Optimizing Speed and Scale of User-Facing Real-time Analytics

Using Apache Kafka and Apache Pinot

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#DataAISummit

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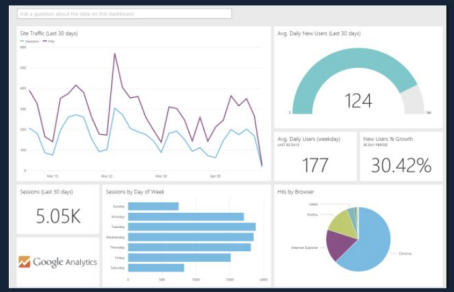
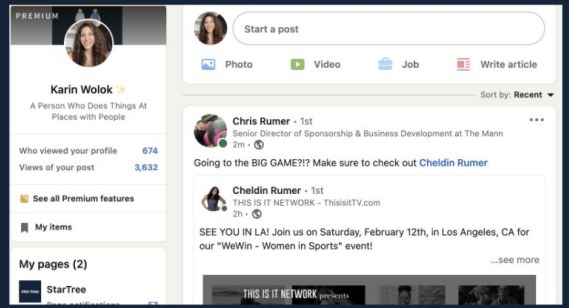
Types of Analytics Use Cases

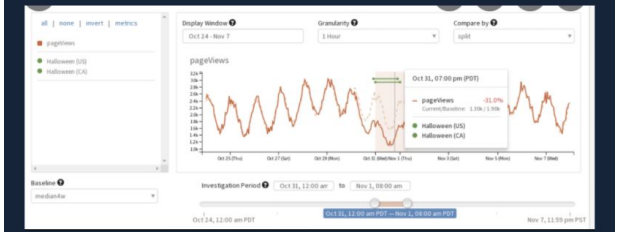
Dashboards / BI Tools



User-Facing Analytics



Machine Learning



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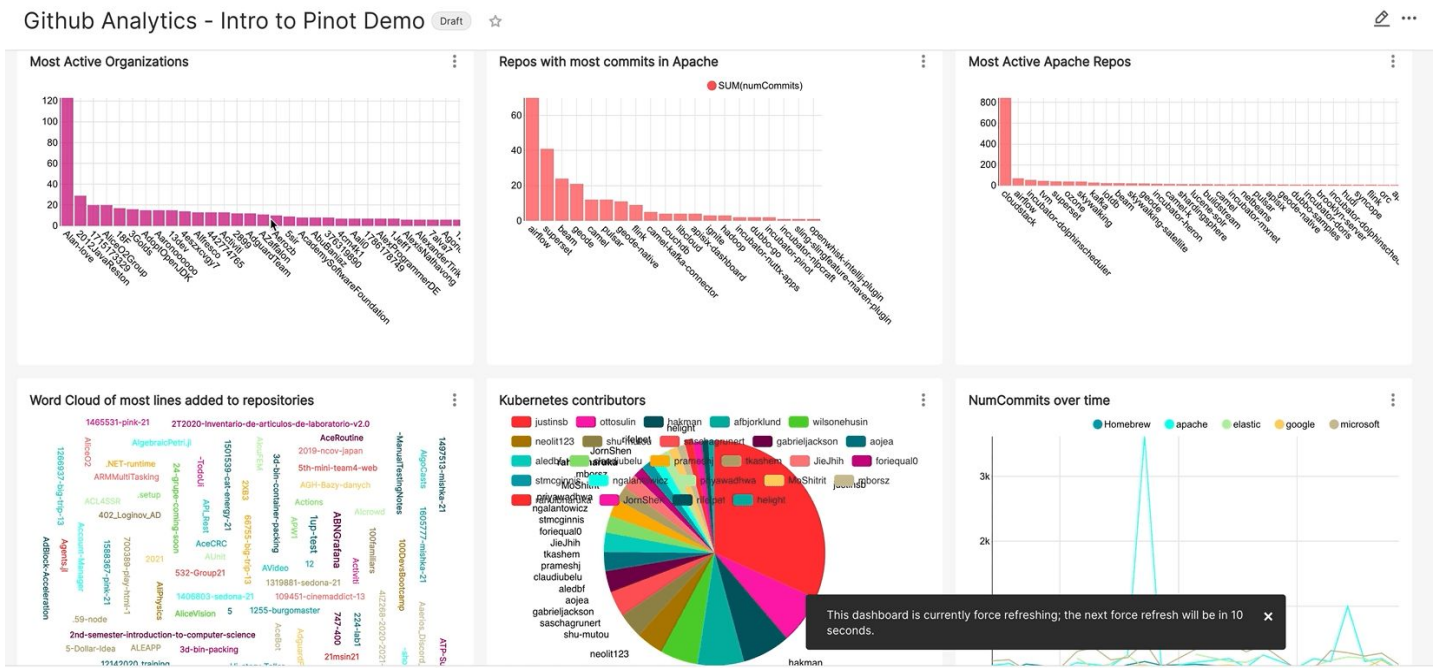
Dashboards / BI Tools



