

BUILDING RESILIENCE in PRODUCTION MIGRATIONS

| Sangeeta Handa
Billing Infrastructure Engineering

NETFLIX



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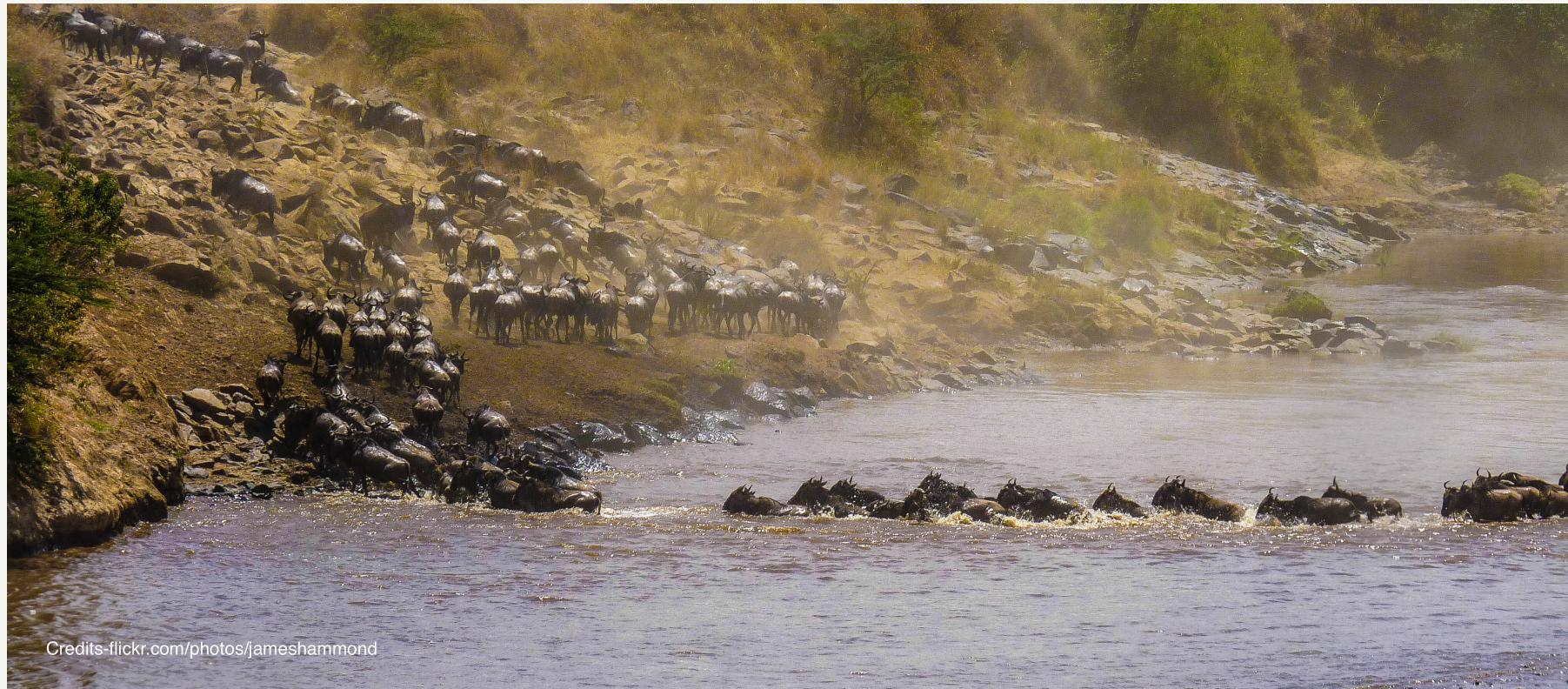
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NETFLIX

**Netflix Billing Infrastructure
enables recurring subscription
Billing**

Member Billing History- Last 12 months



Billing Details

YOUR MEMBERSHIP

Next month's plan
Premium for \$13.99/month
4 screens + **ULTRA HD**

Next billing date
October 16, 2018

Membership fees are billed at the beginning of each period and may take a few days after the billing date to appear on your account. Sales tax may apply.

Date	Description	Service period	Payment method	Total
9/16/18	Netflix Service	9/16/18-10/15/18	PayPal	\$13.99
8/16/18	Netflix Service	8/16/18-9/15/18	PayPal	\$13.99
7/16/18	Netflix Service	7/16/18-8/15/18	PayPal	\$13.99
6/16/18	Netflix Service	6/16/18-7/15/18	PayPal	\$13.99
5/16/18	Netflix Service	5/16/18-6/15/18	PayPal	\$13.99
4/16/18	Netflix Service	4/16/18-5/15/18	PayPal	\$13.99
3/16/18	Netflix Service	3/16/18-4/15/18	PayPal	\$13.99
2/16/18	Netflix Service	2/16/18-3/15/18	PayPal	\$13.99
1/16/18	Netflix Service	1/16/18-2/15/18	PayPal	\$13.99
12/16/17	Netflix Service	12/16/17-1/15/18	PayPal	\$13.99
11/16/17	Netflix Service	11/16/17-12/15/17	PayPal	\$11.99
10/16/17	Netflix Service	10/16/17-11/15/17	PayPal	\$11.99

NOTE: We only show up to 1 year of billing history

Balance in gift card credits

NETFLIX Home TV Shows Movies Recently Added My List

KIDS DVD

Account

MEMBERSHIP & BILLING

[Cancel Membership](#)

Password:

Phone:

[Change email](#)
[Change password](#)
[Change phone number](#)

No payment info

Your \$25 credit will be applied to your next bill.

