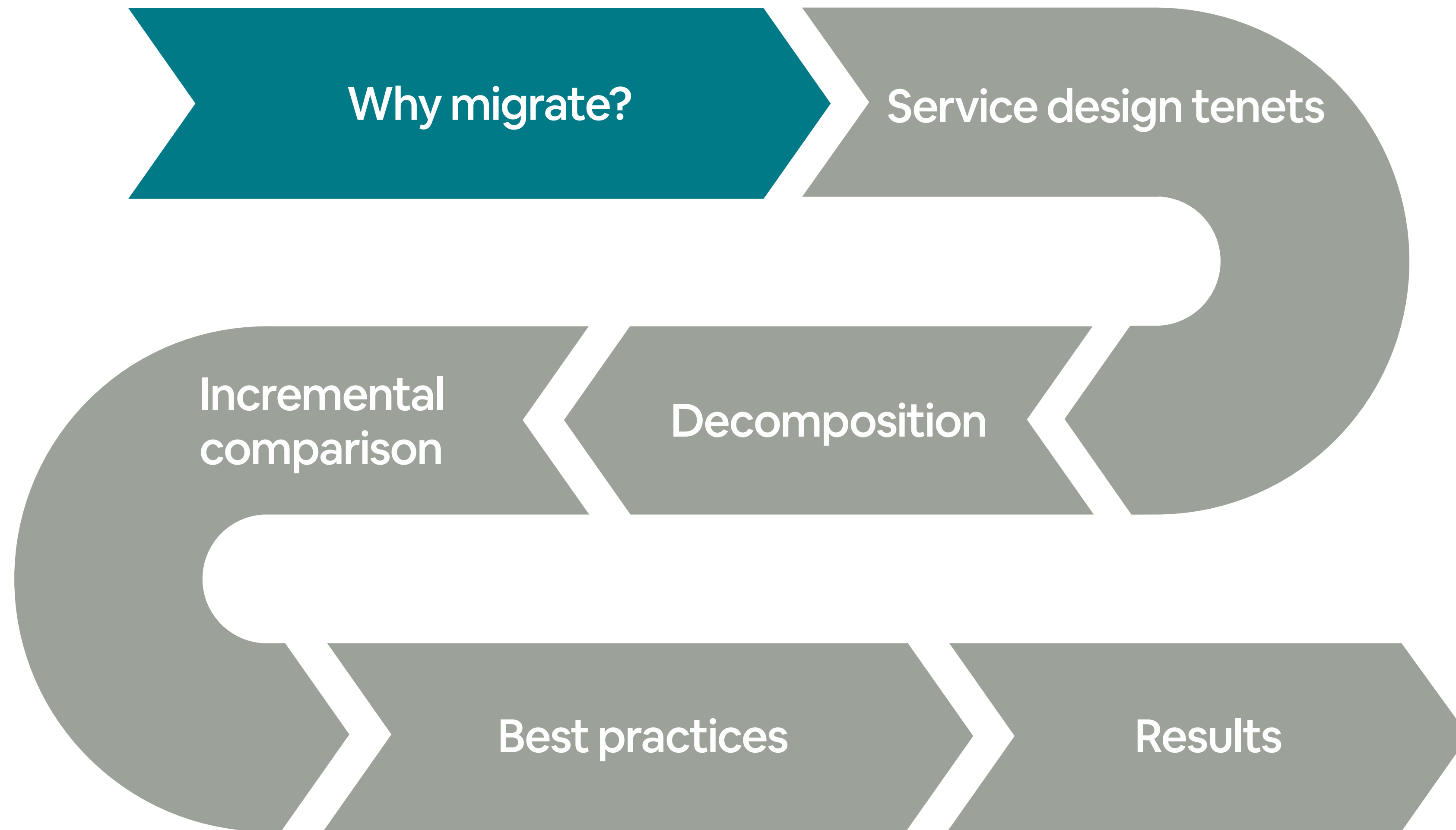
@jessicantai

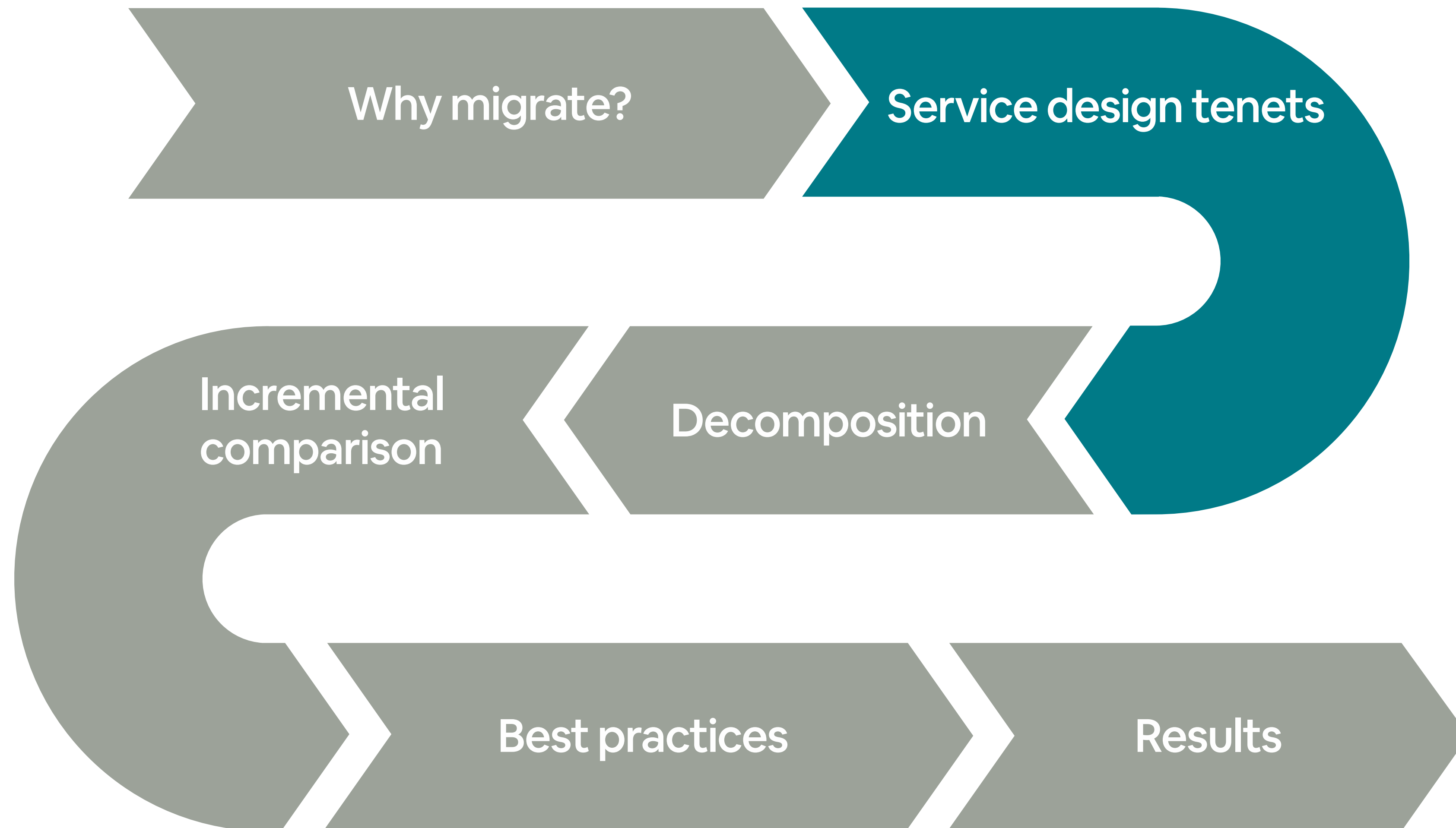
Hi, I'm Jessica.

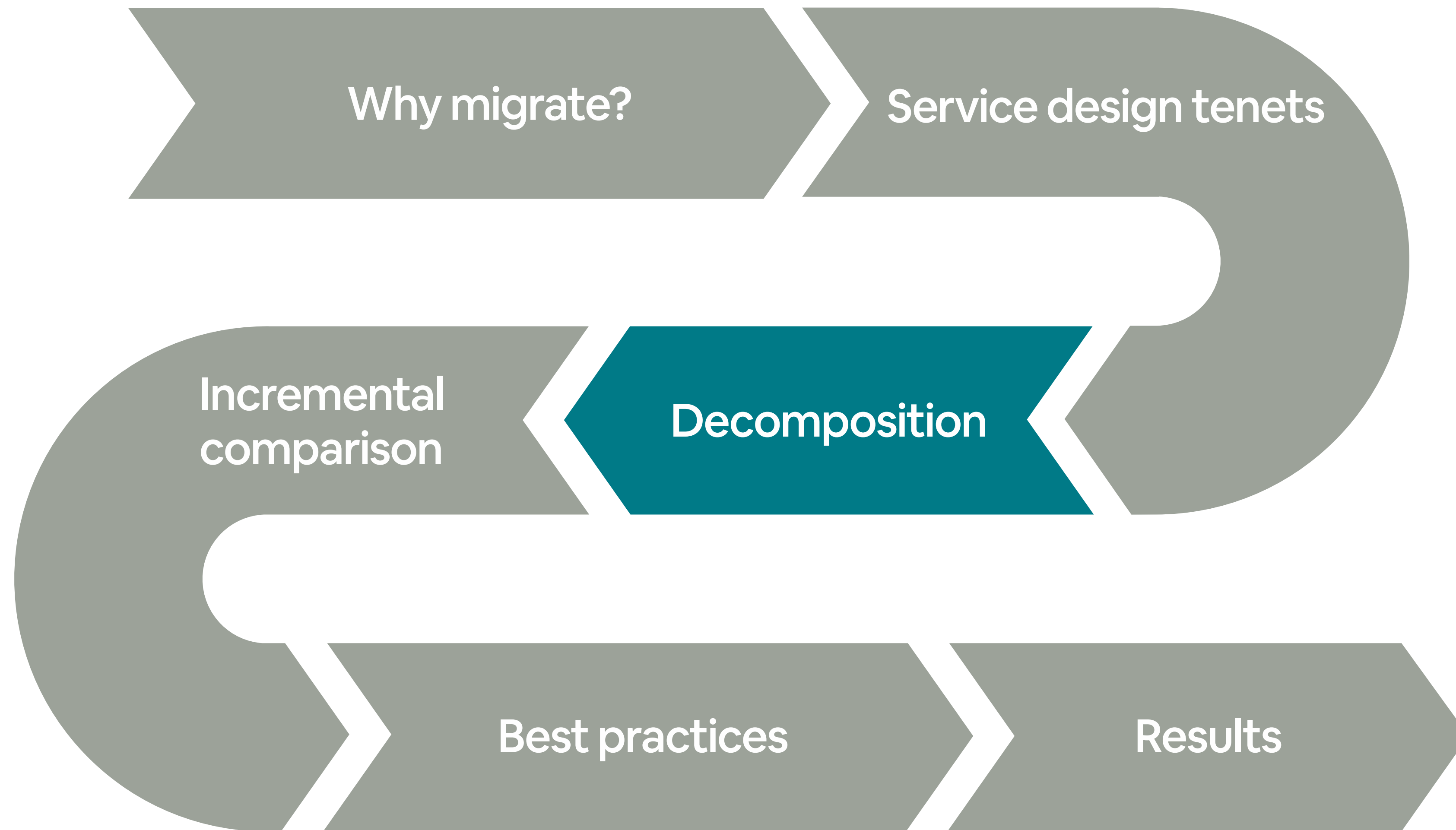
**I pair program
with my corgi.**

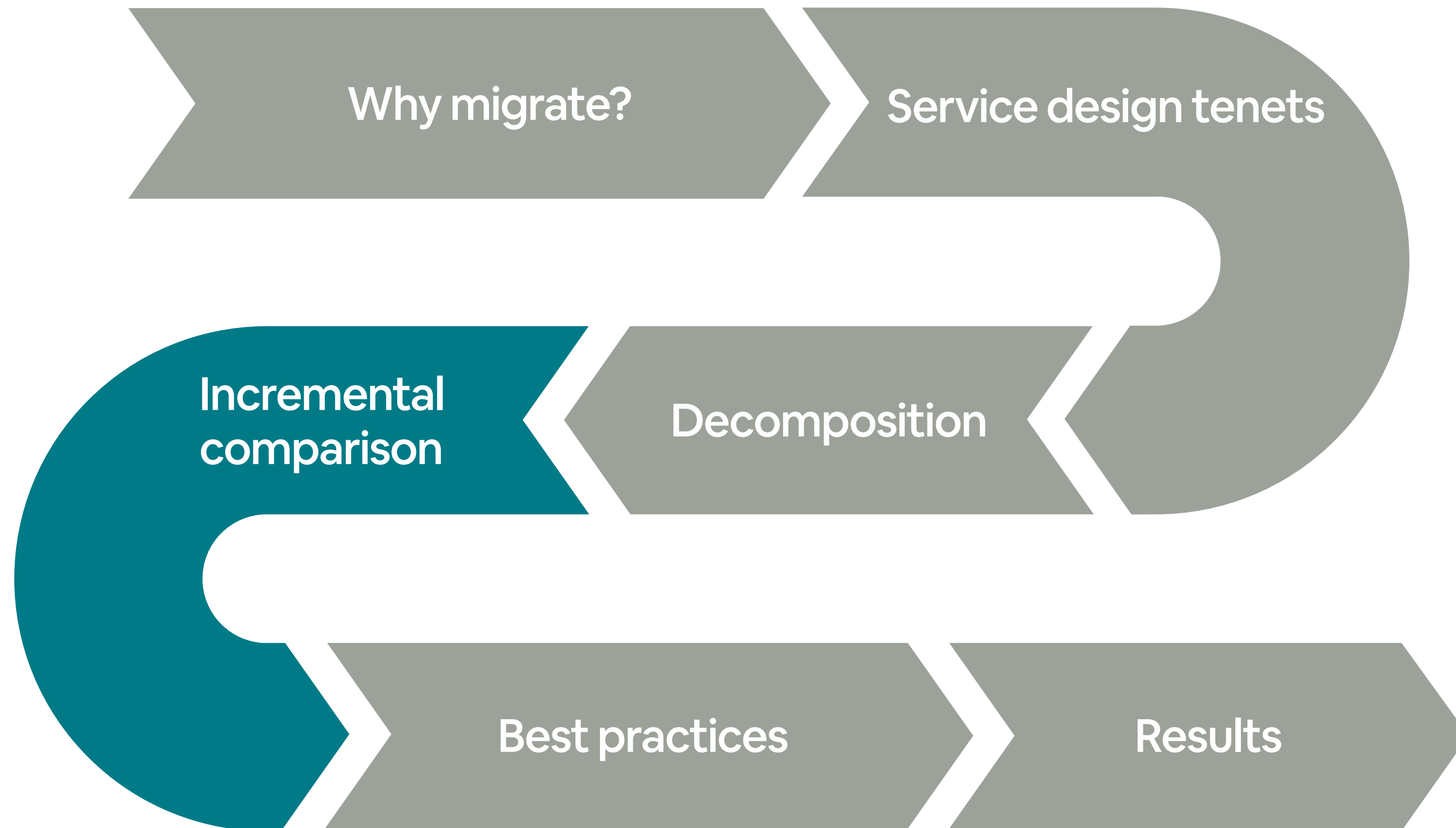


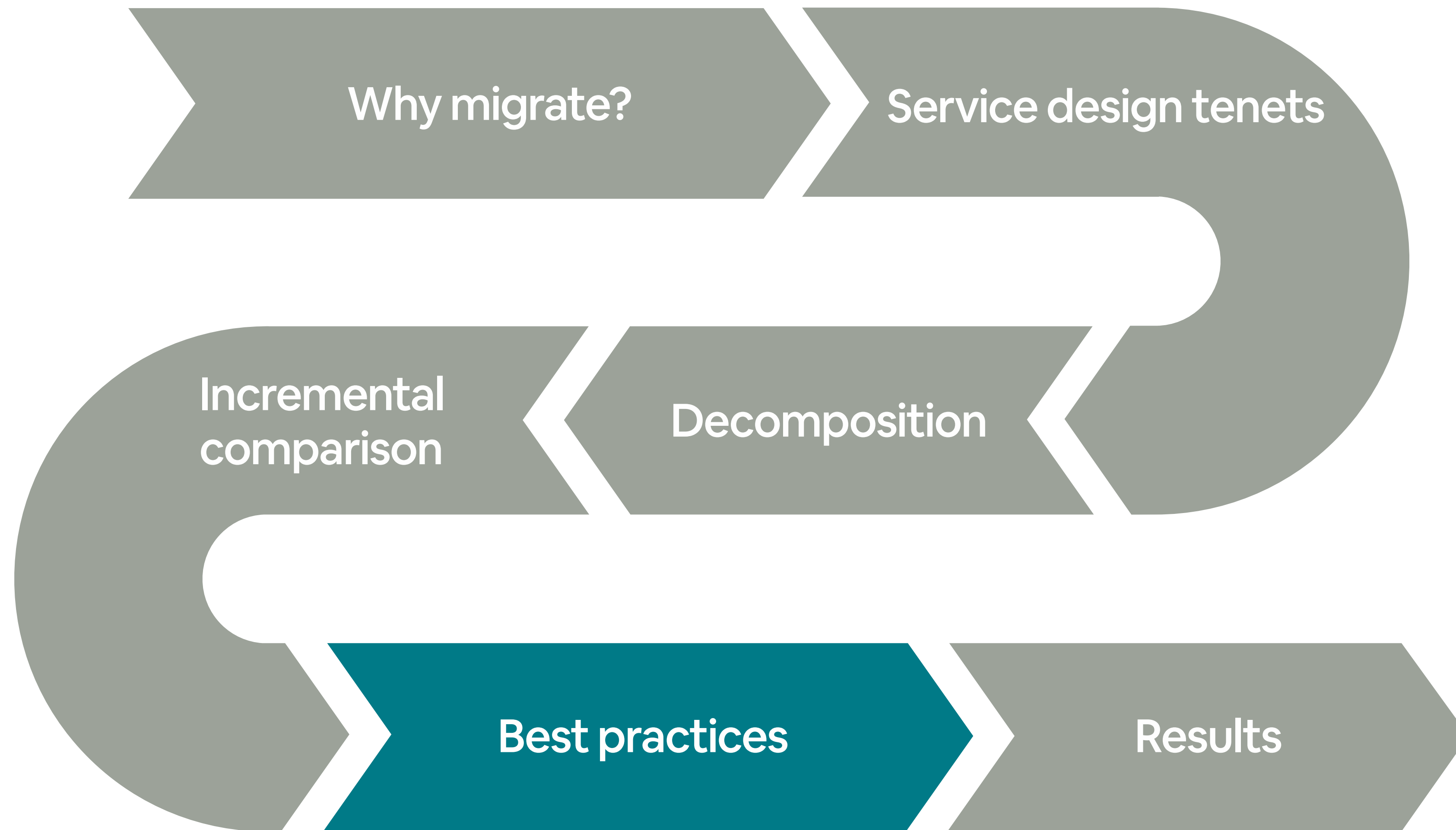
@jessicamtai

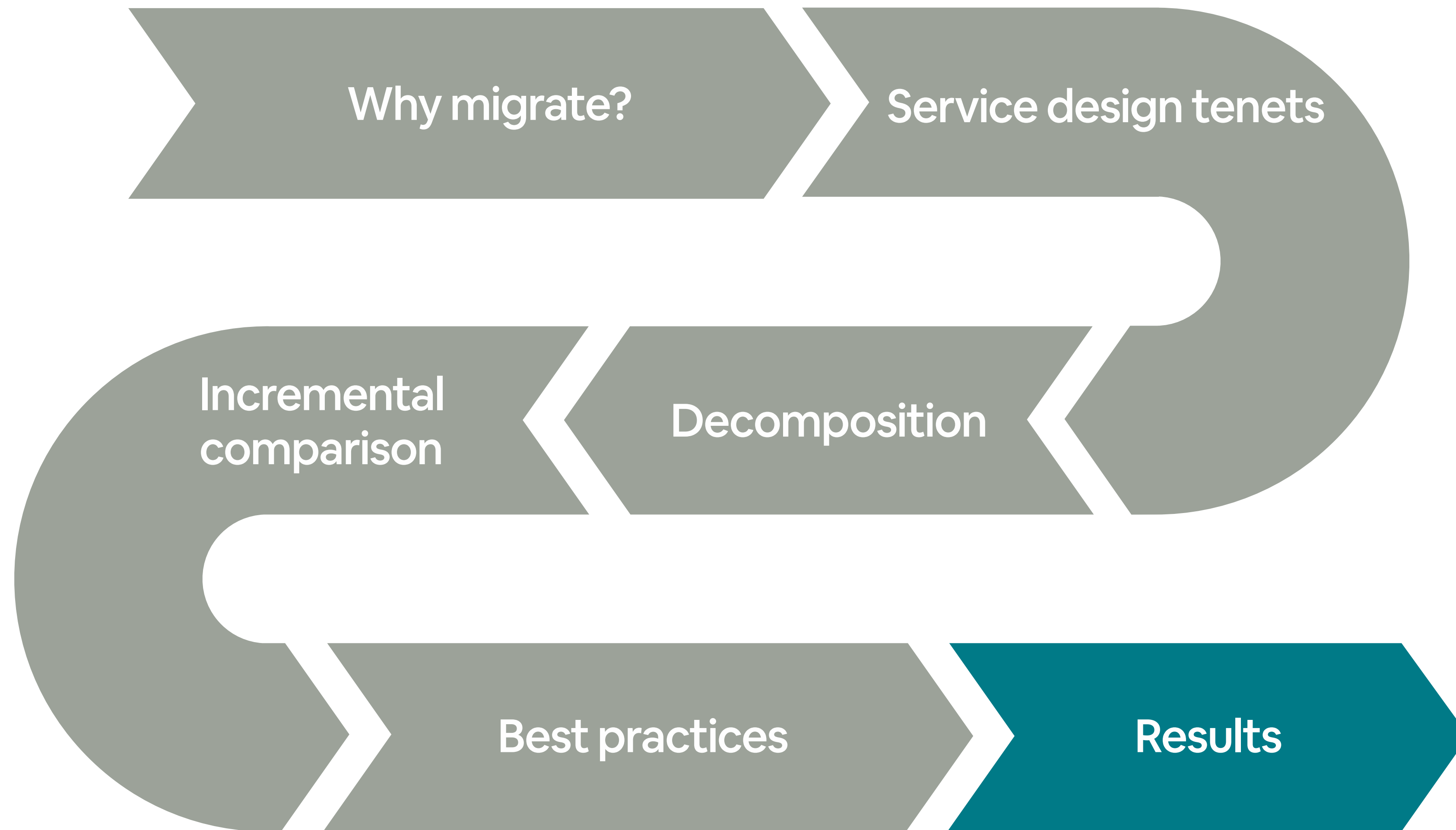












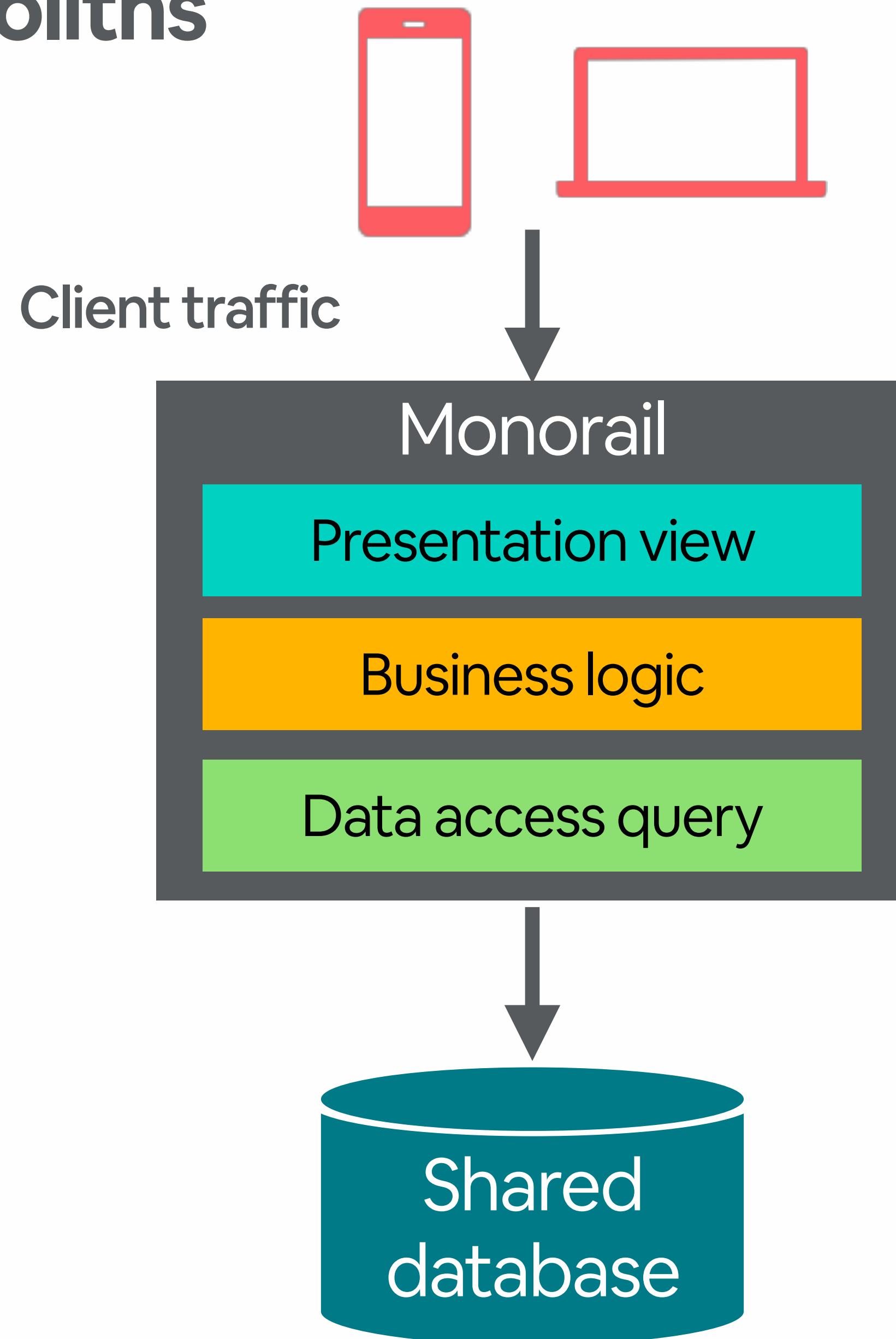
Monorail, our Ruby on Rails monolith



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Easy start with monoliths

EARLY AIRBNB





View Photos

DOME HOUSE

Mushroom Dome Cabin: #1 on airbnb in the world

Aptos



Kitty

This home is on people's minds.
It's been viewed 500+ times in the past week.



3 guests 1 bedroom 2 beds 1 bath

Great location
100% of recent guests gave the location a 5-star rating.

Kitty is a Superhost
Superhosts are experienced, highly rated hosts who are committed to providing great stays for guests.

Great check-in experience

\$130 per night
★★★★★ 1263

Request to Book

rules > 2. Who's coming? > 3. Confirm and pay

Who's coming?



This is a rare find. Kitty's place is usually booked.

Guests

1 guest



What's the main purpose of this trip?

- Personal travel
- Business travel

Say hello to your host

Let Kitty know a little about yourself and why you're coming.



Hello Kitty! Can't wait to spend 1 night in your home.

Continue

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Mushroom on airbnb in

Entire home/

★★★★★ 12

1 guest

Mar 4, 2

\$130.00 x 1

Cleaning fe

Service fee

Occupancy

Gift Credit

Total

Due now (U

Due on Feb

Moderate -

Cancel withi
get a full refu



DOME HOUSE

Mushroom Dome Cabin: #1 on airbnb in the world

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Continue



WHY DECIDE TO MIGRATE?



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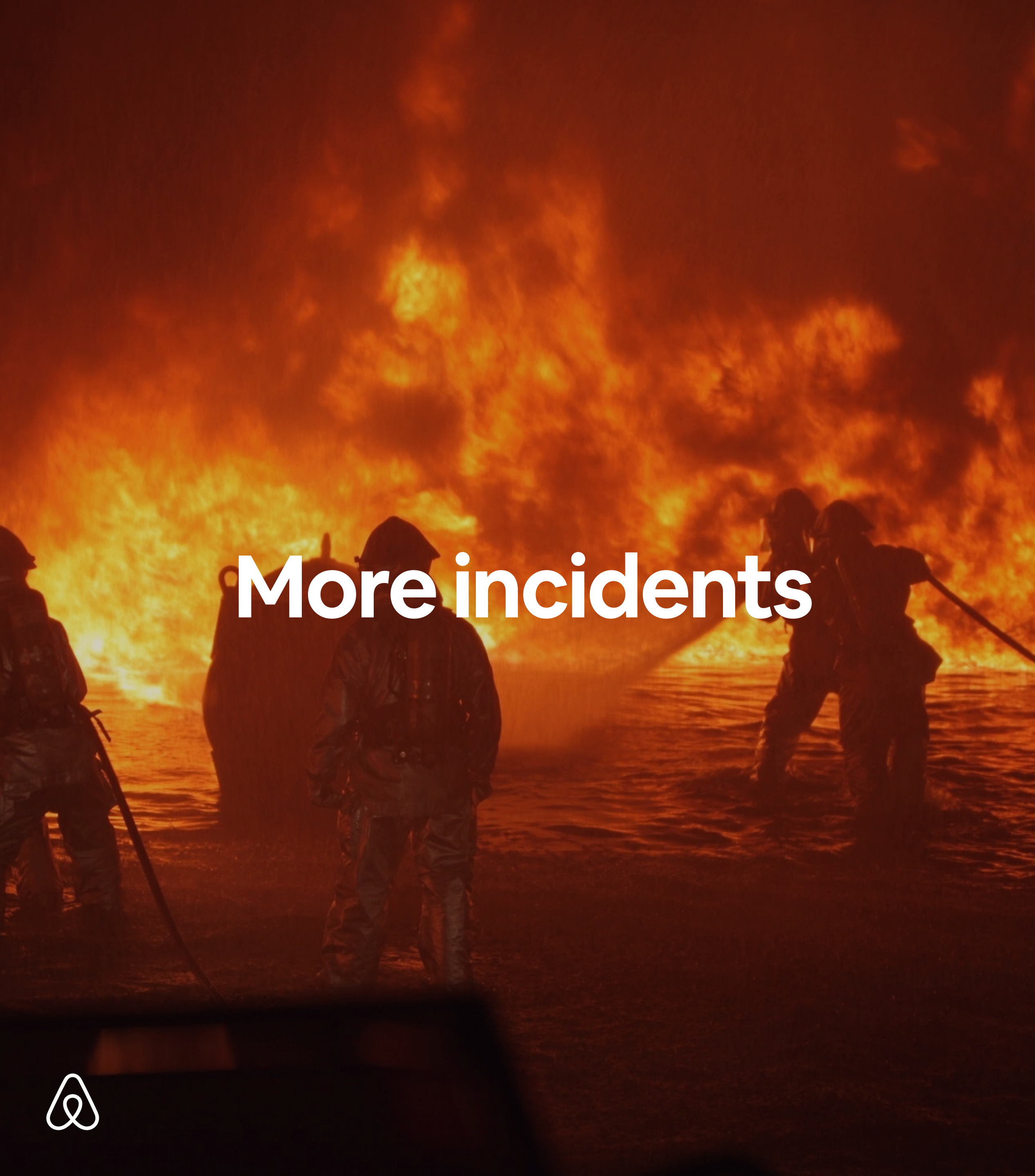


