



# Ad Serving at Spotify Scale

A journey of incremental full stack overhaul

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# A lucky mistake

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OPTIONS

## Removing Full promoted song ads

Submitted by Drewman24 on 2014-12-11 10:12 PM

I had my first experience with a promoted 4+ minute spotify ad of a song from an artist.

Has anyone experienced the same thing? I'm not a fan at all for the 4 minute long ad that I'm forced to listen to.

I can listen to ads using the free version, but I can't listen to an entire song that I'm not interested in.

STATUS:  
Case Closed

### Status Update

2014-12-12

Hey everyone! Some of you received full song ads yesterday as the result of a temporary issue. This is now resolved and you shouldn't be hearing this anymore. If you're still having trouble

# Expected consequences



シヤレド @KimJongTrilll · 11 Dec 2014

This **spotify ad** is literally a full **song**. I'm 2 minutes in and it won't let me change it. Fuck this **4 minute ad**. Fuck you **spotify**.



1



3



Eric Seiler @EricSeiler · 11 Dec 2014

Seriously? You are going to force me to listen to a terrible **4 minute long song** instead of a 30 second **ad**? Fuck you, **Spotify**.



# Sarcastic empathy



**Evan Habeeb** @evanhabeeb · 11 Dec 2014



First time encountering a **Spotify ad** that forced me to listen to an entire **4-minute song**. Must've been an expensive **ad**.



# Some valuable feedback

← In reply to Spotify



**Whar Garble** @Whargarrrrbllll · 11 Dec 2014

@Spotify It also launched a **4 minute** unskippable **ad** that plays a **song** that doesnt fit your music styles at all and makes you hate the artist



**Bianca Ciotti** @BiancaCiotti · 12 Dec 2014

**Spotify** just forced me to listen to a **4 minute song** as an **ad**, and would not let me skip/pause. #FWP



# The unintended consequence

**Artist engagement**  
for exposed users went up

# The unintended consequence

Promising insights about  
**content promotion use-case**

# The unintended consequence

Confirmation that the  
**ad server is a powerful  
messaging platform**



**Why should you care?**



**Introduction**

**Ad  
technology  
stack**

**Architecture  
Evolution**

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# What I do

- **Founded ads engineering team at Spotify in 2011**
- **Build all things ads engineering - team & software**
- **Major focus areas :**
  - Ad delivery (Backend and Web)
  - Multi-platform native ads (Client Platform)
  - Ad performance (ML and Data)

**3 noteworthy things**

**Full stack refactor**

**Evolution at scale**

**Pragmatic choices**

**100,000,000+**  
**MAU**

**50,000,000+**  
**Subscribers**



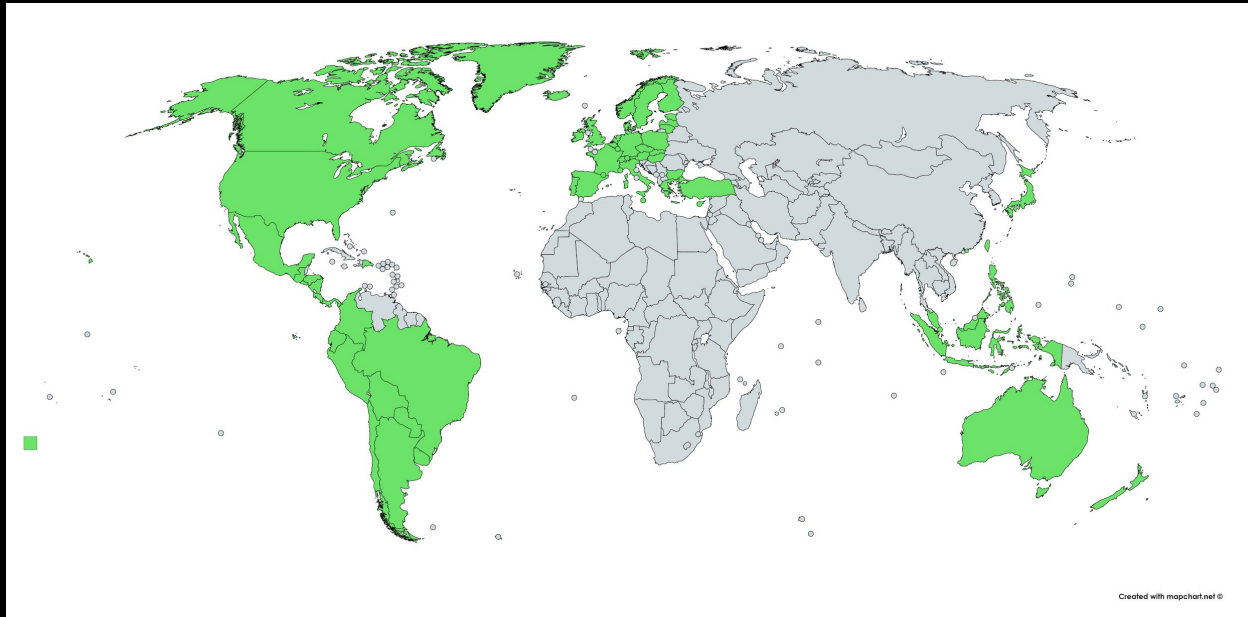
**30,000,000+**  
**Songs**

**2,000,000,000+**  
**Playlists**

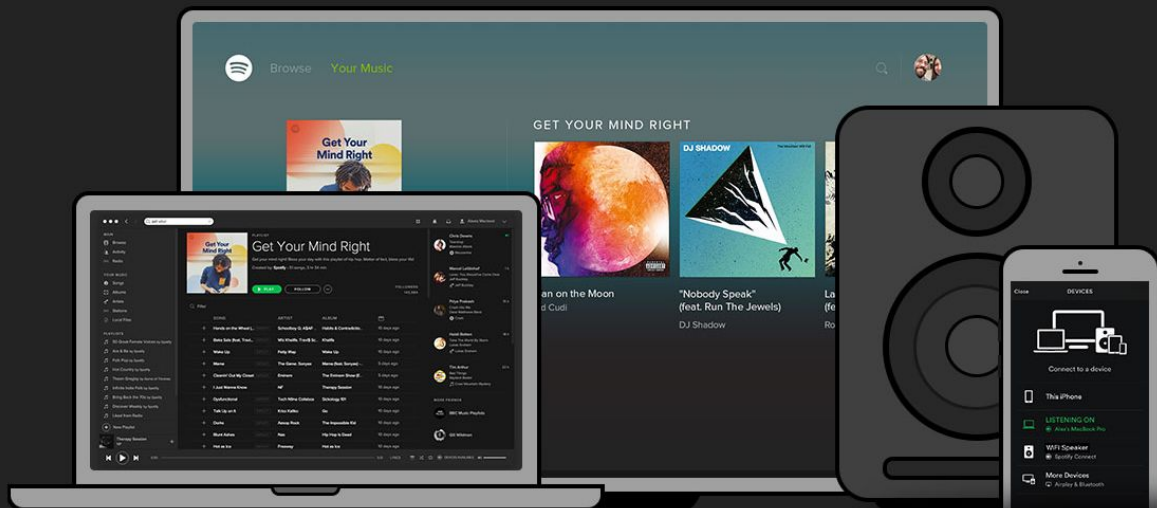
**\$5,000,000,000+**

**Revenue paid to rightsholders**

# 60 Markets



# Platform Ubiquity



Play on all your devices

MOBILE - COMPUTER - TABLET - CAR - SPEAKER - PLAYSTATION® - TV - ANDROID WEAR - WEB PLAYER

# Freemium business model

The image displays the Spotify app interface, illustrating the freemium business model. The background is a purple gradient with various album covers and artist names. The main content is divided into two sections: the free tier and the premium tier.

**Free Tier:**

- Go get the music.**
- Listen free.
- Or go Premium to play on-demand, anywhere.
- Spotify** \$0.00 /month
- Enjoy your favorite albums and artists, with occasional ads.
- GET SPOTIFY FREE**

**Premium Tier:**

- Spotify Premium** \$9.99 /month
- Family and Student offers available
- Play on-demand.
- Listen offline.
- No ads.
- High quality audio.
- GET SPOTIFY PREMIUM**

**Smartphone Mockup:**

The smartphone screen shows a music player interface. At the top, it says "PLAYING FROM ALBUM Etch And Etch Deep". The album art is a dark square with colorful dots. The song title is "Bleak And Beautiful (All Things)" by Haiku Salut. The playback controls include a play button, skip, and shuffle. At the bottom, it says "SPOTIFY CONNECT AVAILABLE".