[Update payment info](#)
[Billing details](#)

Redeem gift card or promo code

Enter code or pin [Redeem](#)

[Where to buy gift cards](#)

PLAN DETAILS

Basic

[Change plan](#)

No DVD plan

[Add DVD plan](#)

SETTINGS

[Communication settings](#)
[Parental controls](#)
[Test participation](#)
[Manage download devices](#)
[Activate a device](#)
[Recent device streaming activity](#)
[Sign out of all devices](#)

MY PROFILE

[Manage profiles](#)

Language [Viewing activity](#)
Playback settings [Ratings](#)

Service On Hold - Invoice declined



Update your payment information to continue.

We were unable to process your last payment. Please update your payment information to continue enjoying Netflix.

[Update Payment](#)



[Home](#) [TV Programmes](#) [Films](#) [Recently Added](#) [My List](#)

[KIDS](#) [DVD](#) [▼](#)

To summarize what we do...

- Recurring charges for Netflix membership
- Track Gift Card and Promotions redeemed by a Netflix Member
- Services to Charge Credit Card or Method Of Payment(MOP), Cancellation etc
- Financial Reporting
- Global Tax



**Netflix Billing Infrastructure
is busy 24X7 supporting 130+
million paying members**



Taking Downtime is not an option



**Resilient Migrations is the
only way to go**

Some known Risks in data migrations

Data Issues

- Data loss
- Duplicate data
- Data corruption

Service Impact

- Unexpected system behavior on migrated state
- Performance degradation post data migration
- Unexpected downtime



Using Zero Downtime as a Resilience Metric

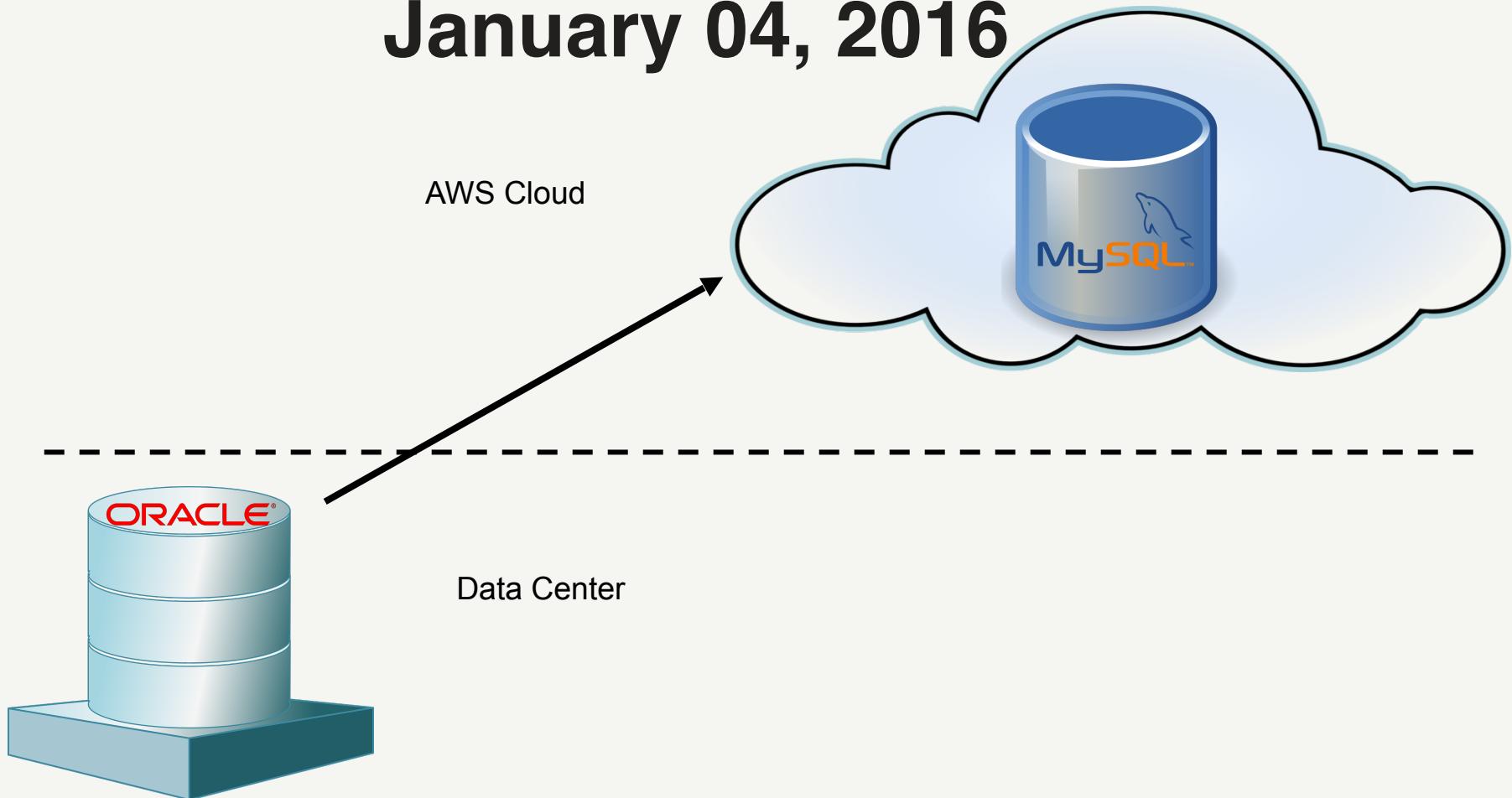
Zero Downtime Variations in stateful migrations