2 Europe, Middle East & Africa

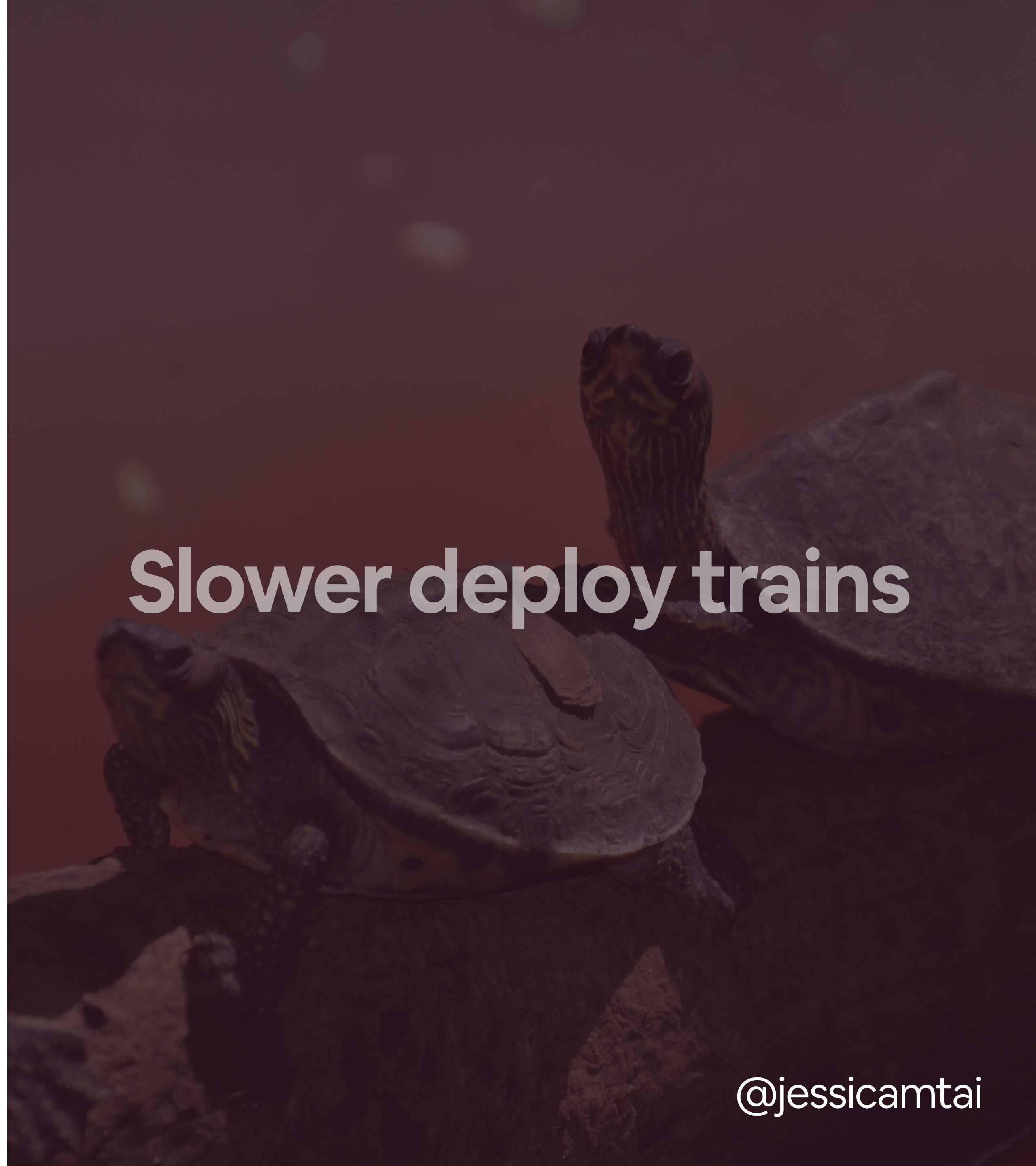
LONDON

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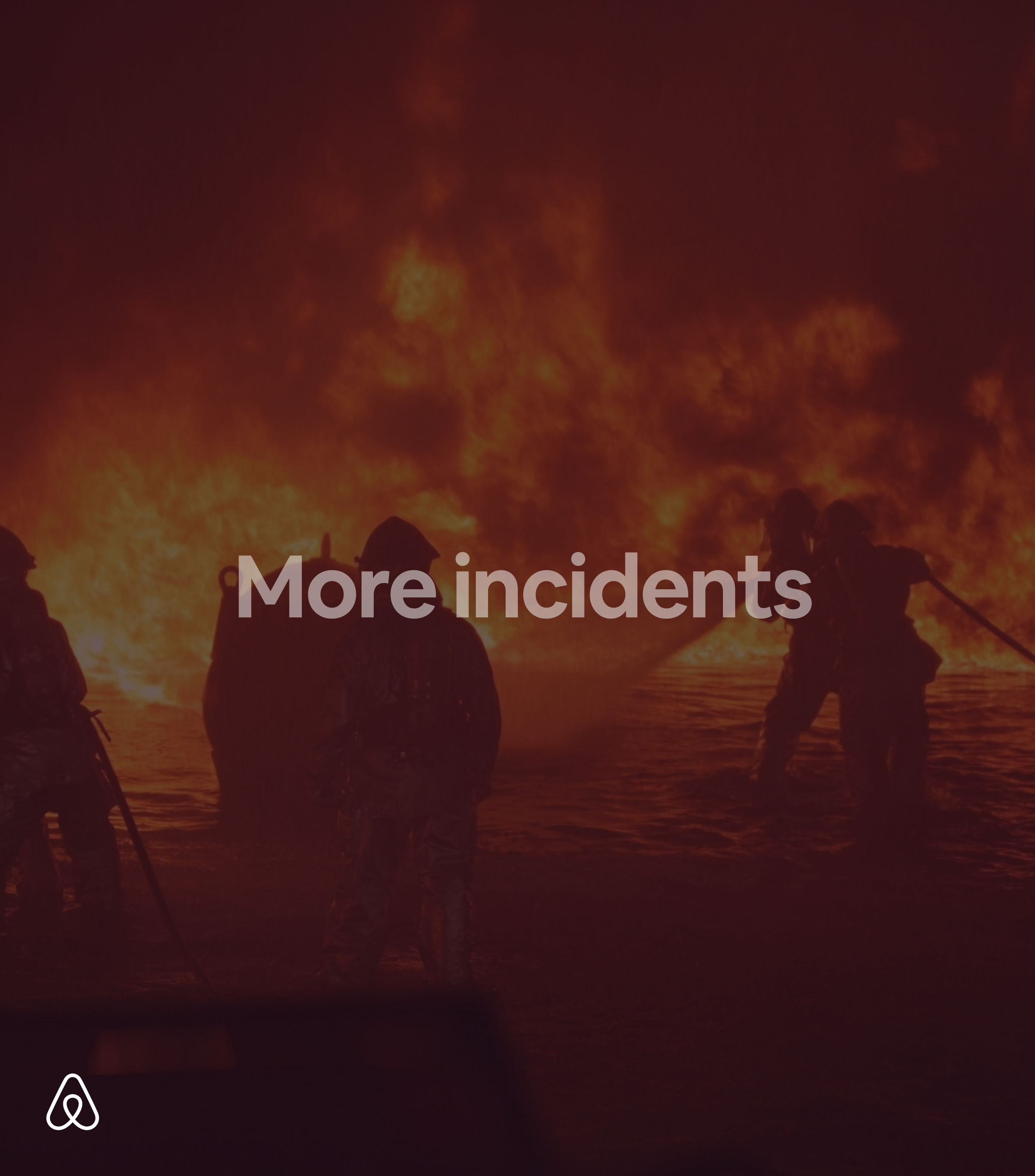


More incidents

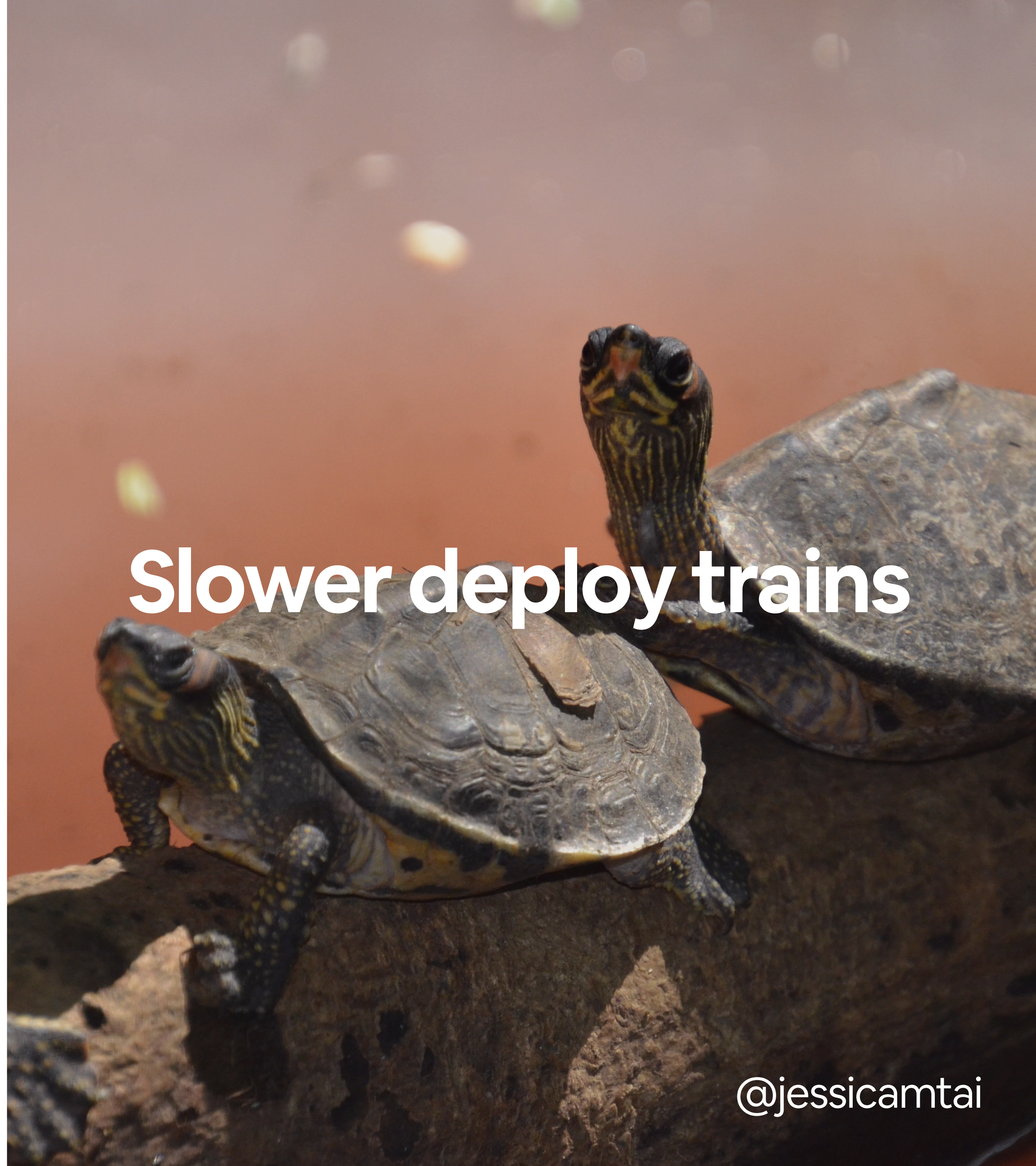


Slower deploy trains

@jessicamtai



More incidents

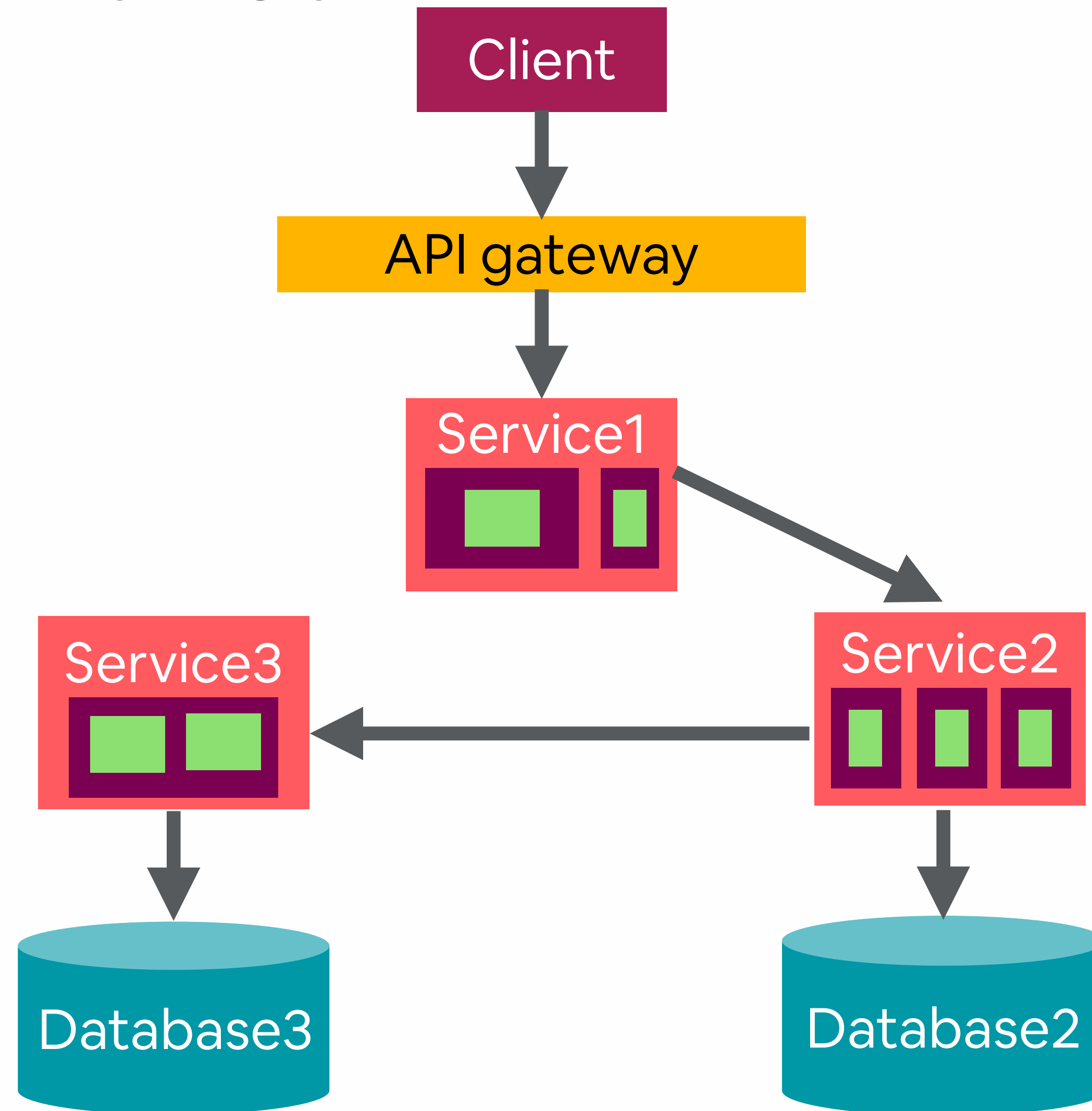


Slower deploy trains

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Our solution: Service-oriented architecture (SOA)

NETWORK OF LOOSELY-COUPLED SERVICES



Checkout page in SOA

Home demand service

Who's coming?



This is a rare find. Kitty's place is usually booked.

Mushroom Dome Cabin: #1 on airbnb in the world

Entire home/apt in Aptos
★★★★★ 1263 reviews



Home service

Reservation service

Guests

1 guest

1 guest

Mar 4, 2019 → Mar 5, 2019

Business travel service

What's the main purpose of this trip?

- Personal travel
- Business travel

Cleaning fee	\$35.00
Service fee	\$21.29
Occupancy taxes and fees	\$18.15
Gift Credit	-\$102.22
Total	\$102.22

Pricing service

Messaging service

Say hello to your host

Let Kitty know a little about yourself and why you're coming.



Hello Kitty! Can't wait to spend 1 night in your home.

Due now (USD)	\$0.00
Due on Feb 19, 2019	\$102.22

Cancellation service

Moderate — free cancellation

Cancel within 48 hours of booking to get a full refund. [More details](#)



Continue



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A group of seven penguins, likely Adelie penguins, are standing on a snowy, icy landscape. In the background, there is a large, layered ice cliff or glacier. The scene is brightly lit, suggesting a sunny day in a cold environment. The penguins are scattered across the foreground, some looking towards the camera and others looking away. The overall color palette is dominated by whites, blues, and greys, with a warm, golden light from the sun.

SERVICE DESIGN TENETS



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**Services own reads & writes
to their data**



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Services address a specific concern



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Avoid duplicate functionality





**Data mutations propagate
via standard events**




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A top-down view of a wooden workbench. In the upper left, there are several pieces of light-colored wood, possibly plywood or thin boards, stacked together. A hammer with a dark handle and a metal head is positioned in the upper right. In the center and lower right, there is a large pile of silver-colored nails. The background consists of vertical wooden planks.

Build for production



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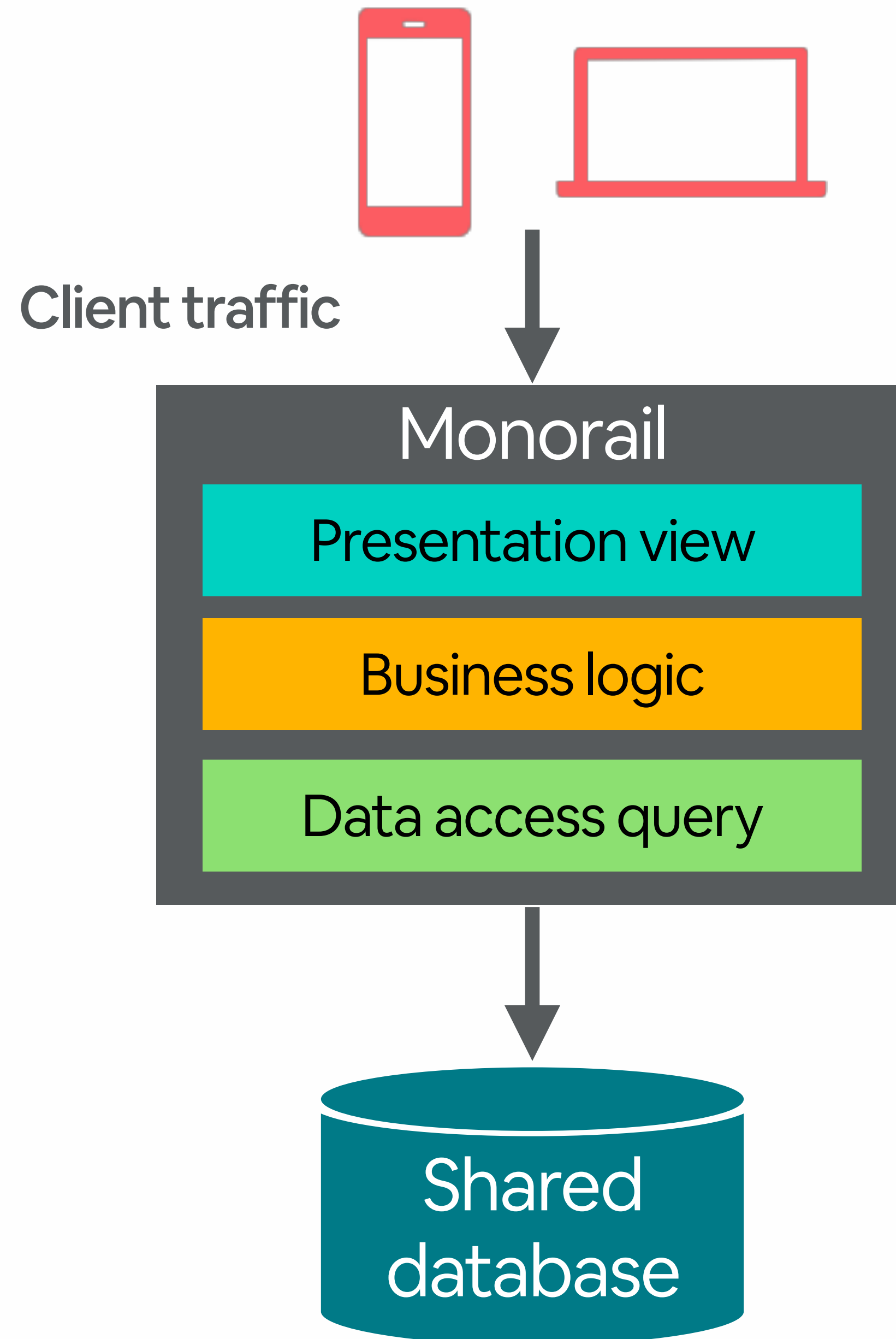
DECOMPOSE BY REQUEST LIFE CYCLE



