Building an End-to-End De-Identification Pipeline for Advertising Activity Data at LinkedIn

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Agenda

1. Introduction
2. Design and architecture
3. Implementation challenges
4. Privatization mechanisms
5. Results and future work

1. Introduction

Motivation

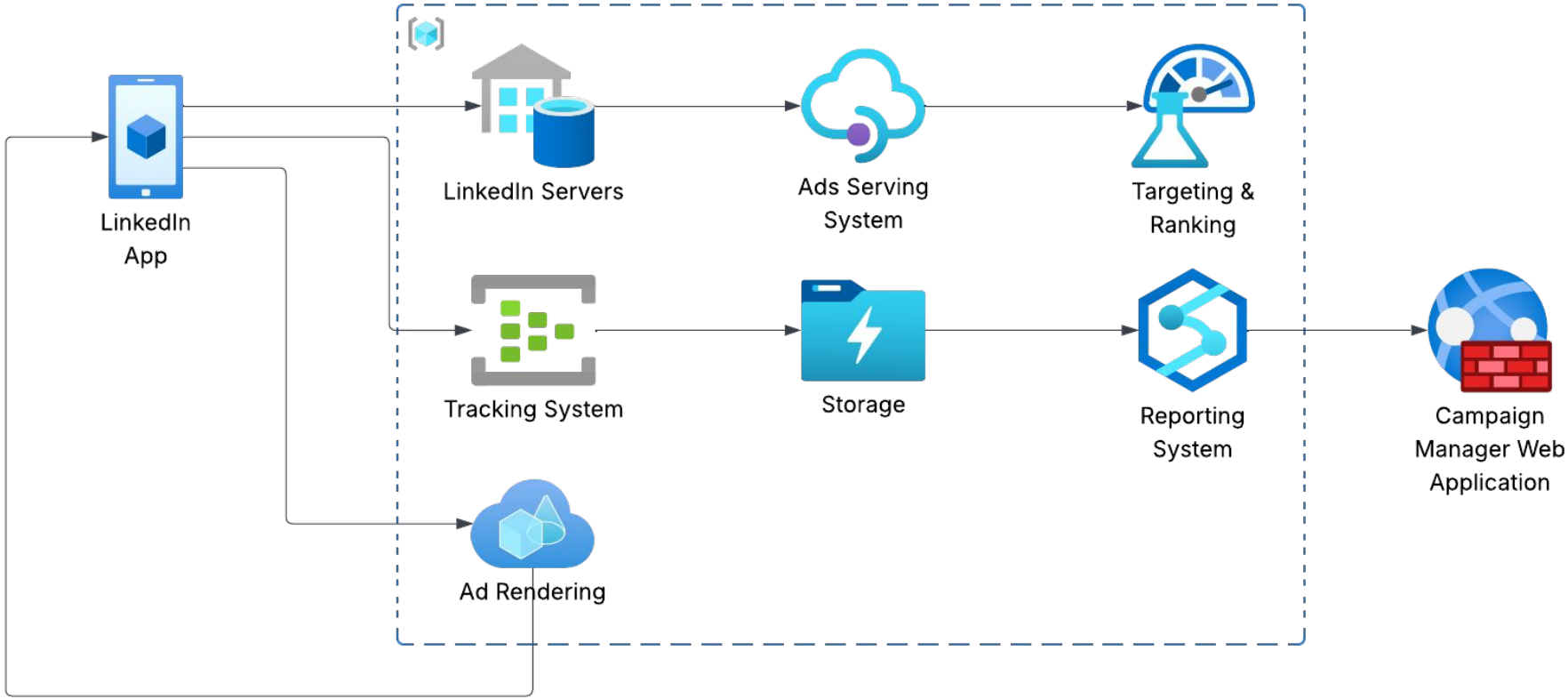
- Ads stack relies on members' activity data.