1. Perceived Zero Downtime
2. Actually Zero Downtime
3. No Migration of State

1. Perceived Zero Downtime

Multi TeraBytes (TB) Customer billing data Migration from Oracle to MySQL

January 04, 2016



- Multi TB Migration from Oracle to MySQL

Characteristics of Migration

Scale

- Billions of rows to be migrated
- 8TB of data
- Migrate constantly changing data

Heterogeneous Environments

- Different OS and Databases- Oracle to MySQL
- Migrate between Data Centers- Netflix Data Center to AWS Cloud
- Multi TB Migration from Oracle to MySQL

How do we migrate data reliably?

- Multi TB Migration from Oracle to MySQL

So we tried many possibilities

- Snapshot?
 - Apache Sqoop?
 - Something else?
-
- Multi TB Migration from Oracle to MySQL

Real time replication of data

Granular migration

- Migrate at Record level, by table
- Clean up and restart load at table level
- Pause migration if needed

Granular Error visibility

- Catch failures at record level
- Sustain foreign key Integrity
- Avoiding Duplicates

- Multi TB Migration from Oracle to MySQL

How do we Build Confidence In Migrated Data?

- Multi TB Migration from Oracle to MySQL

Achieving Data Integrity

- Daily automated snapshot reconciliation to catch mismatch
 - Checks on row counts
 - Run test environment only on MySQL database for a few weeks before flipping
 - Run financial reports on both database
-
- Multi TB Migration from Oracle to MySQL

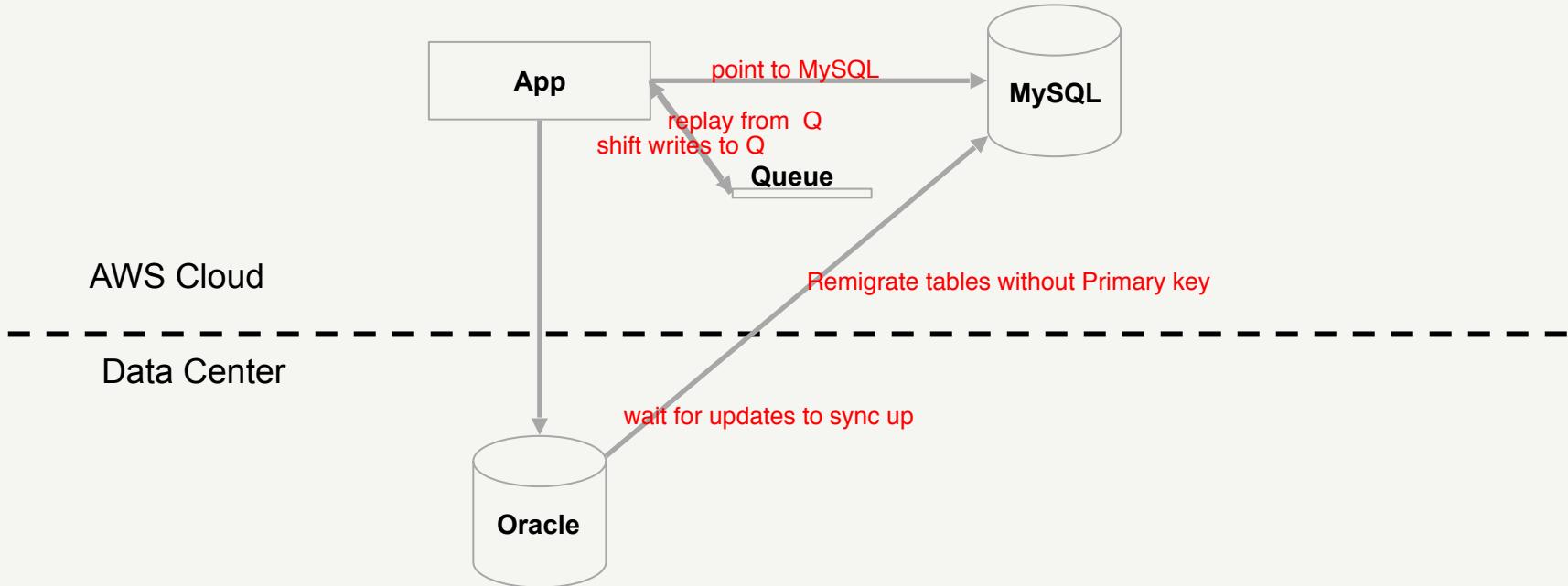
Do we need to decouple Customer Interactions?