@jessicamtai

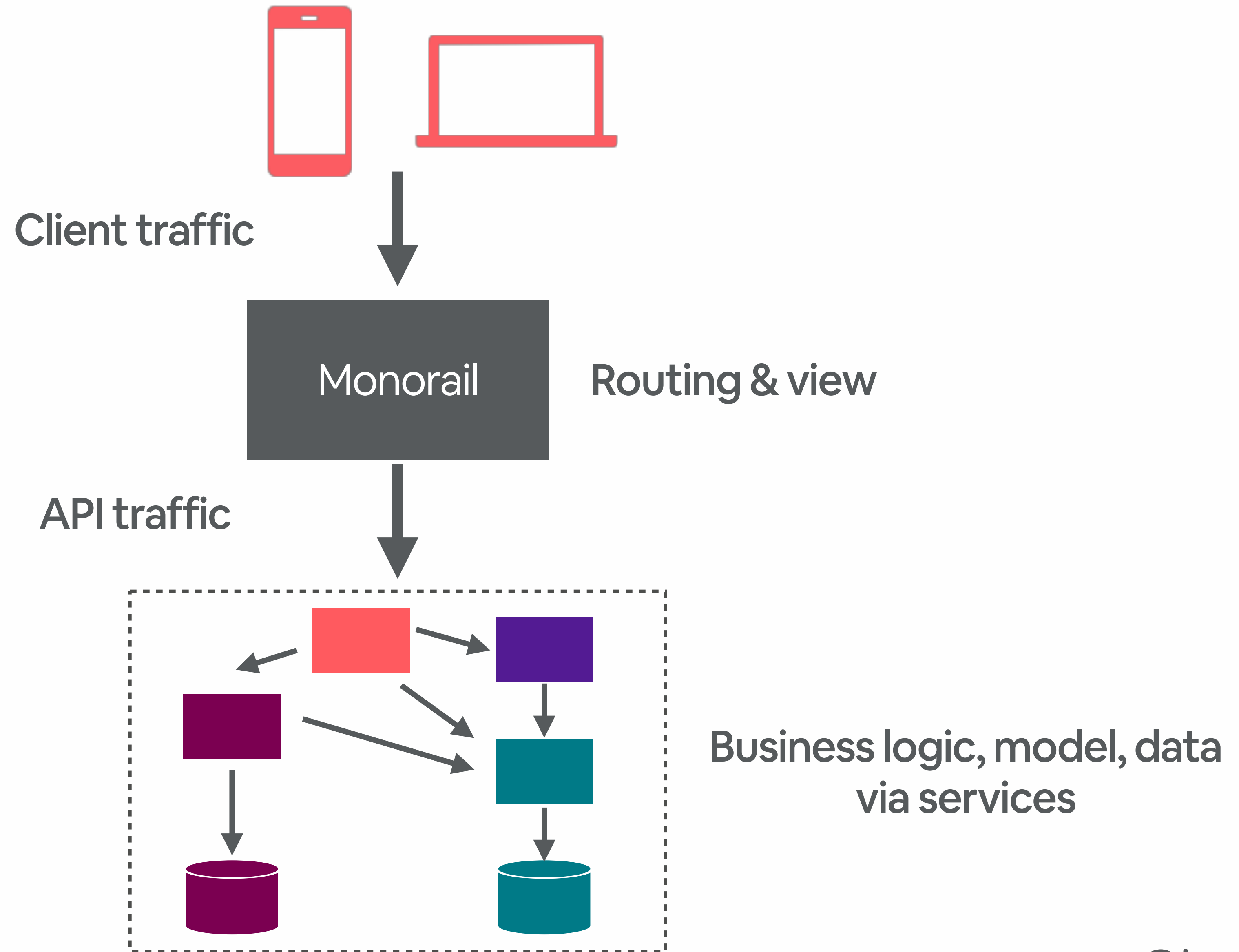
Request life cycle

V1: MONORAIL



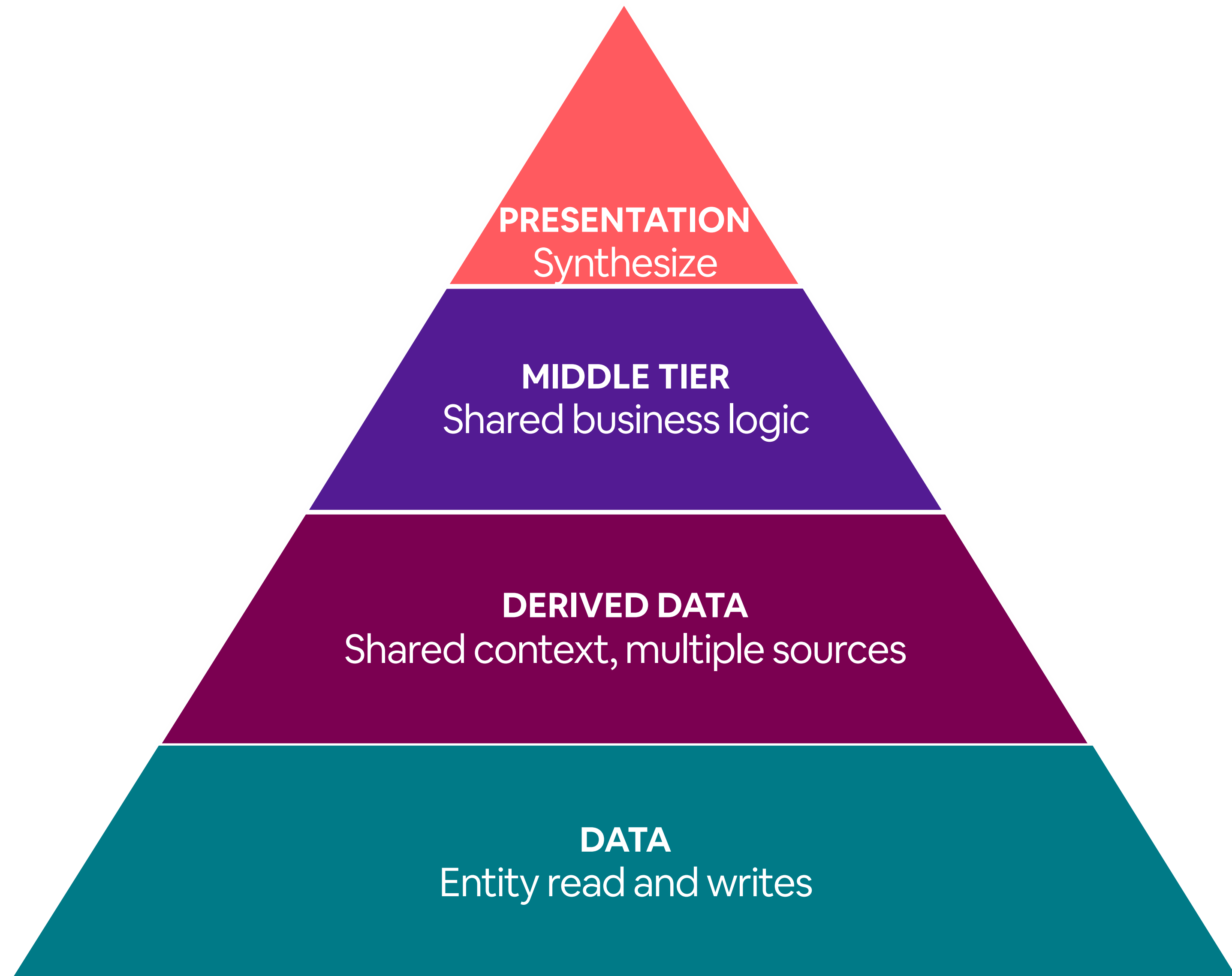
Request life cycle

V2: MONORAIL & SERVICES



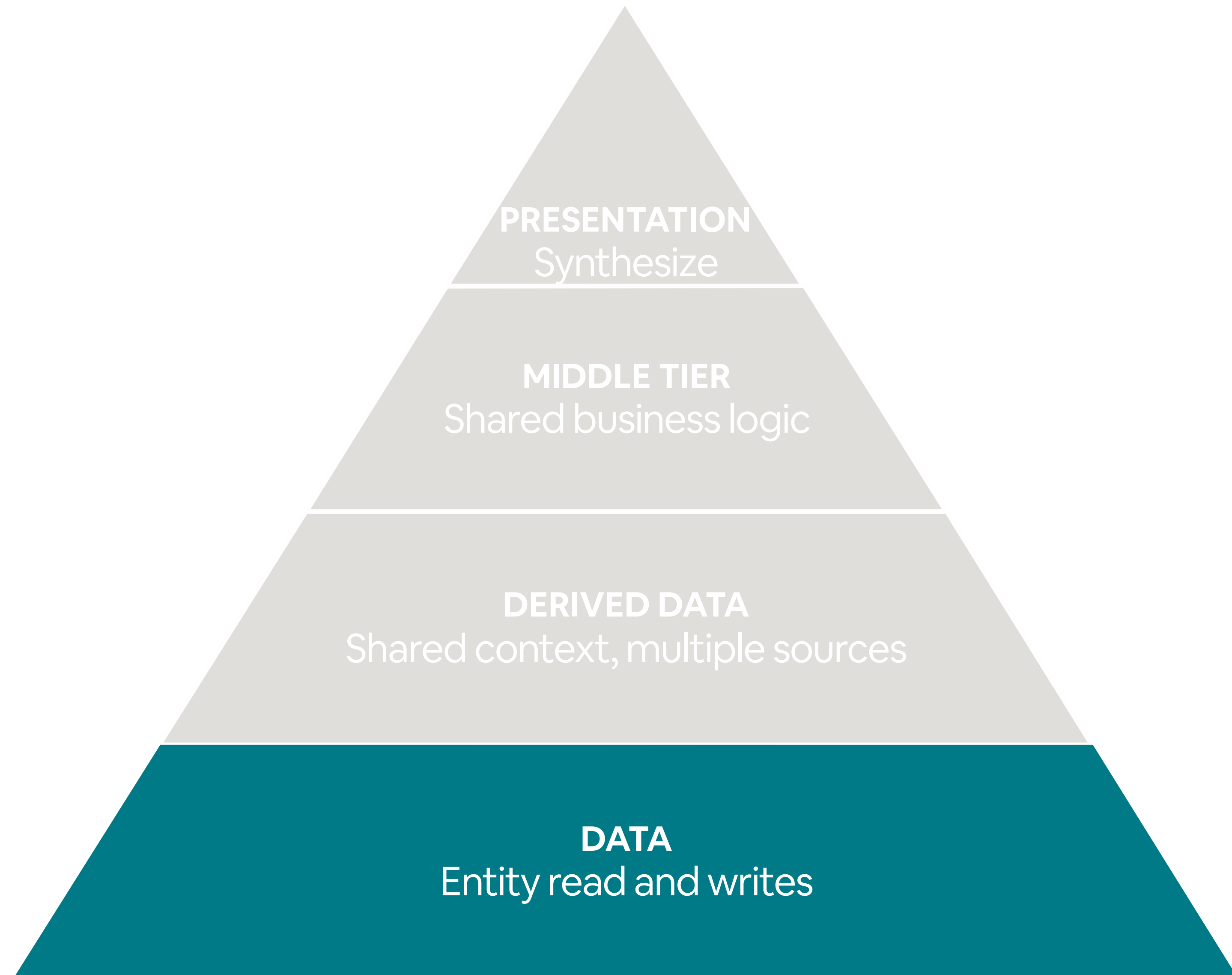
Service types

STRICT FLOW OF DEPENDENCIES



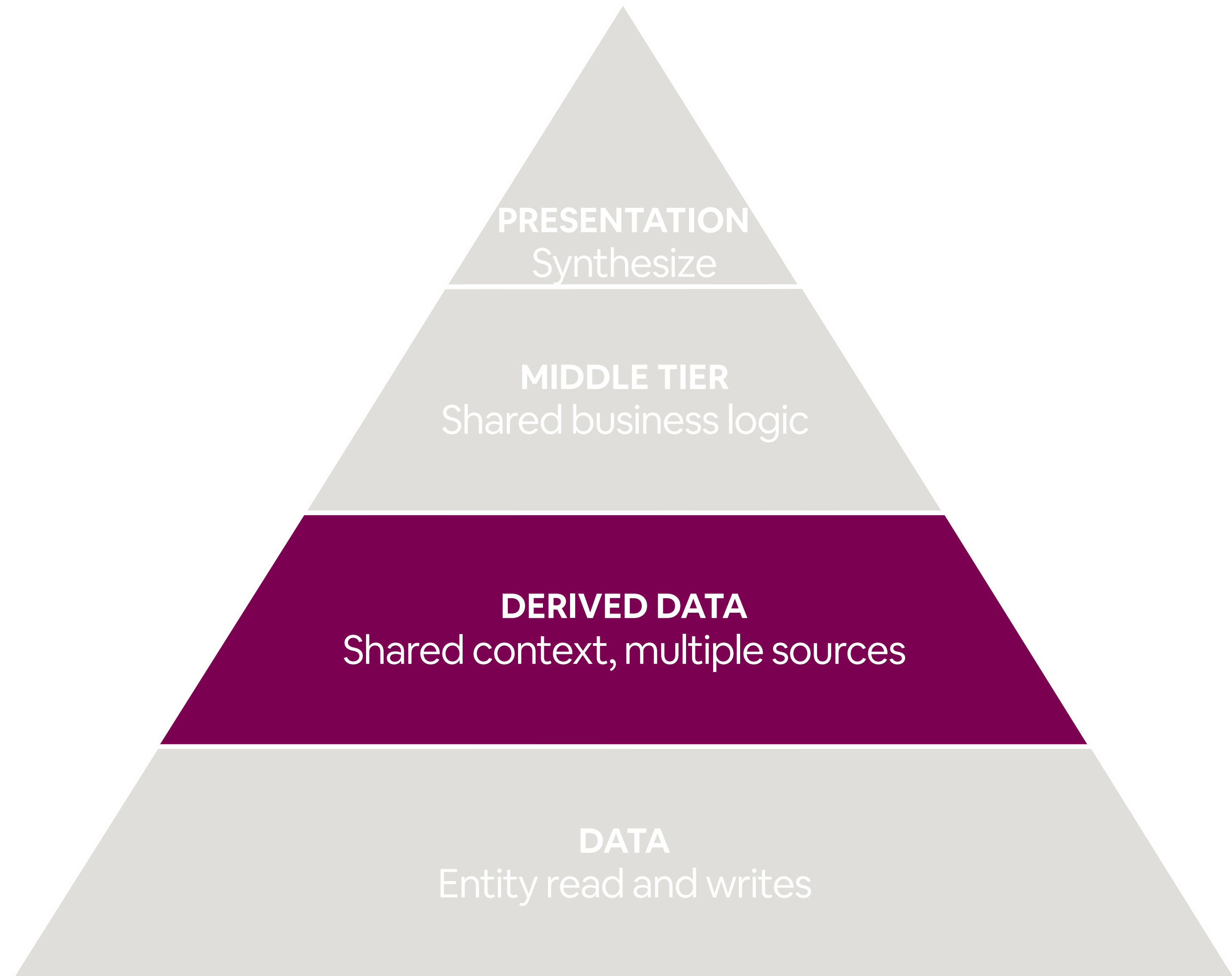
Service types

STRICT FLOW OF DEPENDENCIES



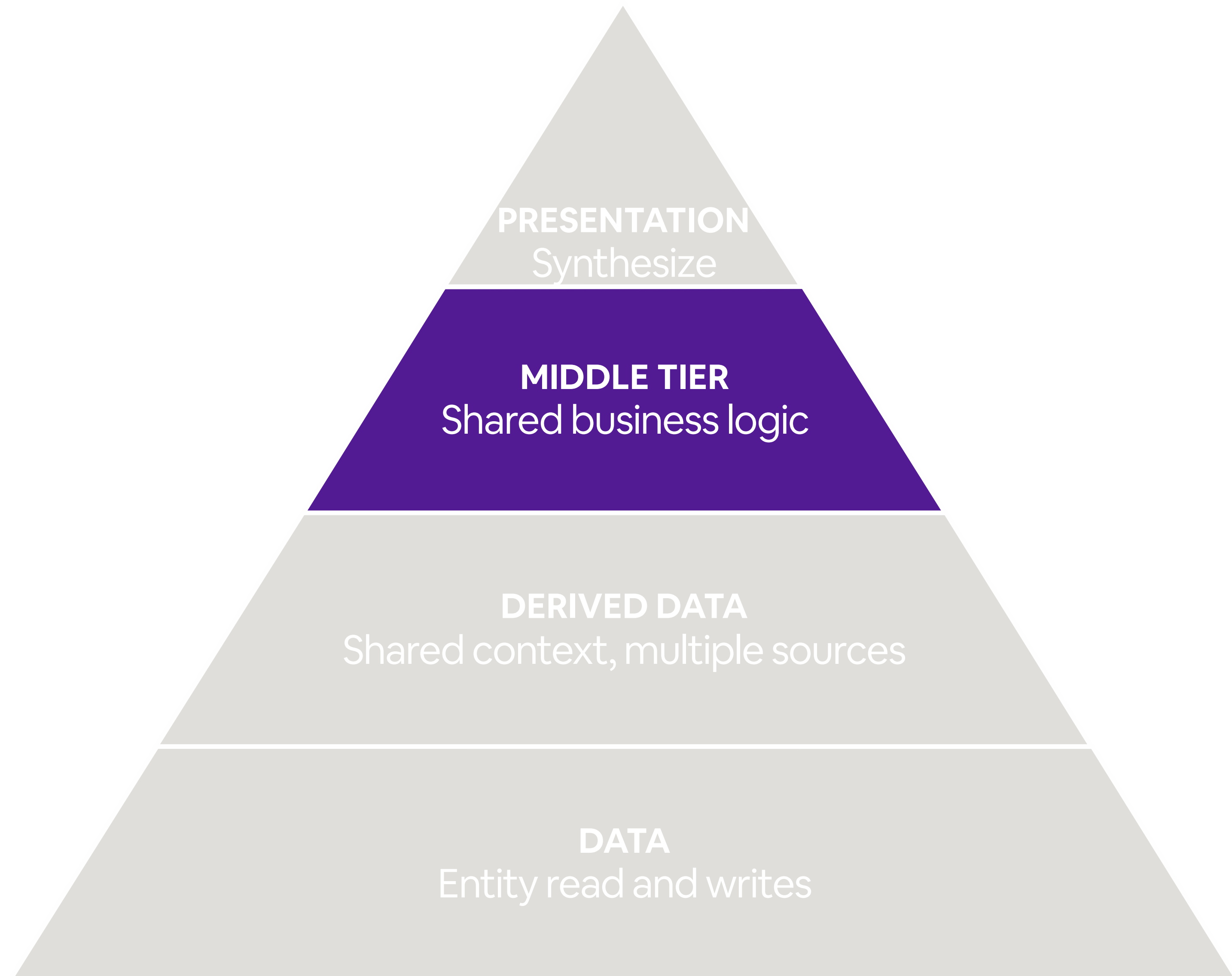
Service types

STRICT FLOW OF DEPENDENCIES



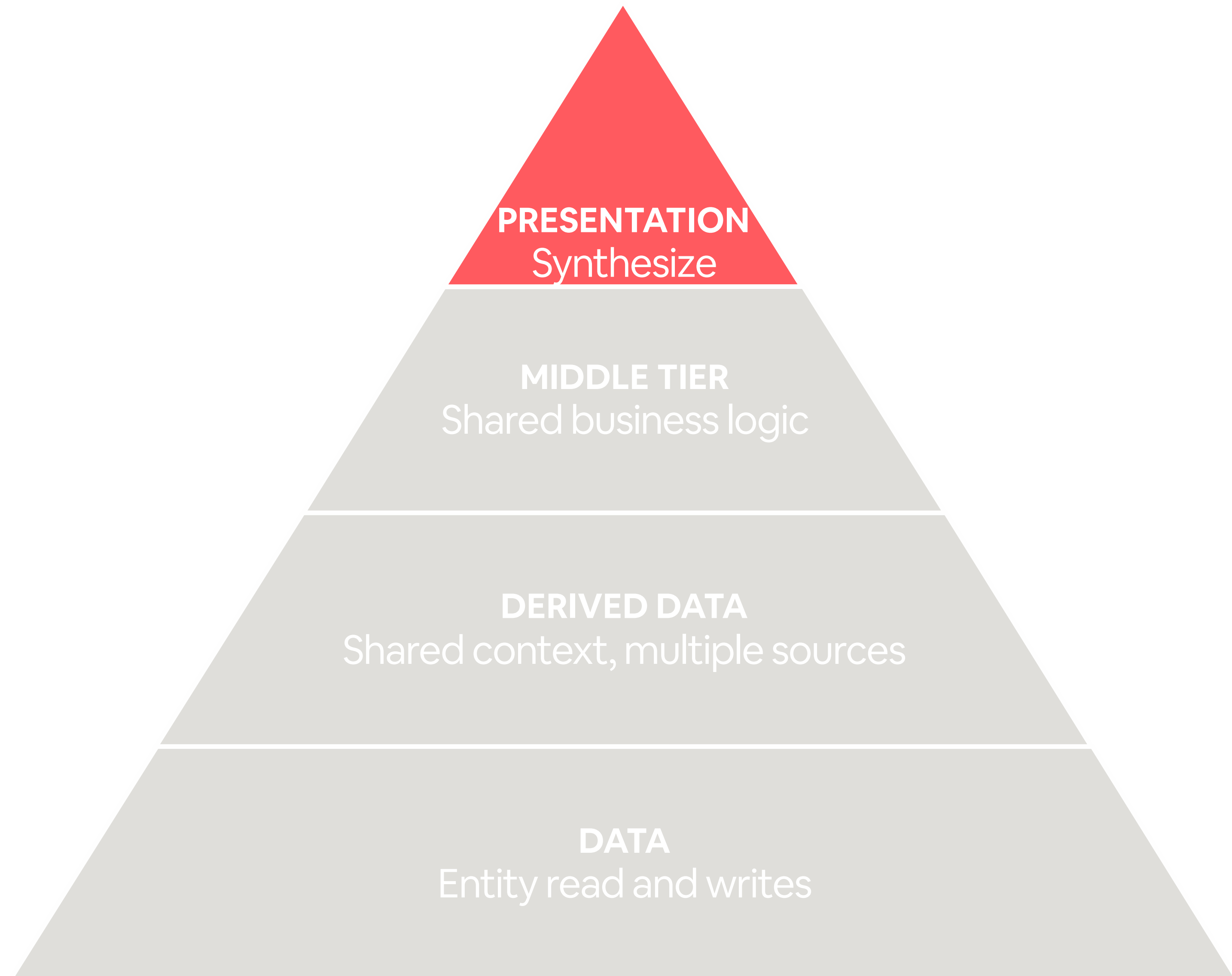
Service types

STRICT FLOW OF DEPENDENCIES



Service types

STRICT FLOW OF DEPENDENCIES





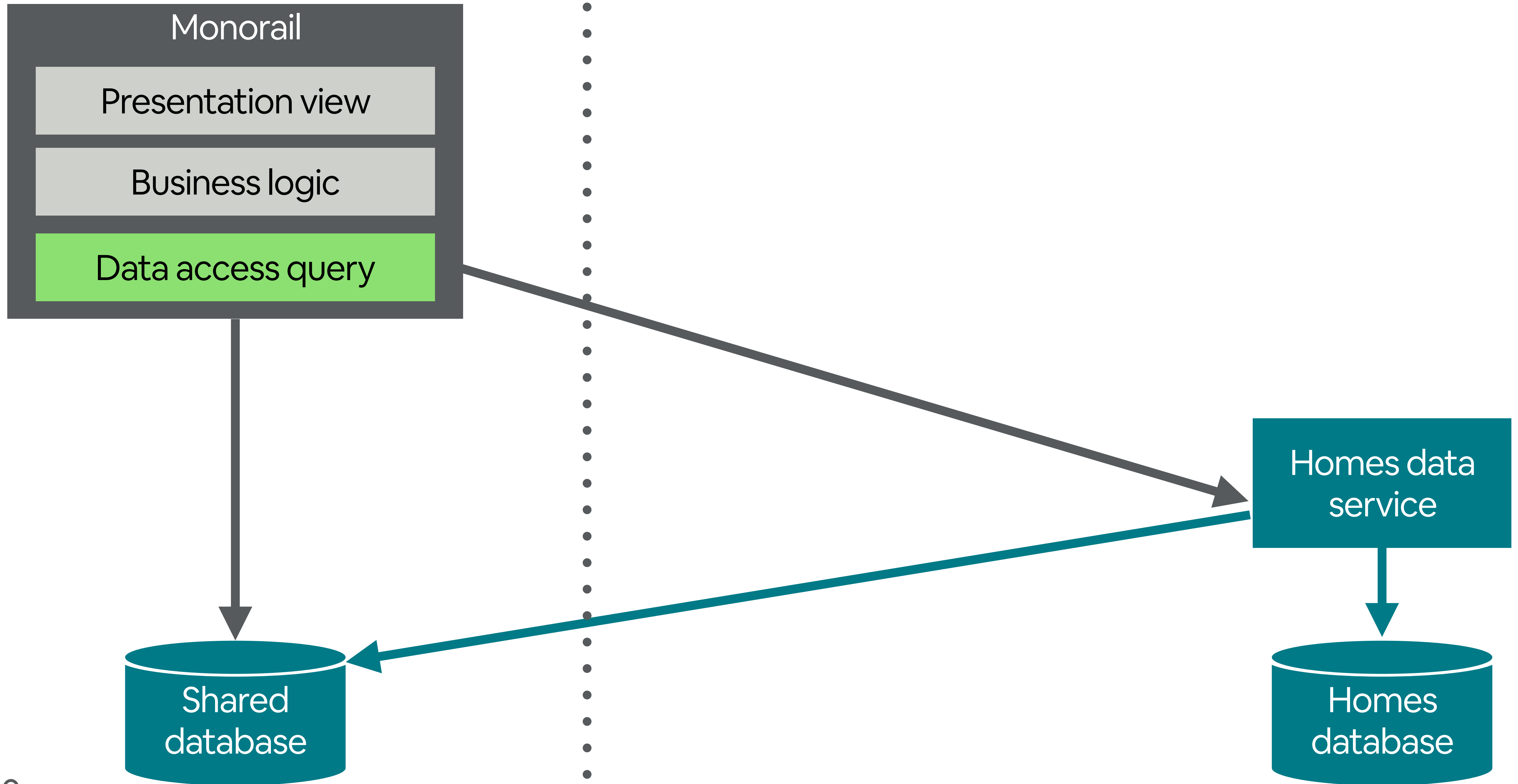
Mushroom Dome

HOSTED BY KITTY · APTOS, CALIFORNIA

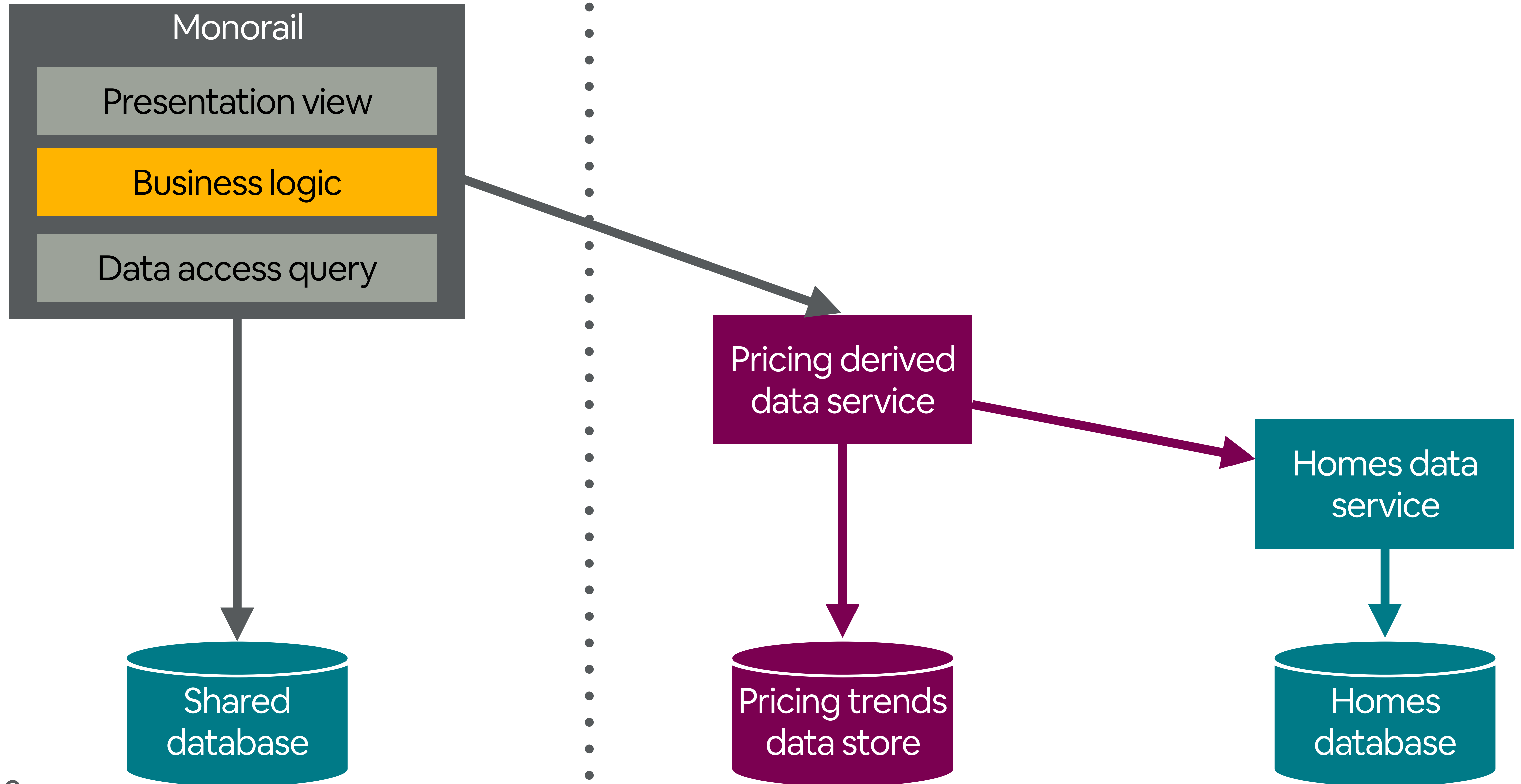


@jessicantai

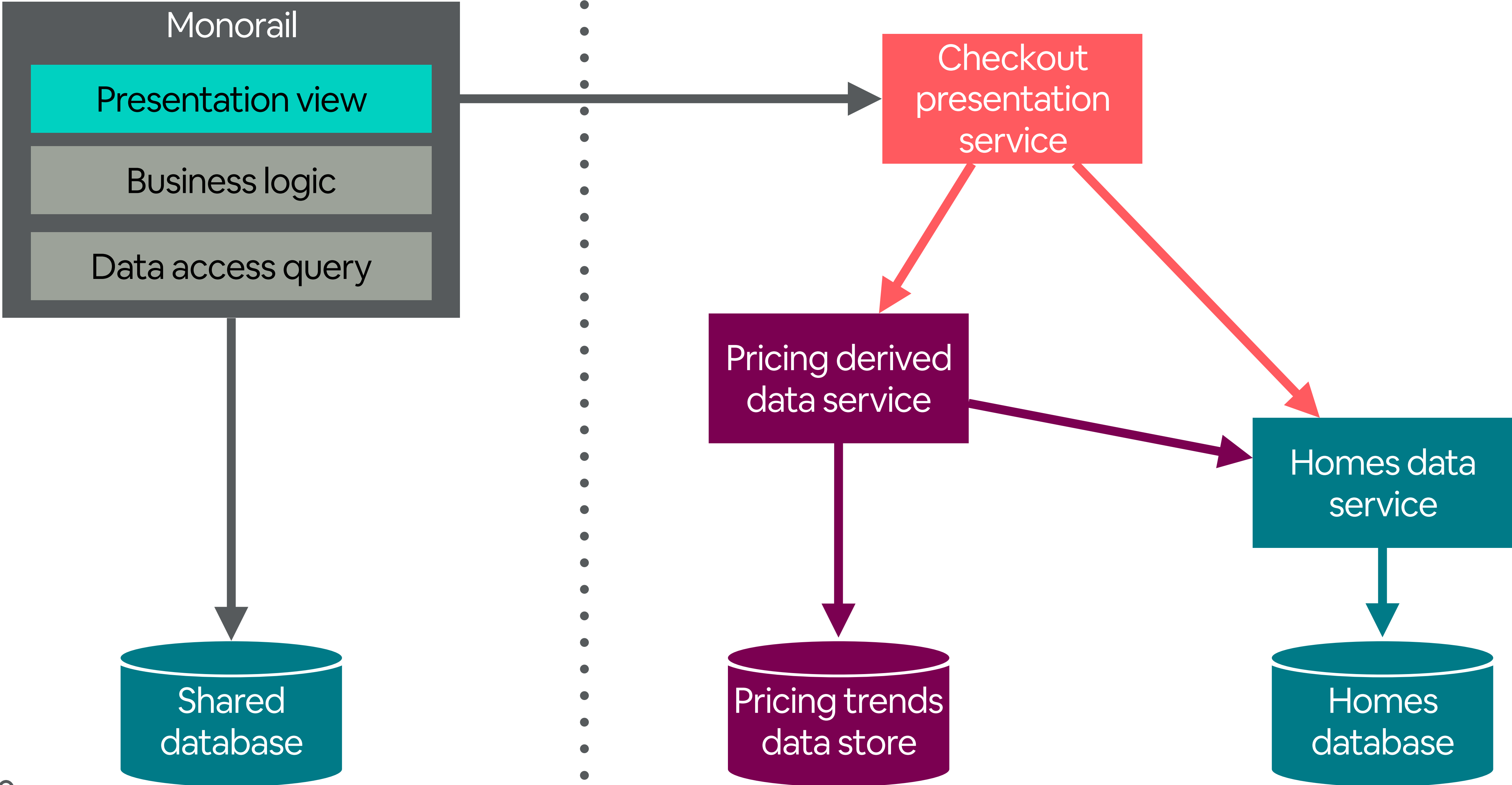
1. Migrating core data models



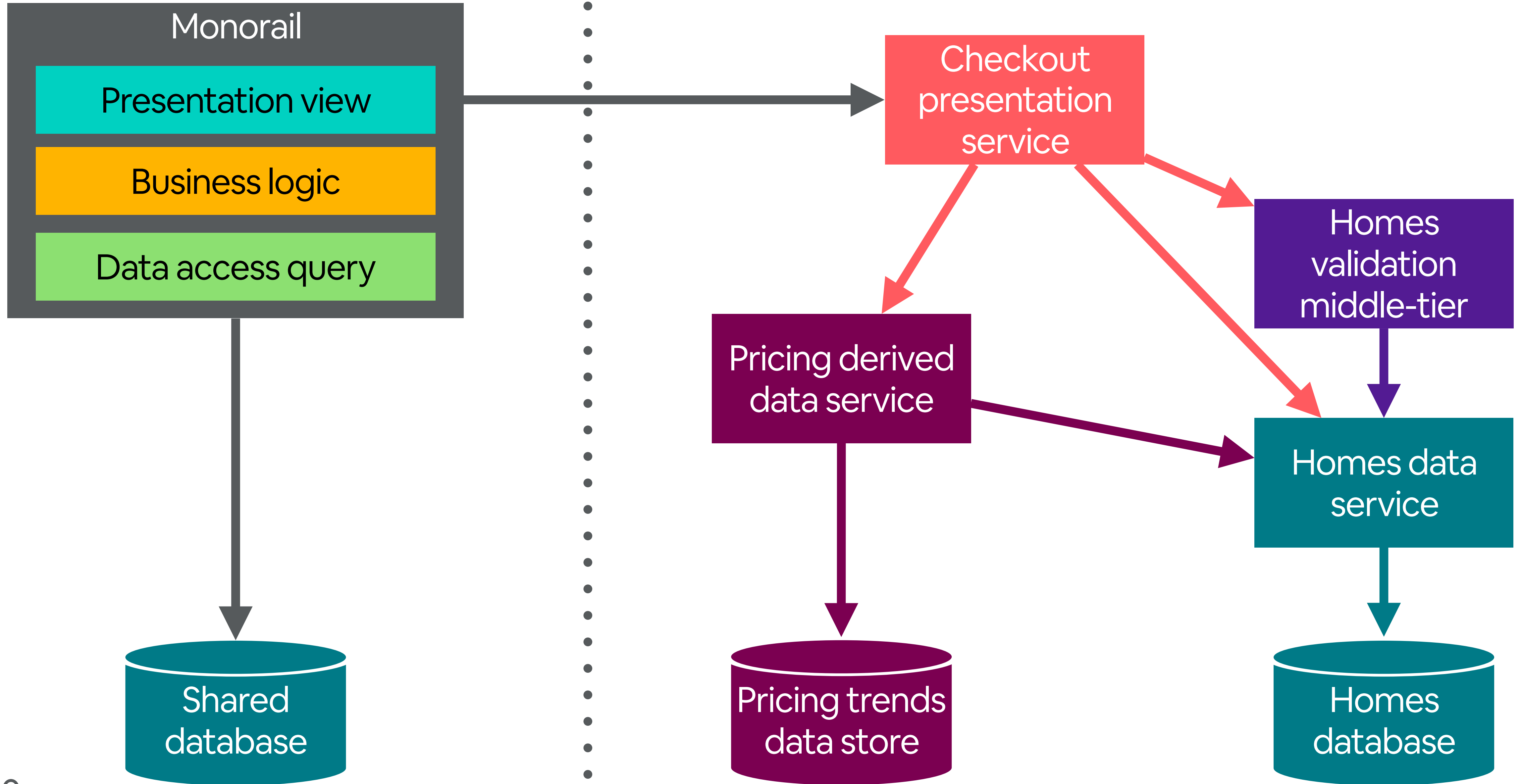
2. Migrating core business logic



3. Migrating core product views

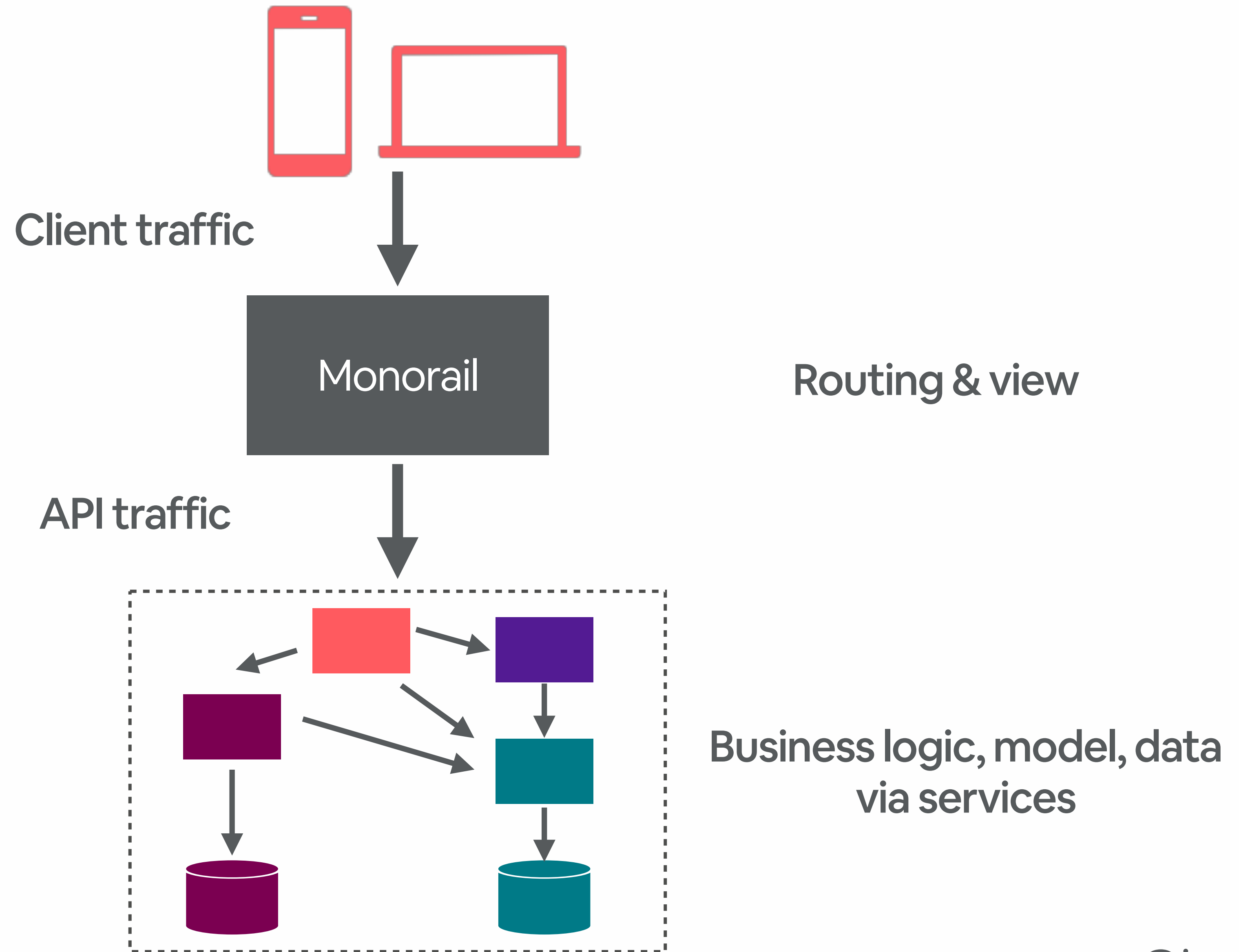


4. Migrating core product writes



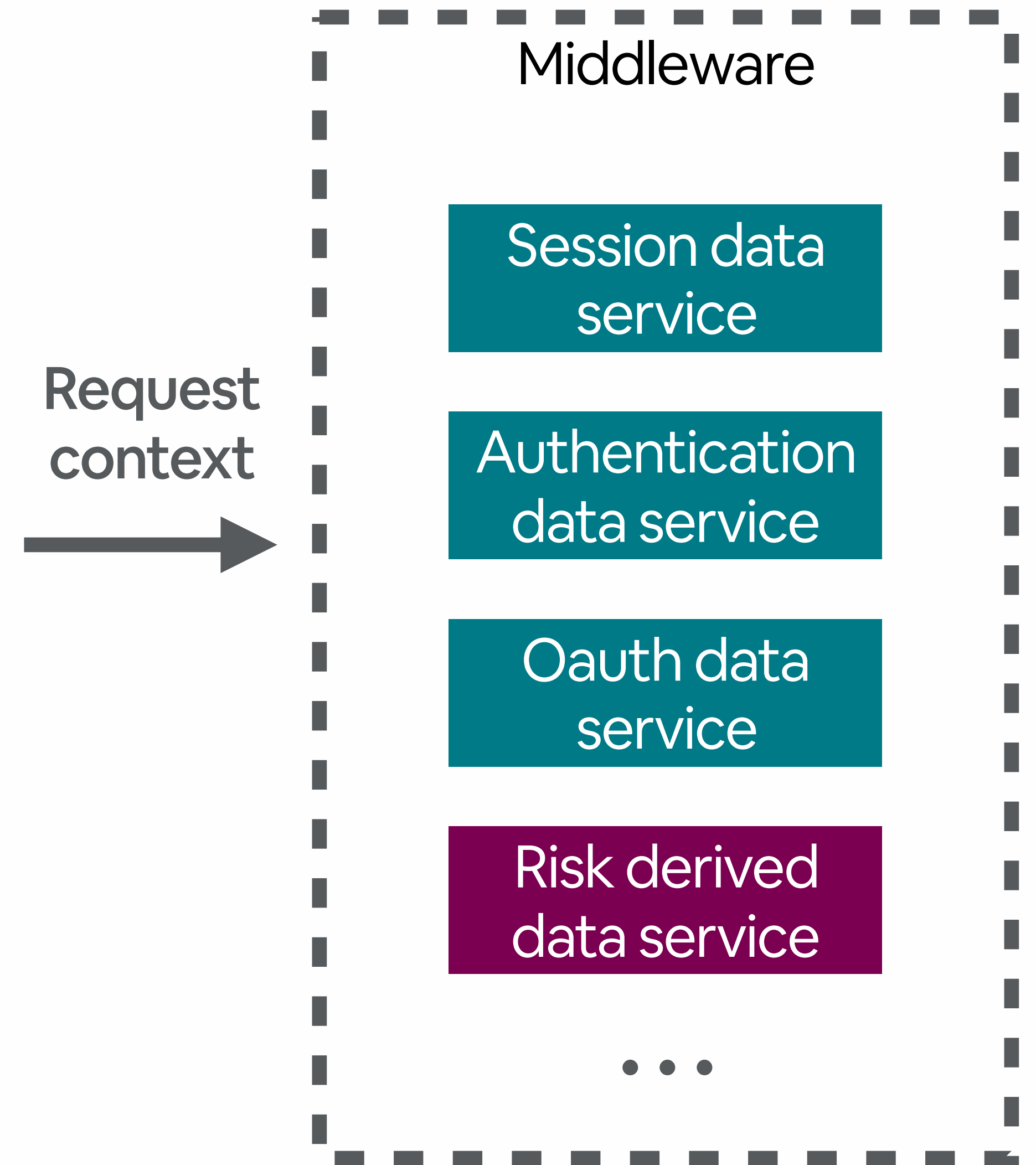
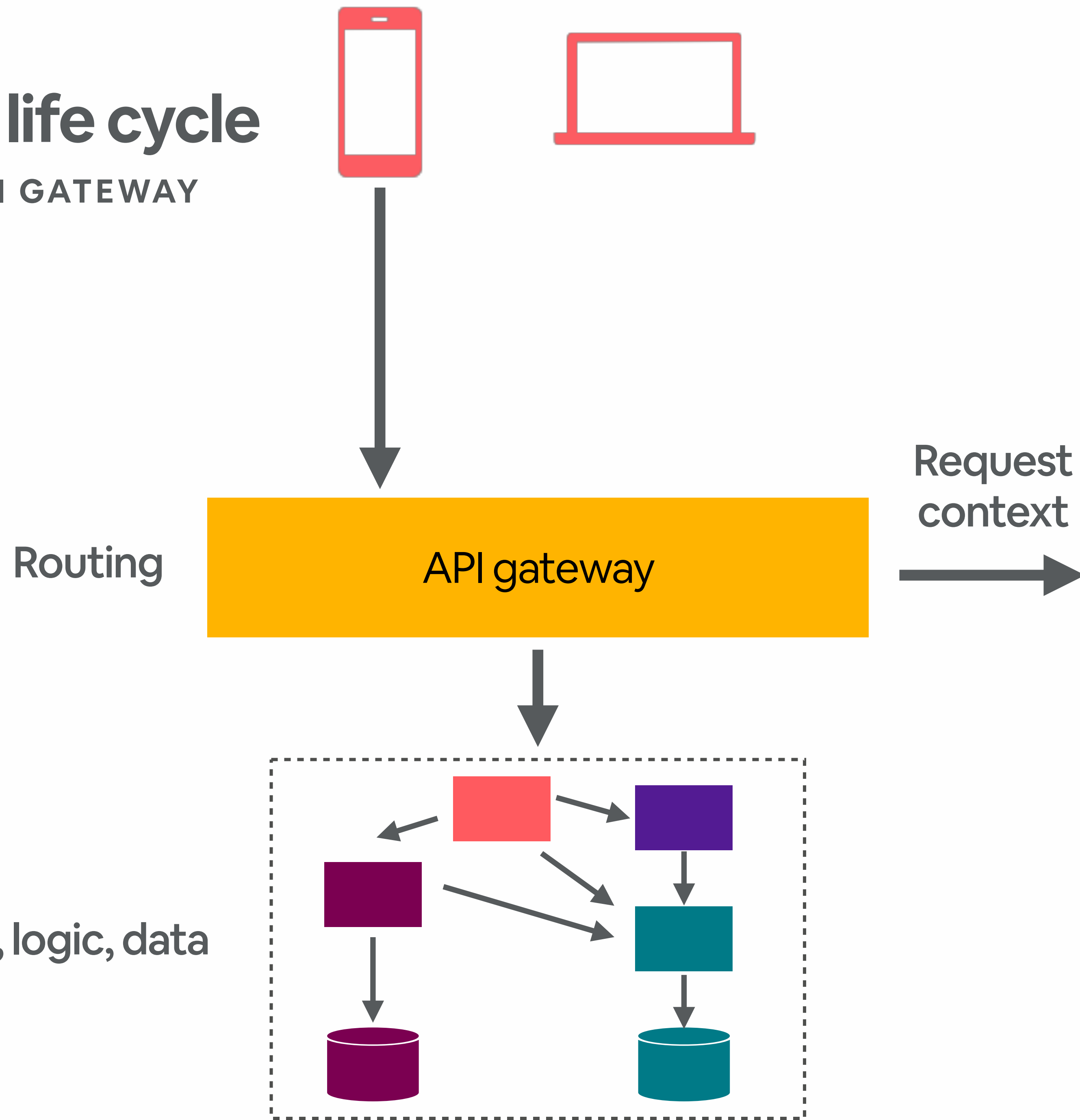
Request life cycle