Spotify



PLAYING:

Bosse - Finlåt

2:13

- X

Sök

MITT  
BIBLIOTEK



Sök

MODER-  
BIBLIO-  
TEKET

Låtar & filer

Spellista

Ad



REKLAM/Spottar

MER  
REKLAM

Verizon 12:21 PM

Today's Top Hits

FOLLOW

3,923,986 FOLLOWERS • BY SPOTIFY

▶ SHUFFLE PLAY

INCLUDES

- Want To Want Me  
Jason Derulo • Want To Want Me
- Where Are Ü Now (with Justin Bieb...  
Jack Ü • Skrillex and Diplo present Jack Ü
- Hold My Hand  
Jess Glynne • Hold My Hand

AT&T 4:14 PM

ADVERTISEMENT

The next 30 minutes are ads free.

After a brief message from our sponsor.

NO THANKS, I'LL KEEP THE ADS.

0:01 0:05

Verizon 12:10 PM

Spotify

0:04 0:15

Verizon 12:10 PM

ADVERTISEMENT

Listen ad-free and on-demand with **Premium**.

TRY PREMIUM FREE

Spotify

Spotify

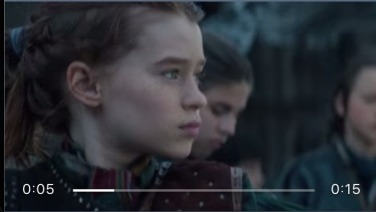
0:01 0:07



The next 30 minutes are ads-free.

Thanks to the following sponsor.

The Huntsman: Winter's War



0:05 0:15

LEARN MORE

Thanks for watching

Now enjoy the next 30 minutes of ad-free music

18:23

EMILY BLUNT is THE ICE QUEEN

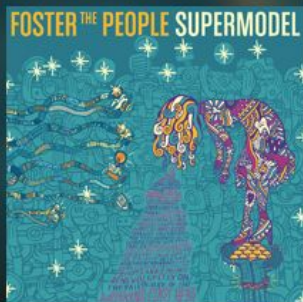


HUNTSMAN WINTER'S WAR

LEARN MORE

Now enjoy the next 30 minutes of ad-free music

18:23



ALBUM

# Supermodel

Foster The People

Listen to the latest album from Foster The People.

▶ PLAY

+ SAVE

...

SPONSORED

OVERVIEW

CHARTS

GENRES & MOODS

NEW RELEASES

NEWS

DISCOVER

Remembering a true Queen.