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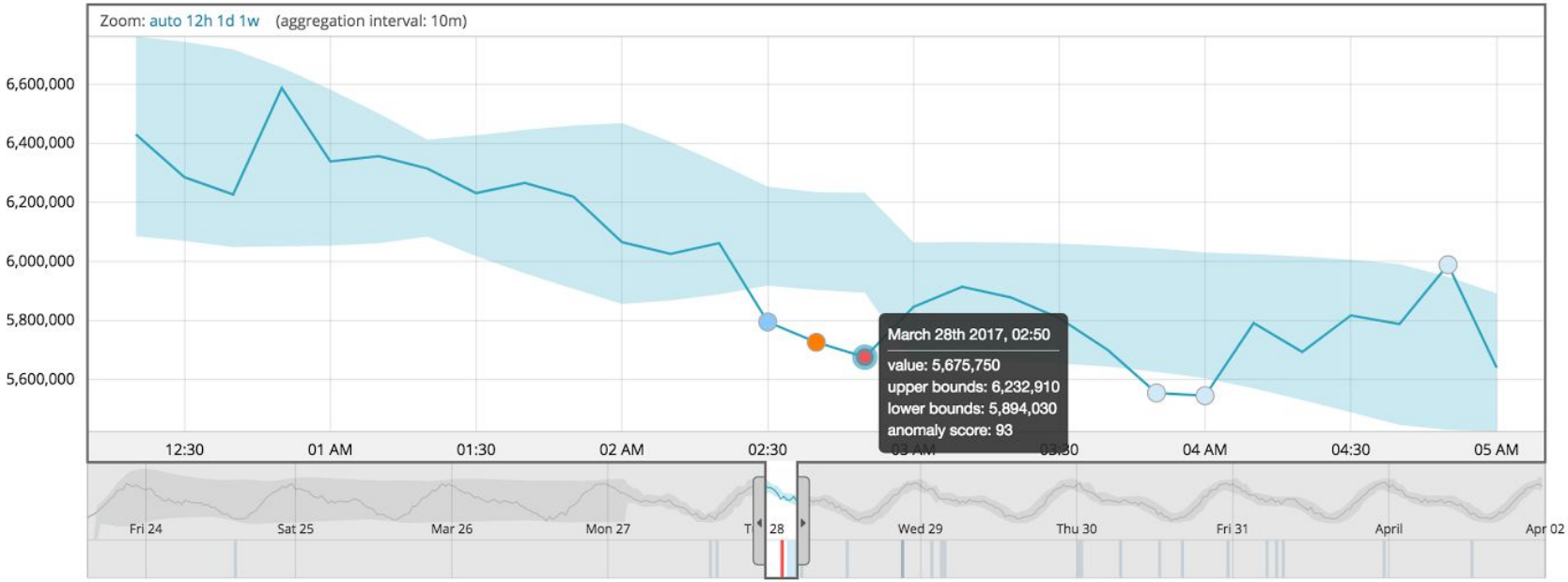
Machine Learning