- Privacy regulations and platform restrictions

- Rebuild with privacy by design

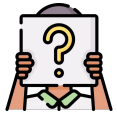
- Balance privacy with utility

Ads data flow

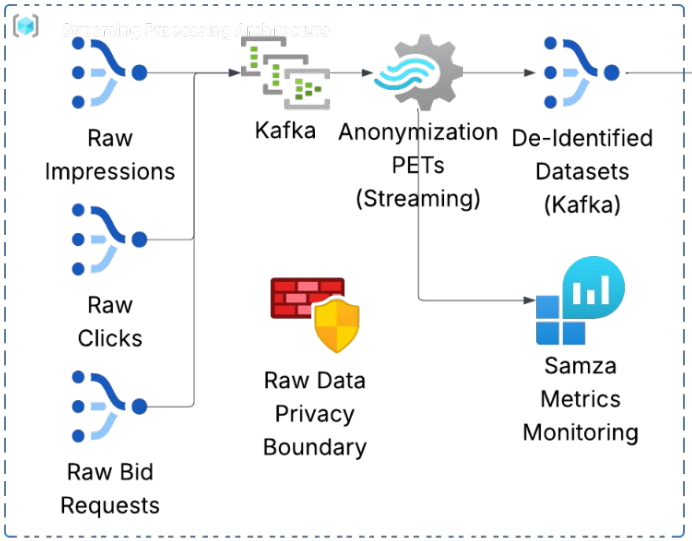


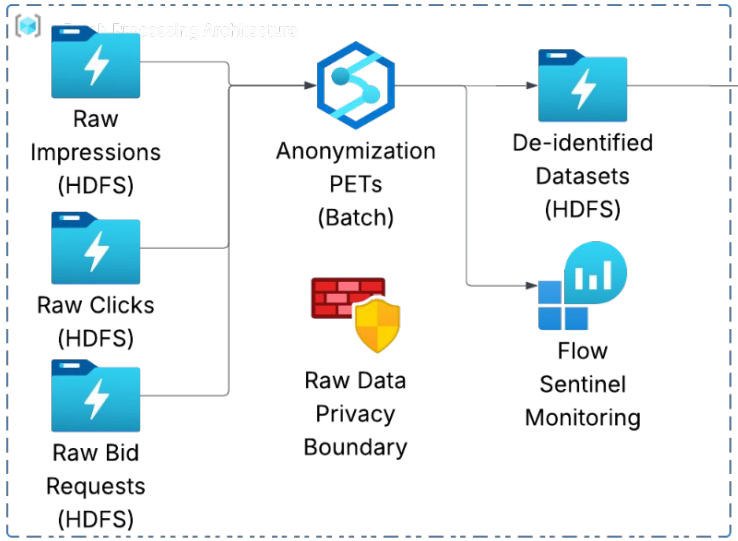
2. Design and architecture

Requirements

Functional	Non Functional	Use Cases
No re-identification 	Consumers SLOs maintained 	Billing 
Aggregated campaign performance metrics 	Privatization Streaming Data – 50ms p95	Reporting 
Consumer true norths	Privatization offline – finished by 3 AM PST daily	Forecasting

System design





Pros - Responsiveness
- Low Latency
- Frequent Checkpointing
- Smooth resource usage