Selena Forever

Remembering the Queen of Tex-Mex music on the 20th



New Music Tuesday

The best newly released songs packed into one playlist. Updated



Today's Top Hits

The 50 best from the world of music. Always fresh and always



Latin American Indie

Nada más que lo mejor de la música indie latinoamericana



Afternoon Acoustic

Unwind and let the afternoon unfold in all its acoustic glory



Fresh R&B

The best of fresh R&B. Keep up to date with the hottest tracks right

**Introduction**

**Ad  
technology  
stack**

**Architecture  
Evolution**

# Beauty of Ad Server



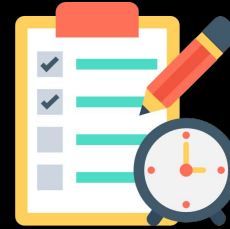
Relevancy



Pacing



Unique View



Sequence



Optimization

# Complexity of Ad tech ecosystem

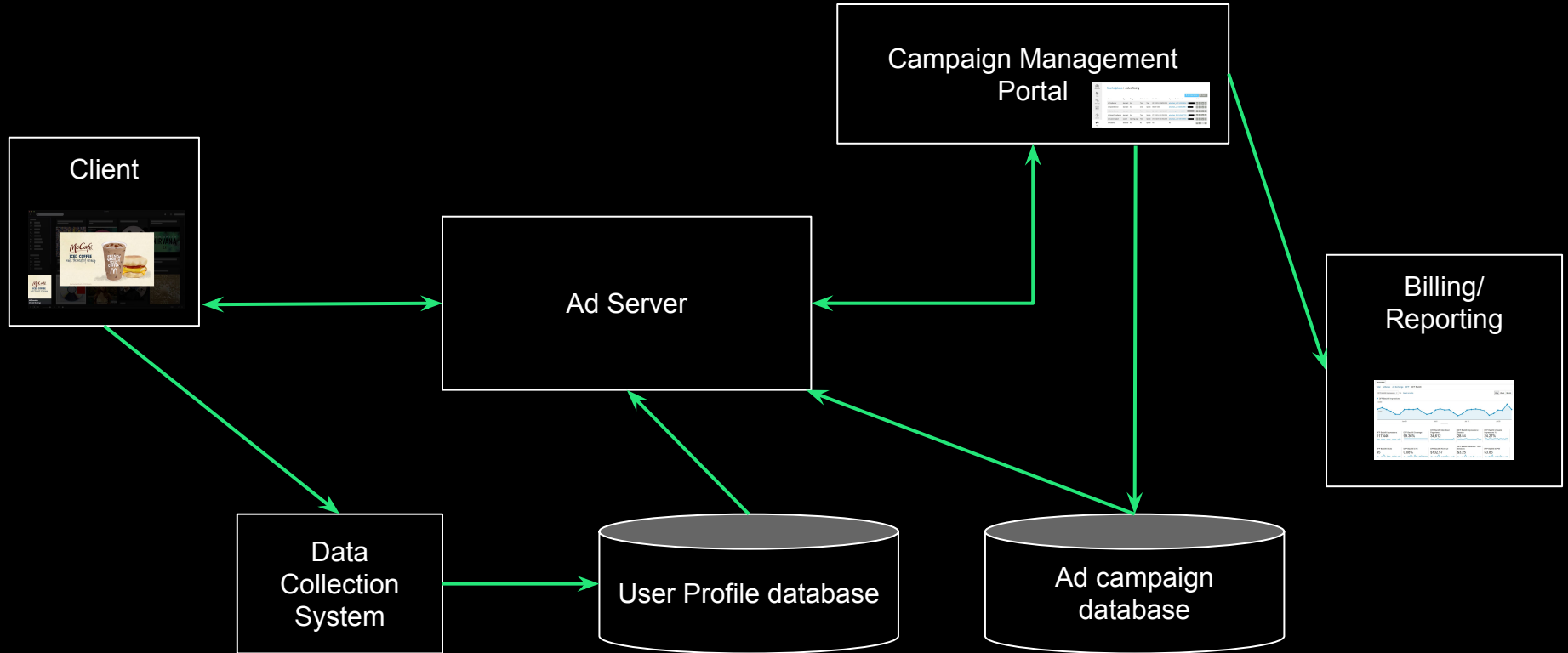
## DISPLAY LUMAscape



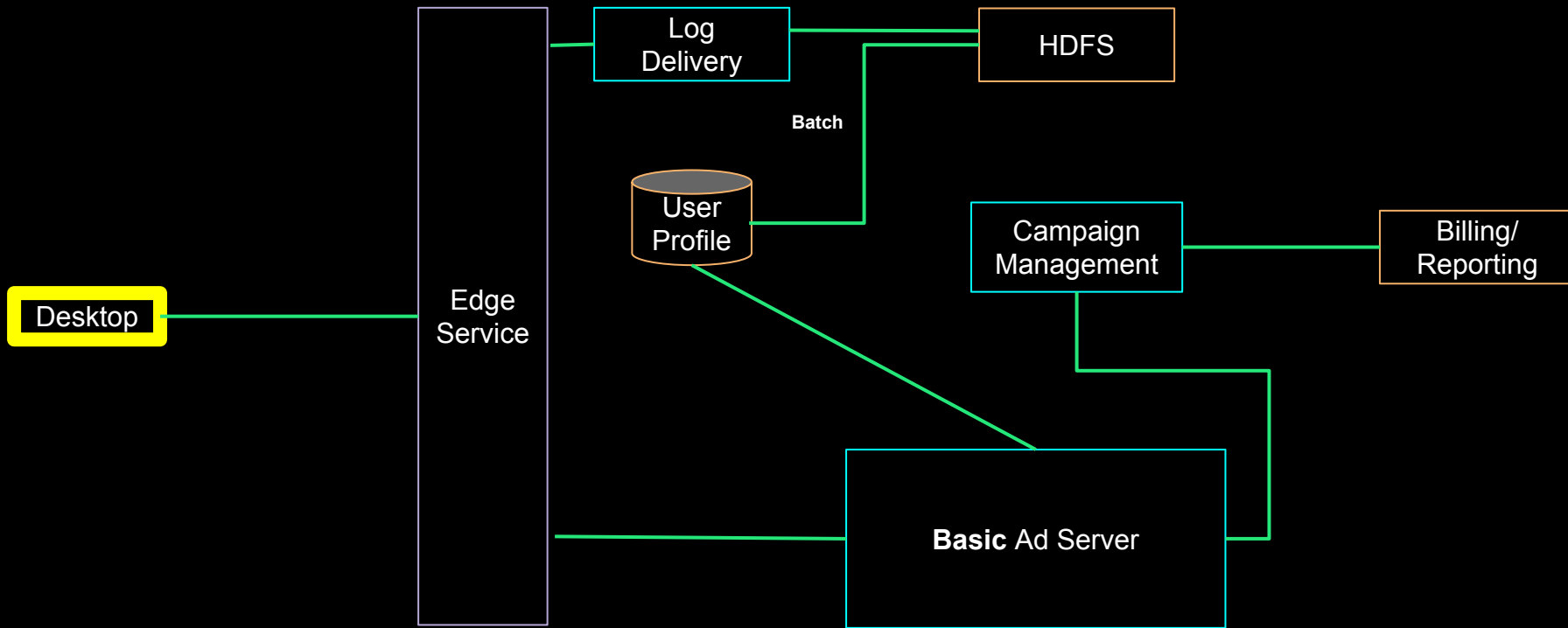
Denotes acquired company

© LUMA Partners LLC 2013

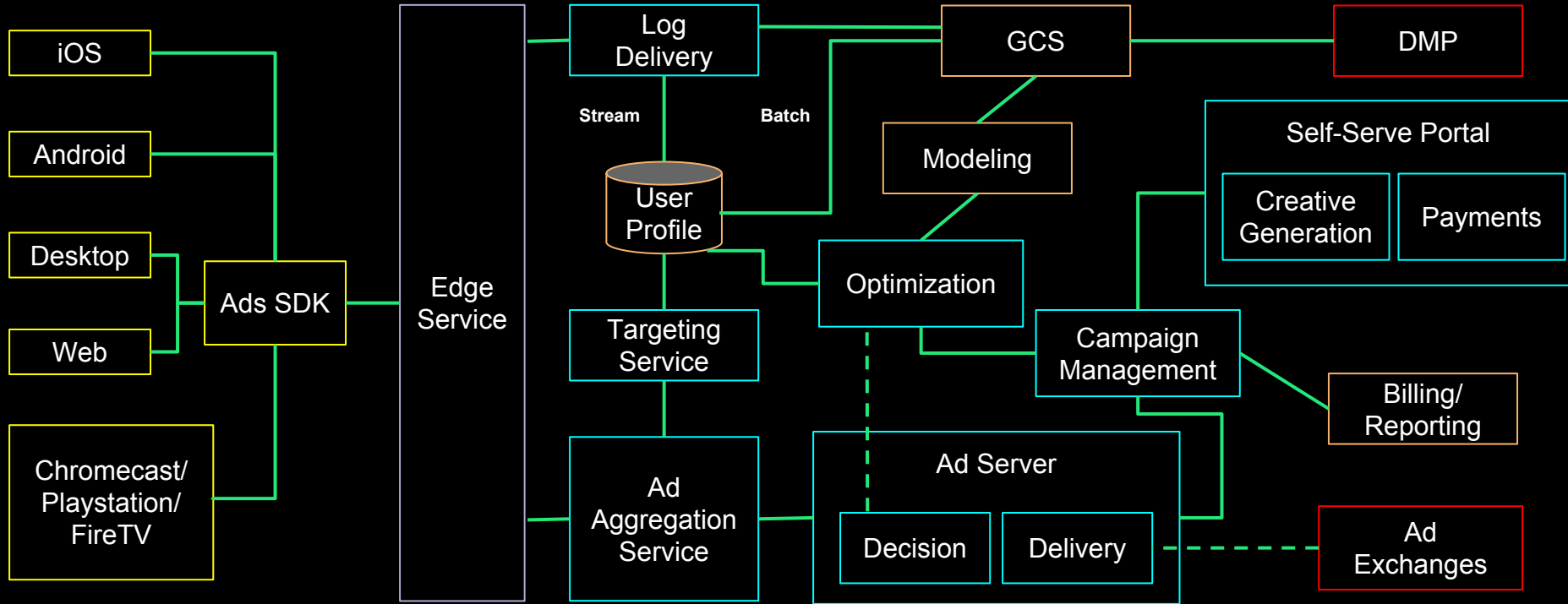
# In essence it is pretty simple



# Spotify Ads infrastructure in 2011

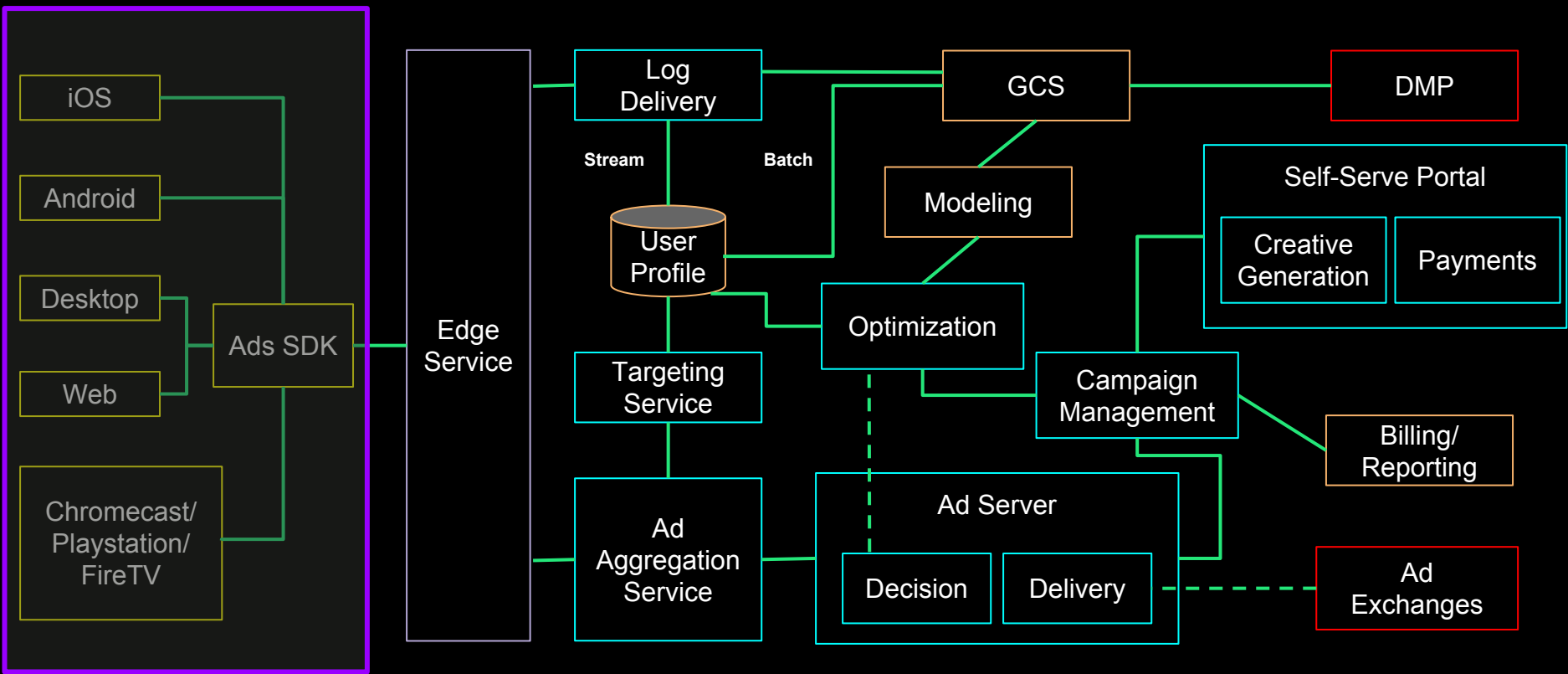


# Spotify Ads infrastructure in 2017



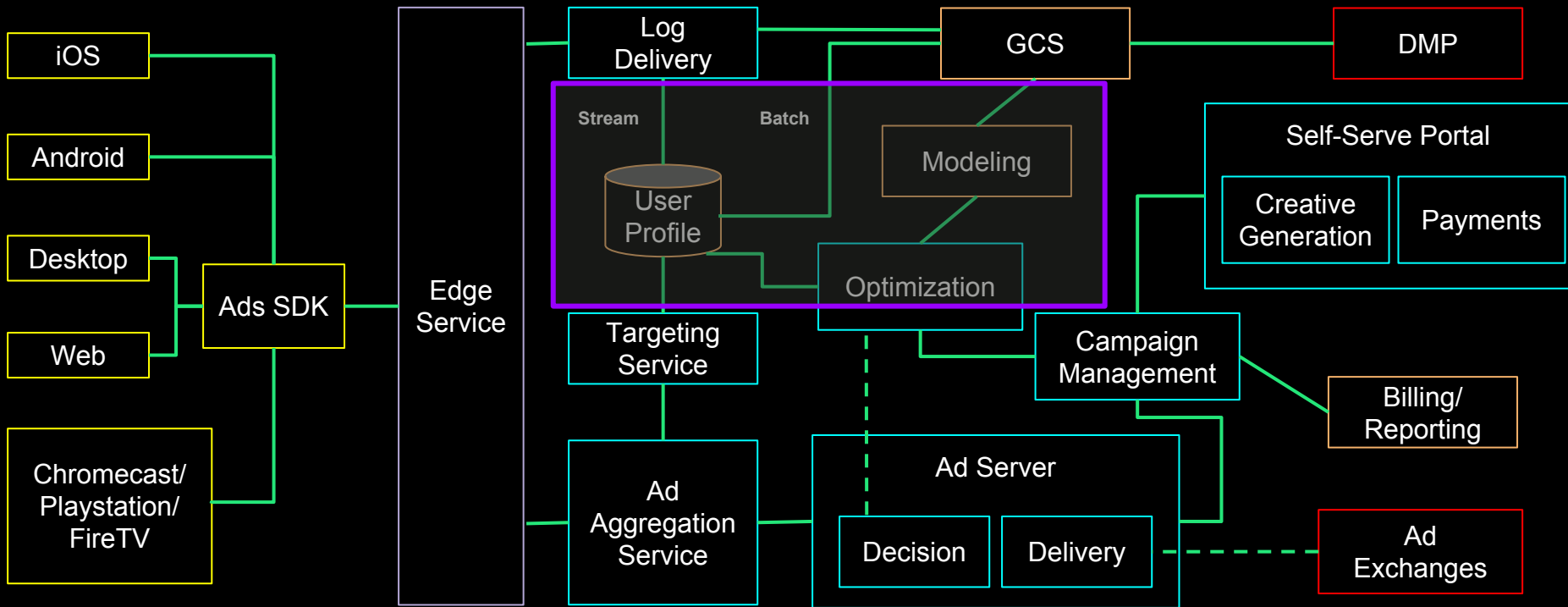


# Multi-platform clients

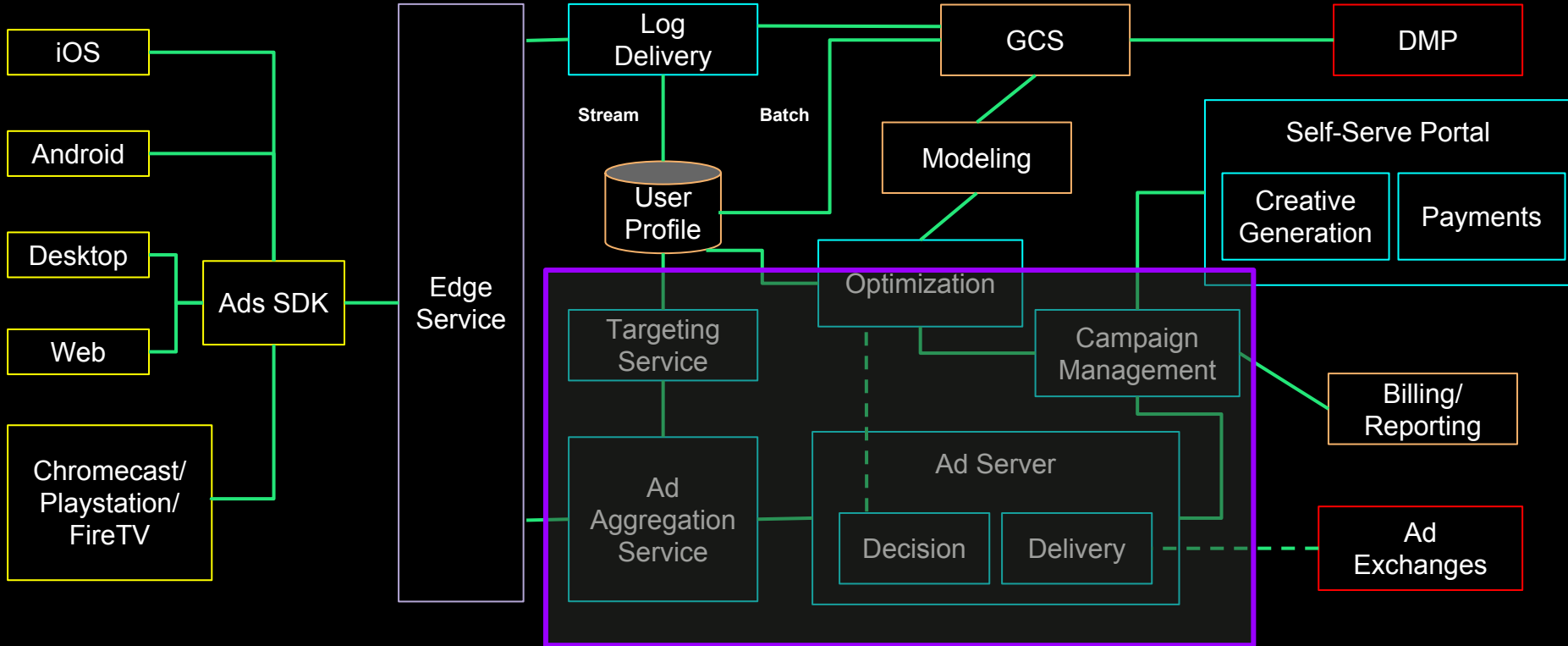




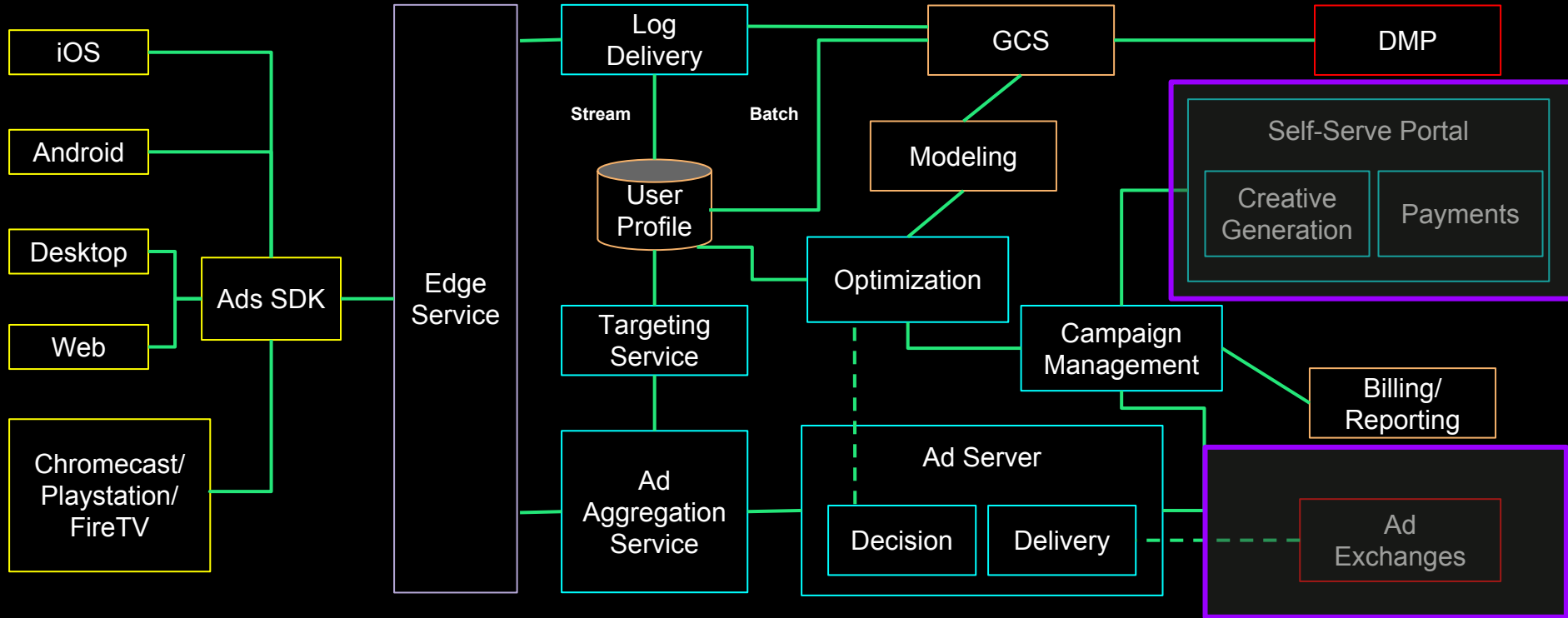