- Multi TB Migration from Oracle to MySQL

Allow Reads and Replay Writes

- Billing history needs to be available while we are down
 - Optimistically releasing Service holds on timeouts
 - Ability to queue and retry posts
-
- Multi TB Migration from Oracle to MySQL

Final Flip



- Multi TB Migration from Oracle to MySQL

2. Actually Zero Downtime

Rewriting Balance Service

Served By Netflix Balance Service

The screenshot shows the Netflix Account page. At the top, there's a navigation bar with links for Home, TV Shows, Movies, Recently Added, and My List. On the right side of the bar are search, KIDS, DVD, and profile icons. The main content area is titled "Account".

MEMBERSHIP & BILLING

- Cancel Membership
- Password: [REDACTED]
- Phone: [REDACTED]
- No payment info (highlighted with a red oval)
- Your \$25 credit will be applied to your next bill.
- Redeem gift card or promo code
- Enter code or pin
- Redeem
- Change email
- Change password
- Change phone number
- Update payment info
- Billing details
- Where to buy gift cards

PLAN DETAILS

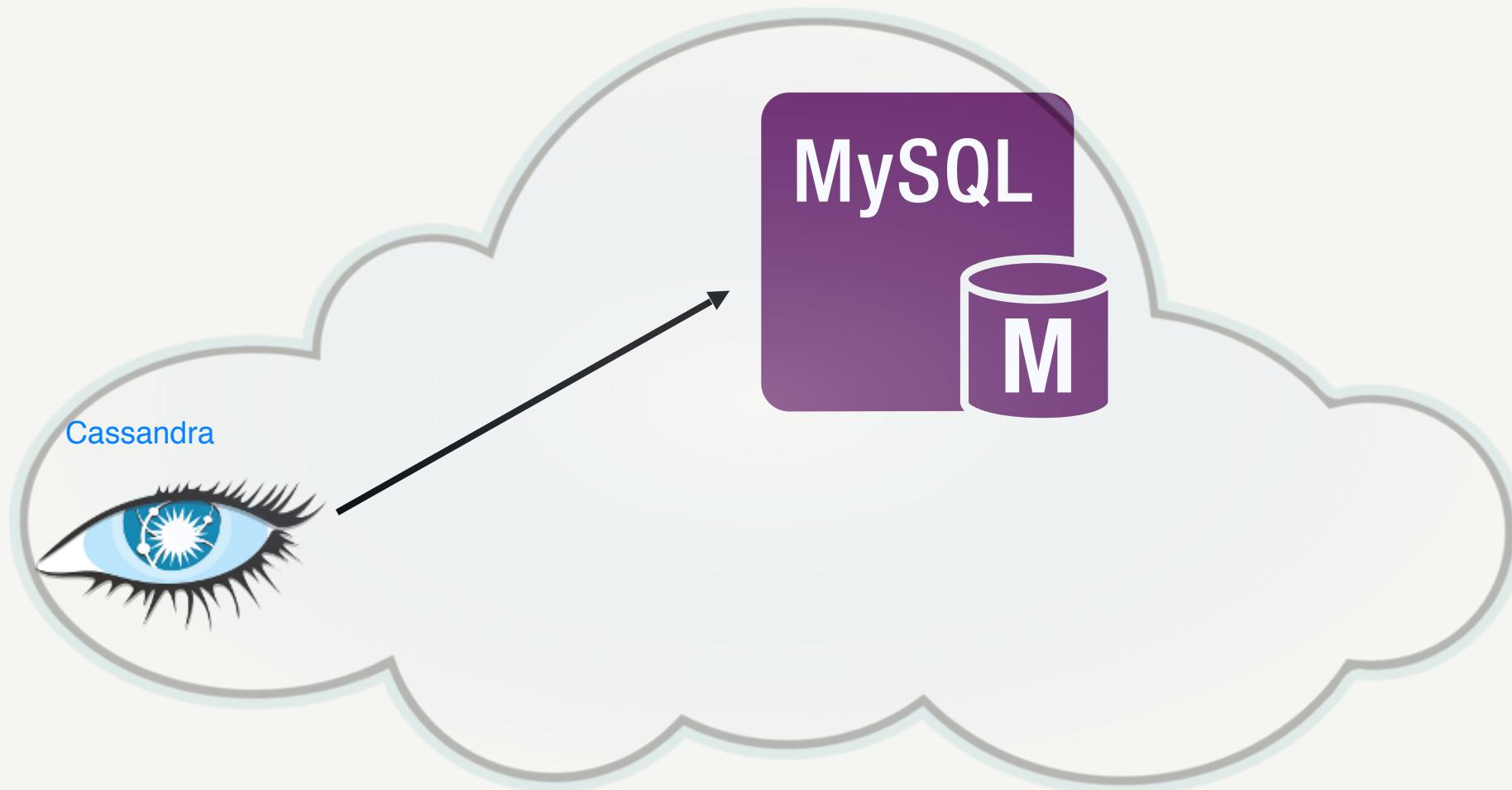
Basic	Change plan
No DVD plan	Add DVD plan