V2: MONORAIL & SERVICES



Request life cycle

V3: SOA & API GATEWAY

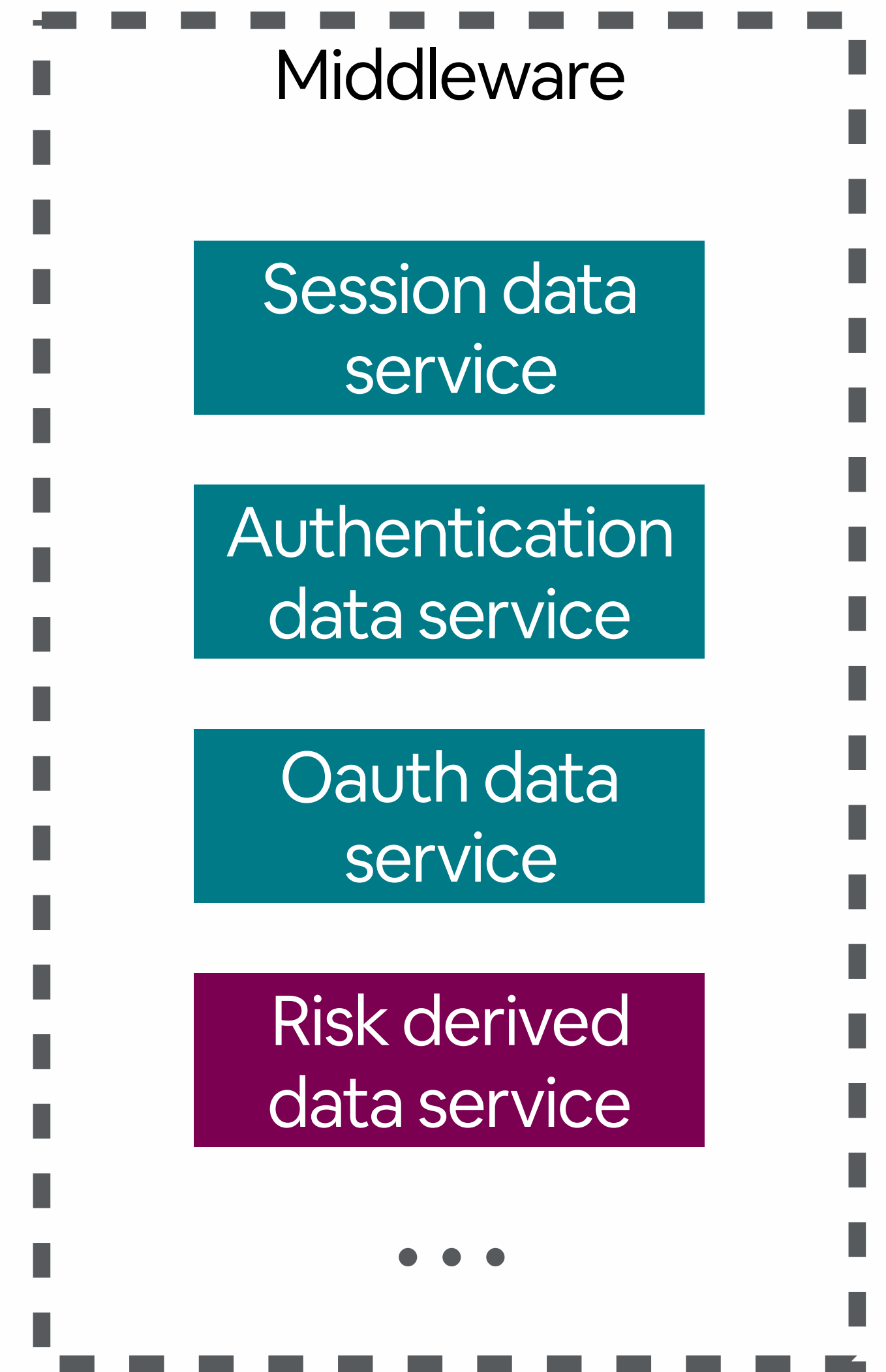
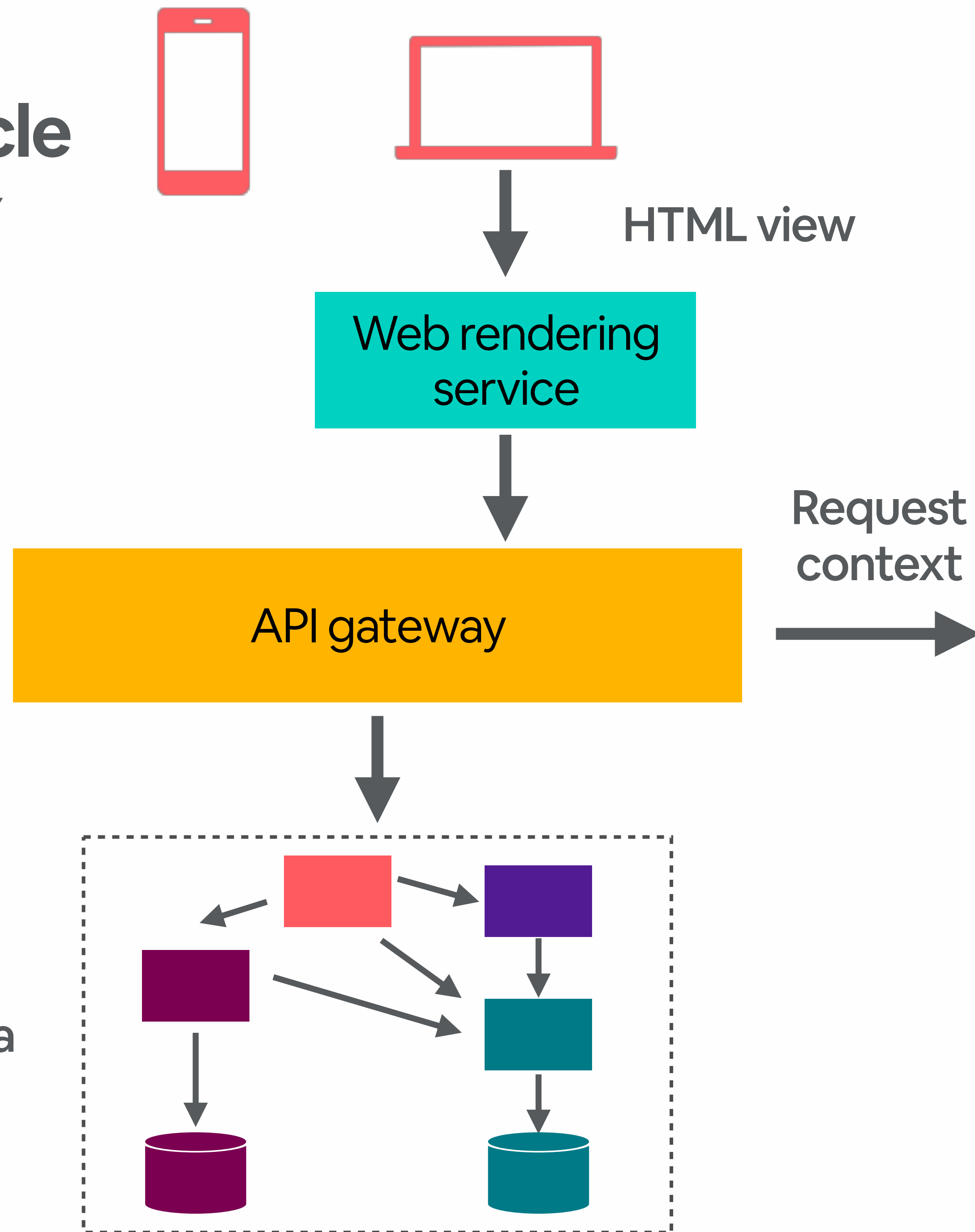


Presentation, logic, data



Request life cycle

V3: SOA & API GATEWAY

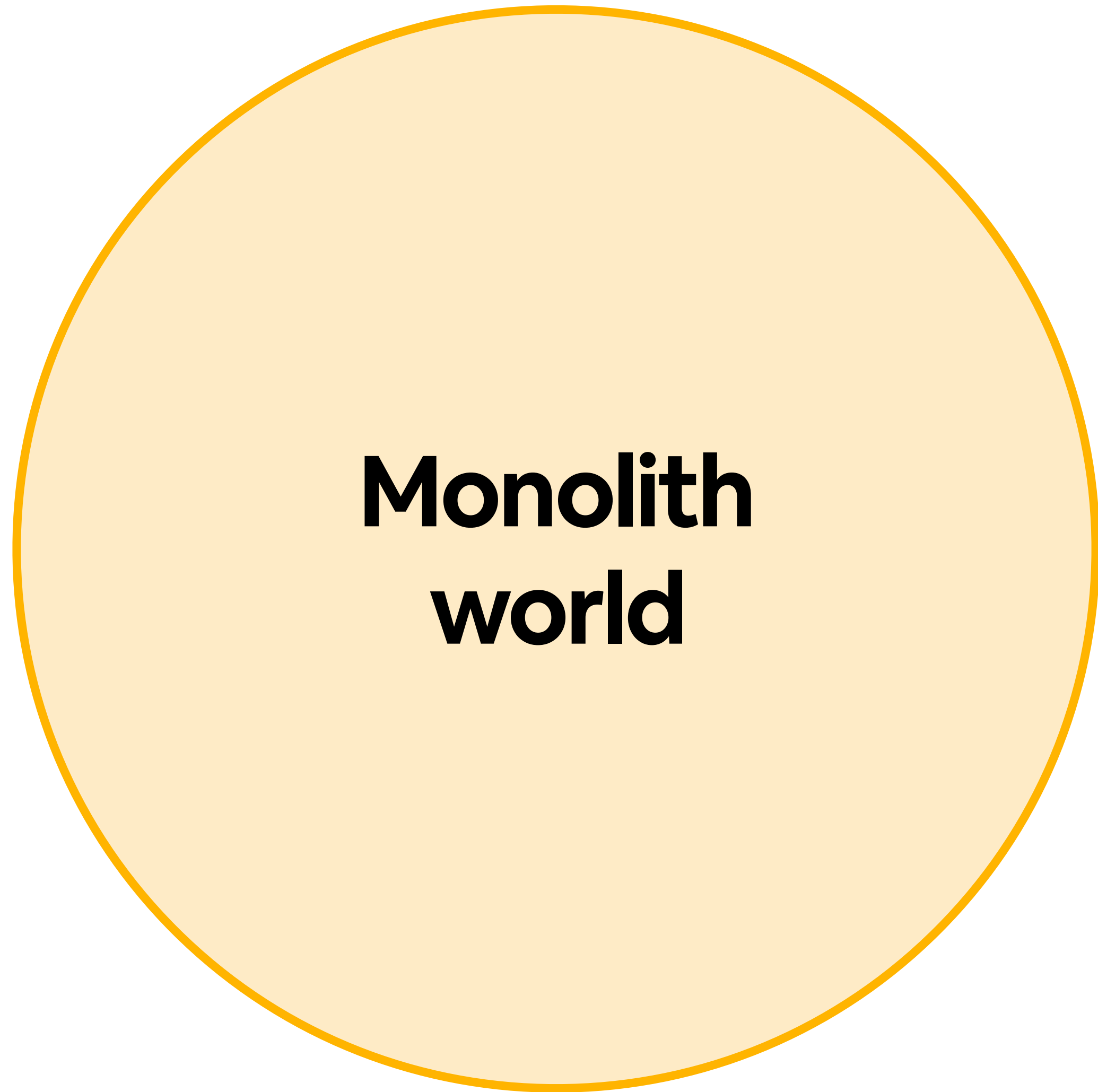


Request context →

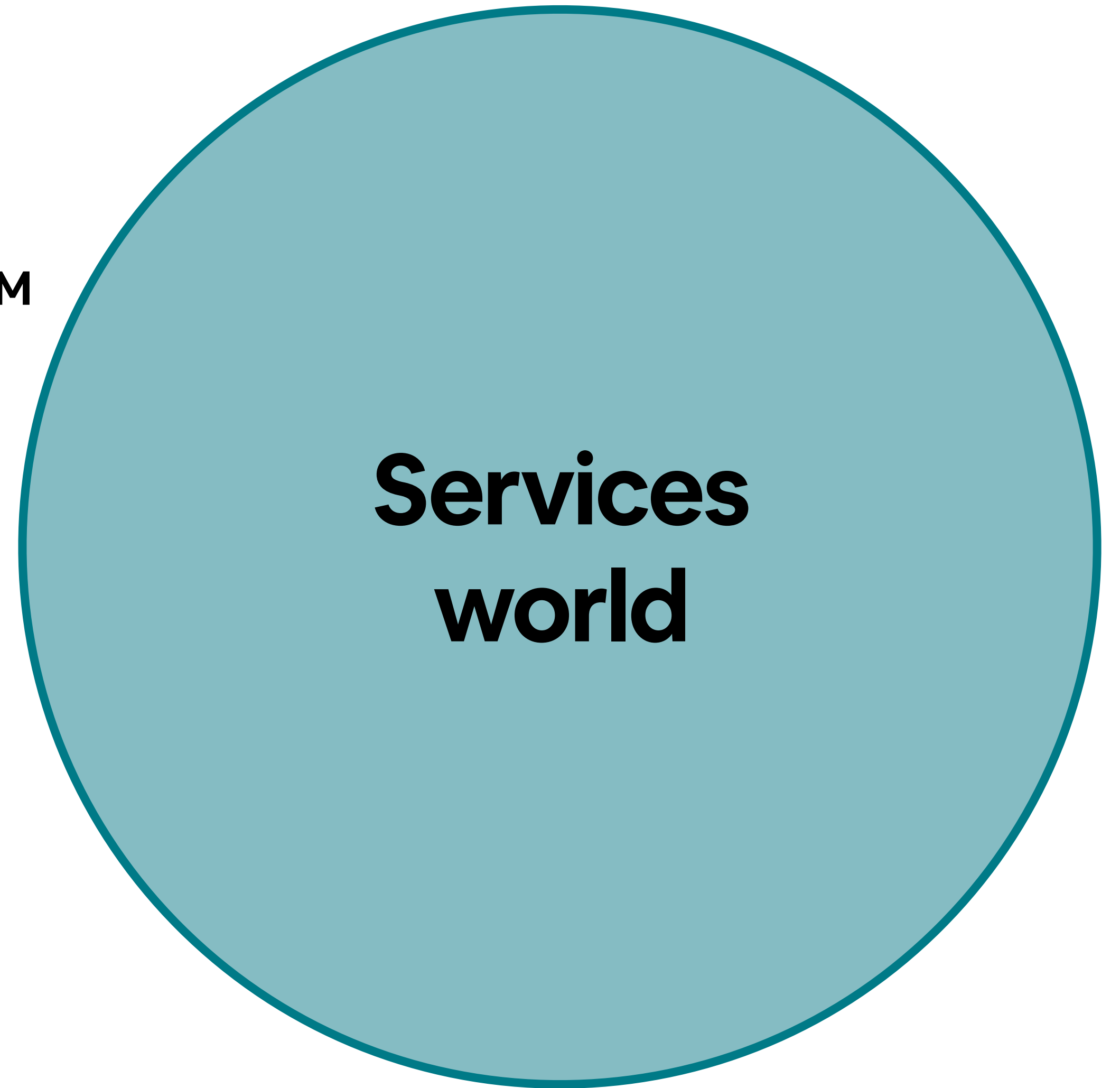
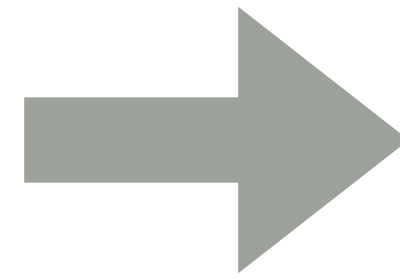
Presentation, logic, data

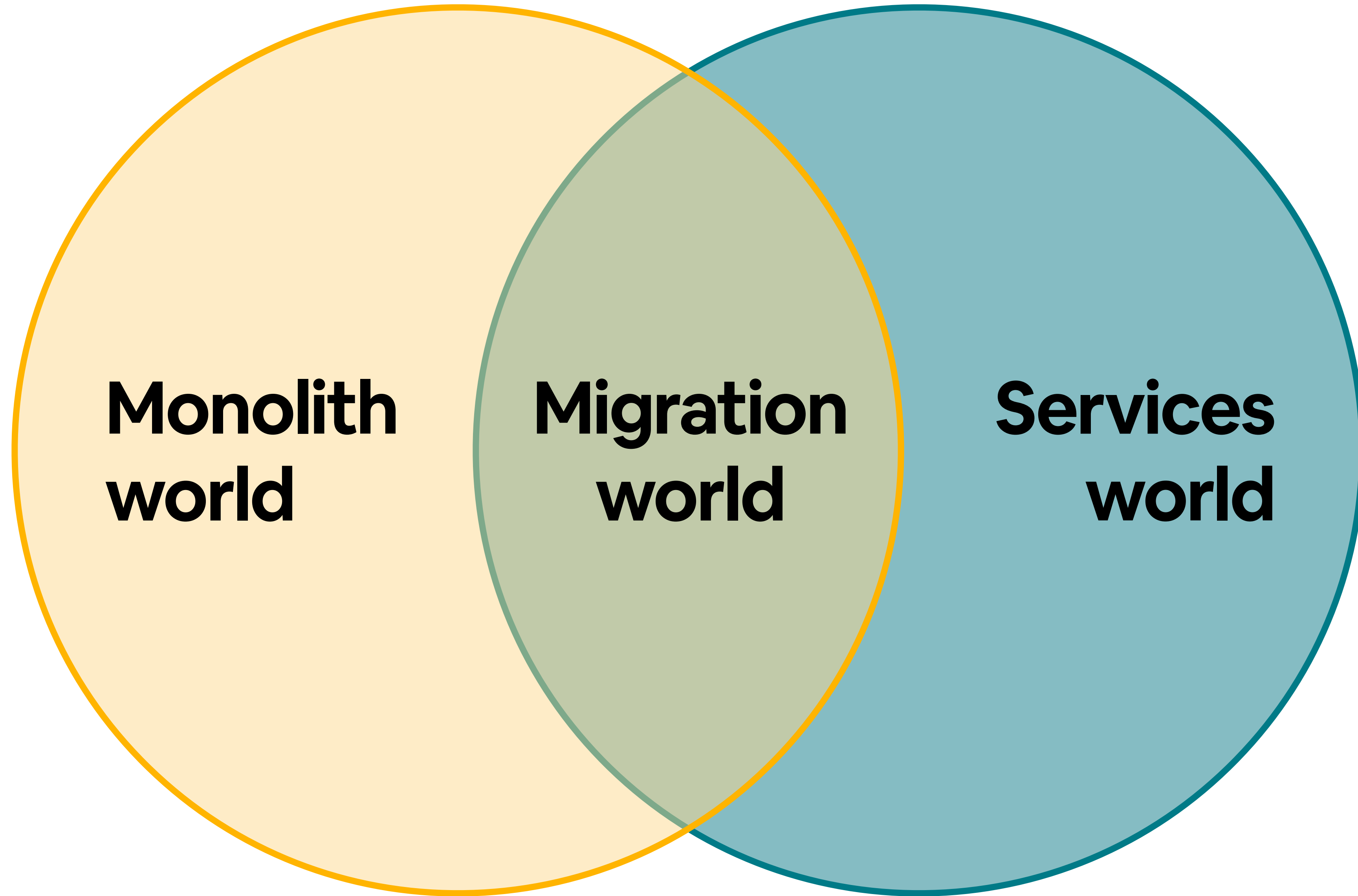


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The Future™



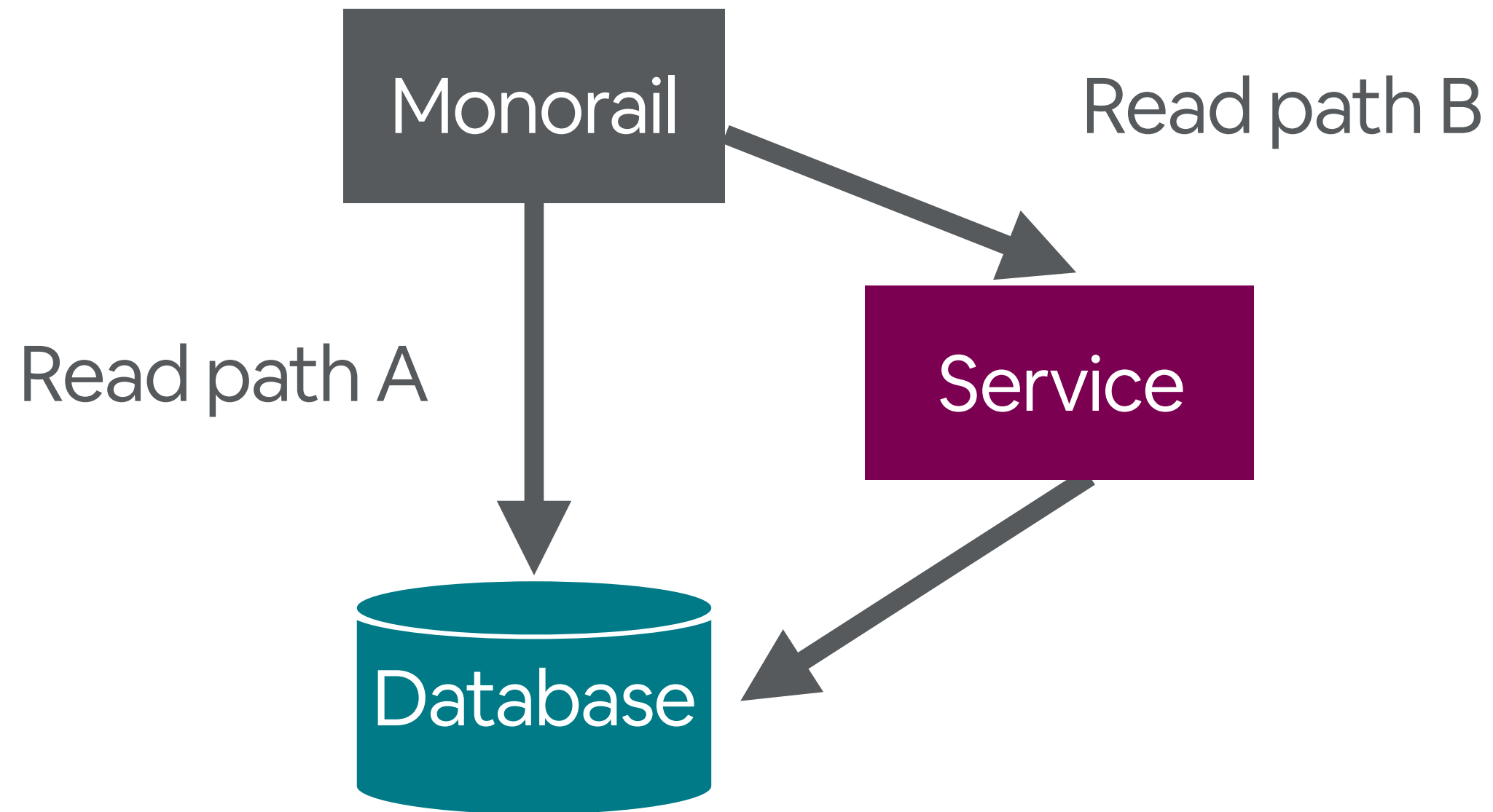


COMPARE FOR DIFFERENCES



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Dual read comparison



Gate

Compare

Ramp & wait

Wait

Switch

Admin web UI
configuration

1% traffic

Gradual
increments

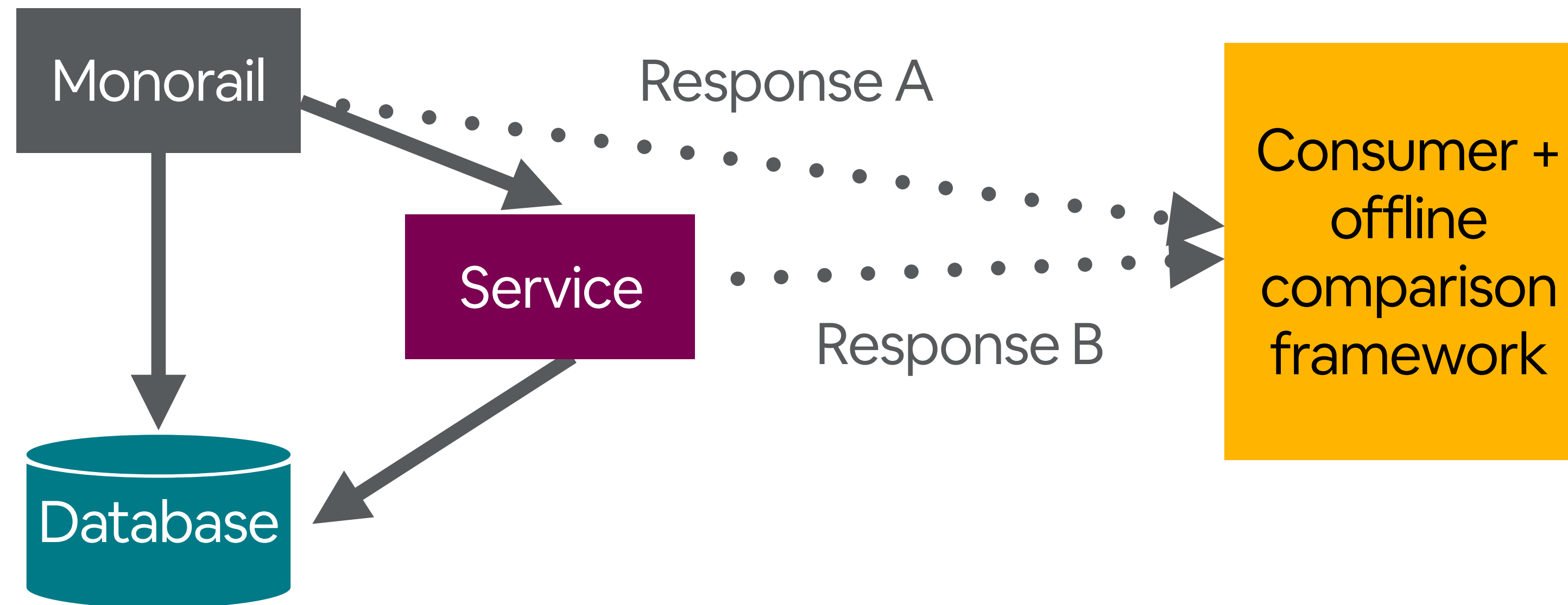
Gather traffic
patterns

All traffic through
service only



@jessicamtai

Dual read comparison



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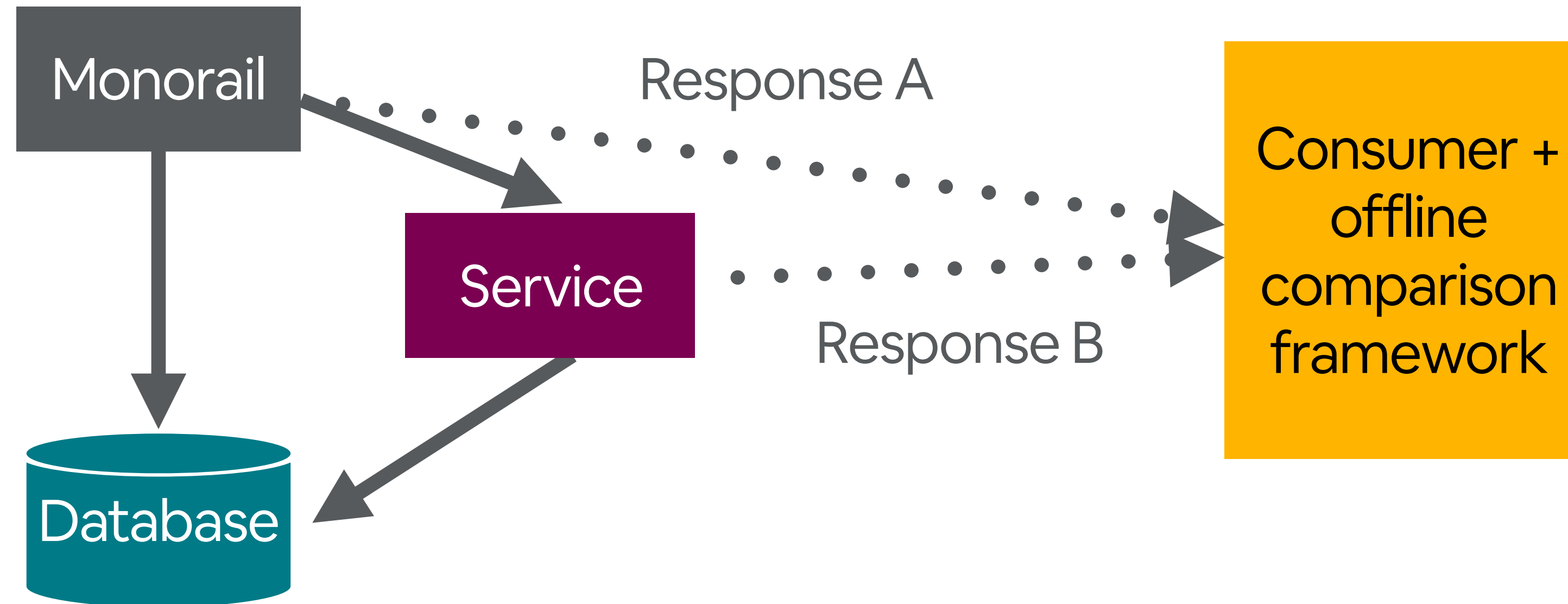
Gather traffic patterns

All traffic through service only



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Dual read comparison



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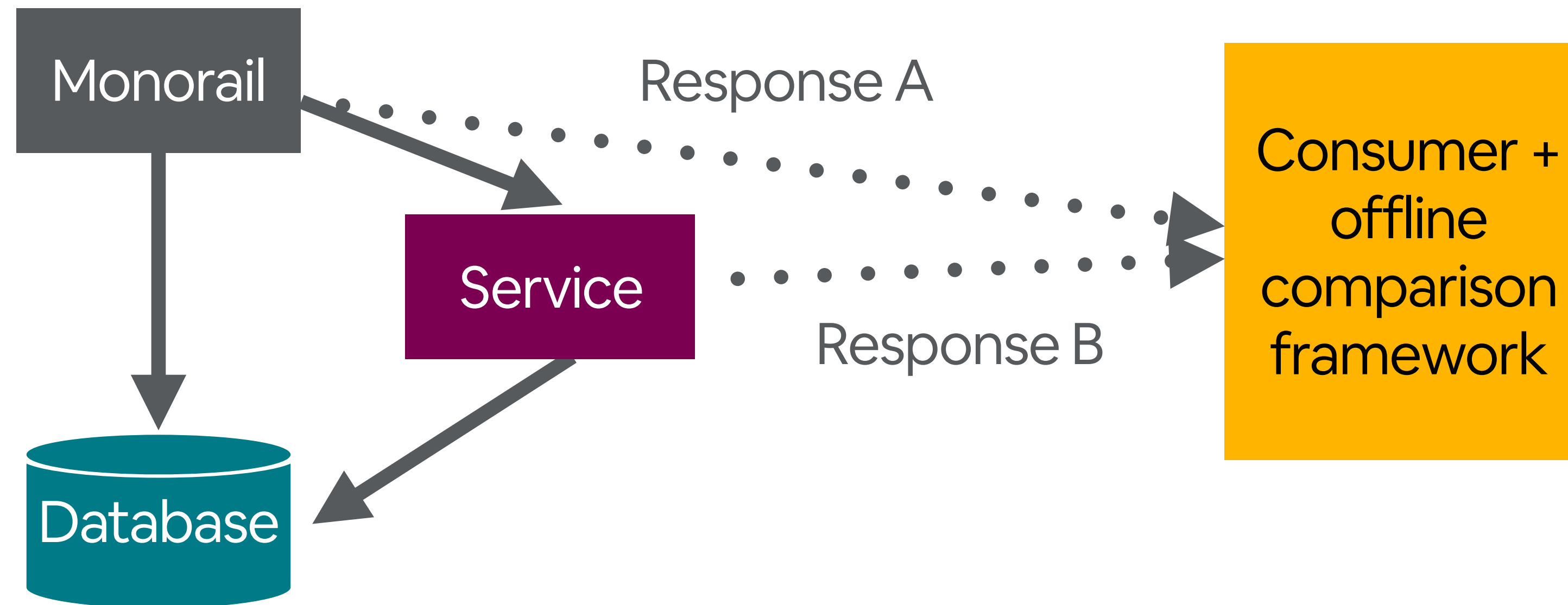
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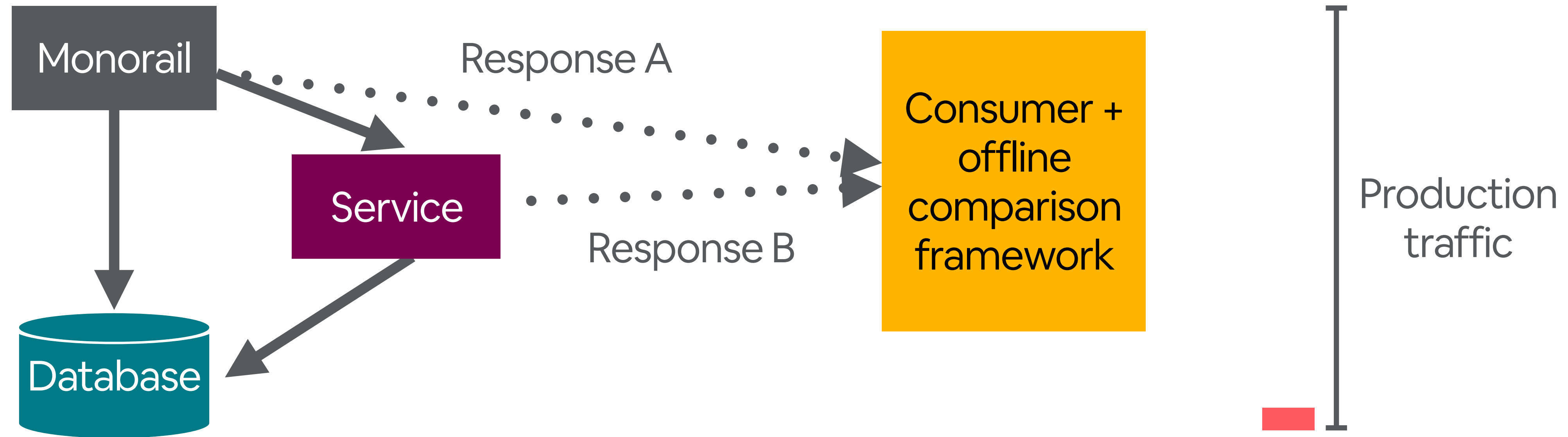
Gather traffic patterns