# Intelligence



# Ad Delivery



# Demand fulfillment



**Now you know too**

**Ad server is a powerful  
messaging platform**

**Introduction**

**Ad  
technology  
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**Architecture  
Evolution**

# Architecture overhaul **is hard**

- **While keeping the** business running
- **While innovating on** new products
- **When you should have done it** yesterday



**Why did Spotify evolve Ads  
architecture?**

# Future needs

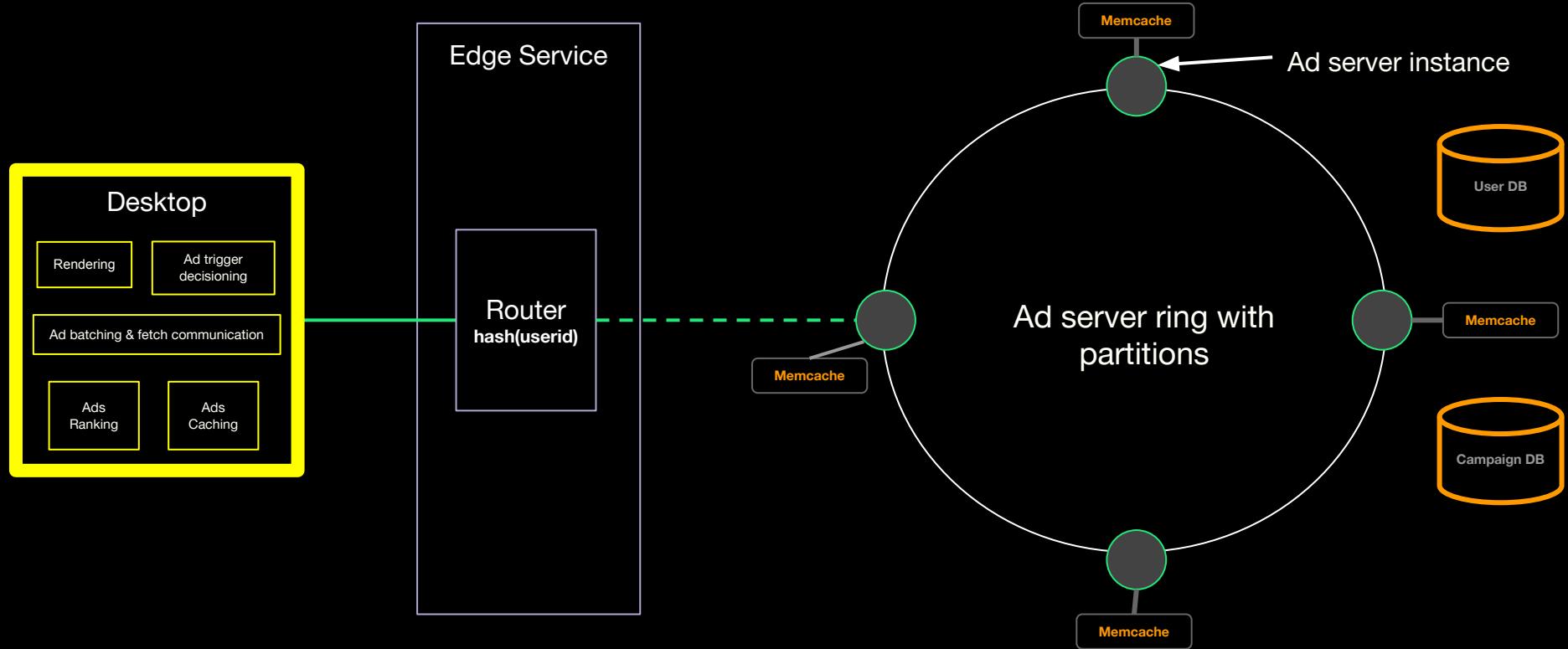
- **Growth in scale**
- **Emergence of new client platforms**
- **Cheap cloud computing**
- **New products to meet business objectives**
- **Technical debt**