SETTINGS

- Communication settings
- Parental controls
- Test participation
- Manage download devices
- Activate a device
- Recent device streaming activity
- Sign out of all devices

MY PROFILE

- [Profile icon] [REDACTED]
- Language
- Playback settings
- Viewing activity
- Ratings
- Manage profiles

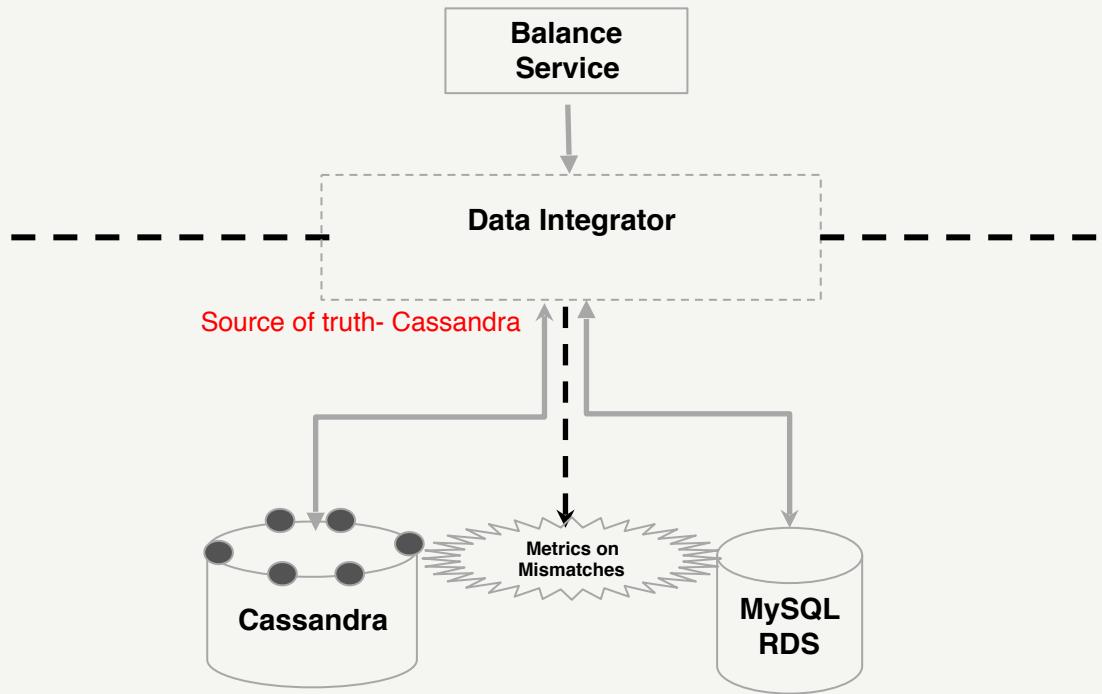


Characteristics of Migration

- Migrate State from Cassandra to MySQL RDS
- Simple data structures
- Smaller data set

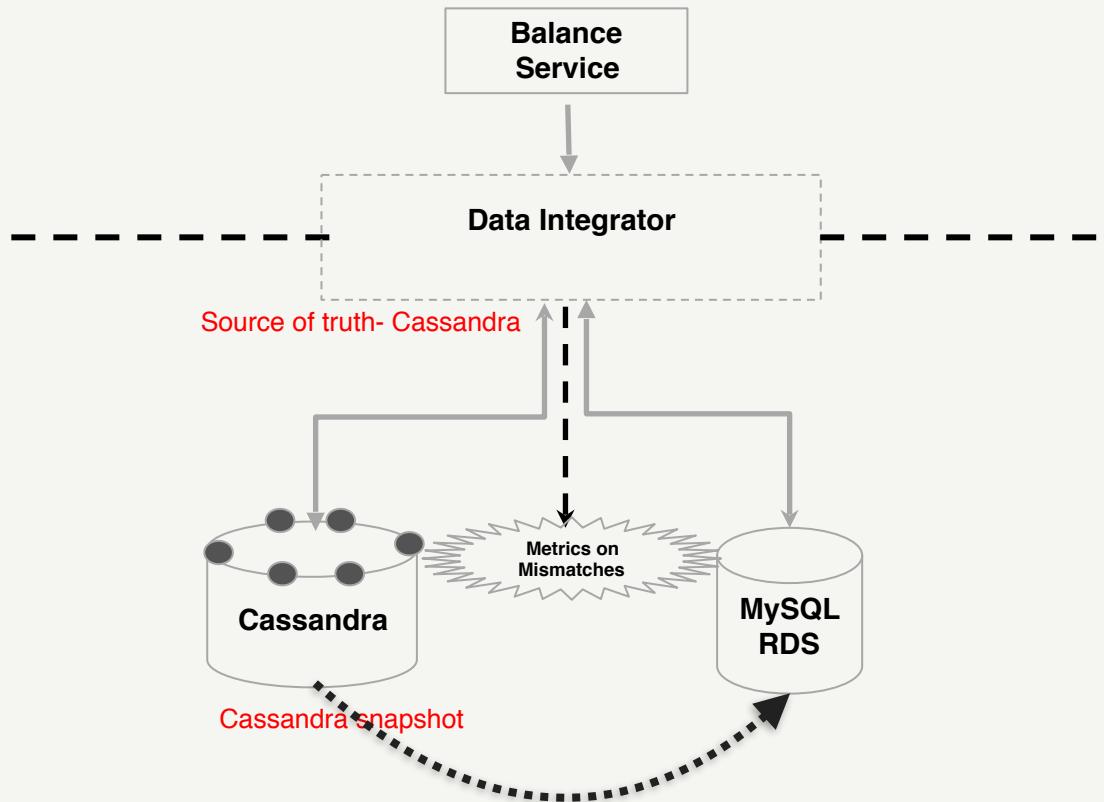
How do we migrate data reliably?