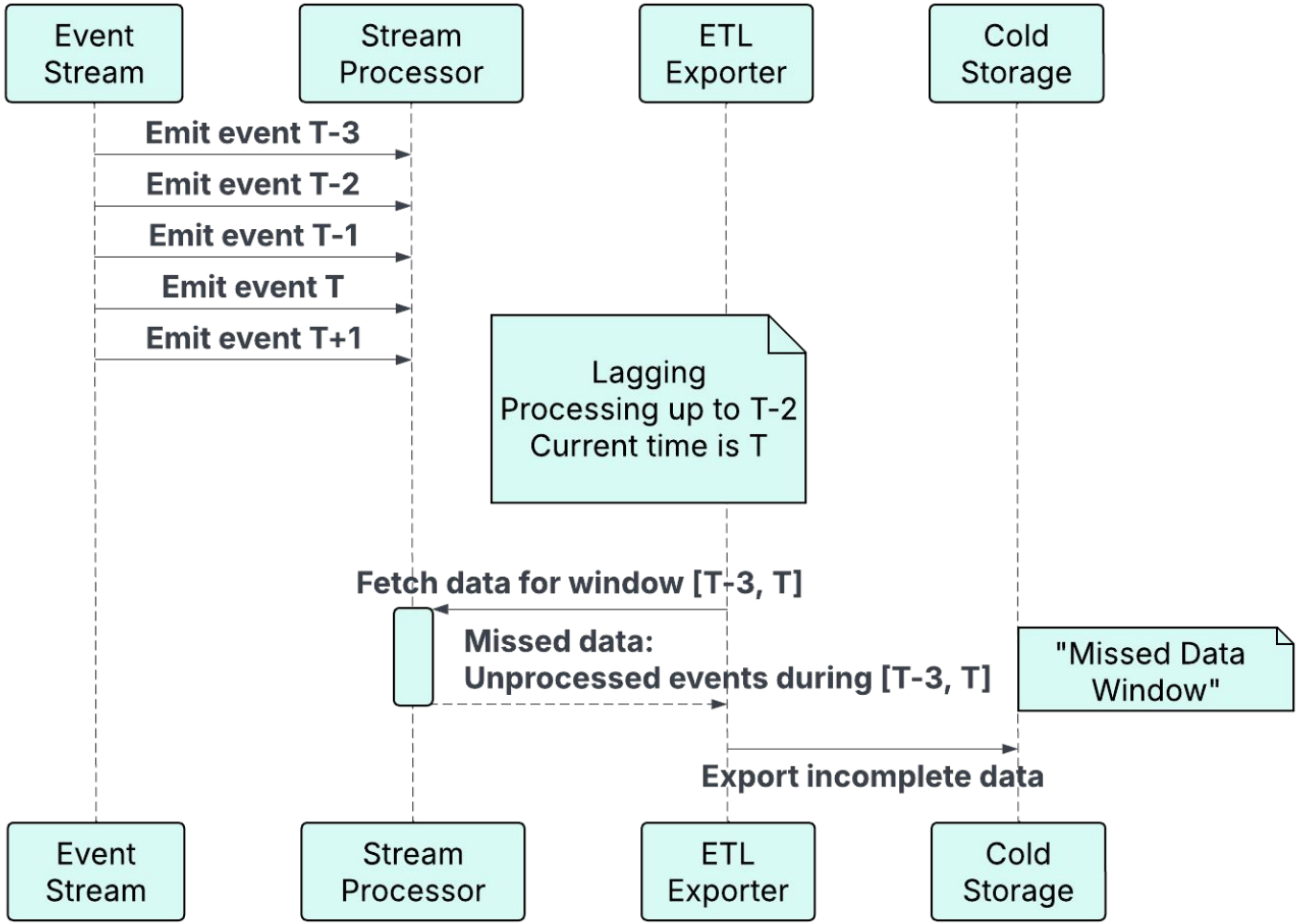
Cons - Complexity
- Operational Burden
- Development Complexity
- Backfills