# The 3 stories

# Story 1

## Fixing the legacy mess

# Original ad server design



# Problems

# Stateful service with faulty persistence

# Cache as a data store



**Service cluster as a hashed ring**

# Ad decisioning in Client

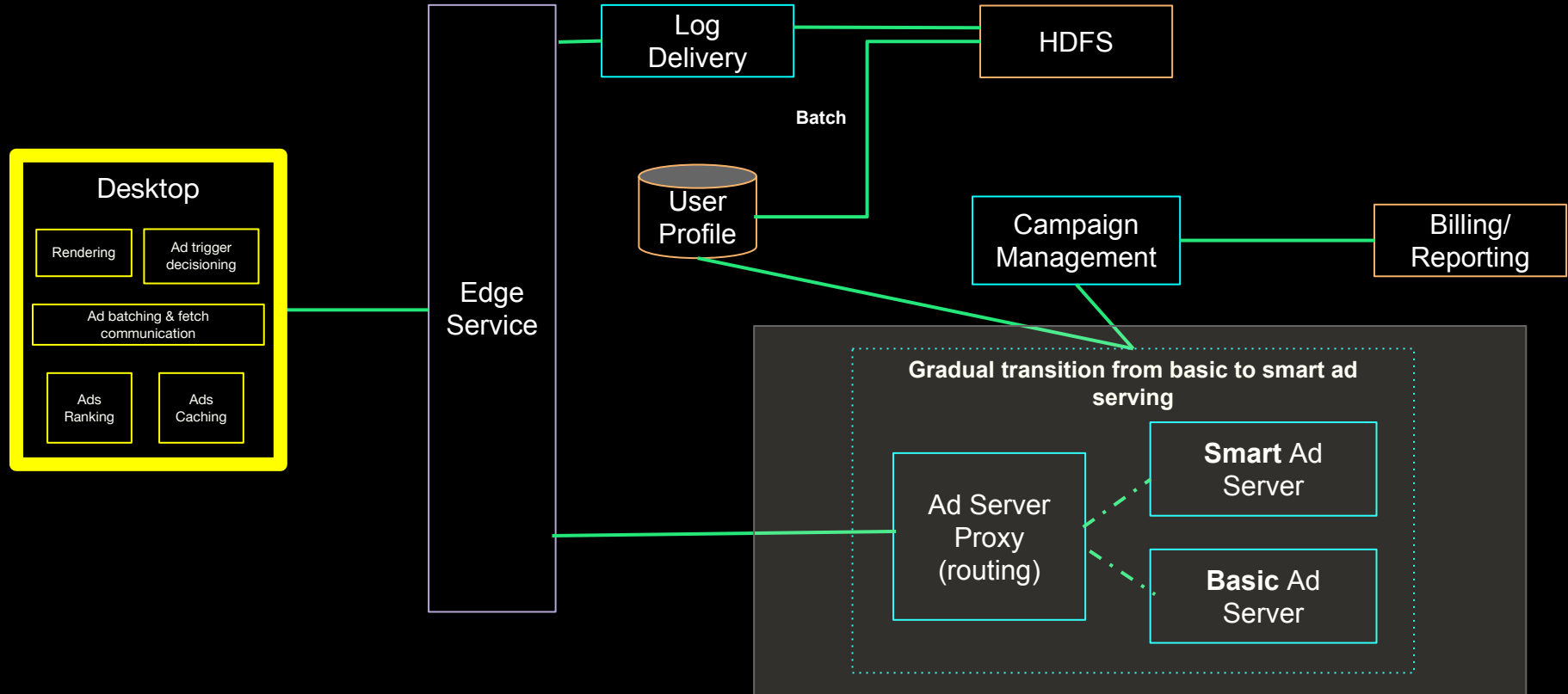
# Batch Client-Server Calls

**Fix strategy**

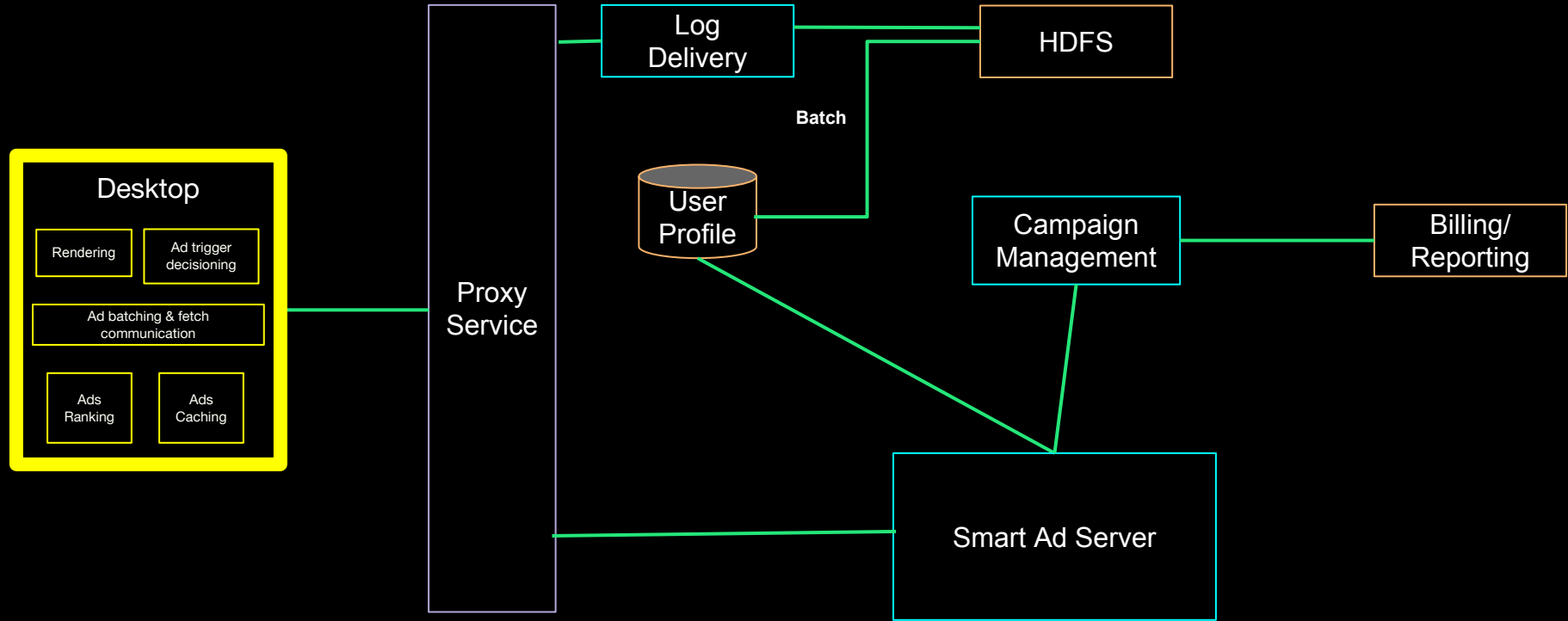
**Fix** ~~strategy~~ **tactic**

**Isolate refactor to one system at  
a time**

# The ad server transition



# After the ad server transition



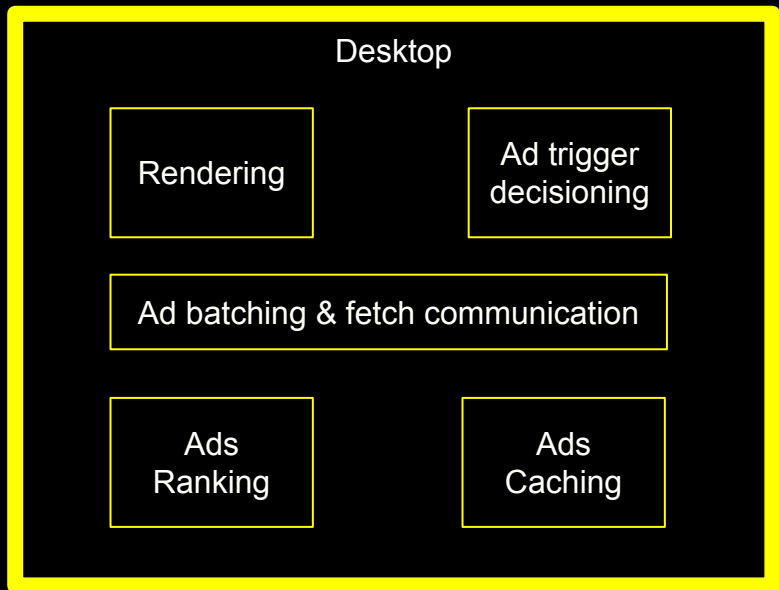


## Story 2

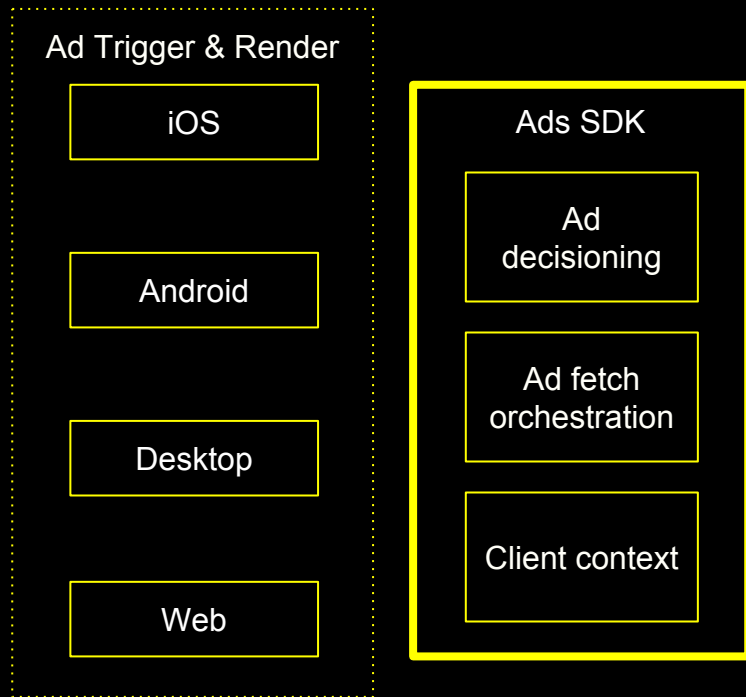
**Lean, mean and fast**

# Division of responsibilities

Before



After



**Problems**

# Thick Clients

**Logic duplication**

**Tightly coupled monolith**

**Fix strategy**

**Reduce State Management**



**Break monolith into services**

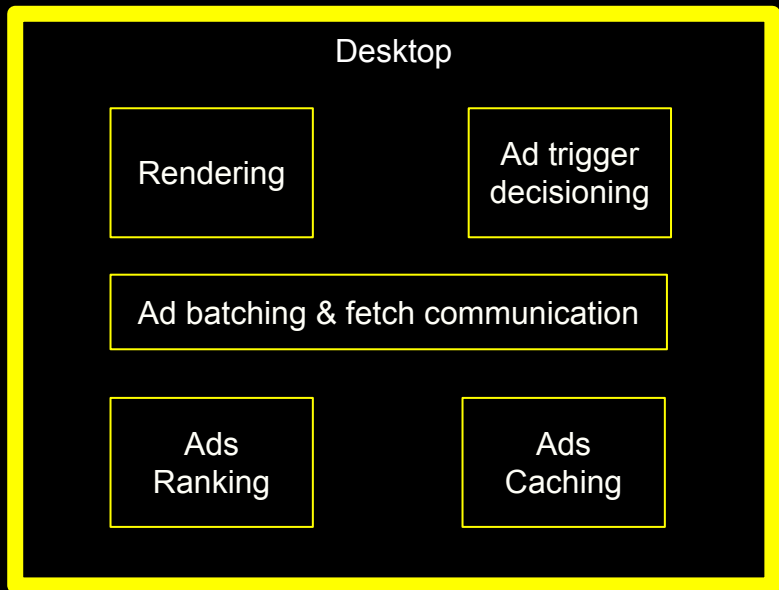
**Isolate platform independent  
logic into a lib**