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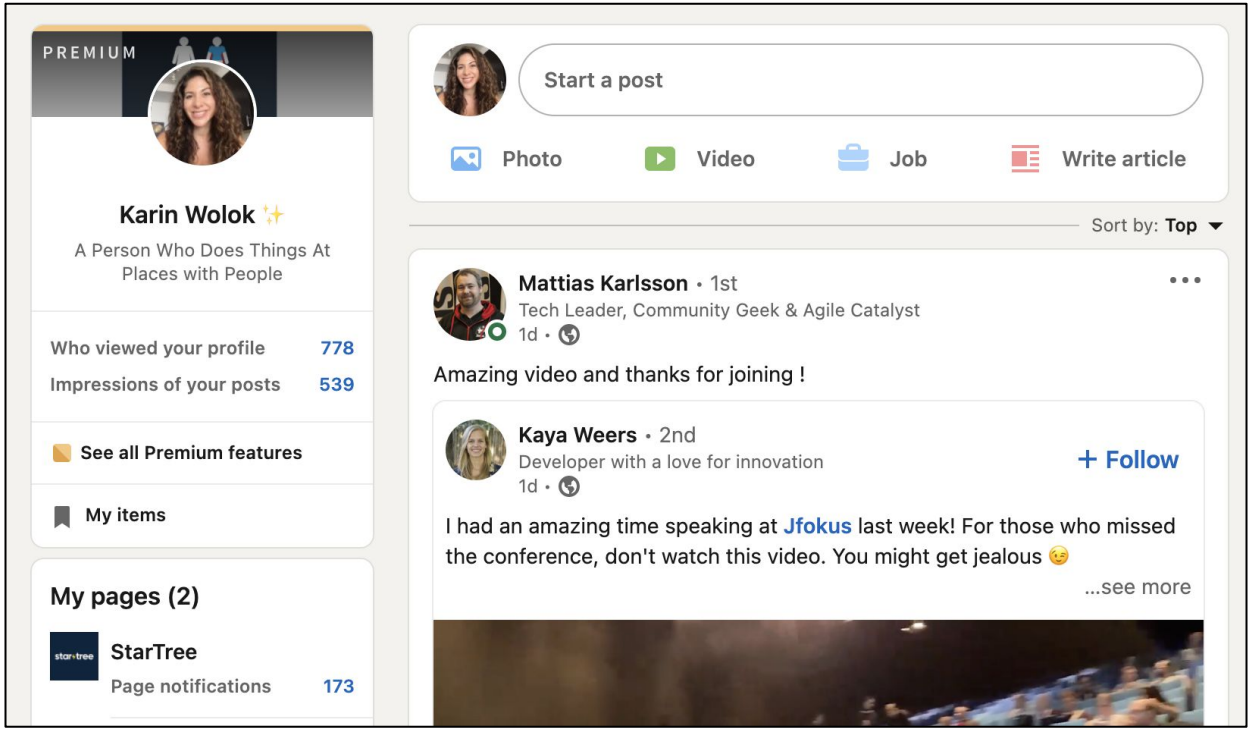
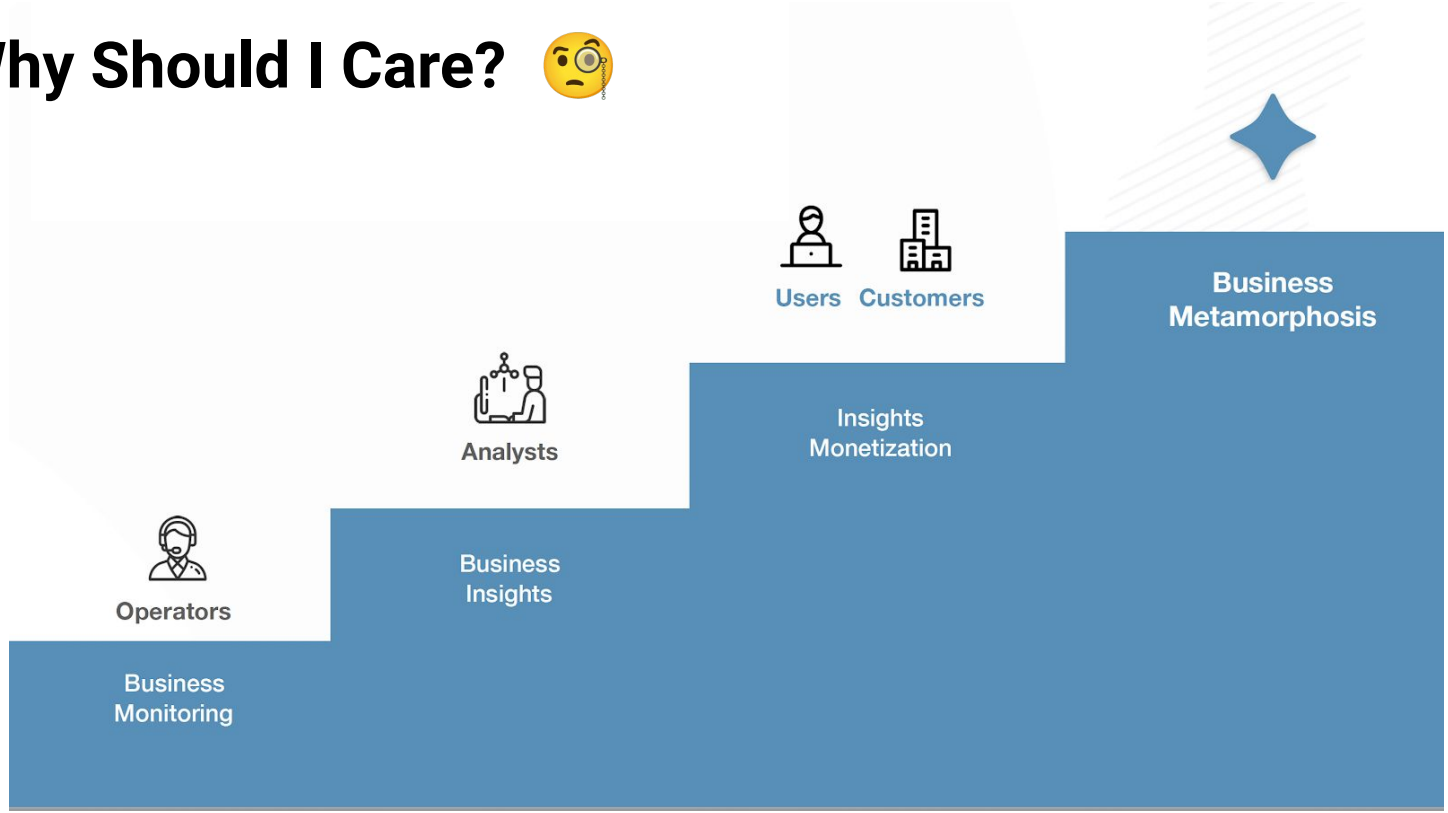
User-Facing Analytics