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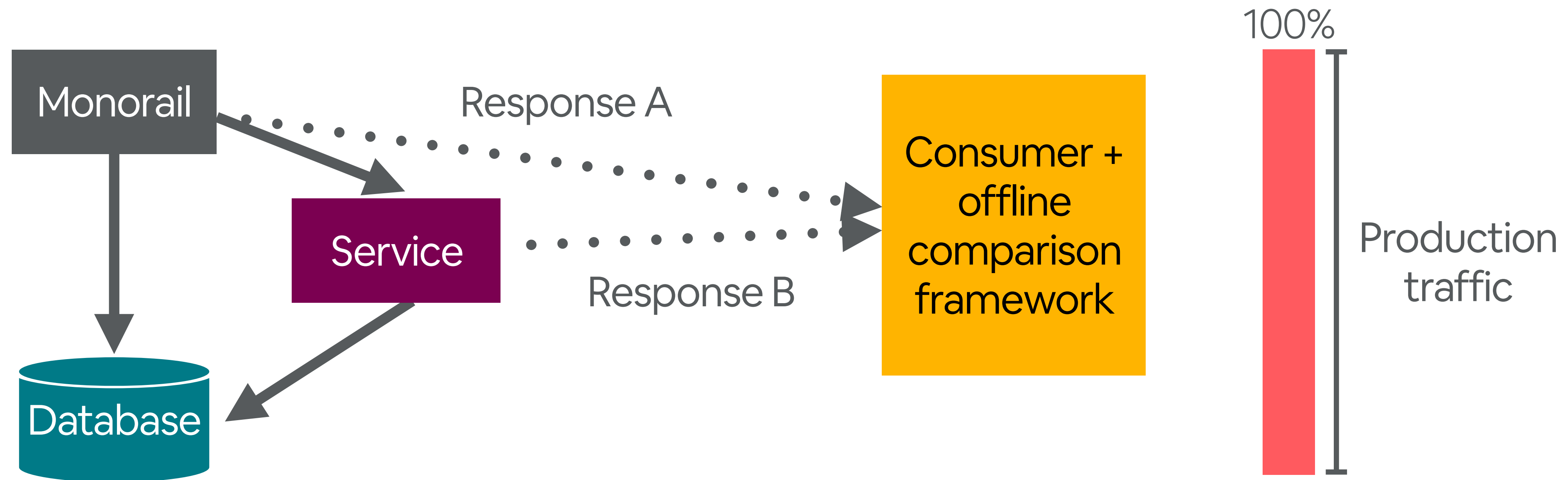
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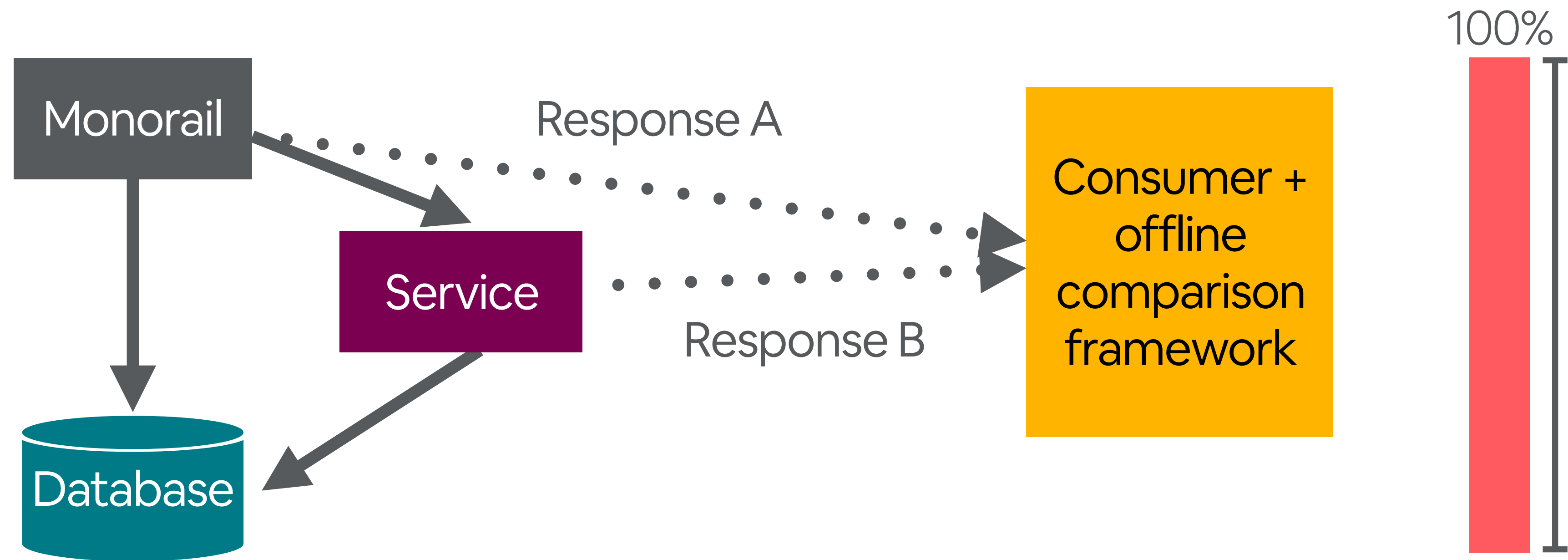
Gather traffic patterns

All traffic through service only



@jessicamtai

Dual read comparison



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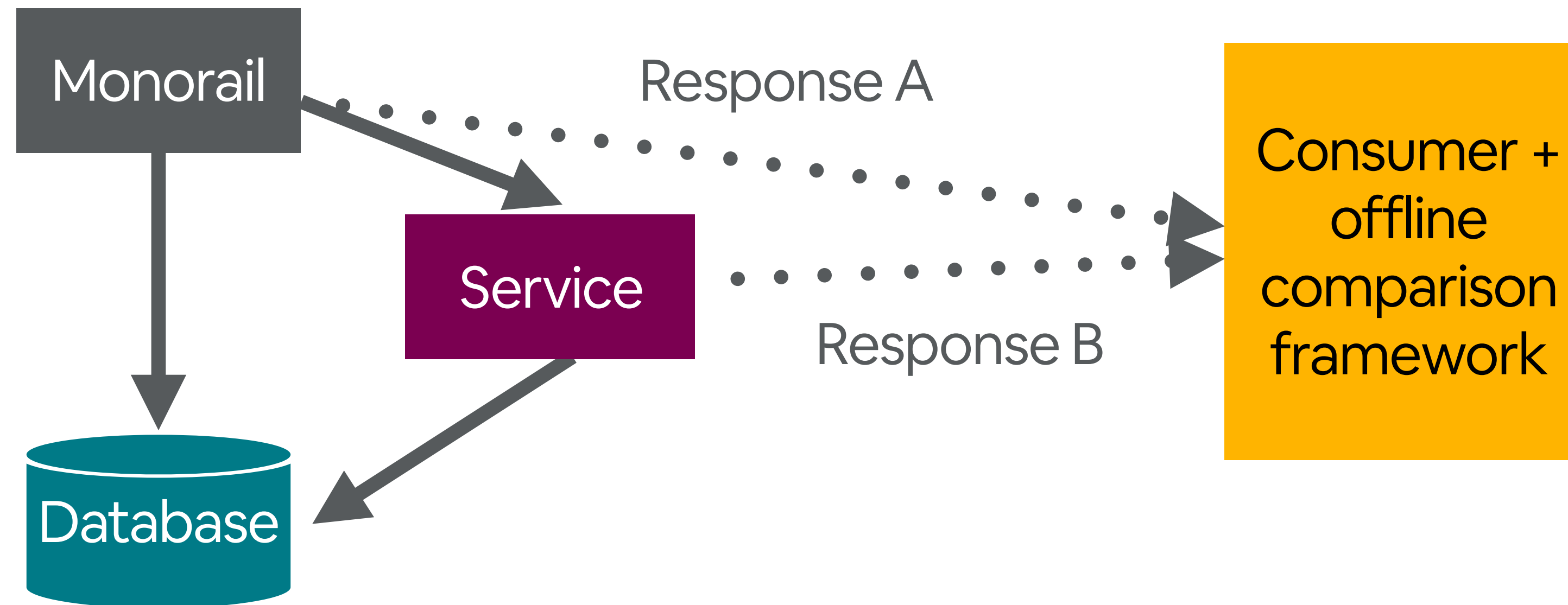
Gather traffic
patterns

All traffic through
service only



@jessicamtai

Dual read comparison



Gate

Compare

Ramp & wait

Wait

Switch

Admin web UI
configuration

1% traffic

Gradual
increments

Gather traffic
patterns

All traffic through
service only



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Dual read comparison



The only read path

Gate



Admin web UI
configuration

Compare



1% traffic

Ramp & wait



Gradual
increments

Wait



Gather traffic
patterns

Switch



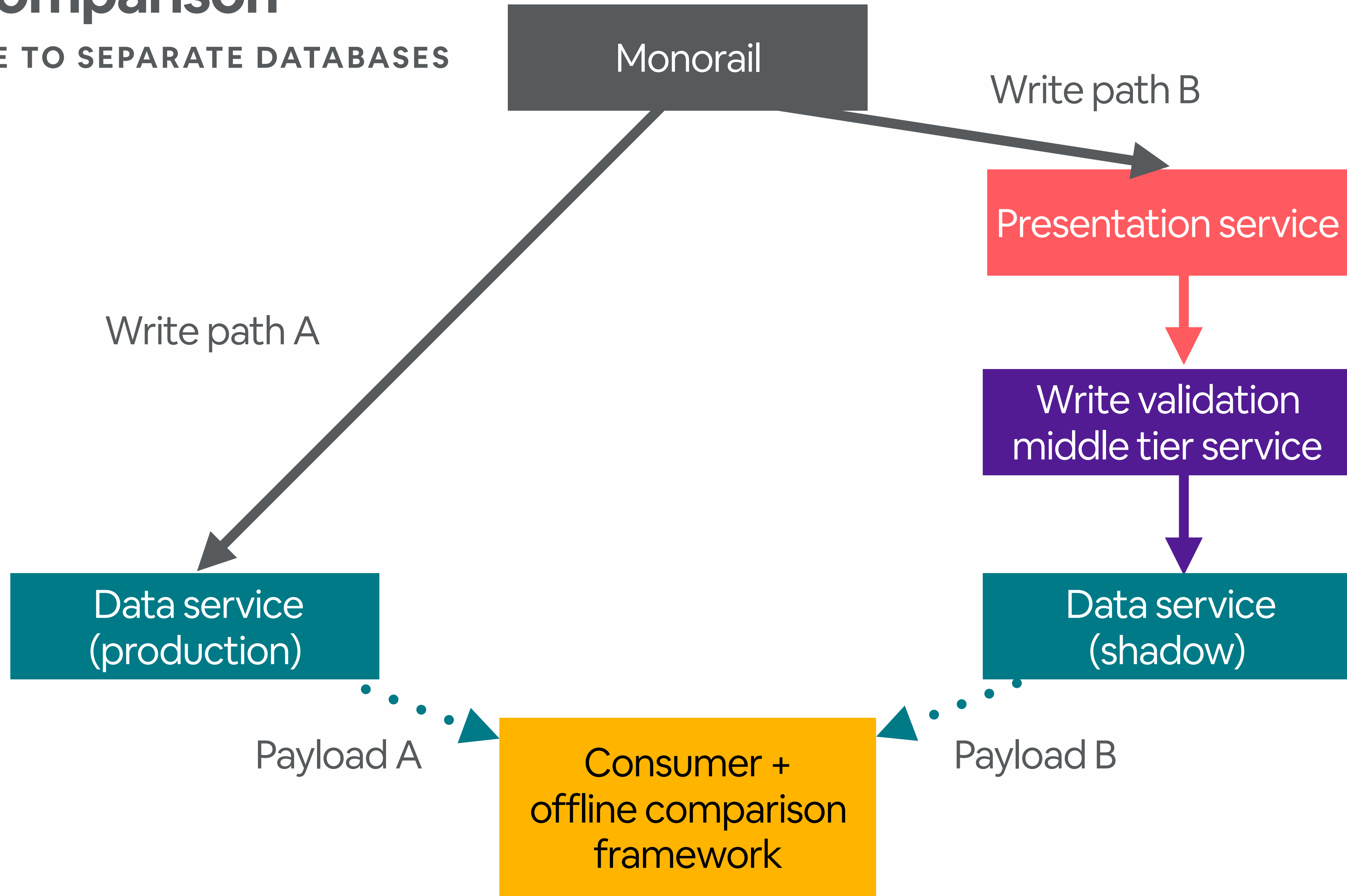
All traffic through
service only



@jessicamtai

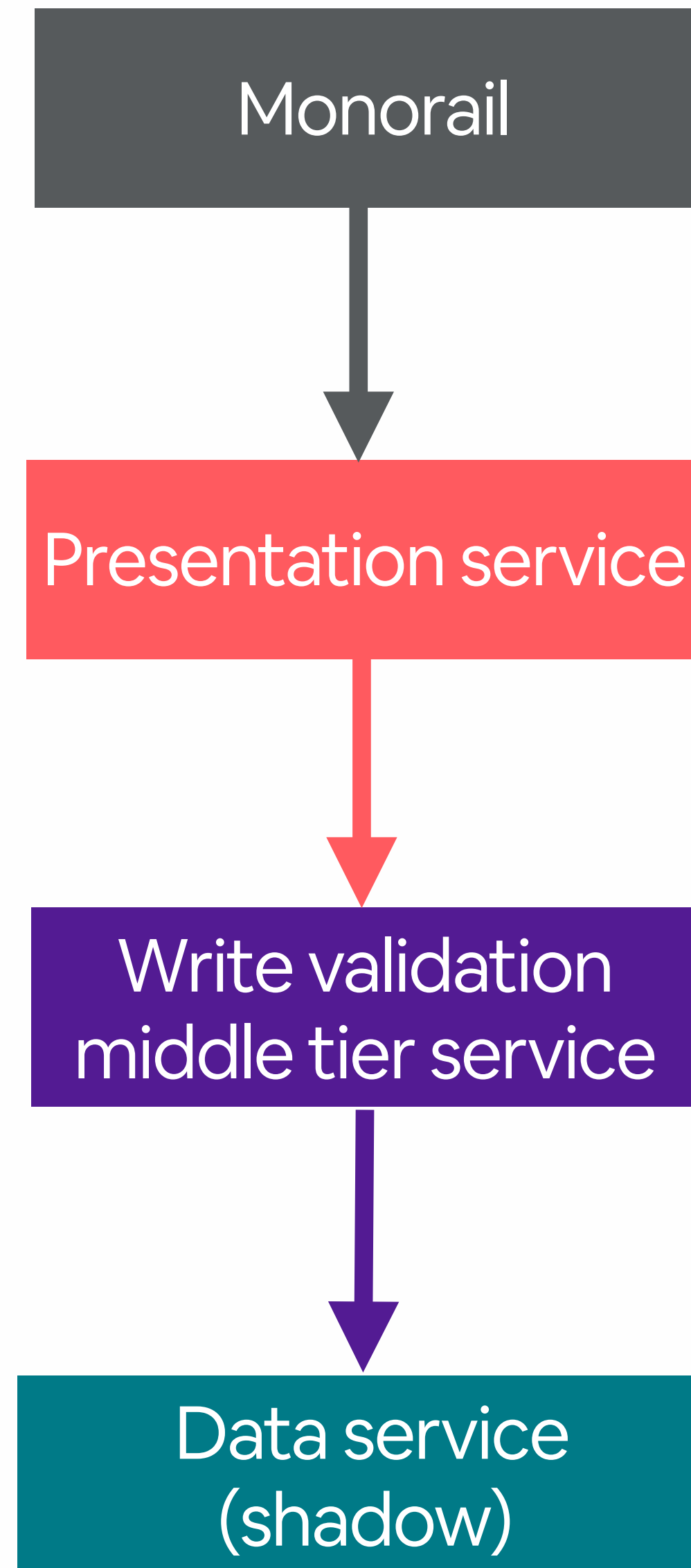
Write comparison

DUAL WRITE TO SEPARATE DATABASES



Write comparison

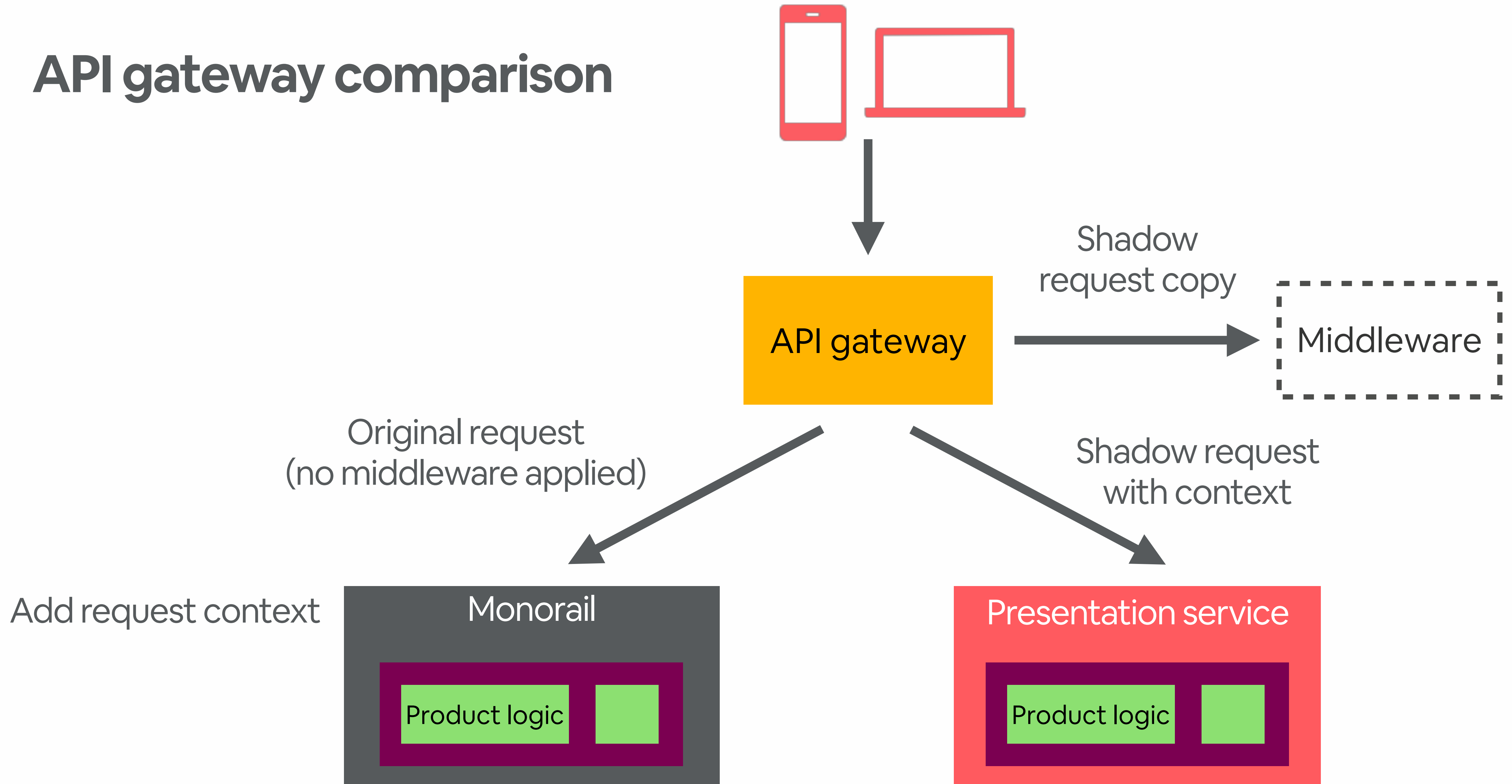
DUAL WRITE TO SEPARATE DATABASES



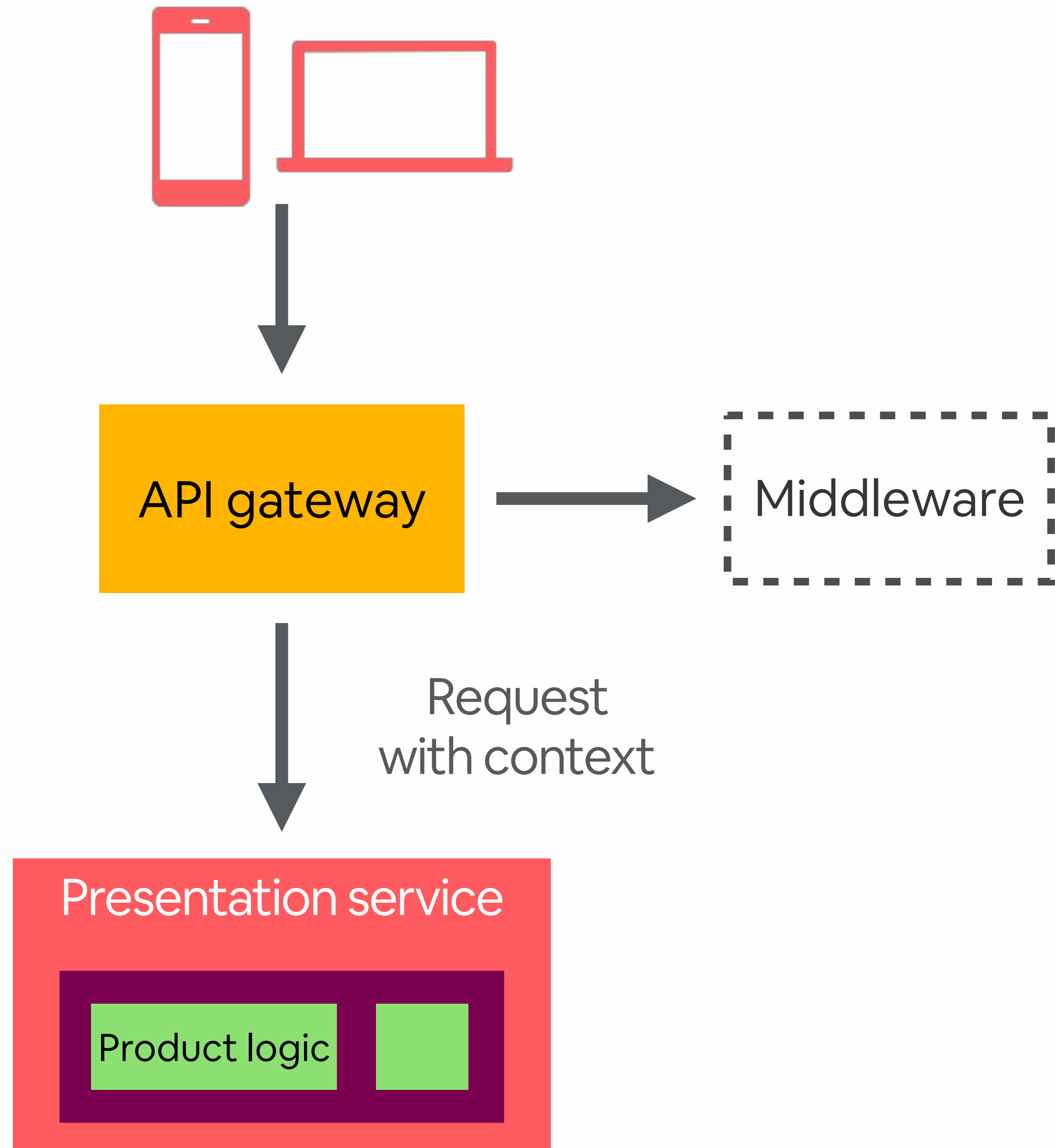
The only write path



API gateway comparison



API gateway comparison



A person wearing a blue dress and white sneakers with dark stripes is standing on ancient stone steps. A camera is hanging from their neck. The background shows a historical site with stone structures and other visitors.

Incremental migration



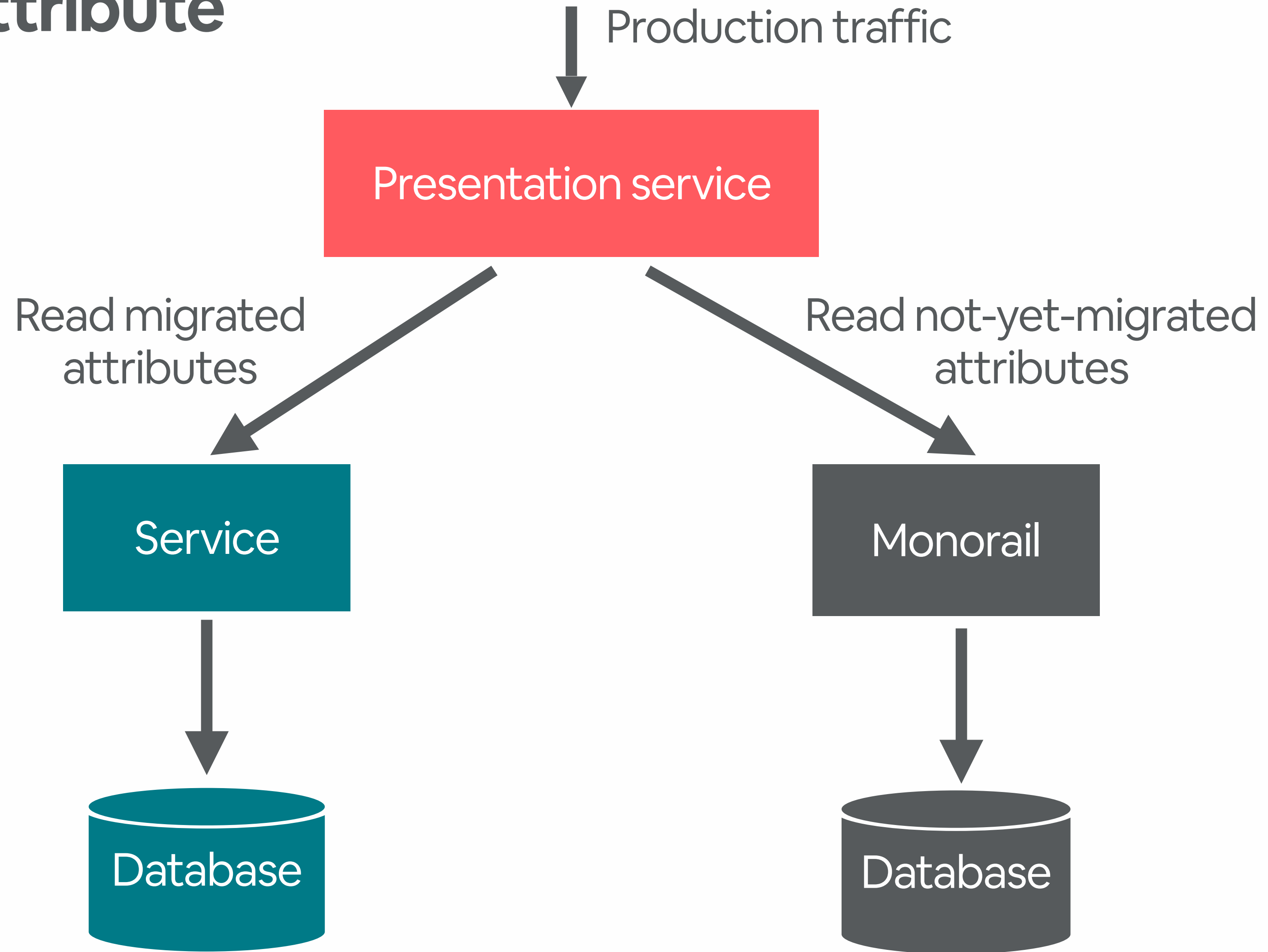
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Migrate by endpoint

- Production traffic with partially complete service
 - e.g. batch API `/LoadUsers`
 - Fetch users only by user id
- Unblock clients



Migrate by attribute



A herd of wildebeest is running across a savanna landscape. The animals are in motion, with some in the foreground and others further back. The background shows sparse trees and a hazy horizon. The image has a greenish-yellow tint.

SOA BEST PRACTICES



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Standardize service building