Pros - Simplicity
- Development complexity
- Efficiency via scale
- Backfills

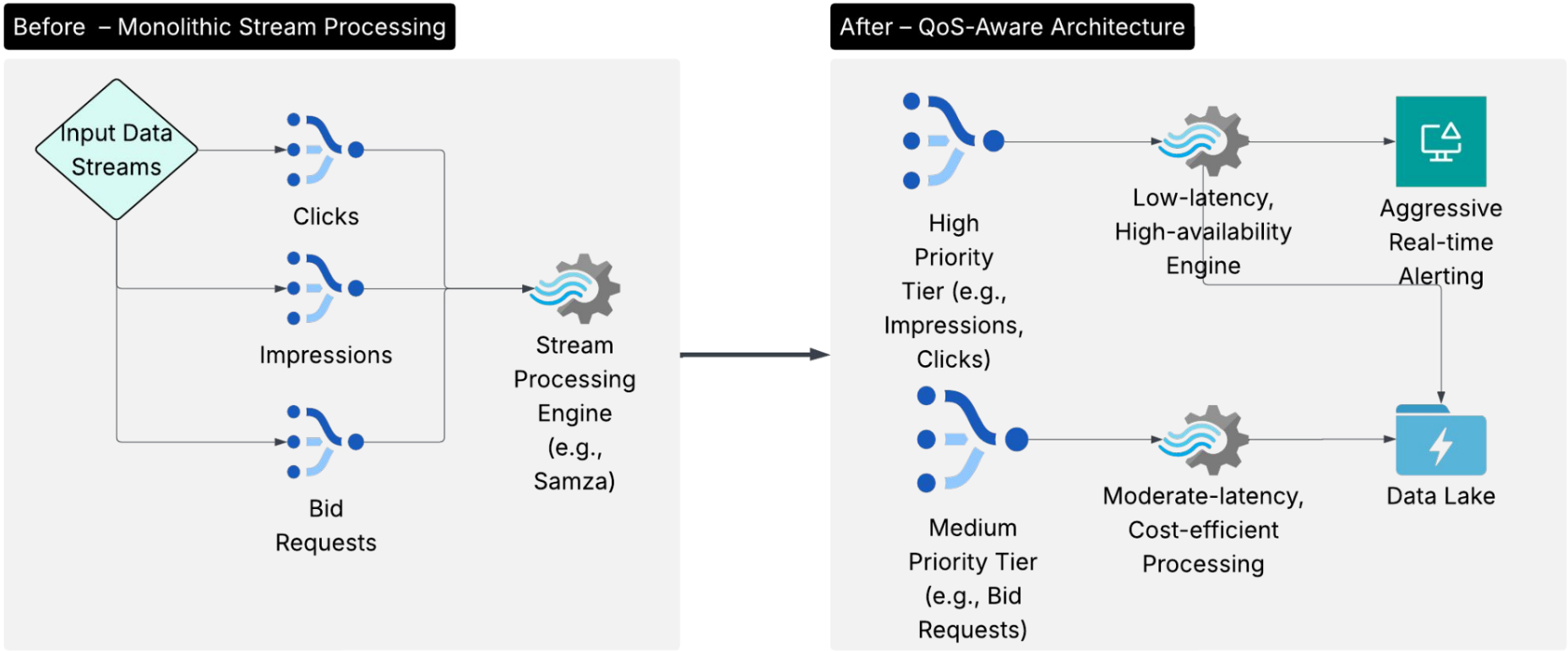
Cons - Freshness
- Latency
- High failure cost
- Spiky resource usage