#1. Enable Shadow/Dual Writes



- Rewriting Balance Service

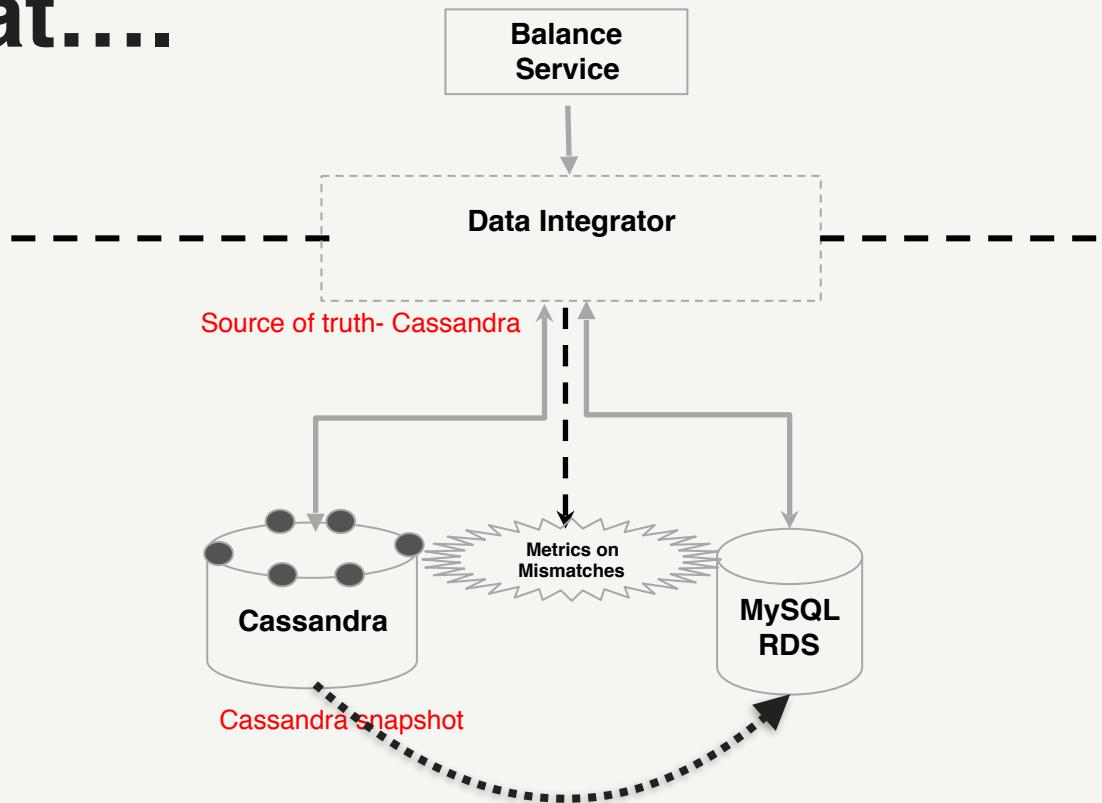
#2. Hydrate MySQL from Cassandra



- Rewriting Balance Service

#3. Check and remigrate failures.

Repeat....



How do we Build Confidence In Migrated Data?