SCALE WITH CONSISTENCY



Frameworks

Auto-generate code



Testing & deploying

Replay production traffic



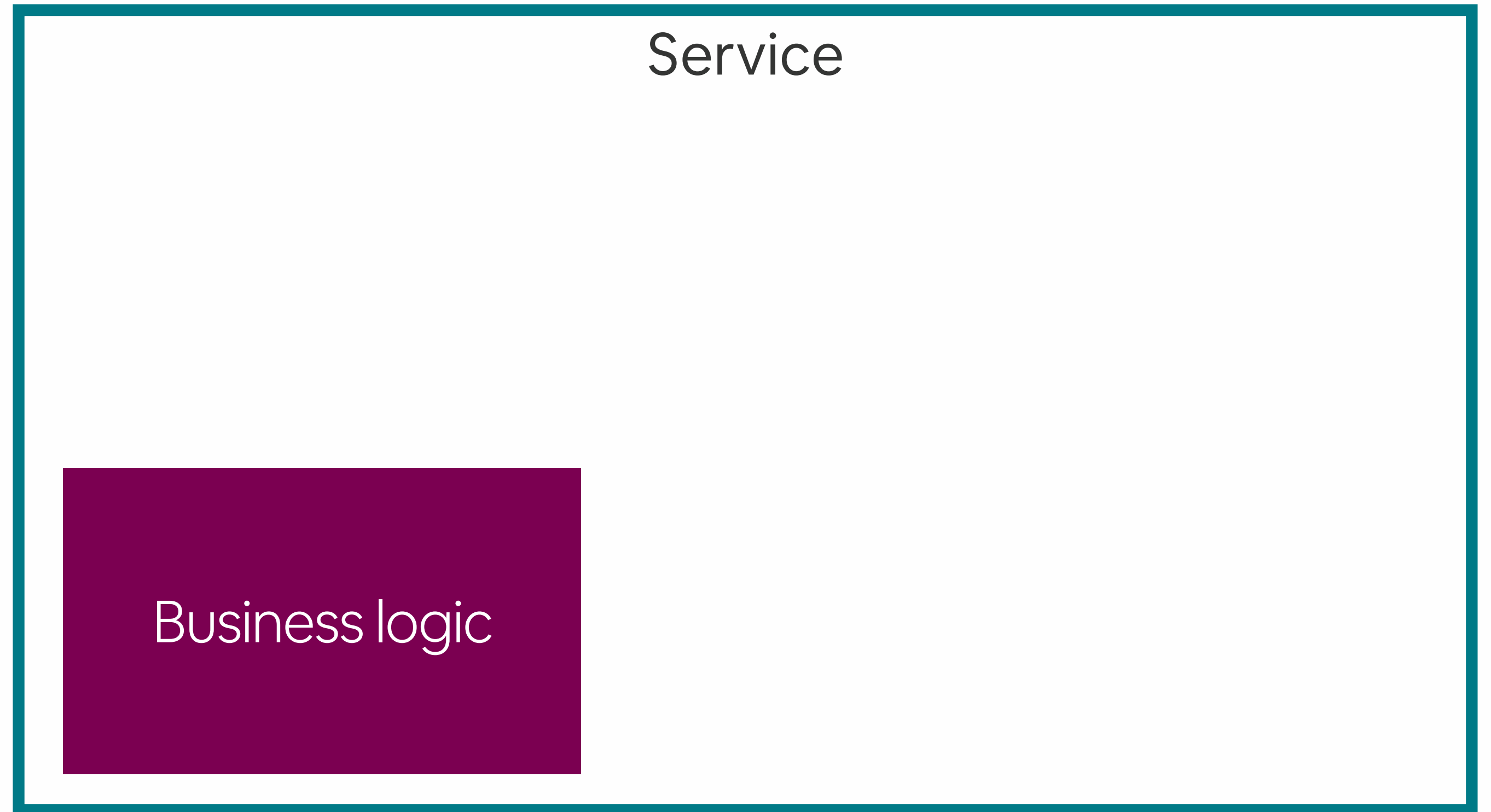
Observability

Standard templates

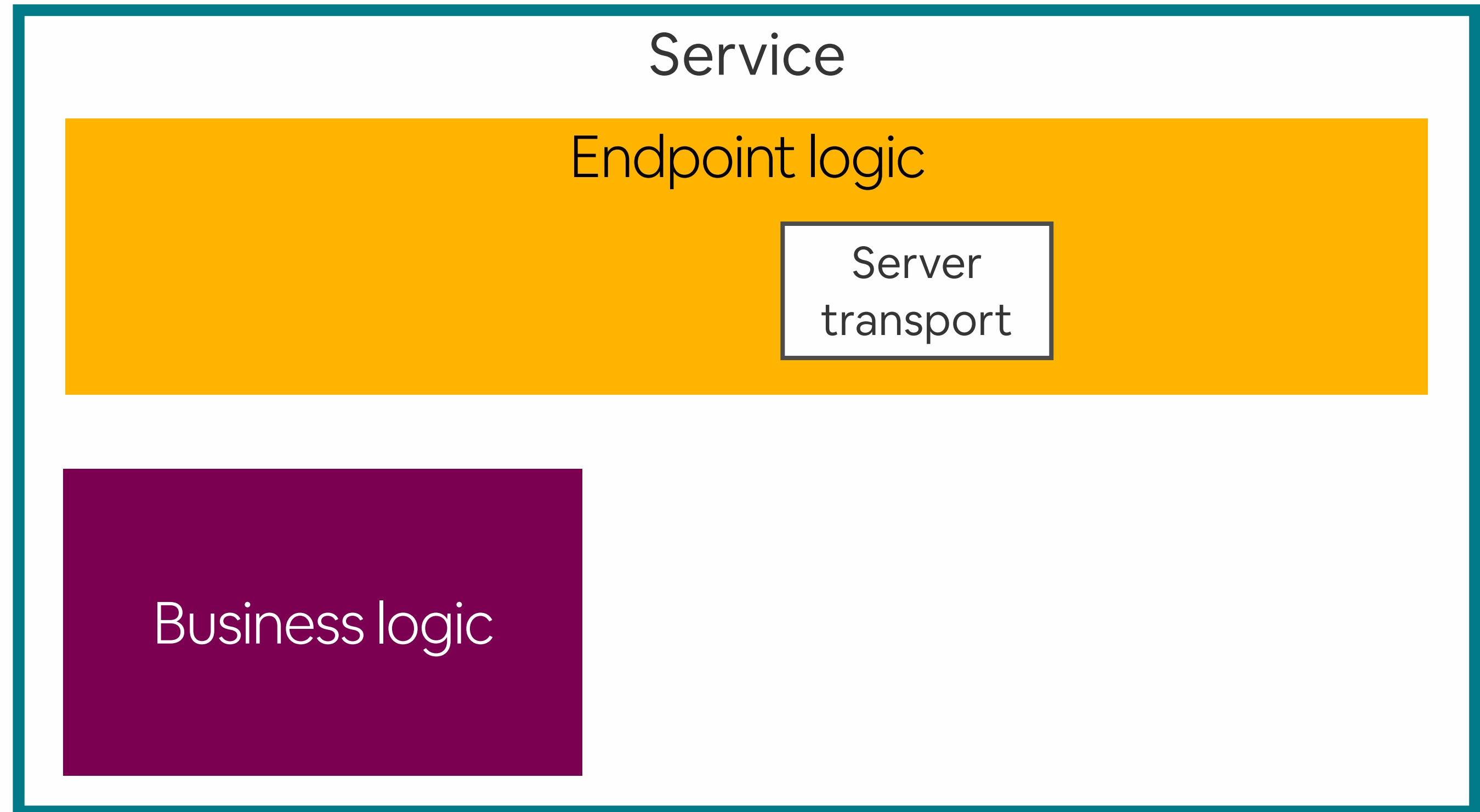


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Service & client setup



Service & client setup



Service & client setup

Java client

Client
transport

Ruby client

Client
transport

Service

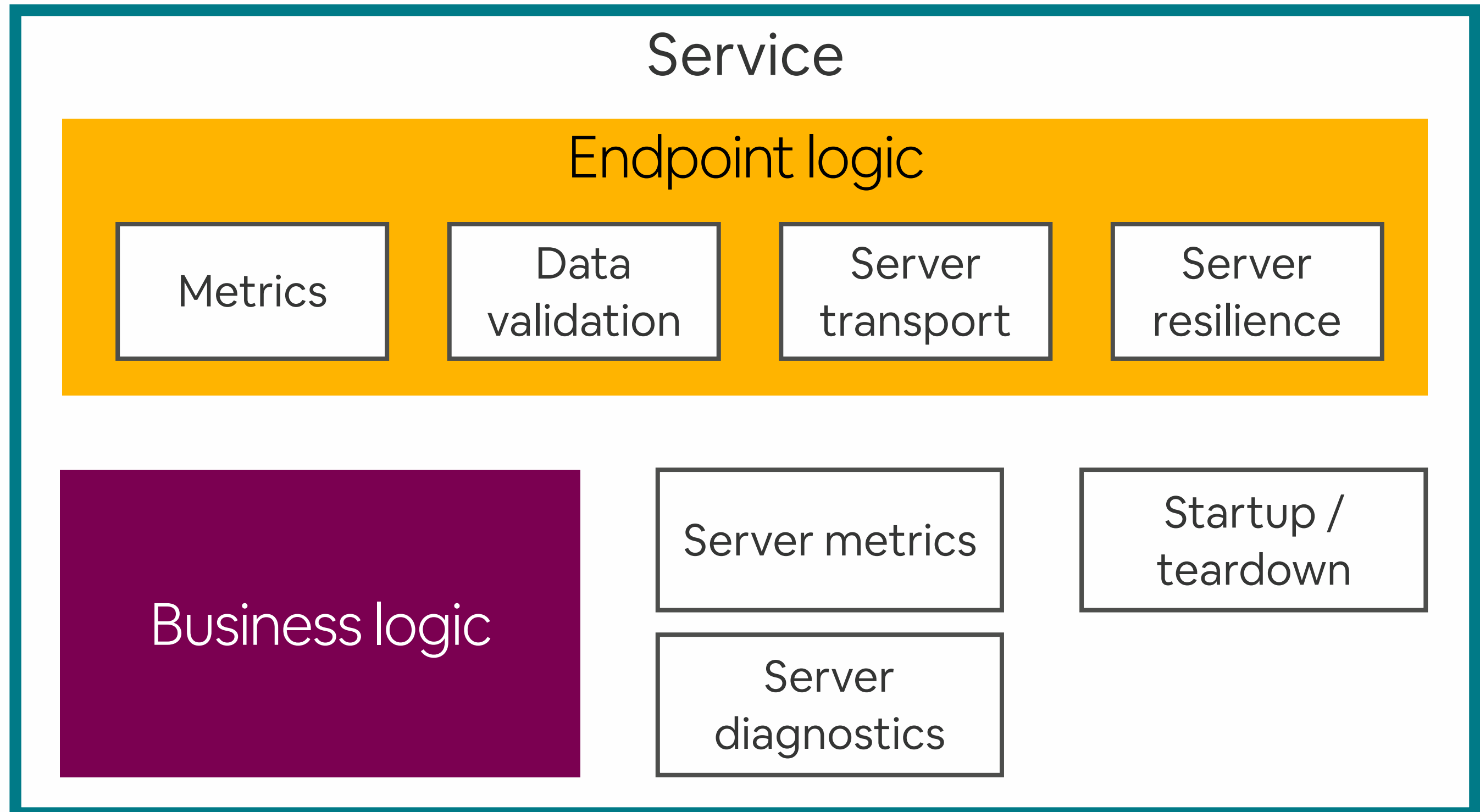
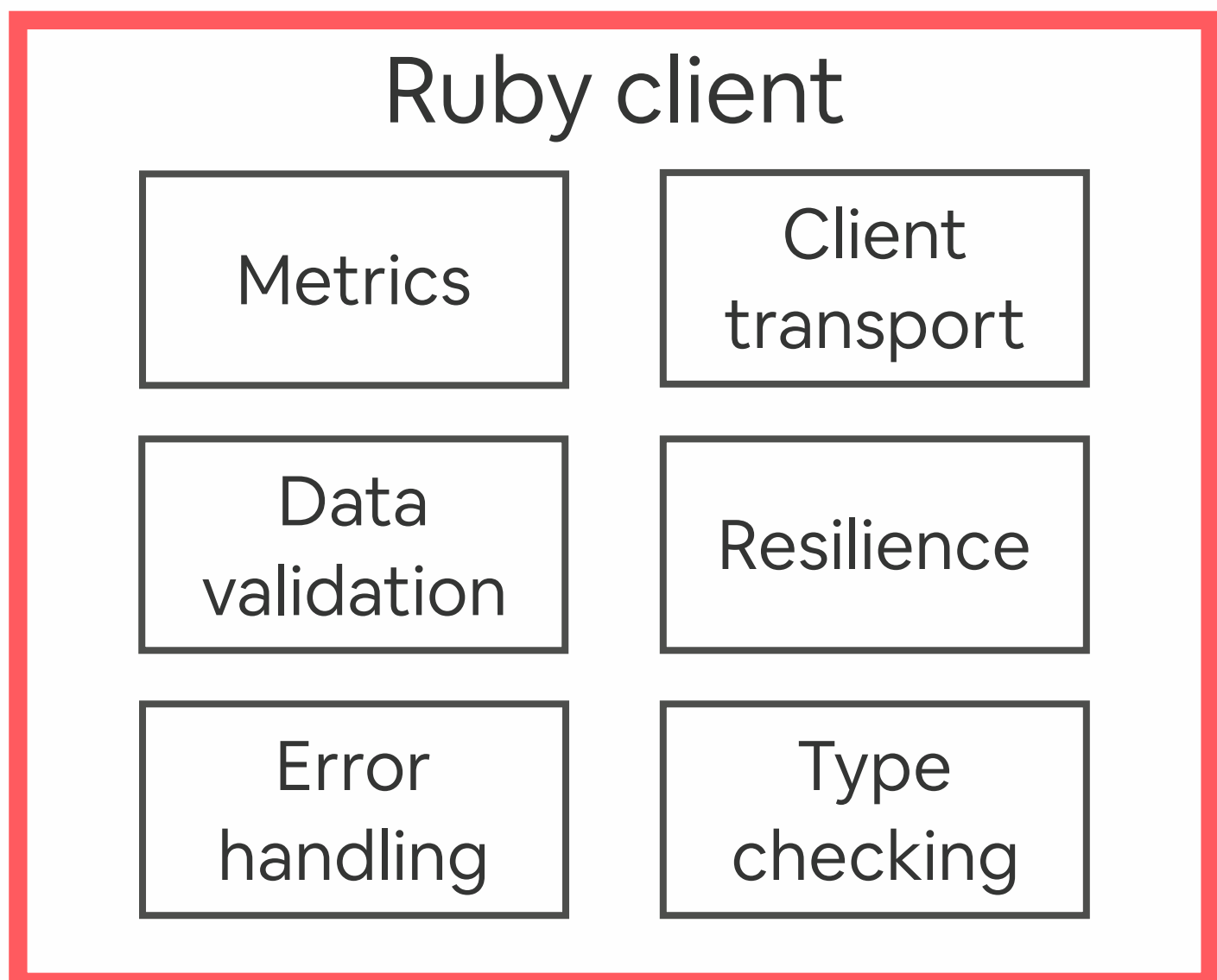
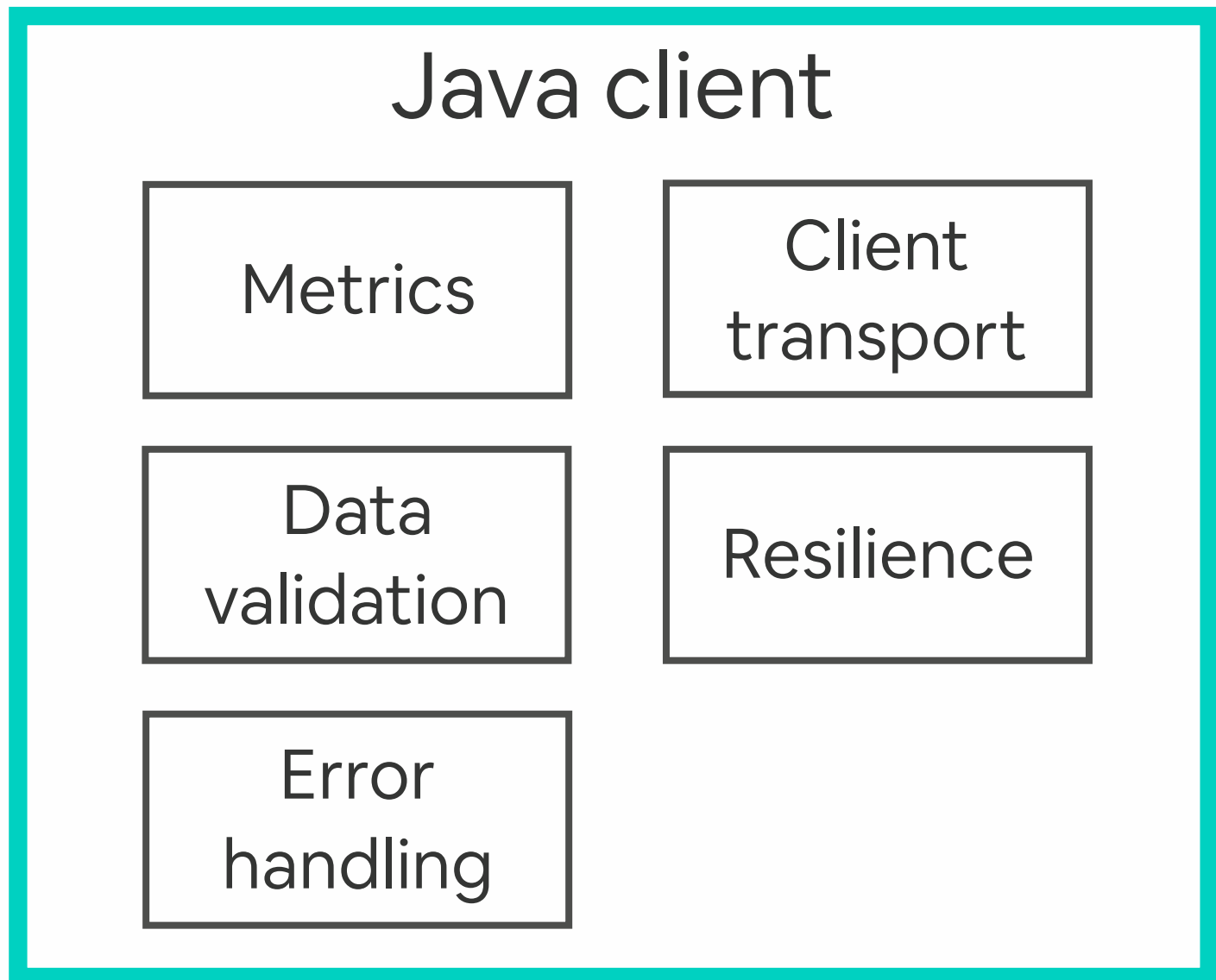
Endpoint logic

Server
transport

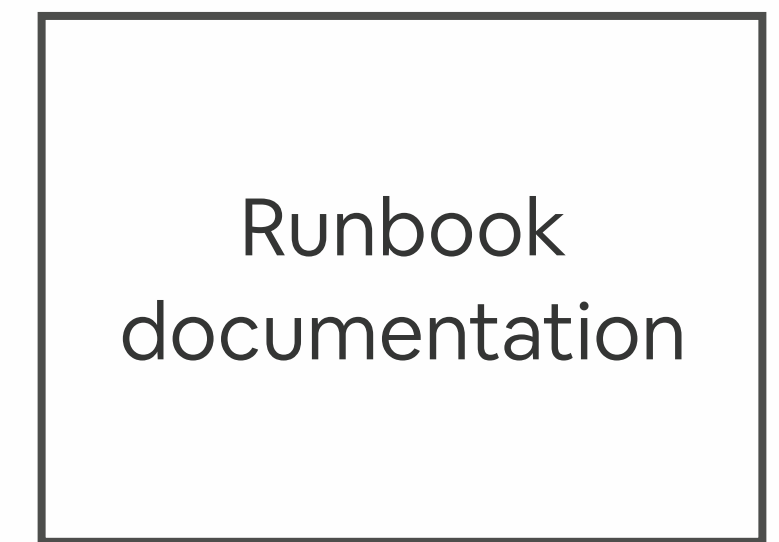
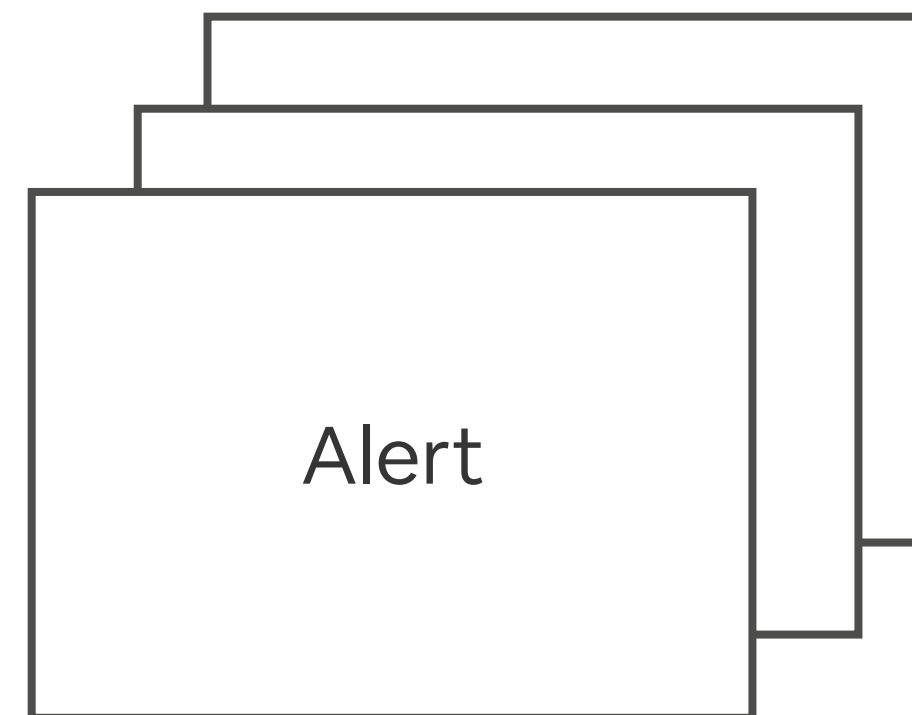
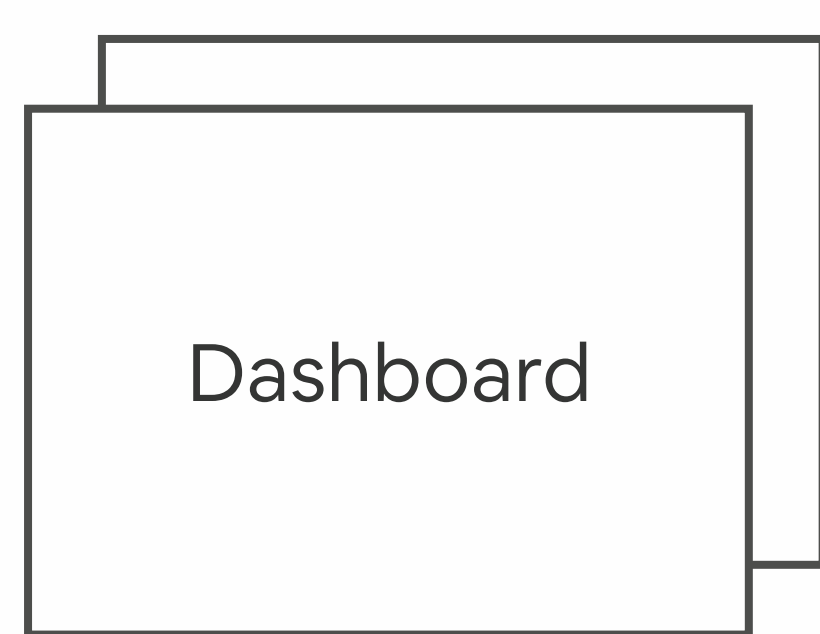
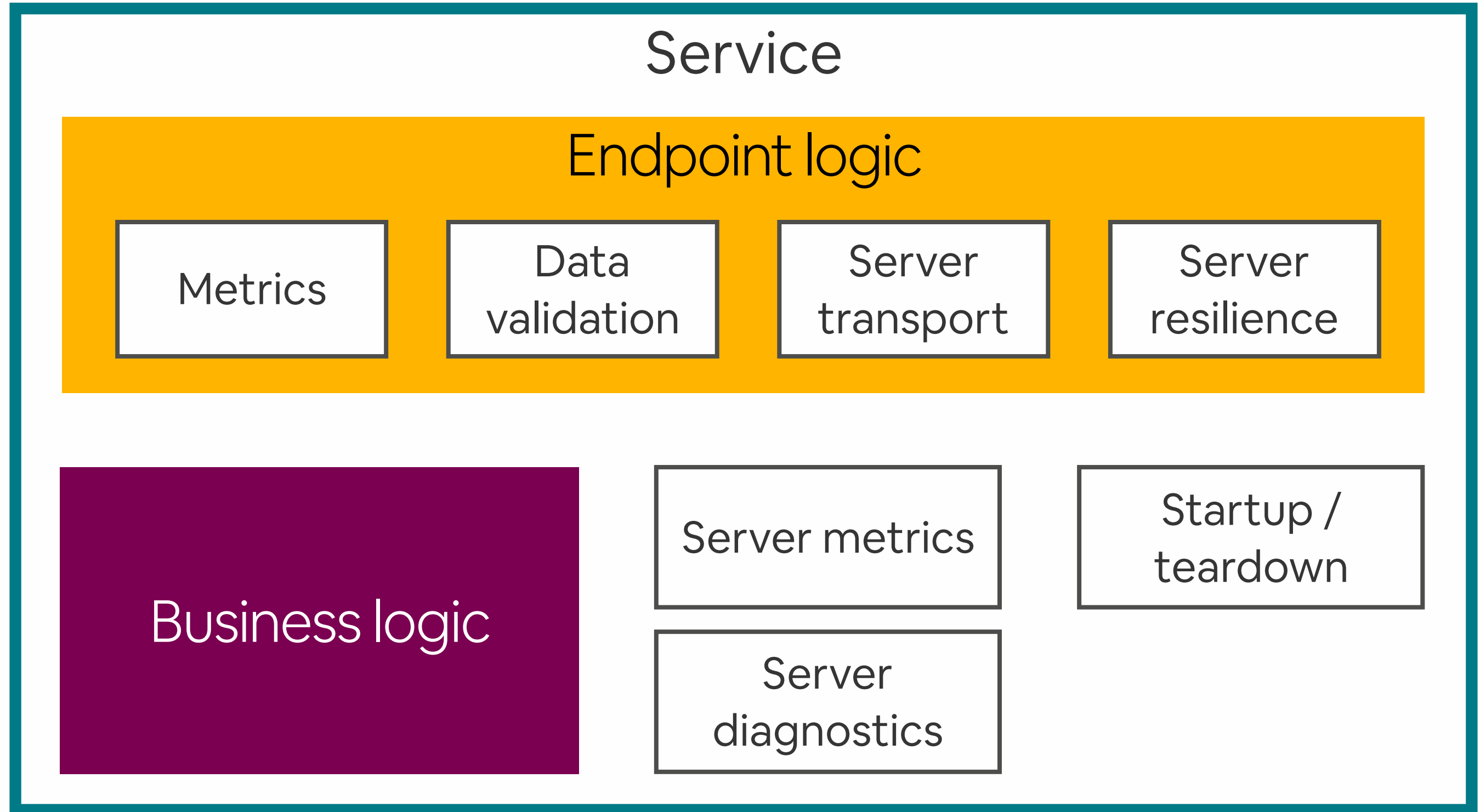
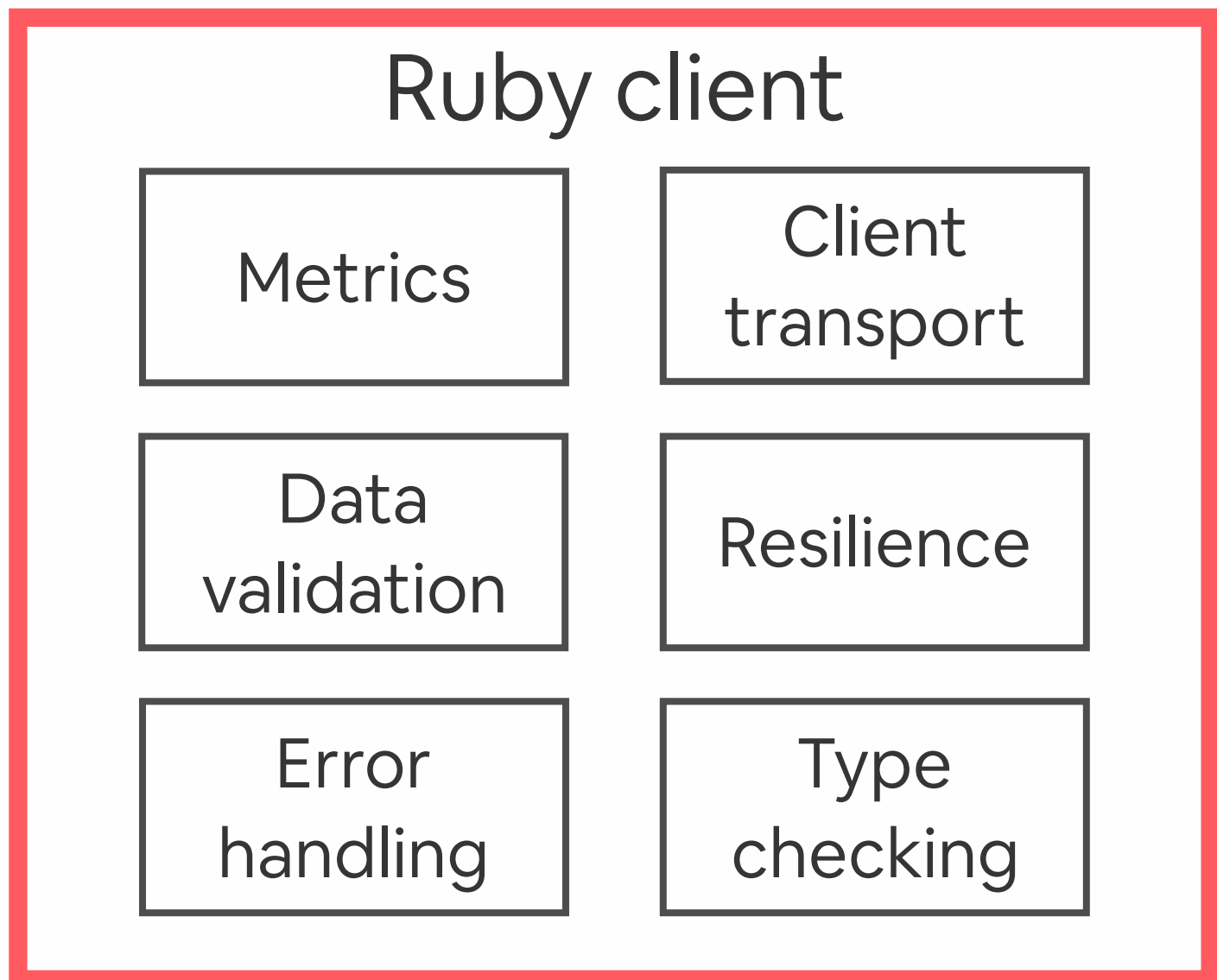
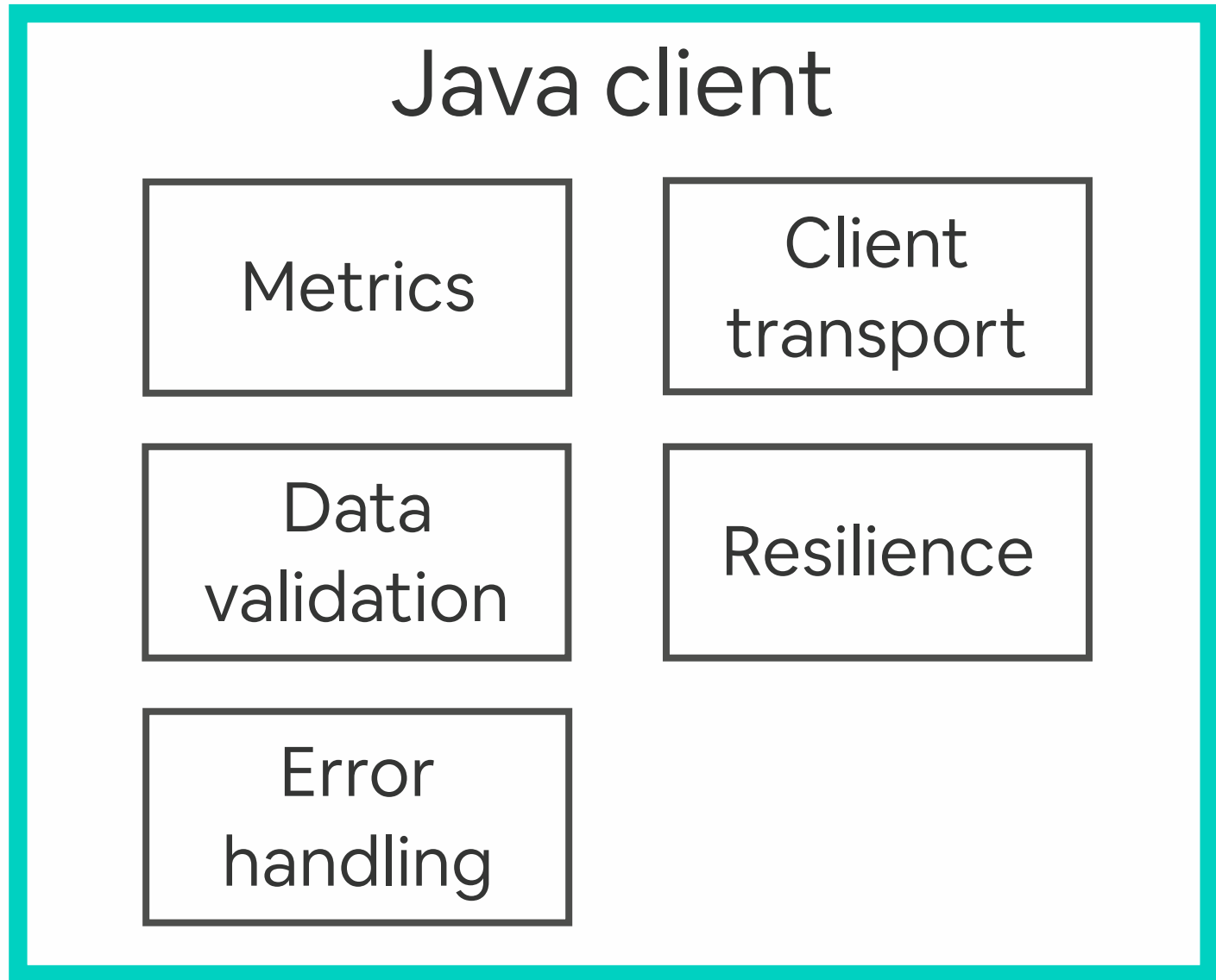
Business logic



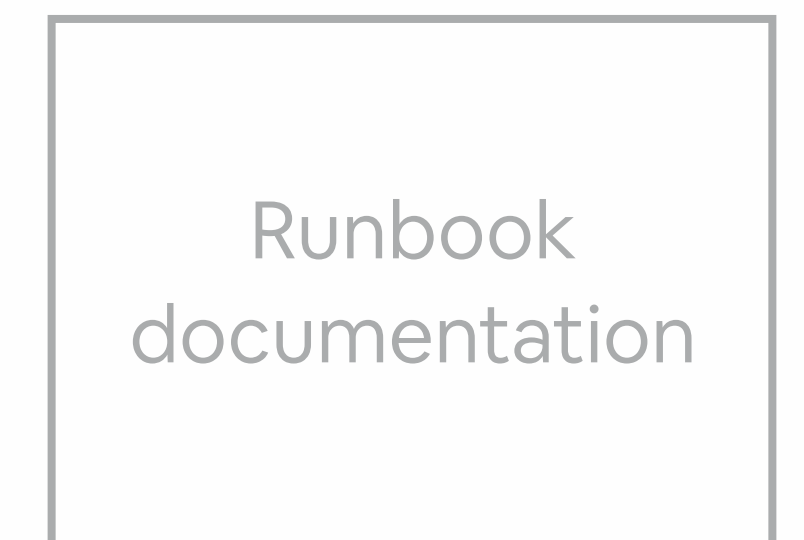
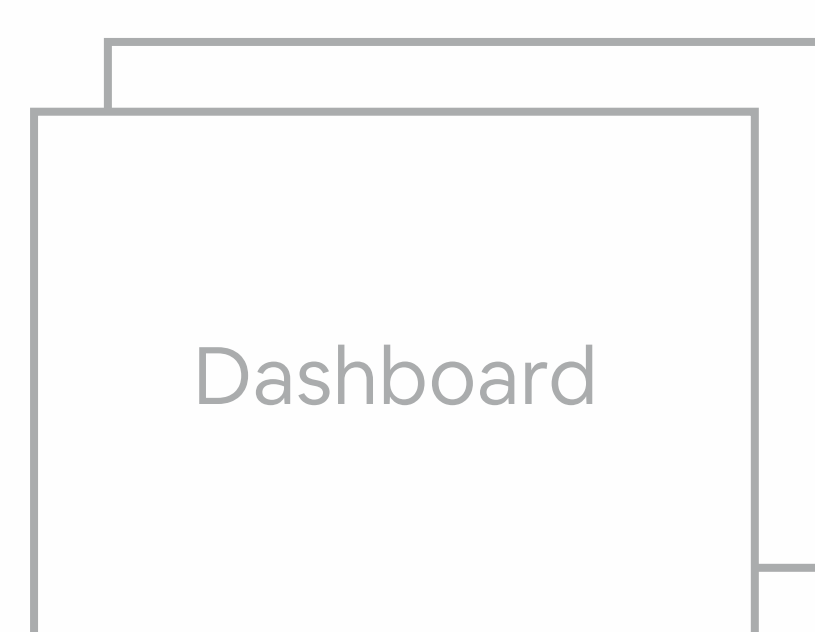
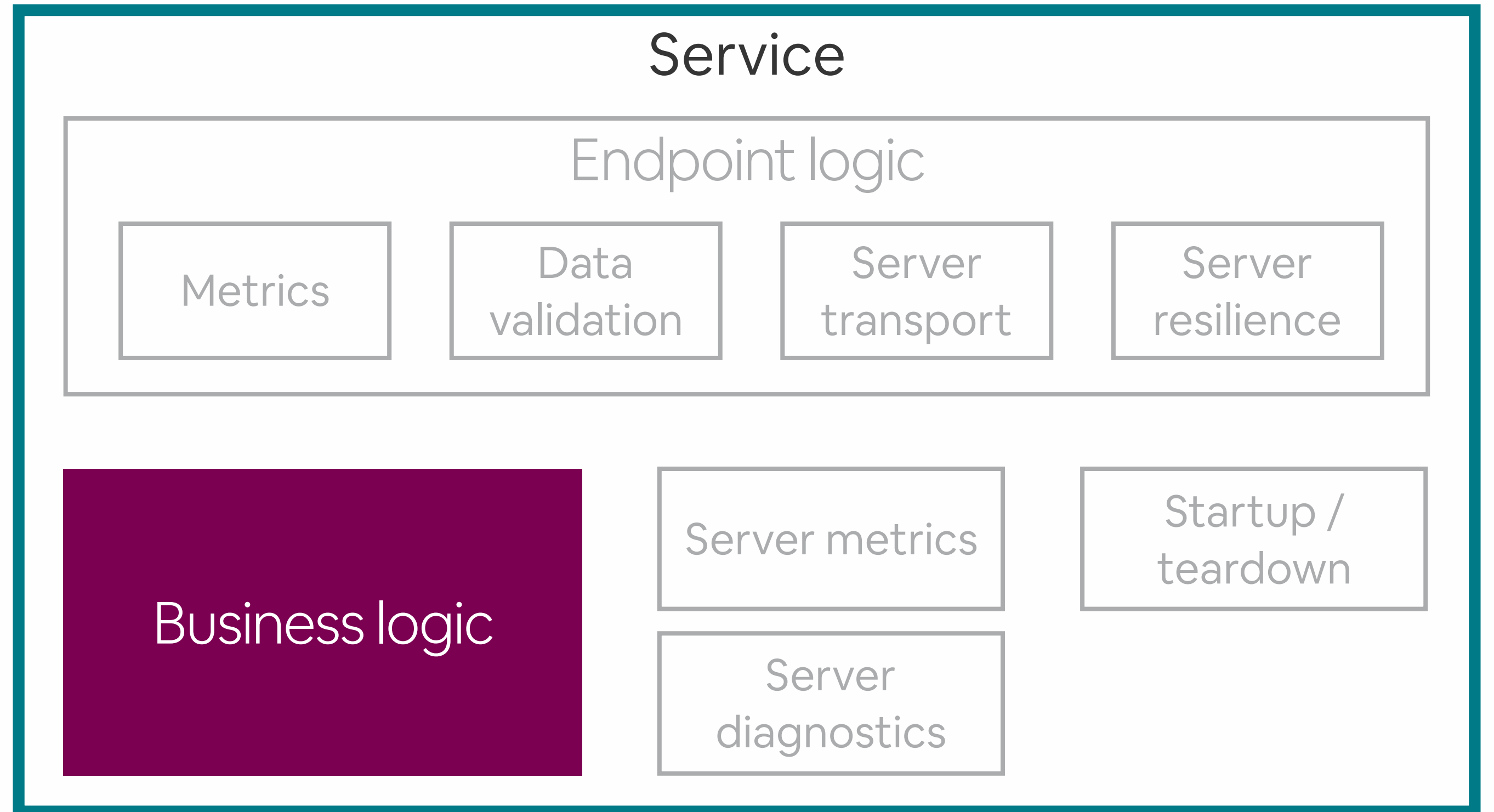
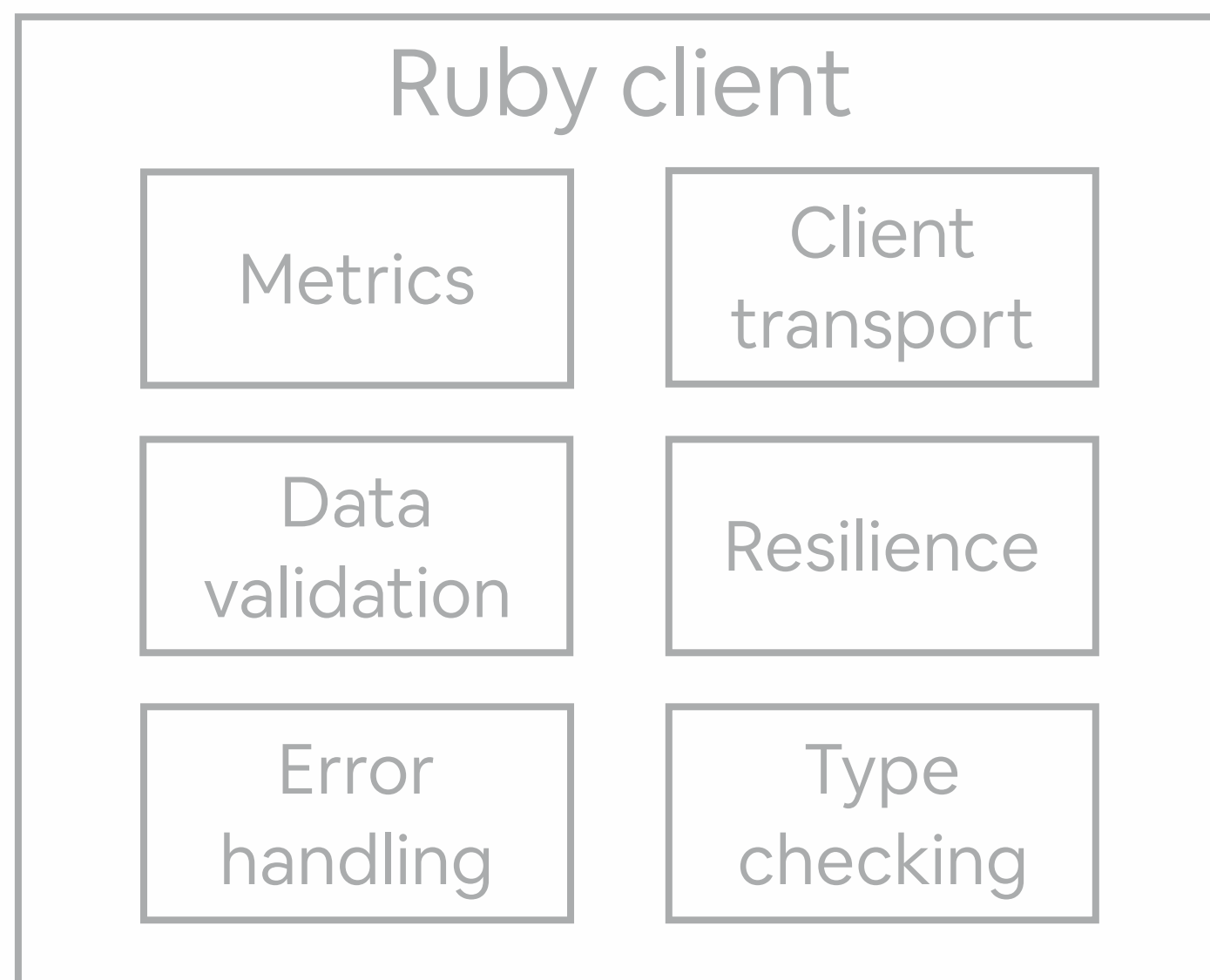
Service & client setup