3. Implementation challenges

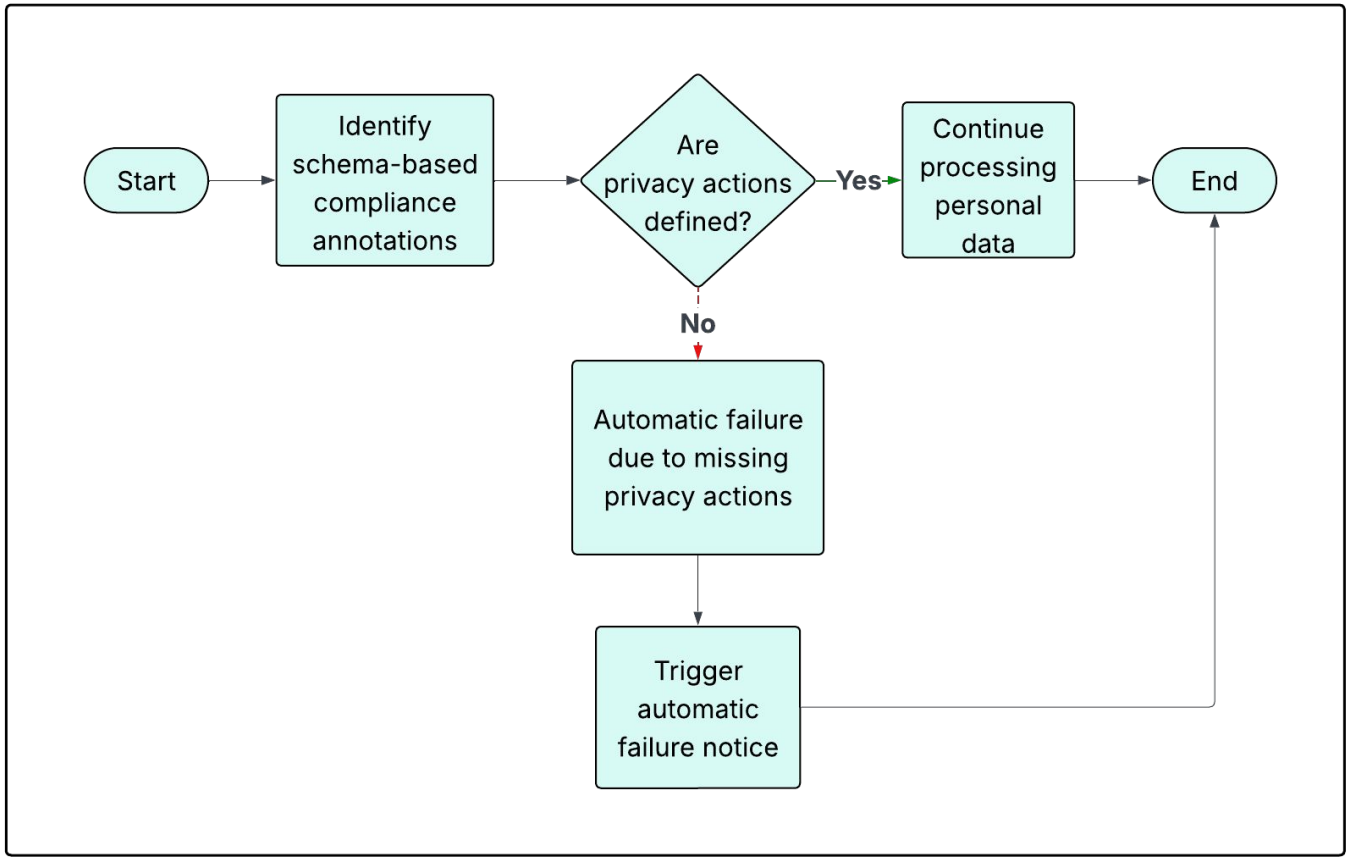
Lag


Event Stream
Stream Processor
ETL Exporter
Cold Storage
Emit event T-3
Emit event T-2
Emit event T-1
Emit event T
Emit event T+1
Lagging
Processing up to T-2
Current time is T
Fetch data for window [T-3, T]
Missed data:
Unprocessed events during [T-3, T]
"Missed Data Window"
Export incomplete data
Event Stream
Stream Processor
ETL Exporter
Cold Storage