Achieving Data Integrity in Target DB

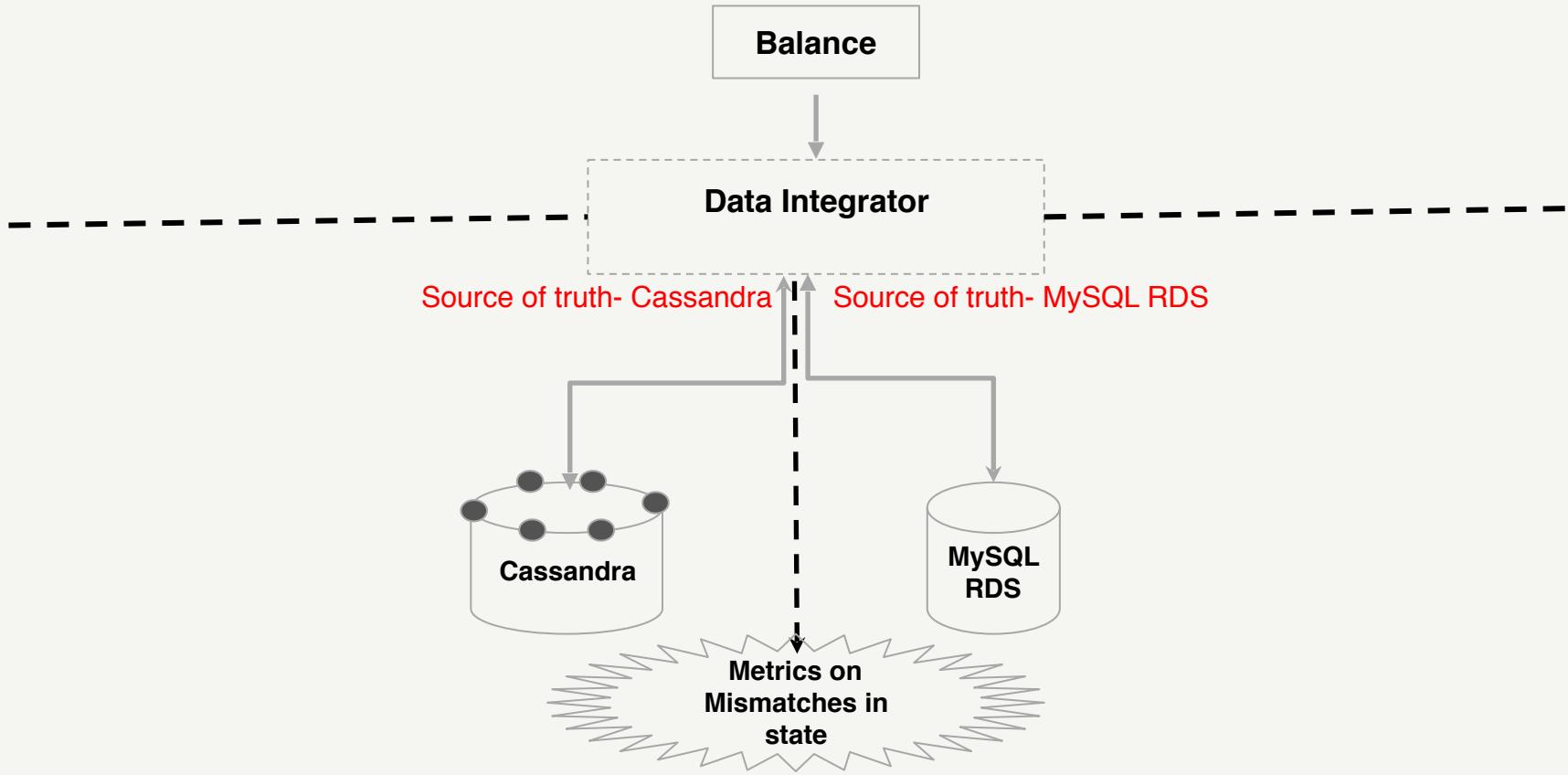
- Daily reconciliation of snapshots to identify mismatches
- Rewrite complete customer balance even if a single miss
- Simulate the setup in test environment for a few weeks before flipping

Do we need to decouple Customer Interactions?

Customer Interactions Un-Impacted

- Redeem Gift Card on Netflix website
- Remove service hold by applying gift card
- Check Credit Balance