Service & client setup



Service & client setup

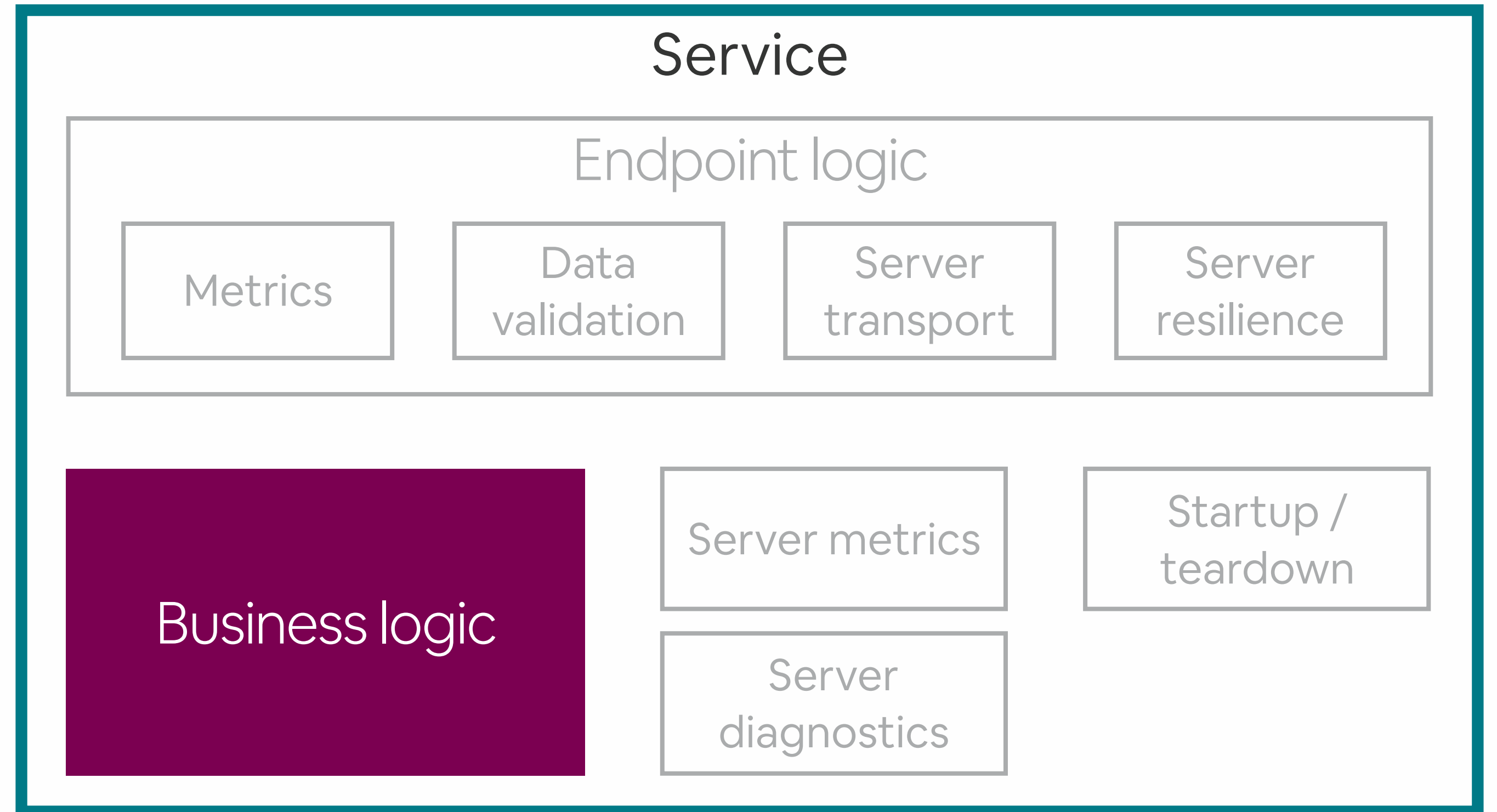
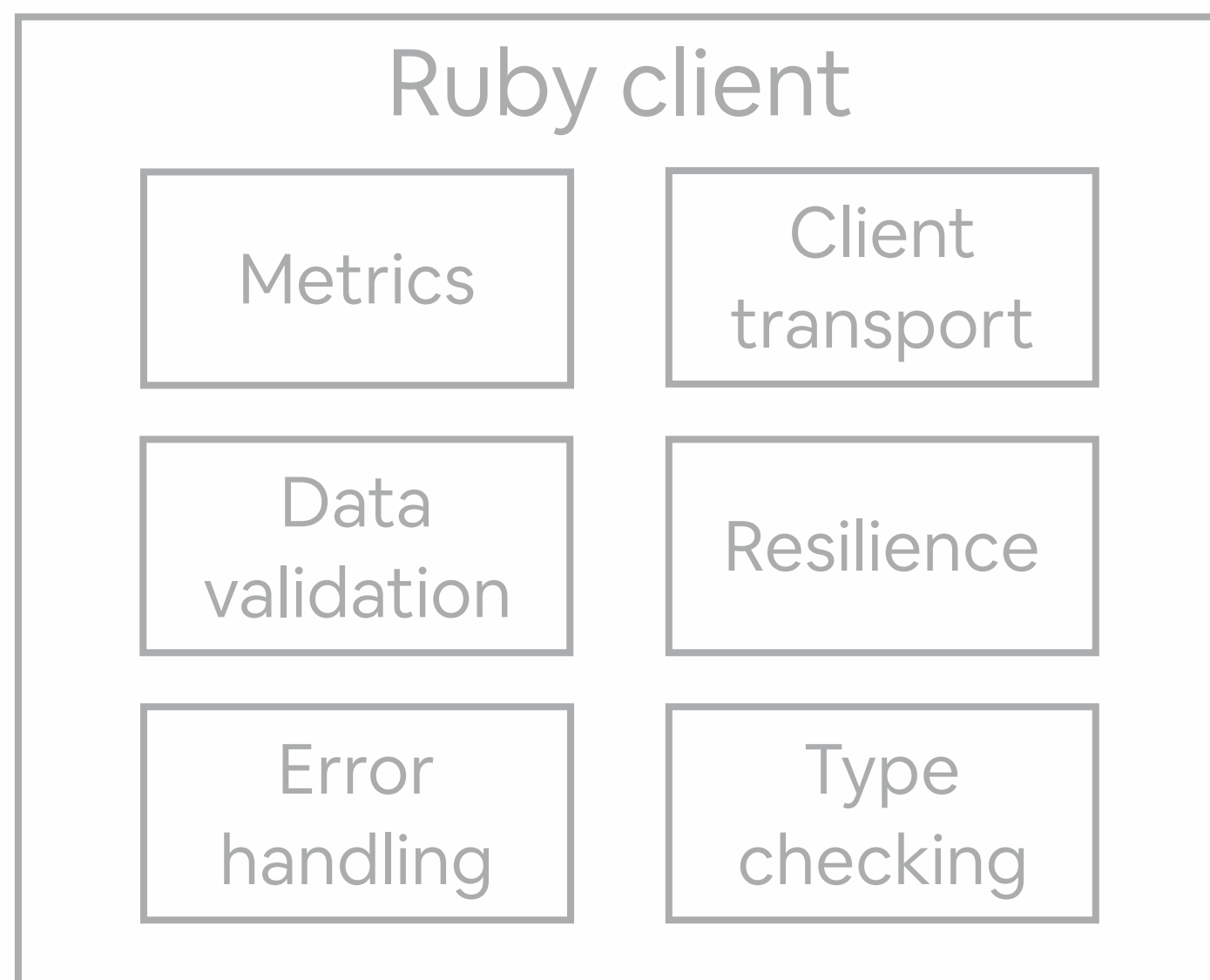


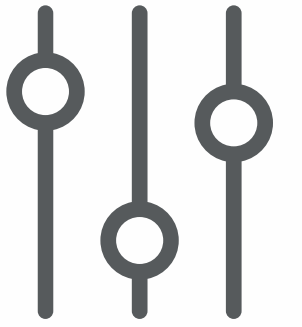
Frameworks using Thrift IDL



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IDL



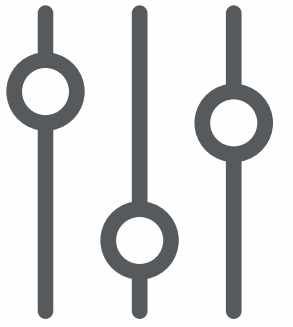


Thrift IDL

API FRAMEWORK

```
/** Batch request for demo data */  
struct LoadSomeDataRequest {  
  1: optional set<i64> ids  
  /** Some extra context baz */  
  2: optional bool fooBar (personal)  
}
```





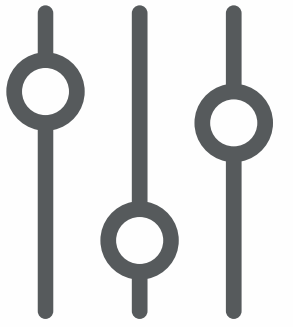
Thrift IDL

API FRAMEWORK

```
/** Batch request for demo data */  
struct LoadSomeDataRequest {  
  1: optional set<i64> ids (personal)  
  /** Some extra context baz */  
  2: optional bool fooBar  
}
```

```
/** id to data response */  
struct LoadSomeDataResponse {  
  1: optional map<i64, SomeData> data  
}
```





Thrift IDL

API FRAMEWORK

```
/** /loadSomeData batch endpoint */
```

LoadSomeDataResponse loadSomeData

(1: LoadSomeDataRequest request)

throws (1: SomeException exception1)

(accept_replay = "true", rate_limit = "true")





RENDERED RAW JSON

demo

Demo Service

JAVA

slacks: #demo-goalie

dashboards: [Standard Service Metrics](#), [Standard Client Metrics](#), [Demo Dashboard](#)

doc link: [Demo tech design doc](#)

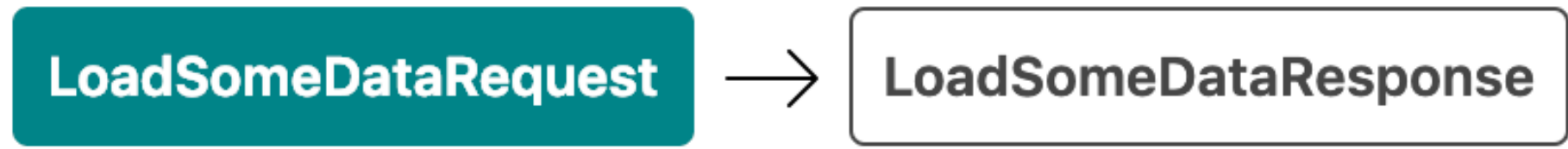
description: The Demo Service owns test data in MySQL and Redis.

Thrift annotations

Search Demo schema (51 structs, 478 fields) ...

loadSomeData RPC

/loadSomeData batch endpoint



@jessicamtai

demo_data | LoadSomeDataRequest

STRUCT

Demo Service

JAVA

slacks: #demo-goalie

dashboards: [Standard Service Metrics](#), [Standard Client Metrics](#), [Demo Dashboard](#)

doc link: [Demo tech design doc](#)

description: The Demo Service owns test data in MySQL and Redis.

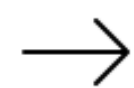
🔍 Search Demo schema (51 structs, 478 fields) ...



loadSomeData RPC

/loadSomeData batch endpoint

LoadSomeDataRequest



LoadSomeDataResponse

demo_data.LoadSomeDataRequest

Batch request for demo data

ID	Req.	Name	Type	Document
1	*	ids	set<i64>	self-explanatory
2		fooBar	boolean	Some extra context baz

Block comments
from .thrift file

STRUCT



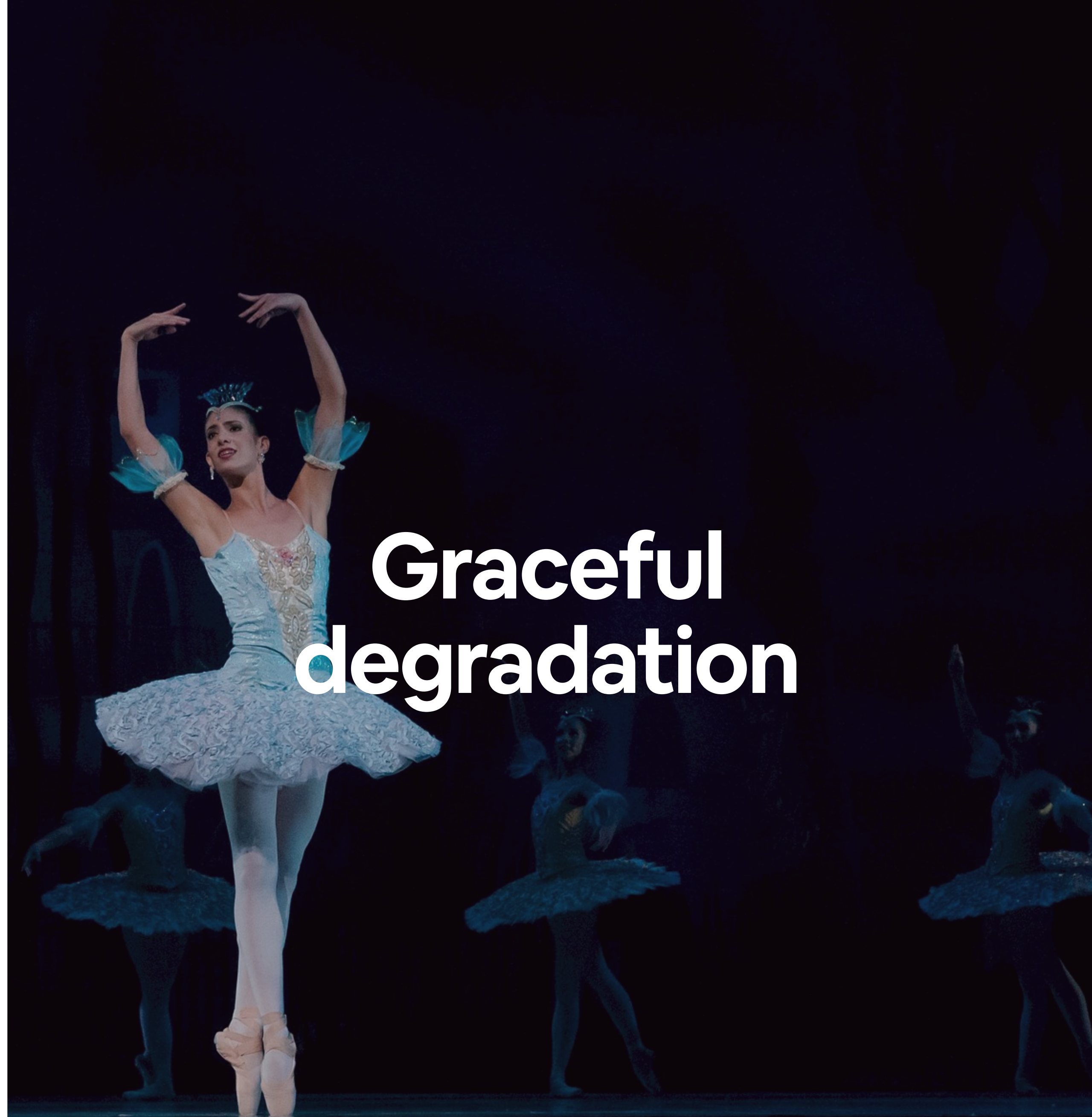
@jessicamtai

FAIL FAST



A background image showing numerous spools of thread in various colors (purple, blue, green, yellow, orange) arranged in rows, with some spools in the foreground being more in focus than others.

**Separate async
worker thread pools**



@jessicantai

Testing & deploying

TIMELINE



Local dev

Staging

Diffy

Canary

Production



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Testing & deploying

TIMELINE



Dev environment supports shared dev services



Local dev

Staging

Diffy

Canary

Production



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Testing & deploying

TIMELINE



Replayed
production
traffic with
other staging
services



Local dev

Staging

Diffy

Canary

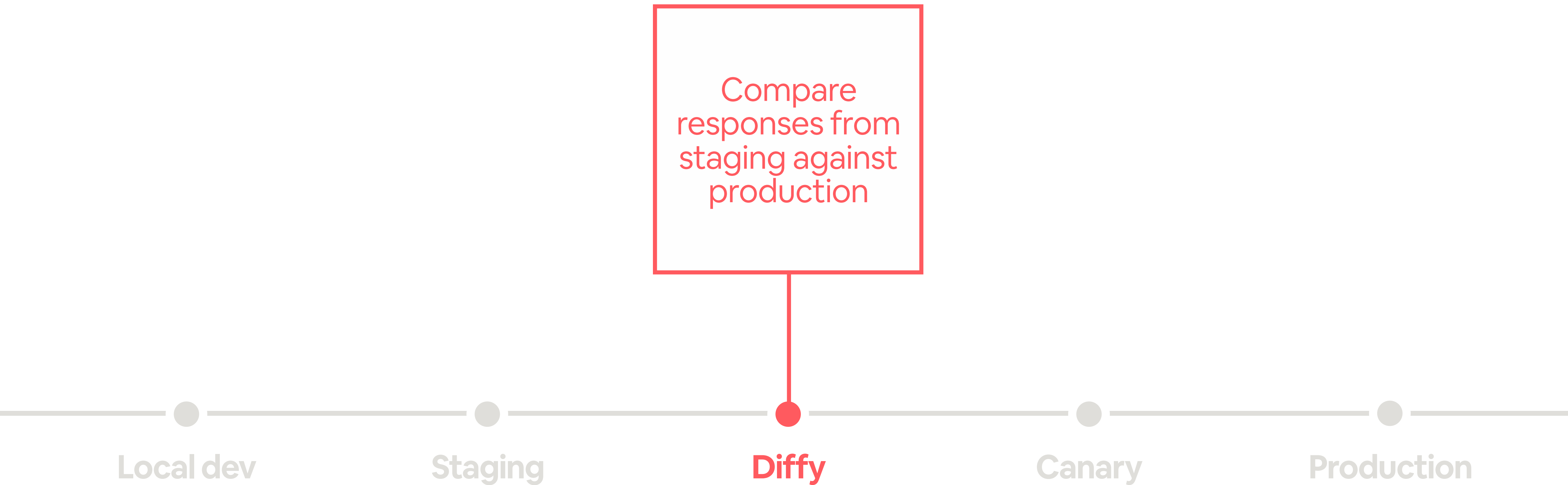
Production



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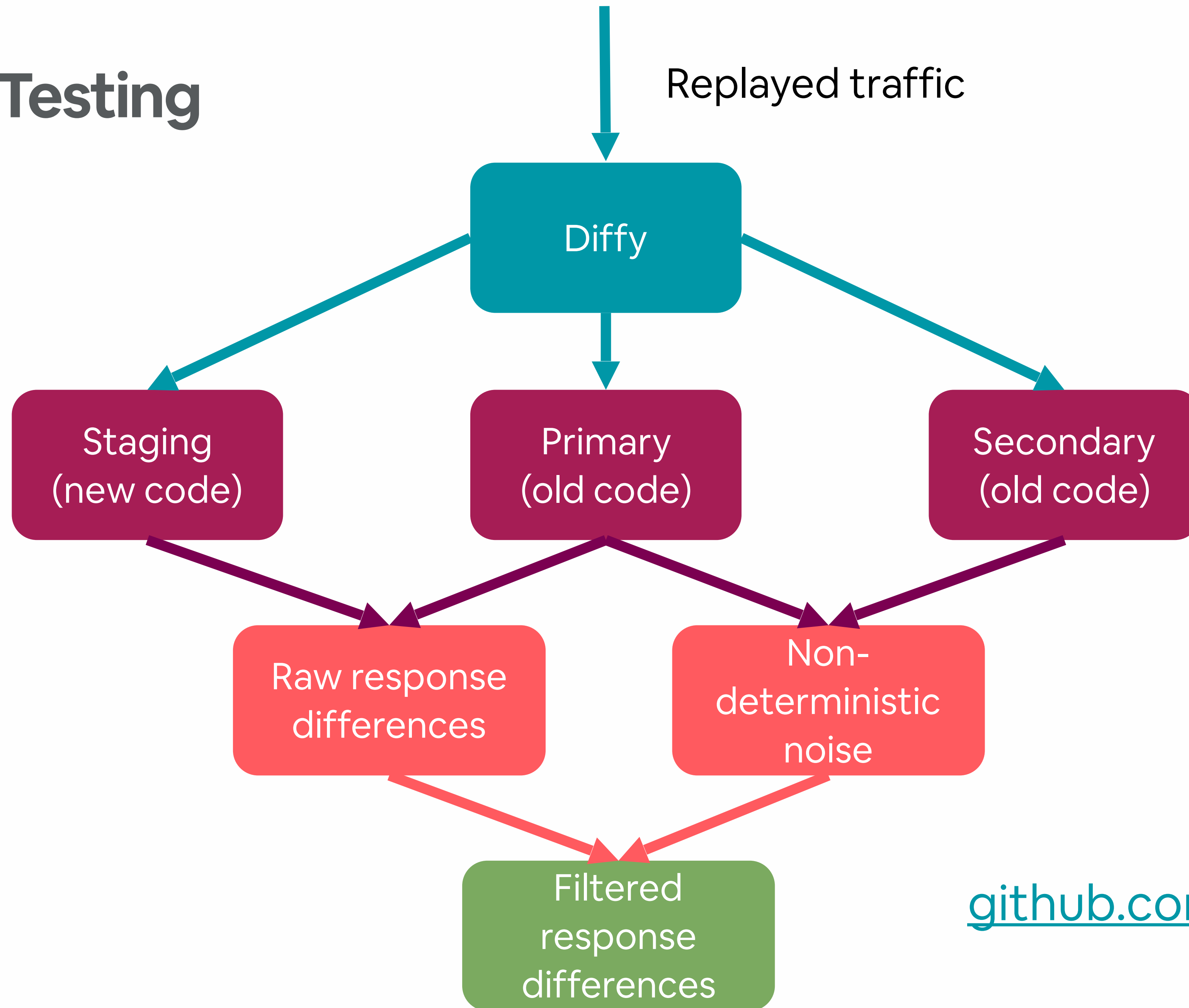
Testing & deploying

TIMELINE



Regression Testing

DIFFY



github.com/twitter/diffy



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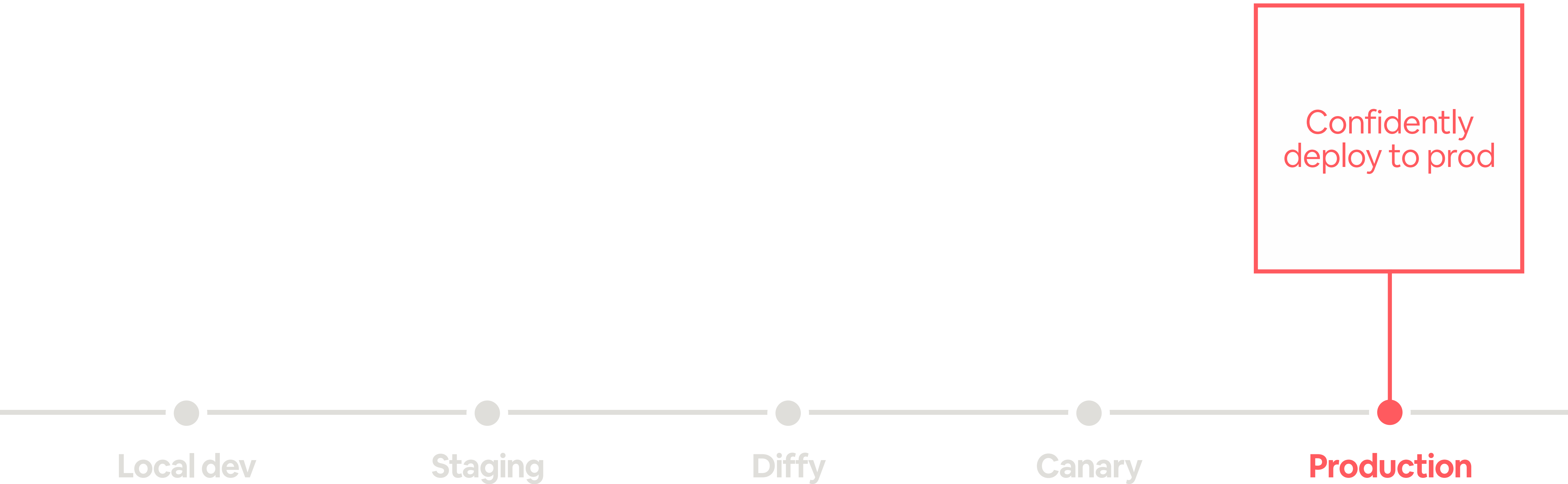
Testing & deploying

TIMELINE



Testing & deploying

TIMELINE



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★ Standard Client-Side Metrics

Add Graphs +

\$service

banana

\$caller_chef_role

*

\$caller_k8s_app

*

\$caller_host

*

\$method

*

\$tie

Search events to overlay...