System robustness

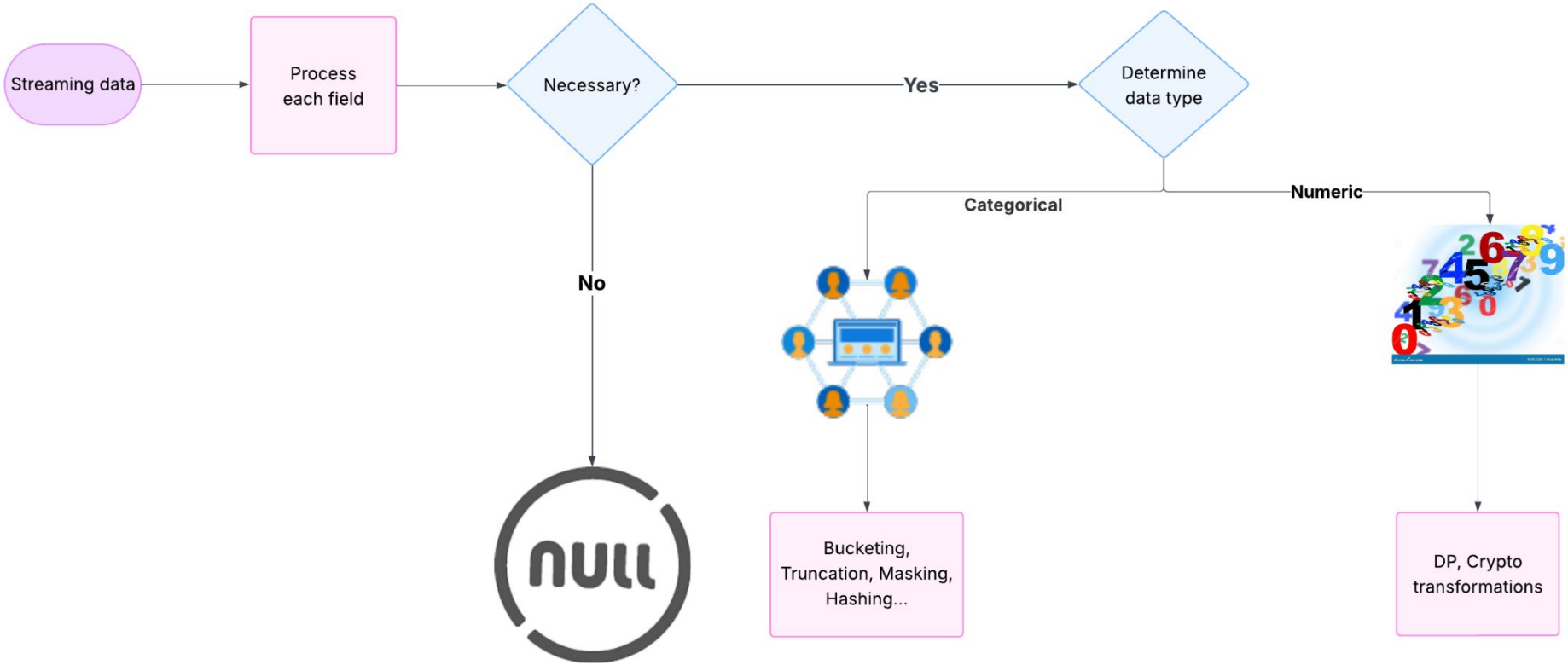


Other challenges



4. Privatization mechanisms

Privatization mechanisms



Eg 1: Timestamps

- Time of impression, how long ad was seen.
- 🤔 Innocuous?

- Rounding?

- **Local DP**
  - Clamp values.
  - Bound sensitivity.
  - Gaussian noise with eps = 4 and Delta = 0.0001
  - Product constraints

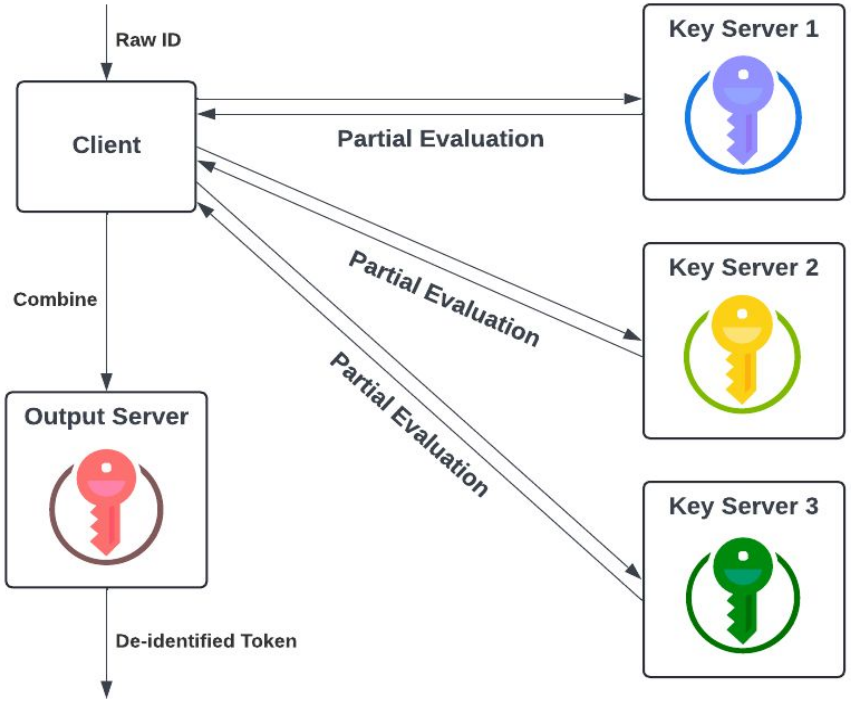
- Formal *metric DP* guarantee.