**Fix tactic**

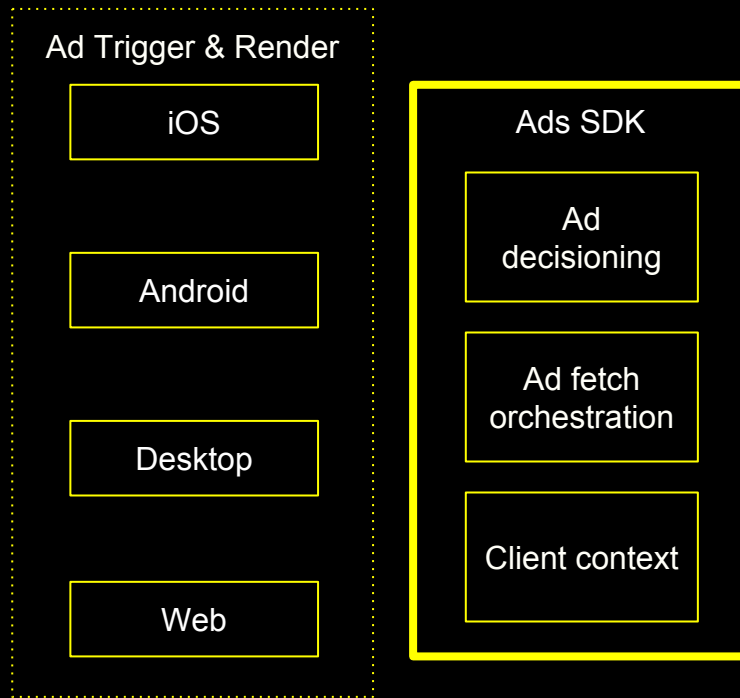
**Design your systems to be  
master of one thing**