star tree

Why Should I Care? 🧐



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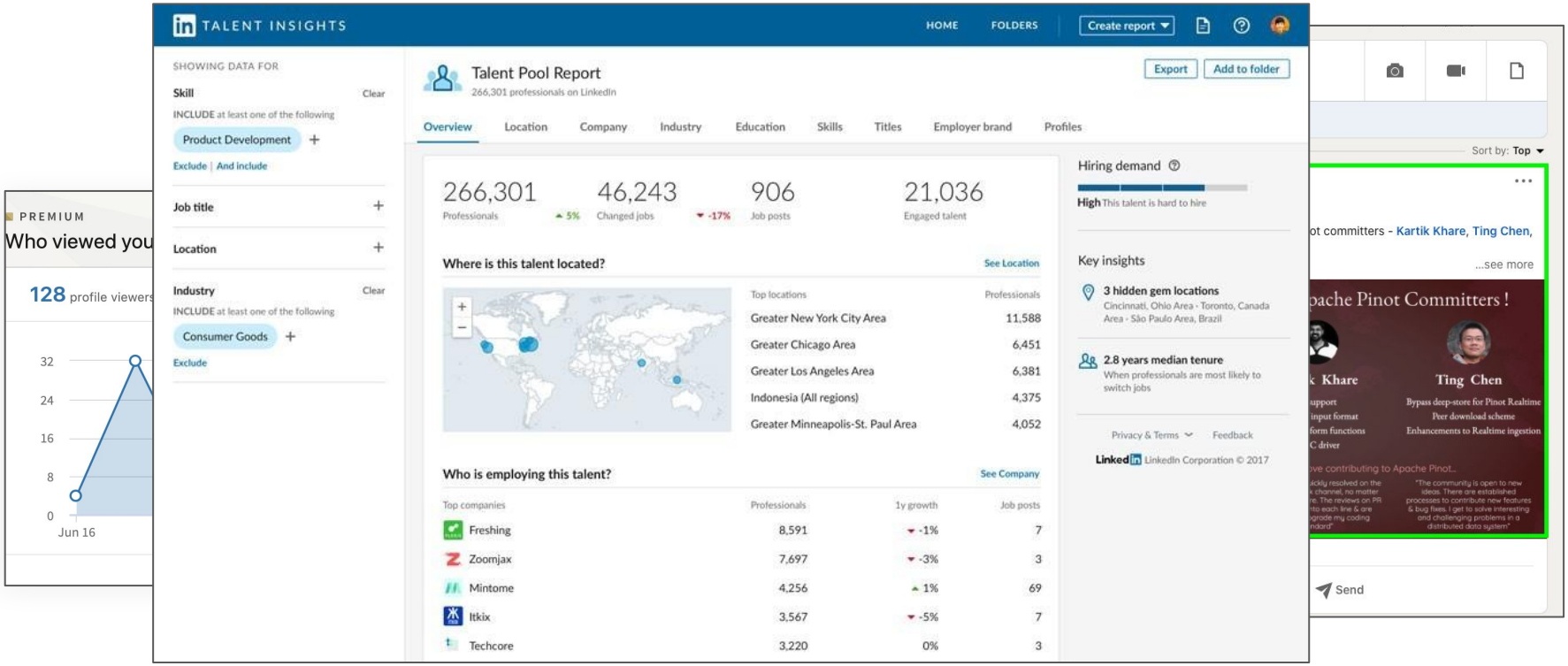
Examples of User-facing Real-Time Analytics