Eg 2: MemberID

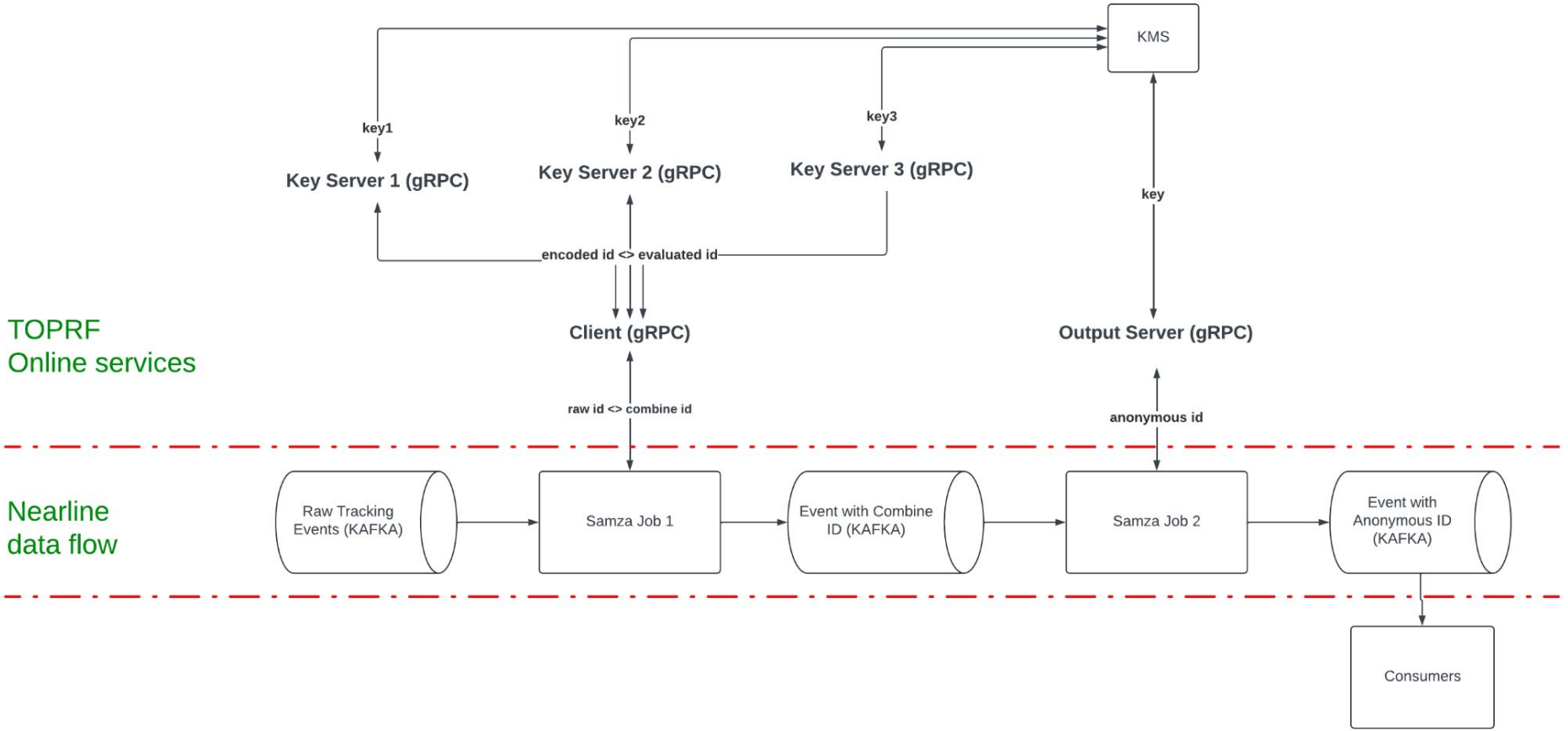
Principles

- Raw ID shouldn’t leave client.
- Raw ID and Token shouldn’t co-exist.
- Token can’t be constructed by one entity.

Threshold Oblivious Pseudorandom Functions



Eg 2: MemberID



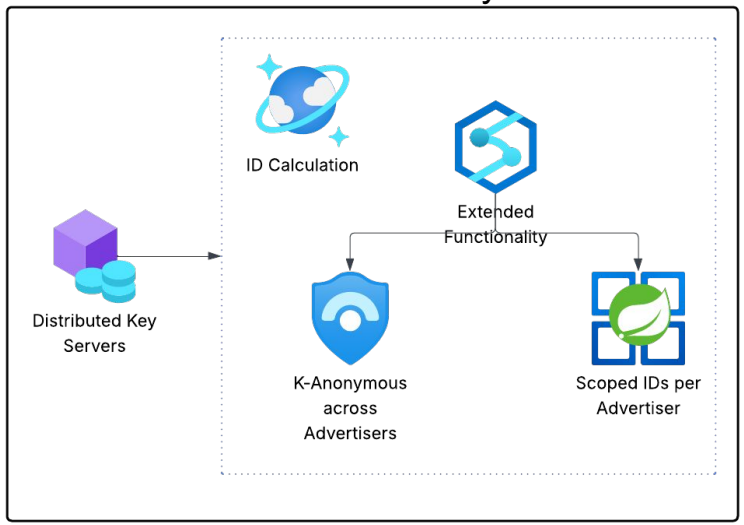
4. Results and future work

Results

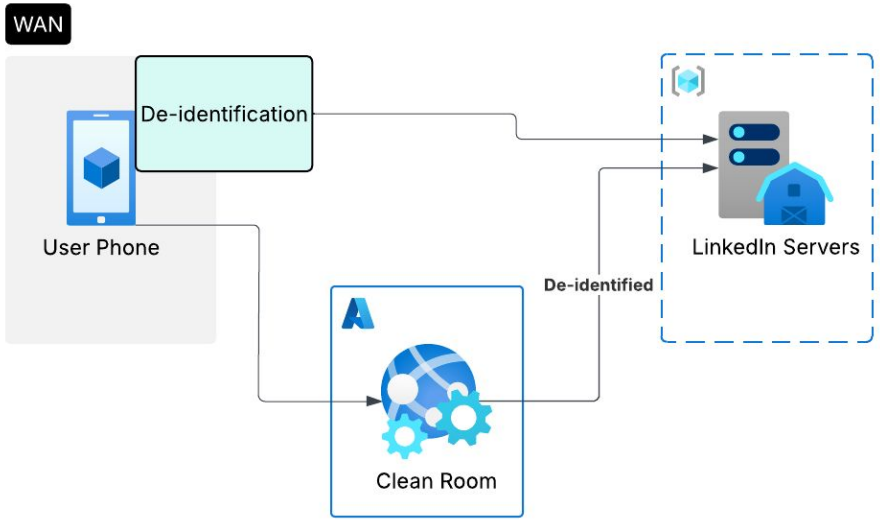
Privacy	Business
User data protected ⛑️	Reporting and billing onboarded 🚀
Smaller retention periods ⏳	No net negative impact 💰
Privacy monitoring 👀	SLA maintained ⏰

Future work

- Extended Functionality



- De-identify early



- 3P Signals
- Support modeling use-cases

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Q&A

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