# Remember division of responsibilities?

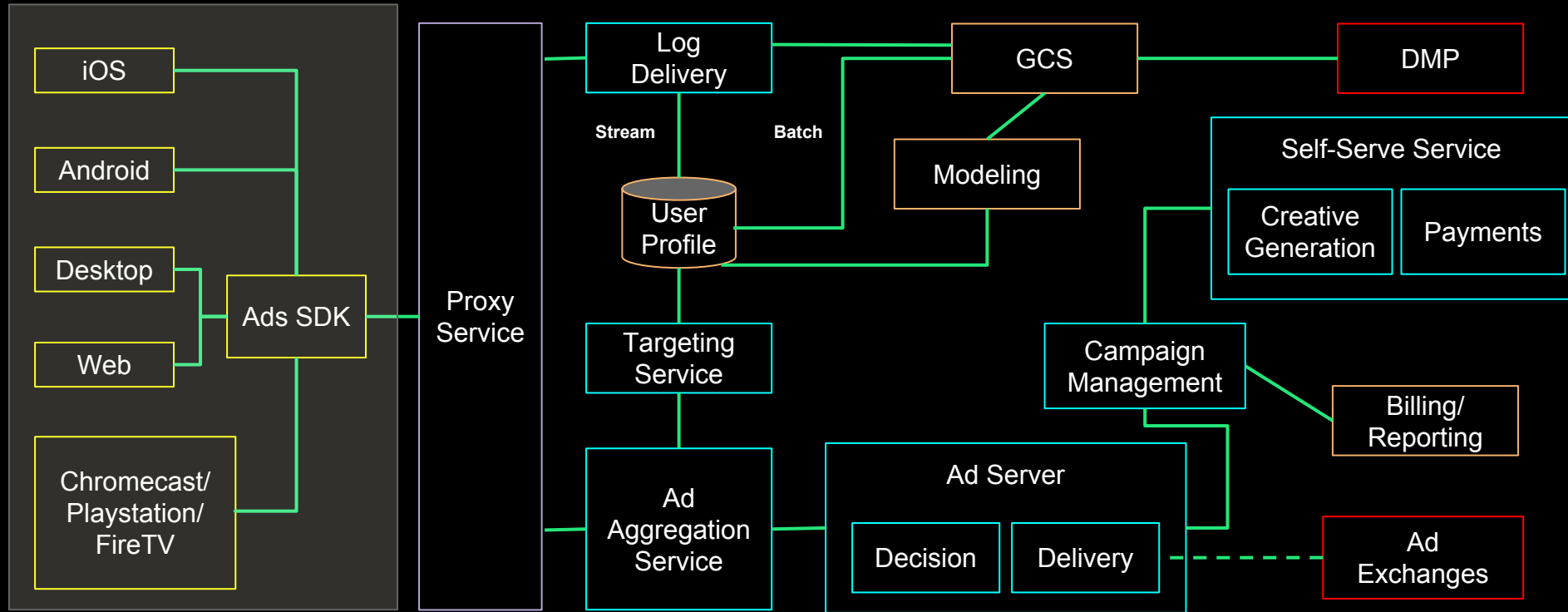
**BAD**



**GOOD**

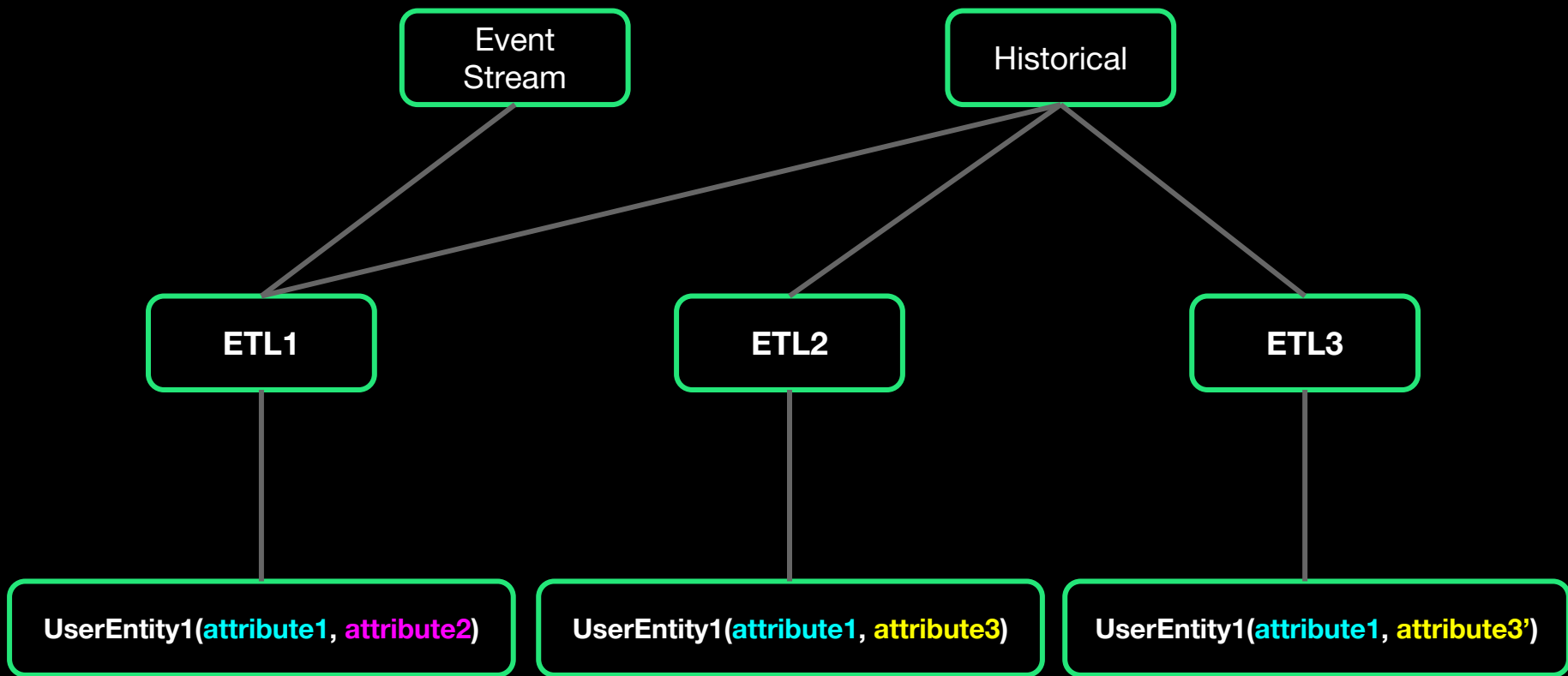


# Multiplatform Client design

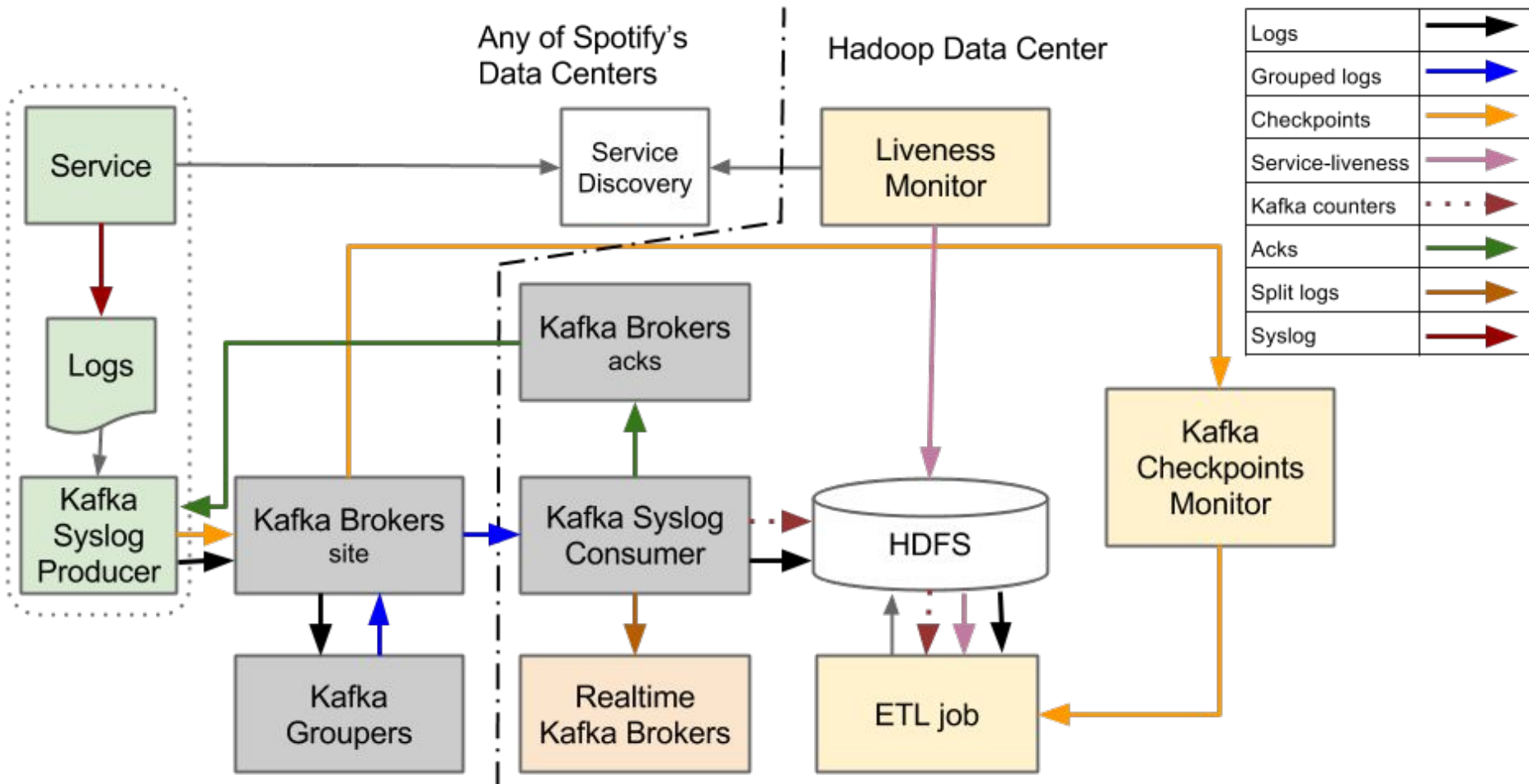


## Story 3

**Knowledge is power,  
Unreliable data is your enemy**







**Problems**

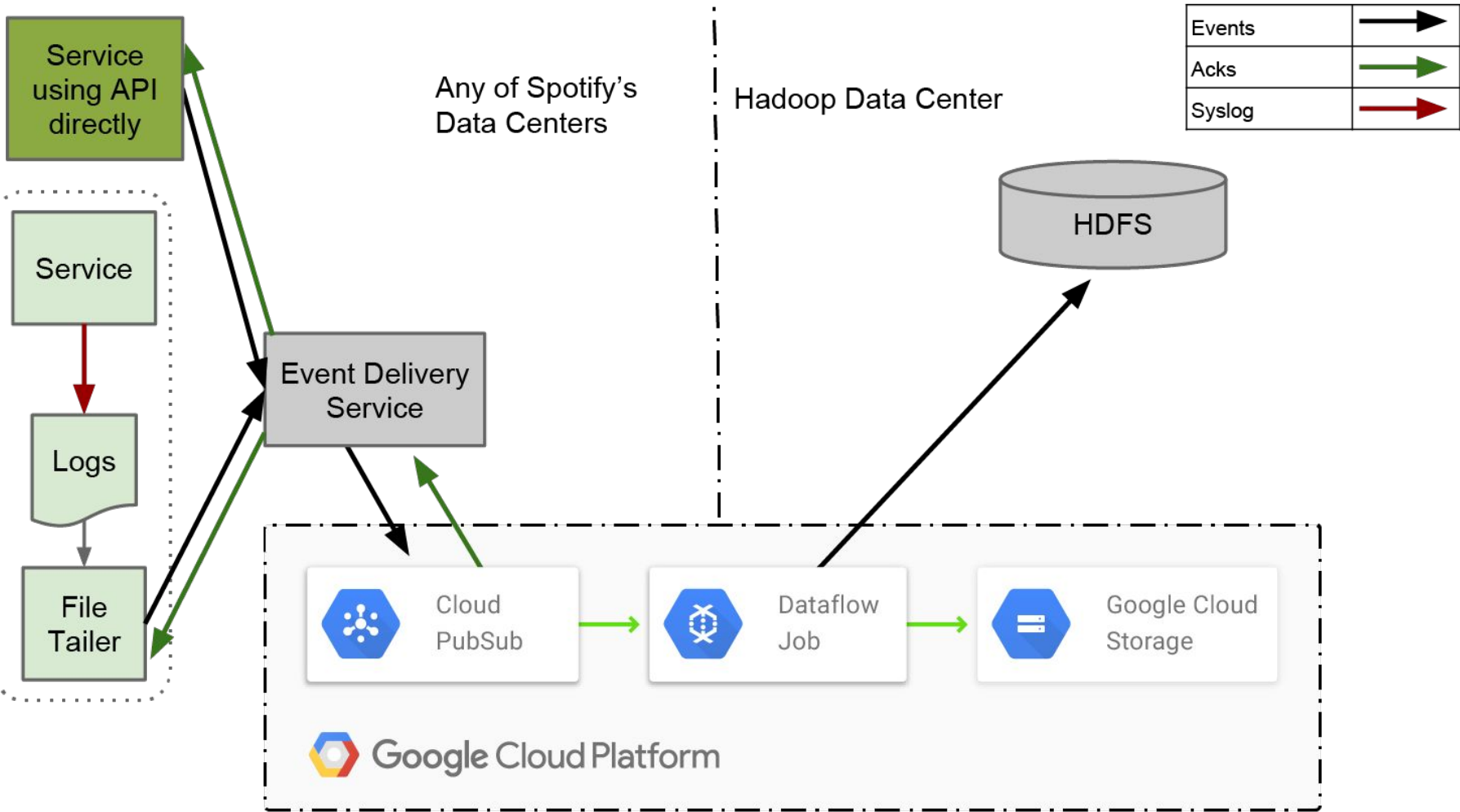
**Duplicate, undiscoverable and  
fragmented datasets**

**Metric inaccuracy**

# Overloaded Data Infra

**Fix strategy**

**Focus on reliable and timely log  
delivery**





# Data engineering with SLA

# Dataset canonicalization

# Some useful lessons learnt from architectural overhaul

**Test with minimal impact radius**

**Mistakes are inevitable**

**Speed up build decisions**

**Think for tomorrow, Solve for today**



# Thank You!

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