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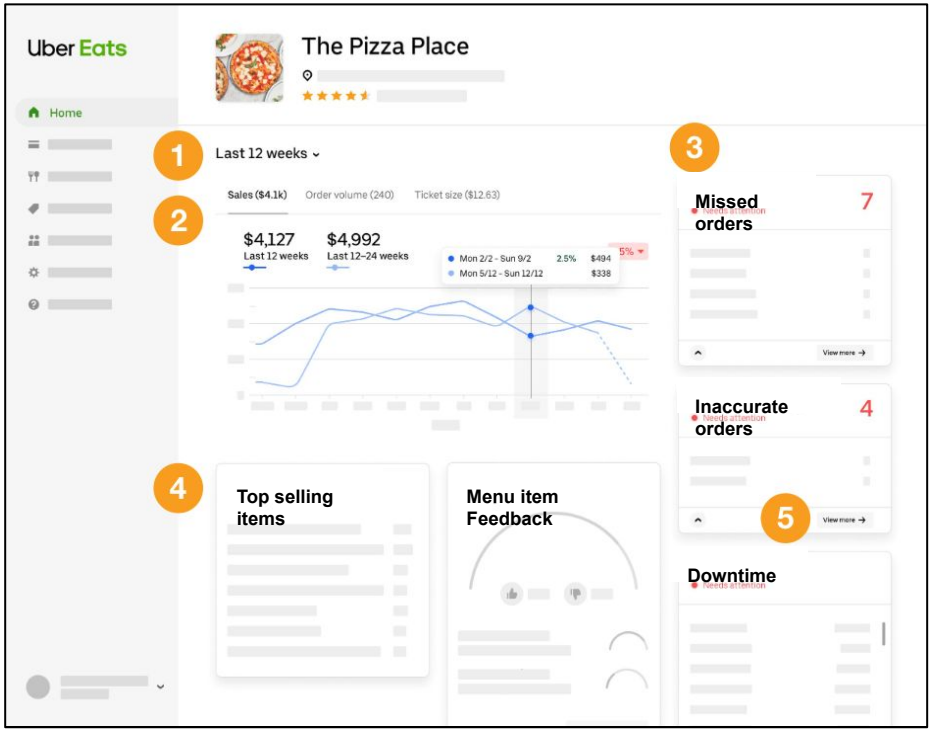
Examples of User-facing Real-Time Analytics

Uber Eats



Total users	500,000+
QPS	100s
Latency SLA	< 100 ms p99th
Freshness	Seconds - Minutes