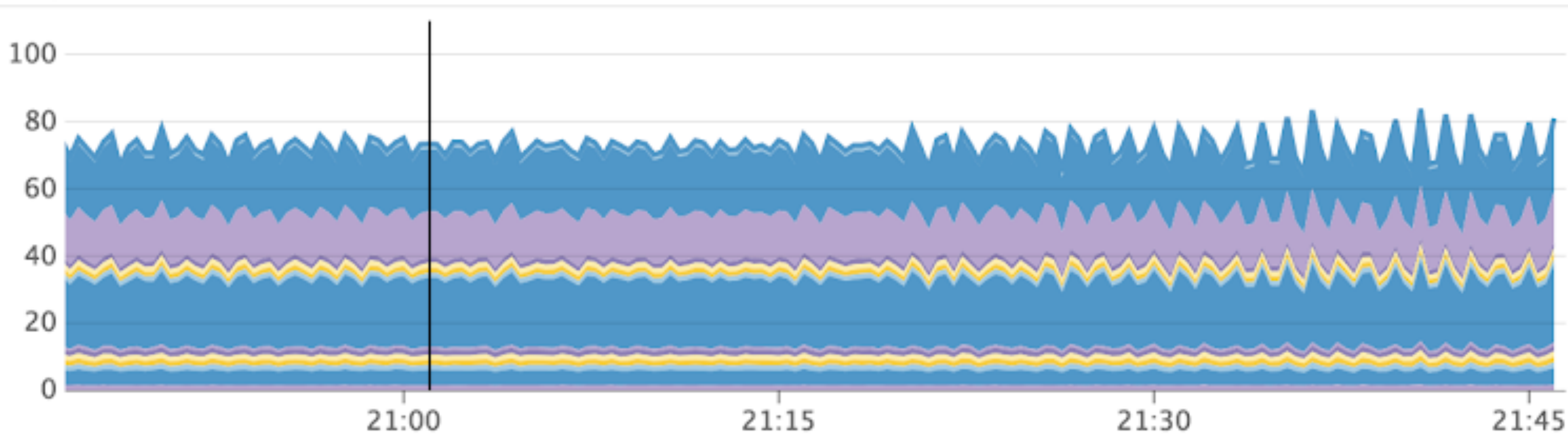


Show

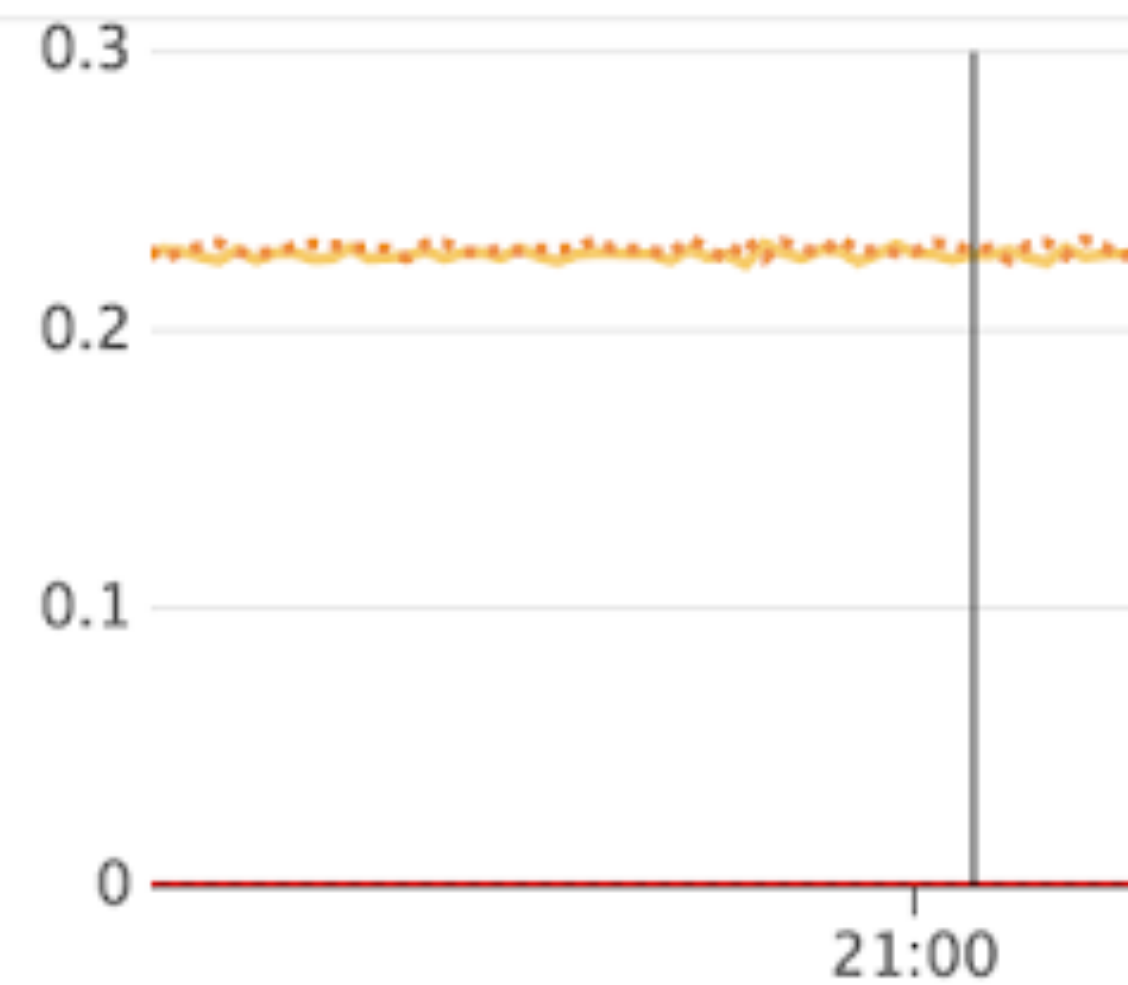
1h

The Past Hour

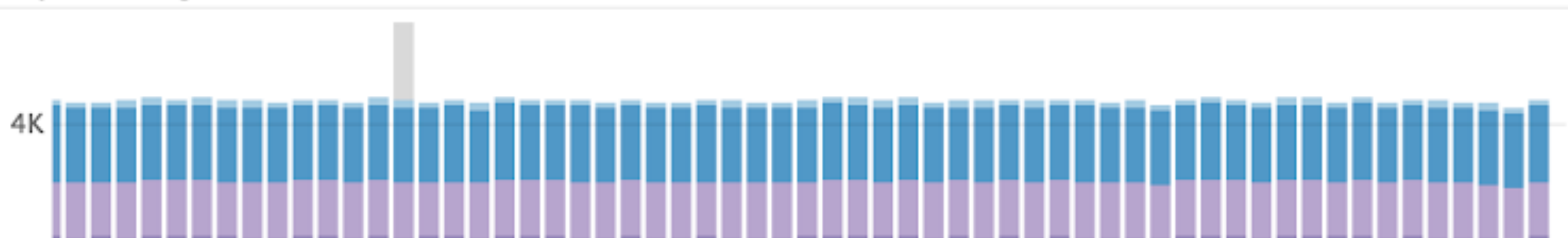
Request Rate (QPS) by Method



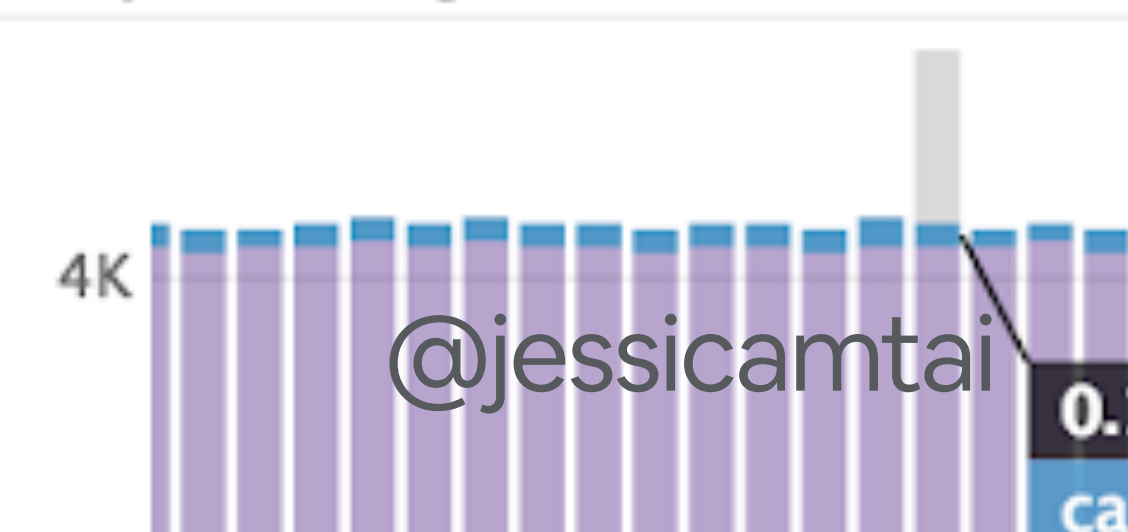
Error Rate Week-over-week



Requests by Method



Requests by Caller



@jessicamtai

★ Standard Client-Side Metrics

Add Graphs +

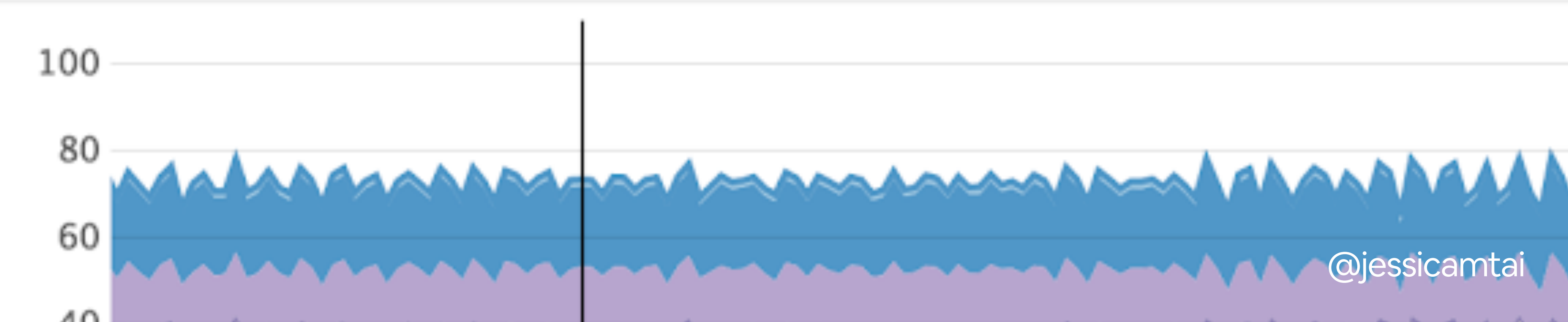
`$service` banana ▼

`$caller_chef_role` * ▼

`$caller_k8s_ap`

🔍 Search events to overlay... ✕

Request Rate (QPS) by Method



@jessicantai



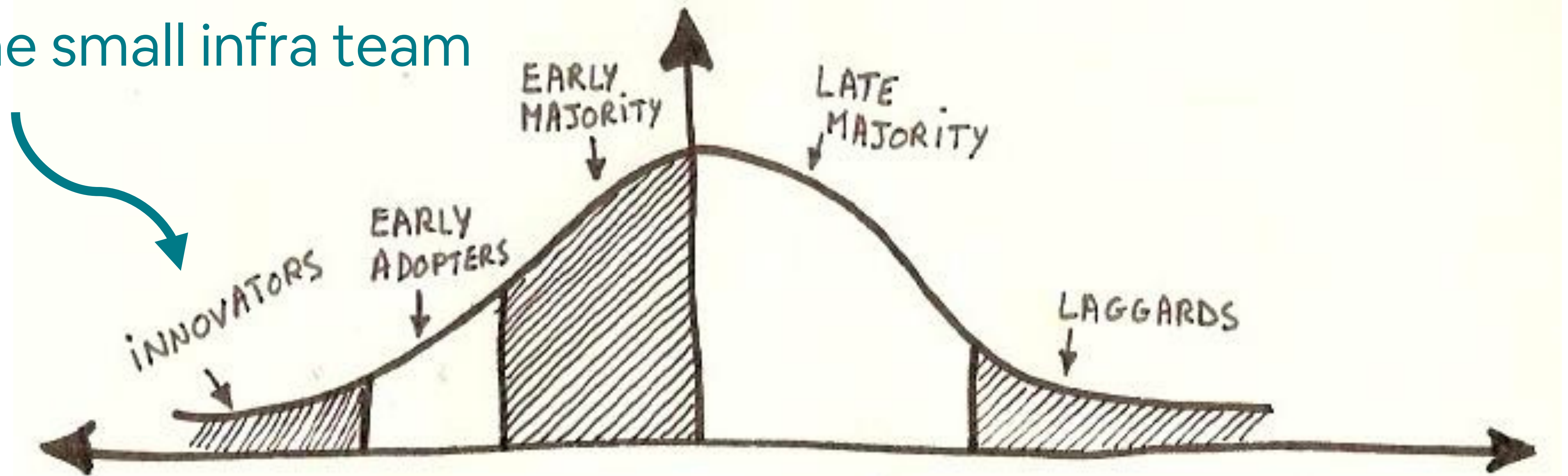


EMPOWERING THE MIGRATION



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2016:
One small infra team



Airbnb's SOA progress



**Product culture:
ship things quickly**

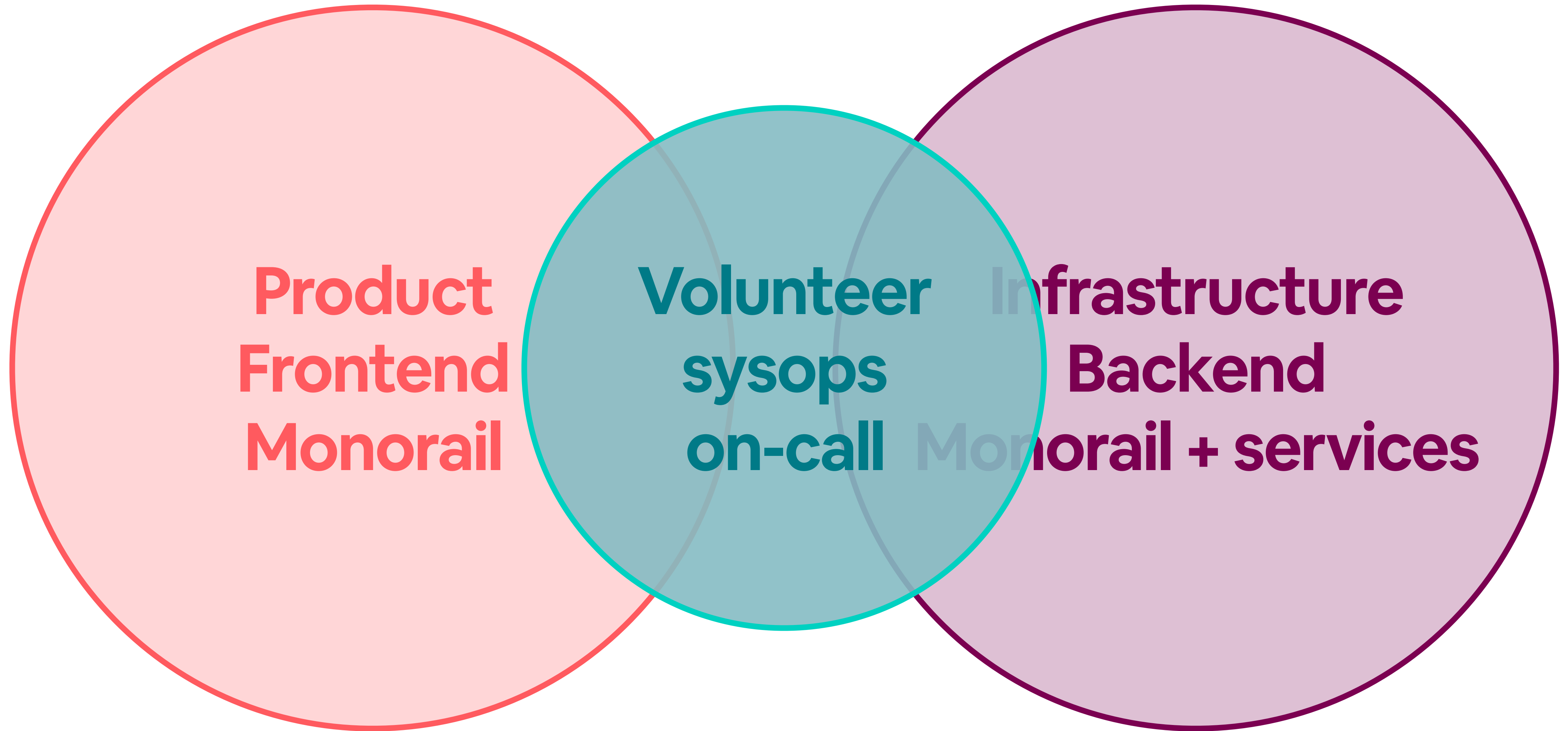


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Org challenges: service building in parallel





Product
Frontend
Monorail

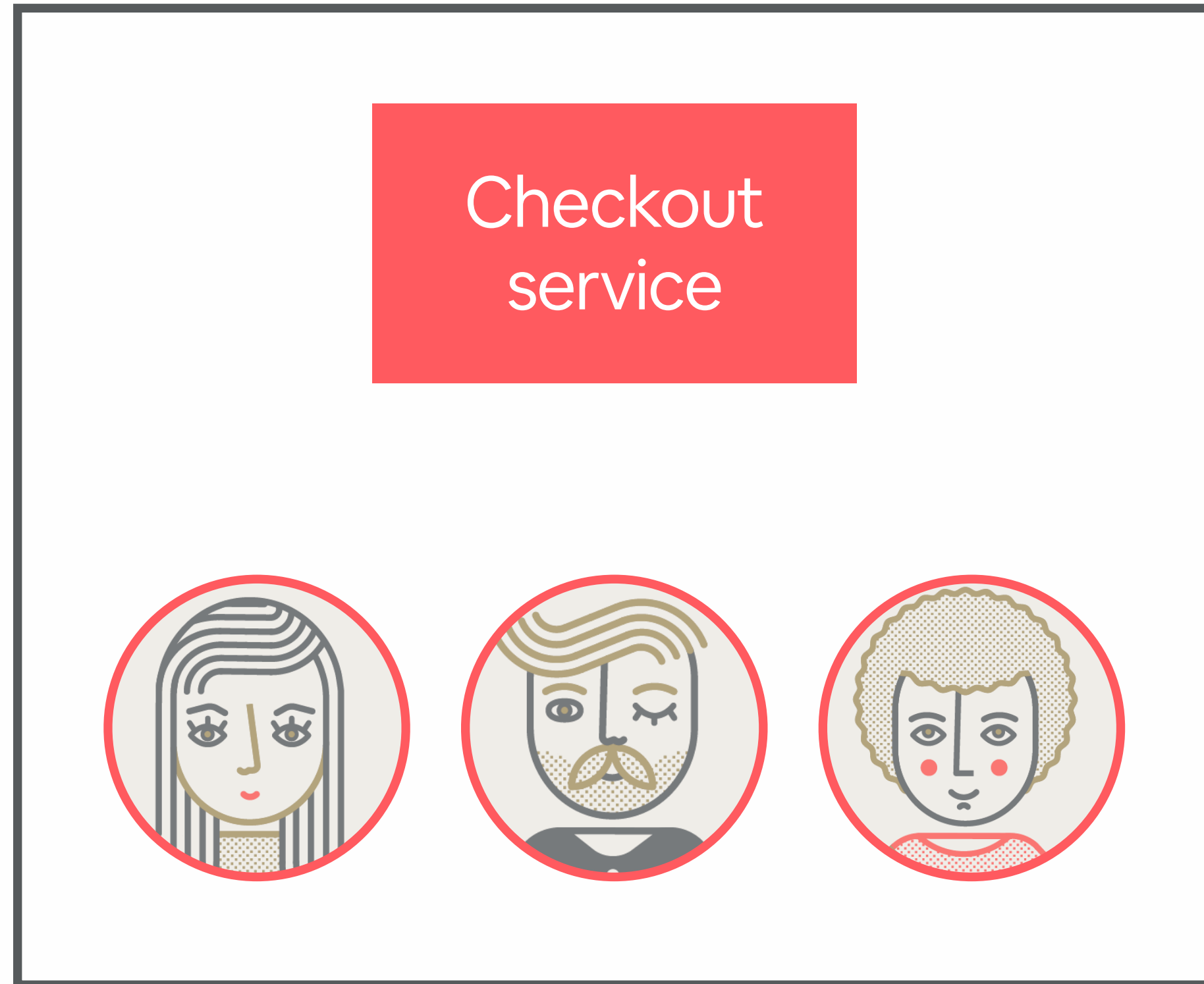
Volunteer
sysops
on-call

Infrastructure
Backend
Monorail + services

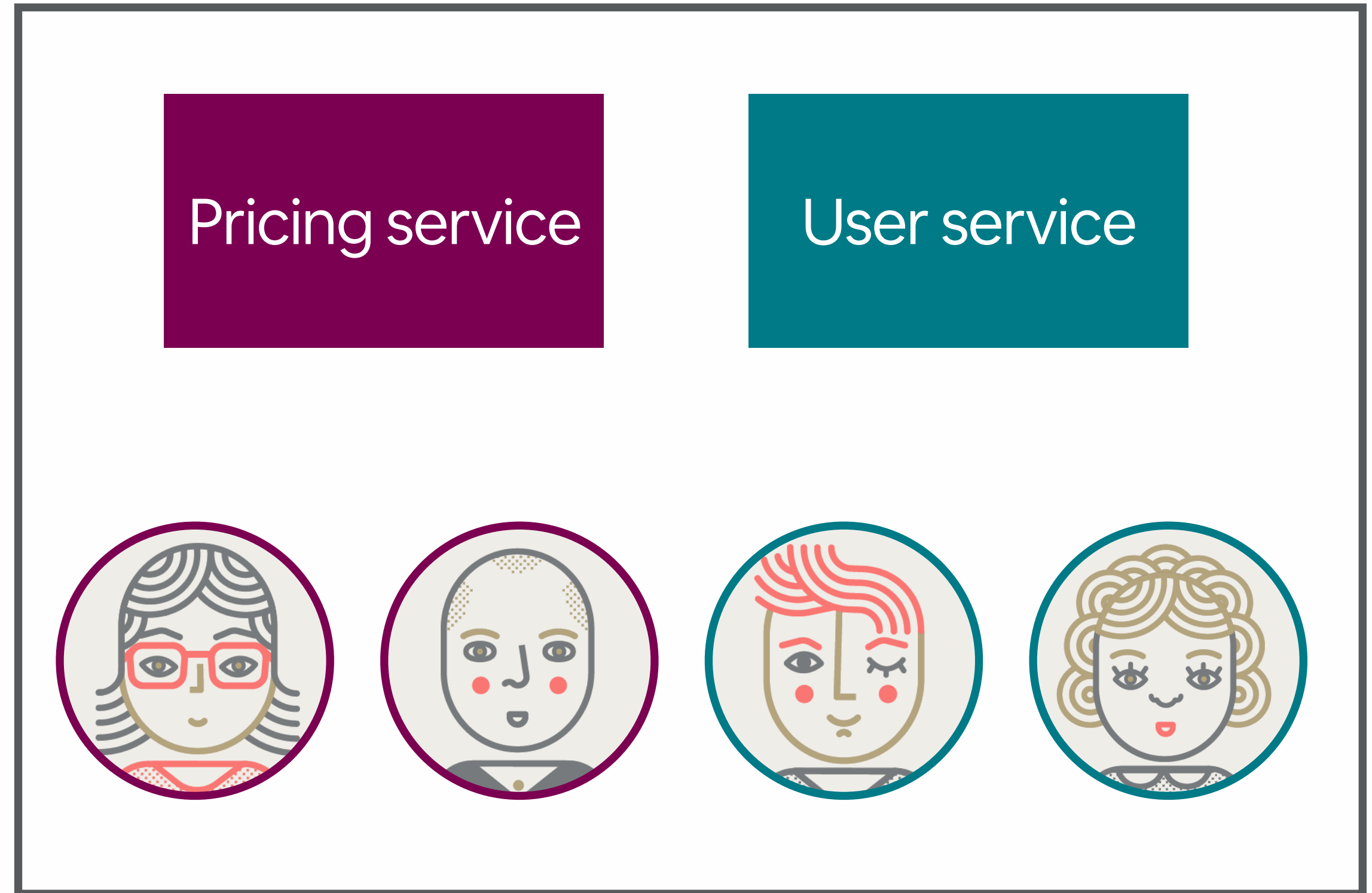


On-call rotation per team

SERVICE OWNERSHIP



Product Team



Infrastructure Team





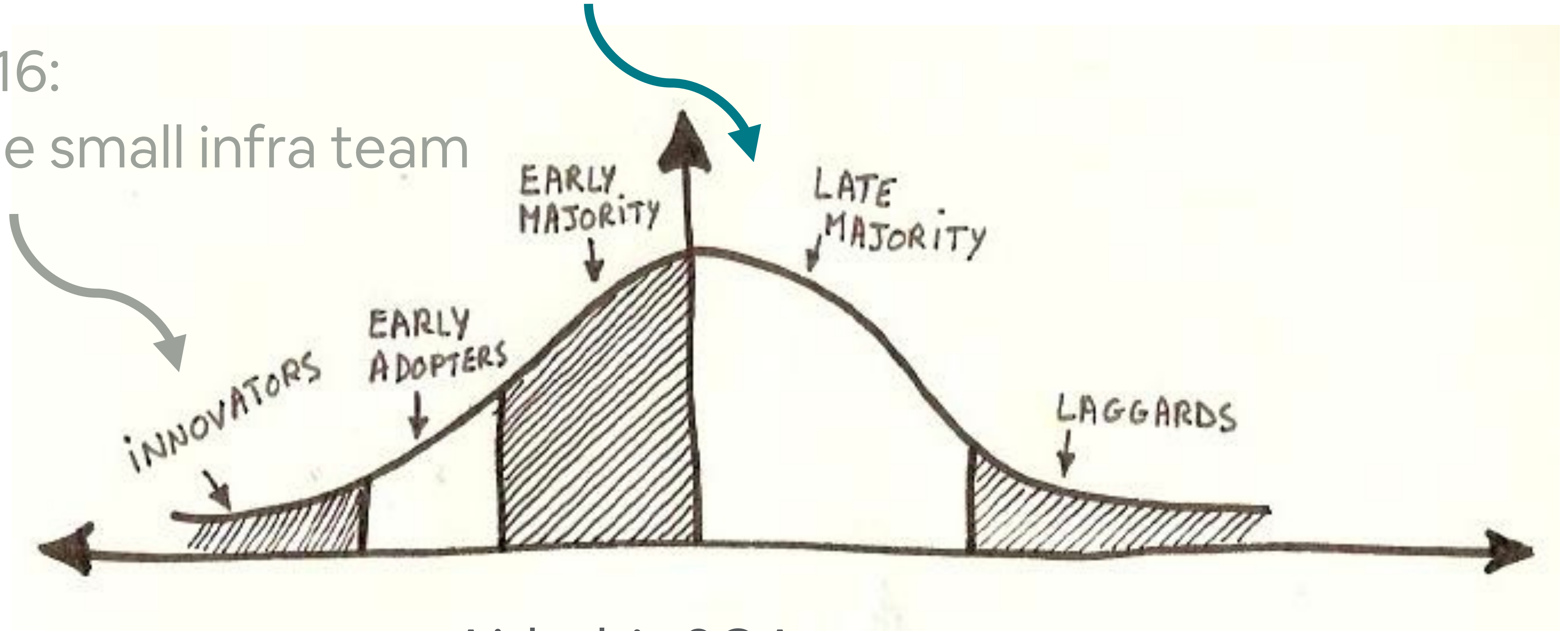
PROGRESS SO FAR?



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2019:
Whole engineering org

2016:
One small infra team



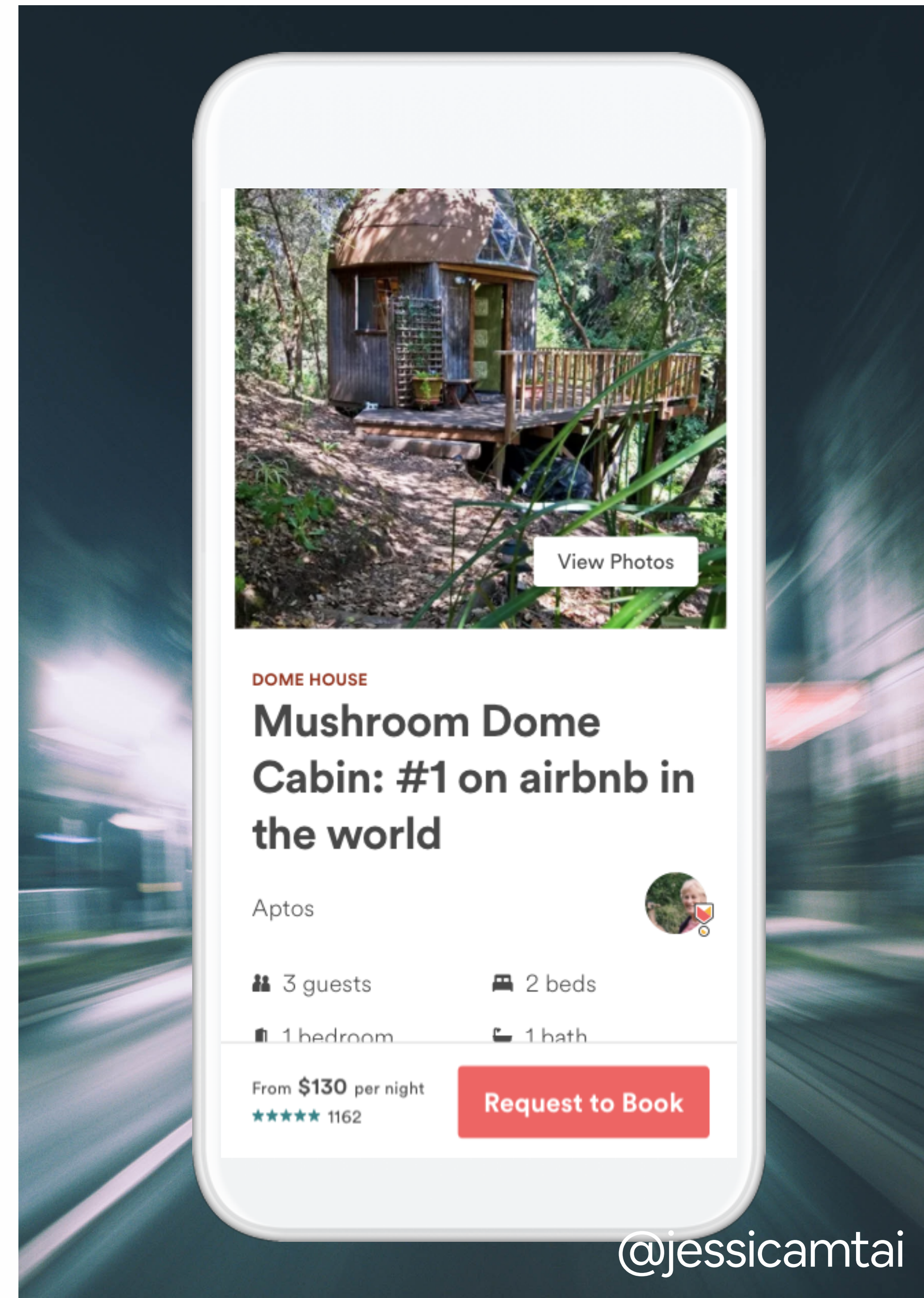
Airbnb's SOA progress



Promising initial results

SUCCESS

- Faster build & deploy times
 - Hours (Monorail) to minutes (service)
 - Fewer reverts
- Quicker bug fixes
- Increased developer productivity happiness

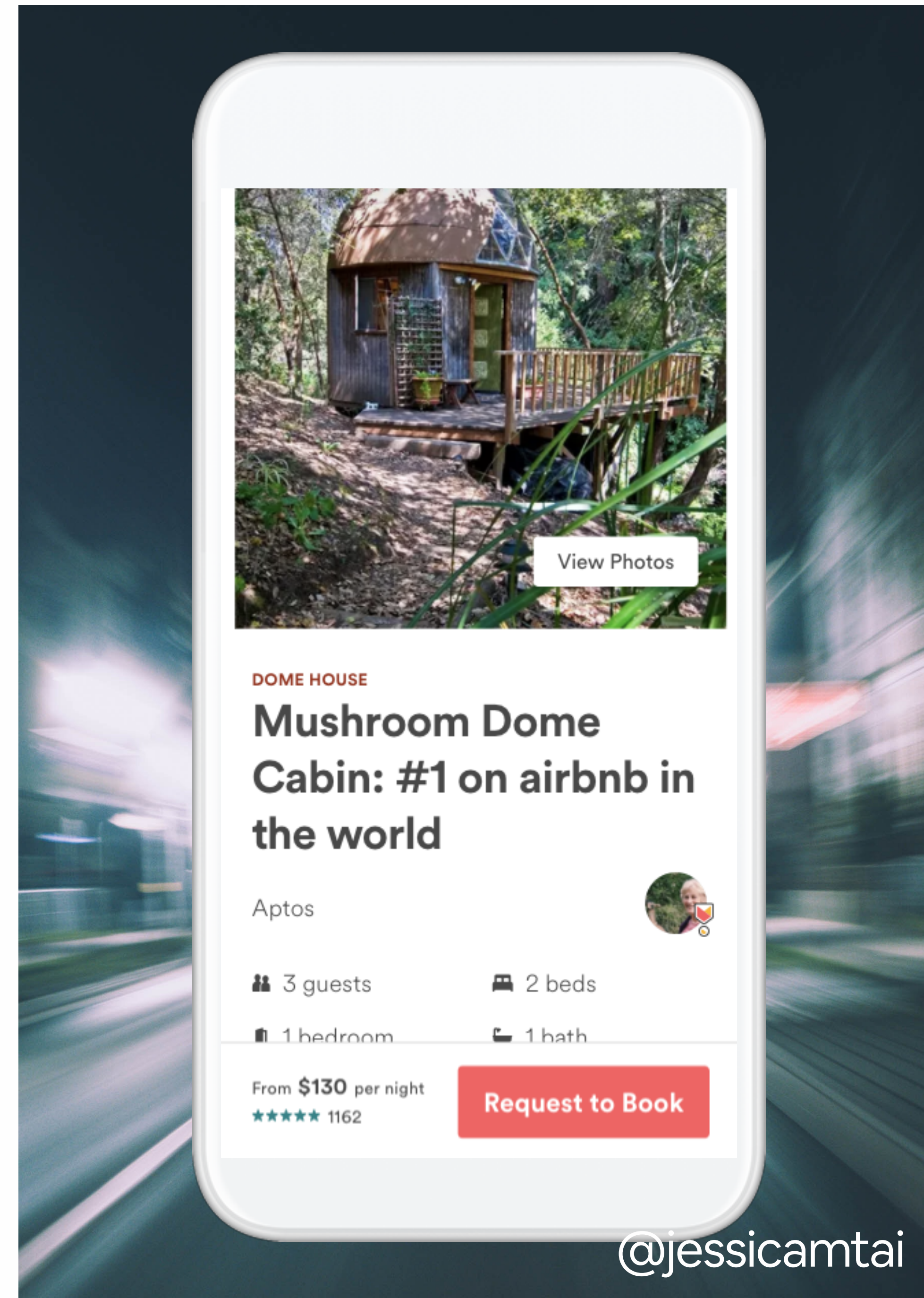


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Latency results

SUCCESS

- Lower latency from parallelization
 - Ruby monorail single-threaded
 - Java services multi-threaded
- Search results page **3x faster**
- Homes description page **10x faster!**



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Monorail freeze



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2016

500+

Engineers

67%

Deploys in Monorail



@jessicamtai

2016

500+

2019

1200+

Engineers

67%

7%

Deploys in Monorail



40%

Production traffic via API Gateway



400+

IDL services in production




Checkout page required message in SOA


Checkout presentation

1. Review trip details > 2. Who's coming? > 3. Confirm and Pay

Home demand
derived data

 **This is a rare find.** Kitty's place is usually booked.

Mushroom Dome Cabin:
#1 on airbnb in the world
Entire home/apt in Aptos
★★★★★ 1165 reviews



Home **data**

Reservation **data**

Who's coming?

Guests

1 guest

1 guest

Jun 21, 2018 → Jun 22, 2018

Business travel
derived data

What's the main purpose of this trip?

Personal travel

Business travel

\$130.00 x 1 night	\$130.00
Cleaning fee	\$35.00
Service fee	\$21.55
Occupancy Taxes	\$18.15
Gift Credit	-\$204.70
Total (USD)	\$0.00

The quoted fees include any applicable exchange rate.

Pricing
derived data

Messaging **data**

Say hello to your host

Let Kitty know a little about yourself and why you're coming.

Hello Kitty! Can't wait to spend 1 night in your home.


Moderate — free cancellation

Cancel within 48 hours of booking to get a full refund. [More details](#)

Cancellation
derived data



Continue

 **Tay** Stayed on April 2018 Featured review

"Staying at the Mushroom Dome was

Review **data**
@jessicamtai

A photograph of a rectangular caution sign mounted on a metal post. The sign features a large orange hand icon with a textured, dotted pattern, set against a dark background. The sign is illuminated from within, making the hand icon glow. Overlaid on the right side of the sign is the text "CAUTION" in a bold, white, sans-serif font, and below it, "SOA has its challenges" in a larger, white, sans-serif font. The background of the image is a blurred outdoor scene with green foliage and a blue sky.

CAUTION
SOA has its challenges



@jessicantai

A photograph of a rectangular metal caution sign mounted on a post. The sign features a large orange hand icon with a dotted texture, set against a dark background. To the right of the hand, the word 'CAUTION' is written in large, bold, white capital letters, and below it, the words 'Distributed services' are written in a slightly smaller, bold, white font. The background of the image is a blurred outdoor scene with green foliage.

CAUTION
Distributed services



A photograph of a rectangular caution sign mounted on a metal post. The sign features a large orange hand icon with yellow dots on the palm, set against a dark background. The word 'CAUTION' is written in large, bold, white capital letters above the text 'Multiple, isolated databases', which is also in white. The sign is slightly weathered and has two screws at the top. The background is a blurred outdoor scene with trees and a building.

CAUTION
Multiple, isolated databases



A photograph of a rectangular caution sign mounted on a metal post. The sign has a dark background and a glowing orange hand icon on the left side. The hand is depicted with a textured, dotted pattern. To the right of the hand, the word "CAUTION" is written in large, bold, white capital letters. Below "CAUTION", the phrase "Complex service orchestration" is written in a smaller, white, sans-serif font. The sign is set against a blurred background of green foliage.

CAUTION
Complex service orchestration



SOA migration

TAKEAWAYS

- Prepare for a long commitment
- Decompose incrementally
- Scale with auto-generating frameworks, tools
- Shift development culture





**Look both ways
during your Great Migration**



@jessicantai

QCON LONDON 2019



@JESSICAMTAI