Final Flip

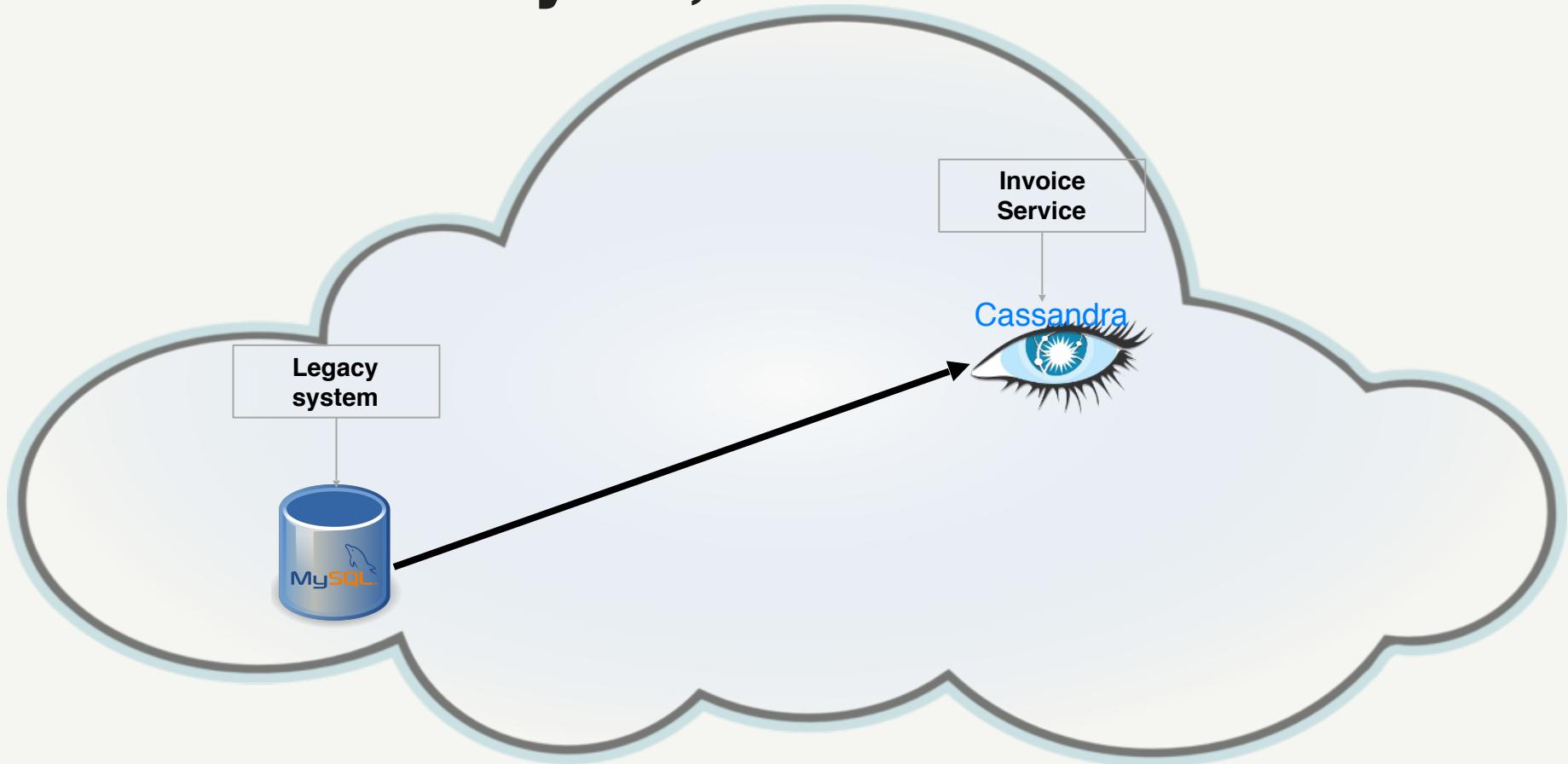


- Rewriting Balance Service

3. No Migration of State

Netflix Invoicing Service

July 02, 2018



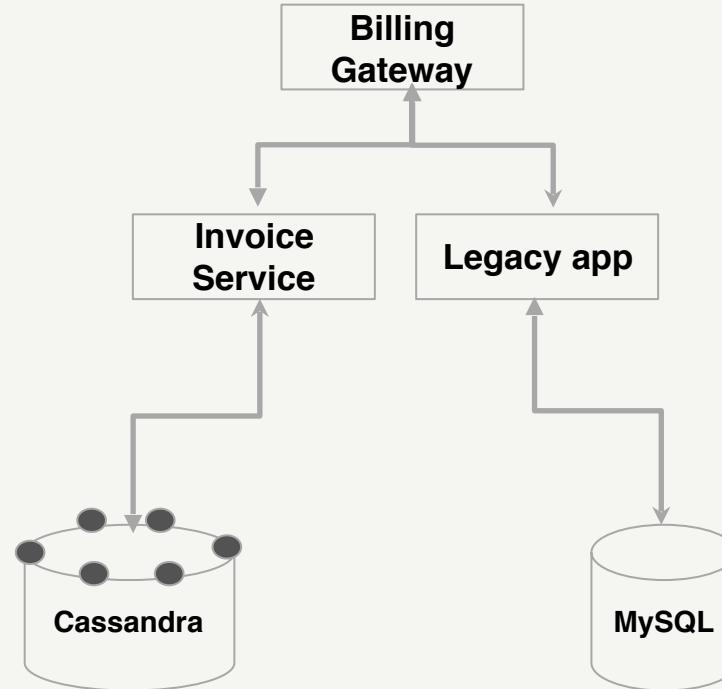
Characteristics of Migration

- Massive scale and velocity of change
- Moving from MySQL based solution to Cassandra based new Invoice service
- Invoices in different state of lifecycle in MySQL

Do we have to migrate data?

Working towards no migration

- New Invoice built aware of “legacy” system
- Running new and old in parallel
- Delegate to legacy system when needed



How do we Build Confidence?

- Rewriting Netflix Invoicing System

Building Confidence In New Service

- **Test in Shadow mode**
 - Test in shadow mode for a time period
 - Reconcile Shadow and Original to catch issues
 - Cleanup shadow and restart once all issues fixed
- **Monitoring and Alerts**
 - Using metrics to catch presence of unexpected behaviors
 - Using metrics to catch absence of expected state
- **Slow go live**
 - Cleanup shadow and enable production mode
 - Canaries. Live One country at a time
- Rewriting Netflix Invoicing System

Rethink Customer Interactions

- Rewriting Netflix Invoicing System

Creating Seamless state across two DB

- Seamless billing history through 2 systems
- Generating new invoices
- Refunds and Chargebacks
- Cancellation Requests
- Retry for failed invoices
- ...

Final Flip

Update Country list for Invoice Service with country codes to be added

To sum it up...

Build for Resilience from Start

- Aim for Zero Downtime even for data migration
- Invest in Early feedback loops to build confidence
- Find ways to decouple customer interactions from your services
- Build independent checks and balances through automated data reconciliation
- Canary Release- Learn and Rollout

Thank you.

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Billing Infrastructure Engineering