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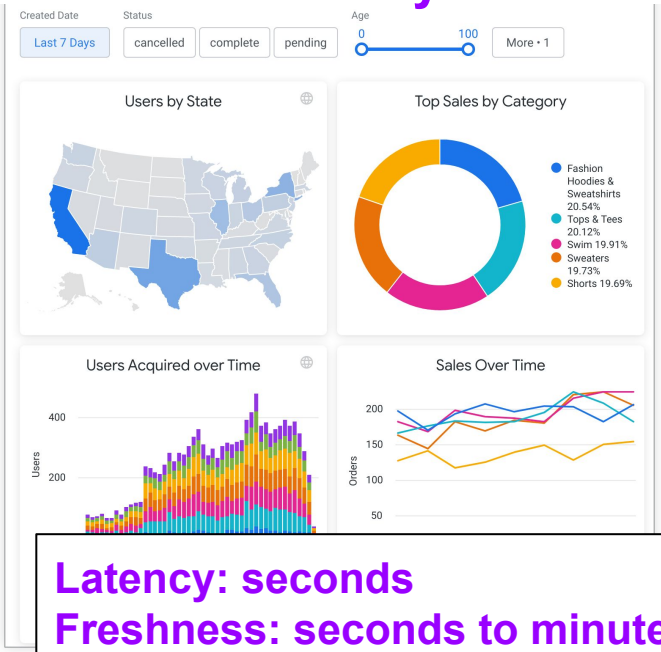
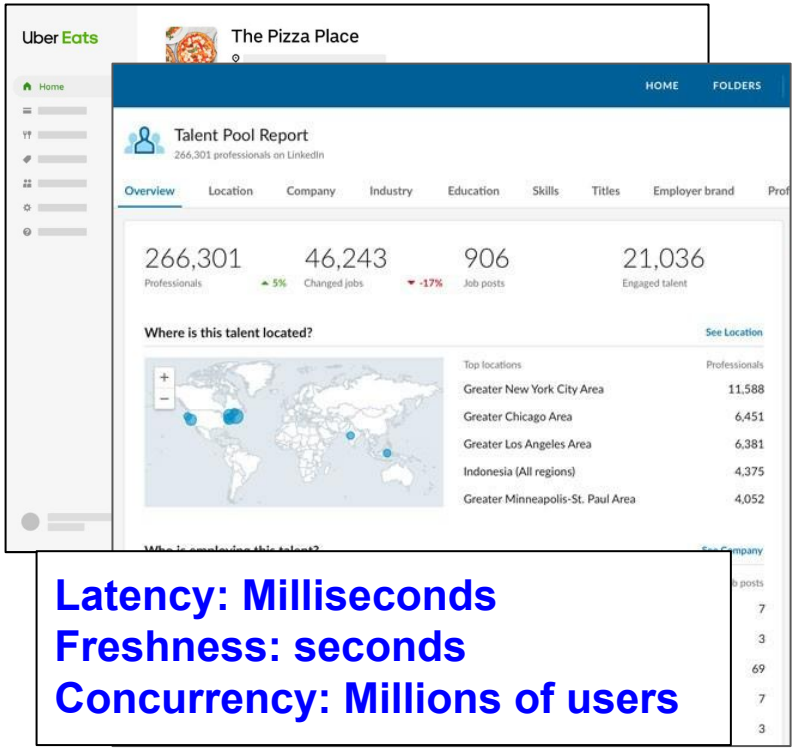
User-Facing Analytics

Internal Analytics



Latency: seconds
Freshness: seconds to minutes
Concurrency: 100s of users

External Analytics



Latency: Milliseconds
Freshness: seconds
Concurrency: Millions of users

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Building a User-facing Real-Time Analytics System

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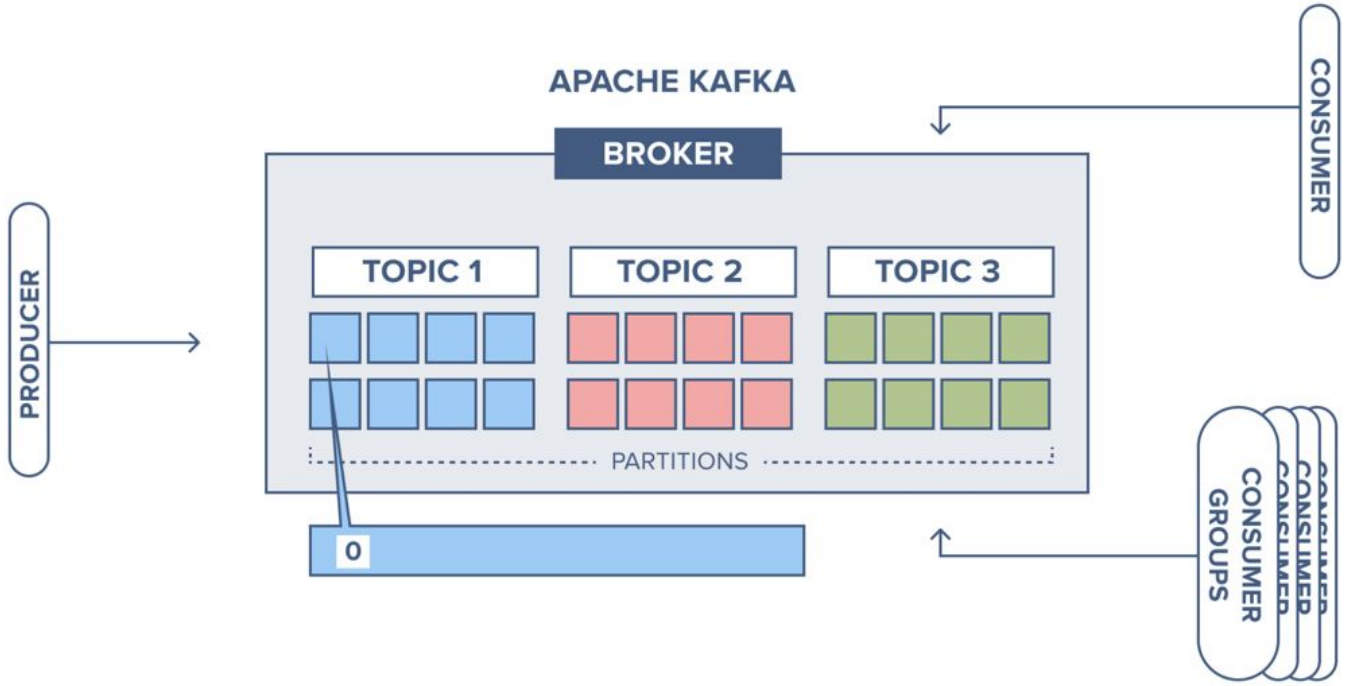
Apache Kafka



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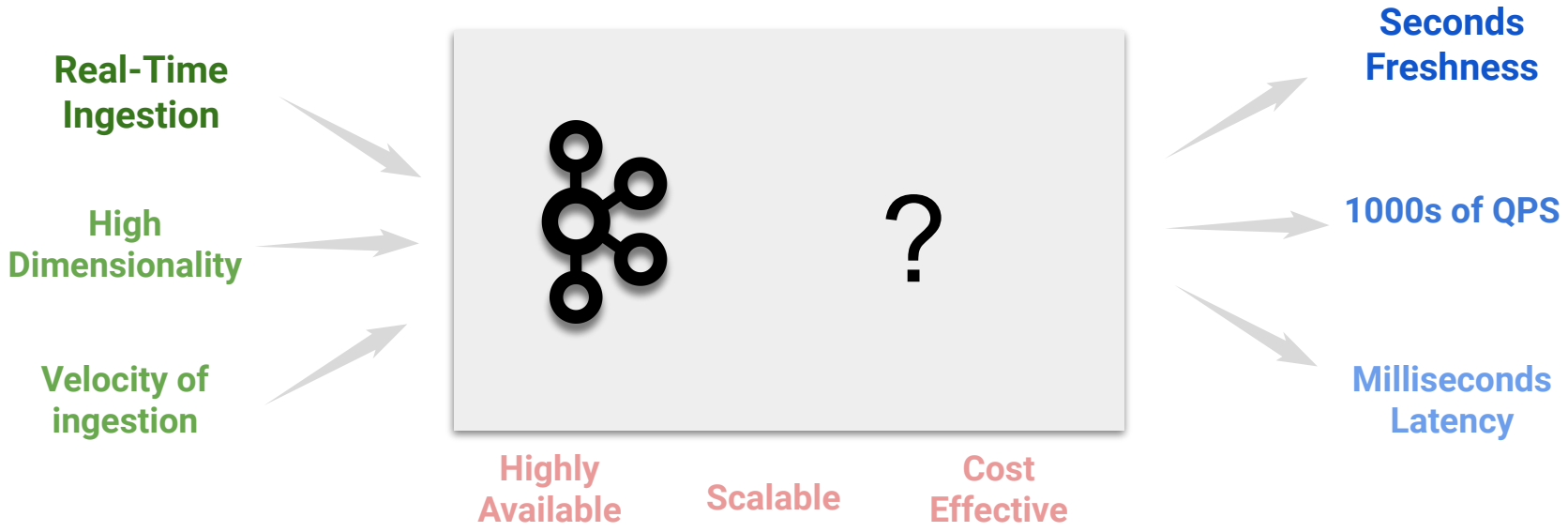
Building a User-facing Real-Time Analytics System



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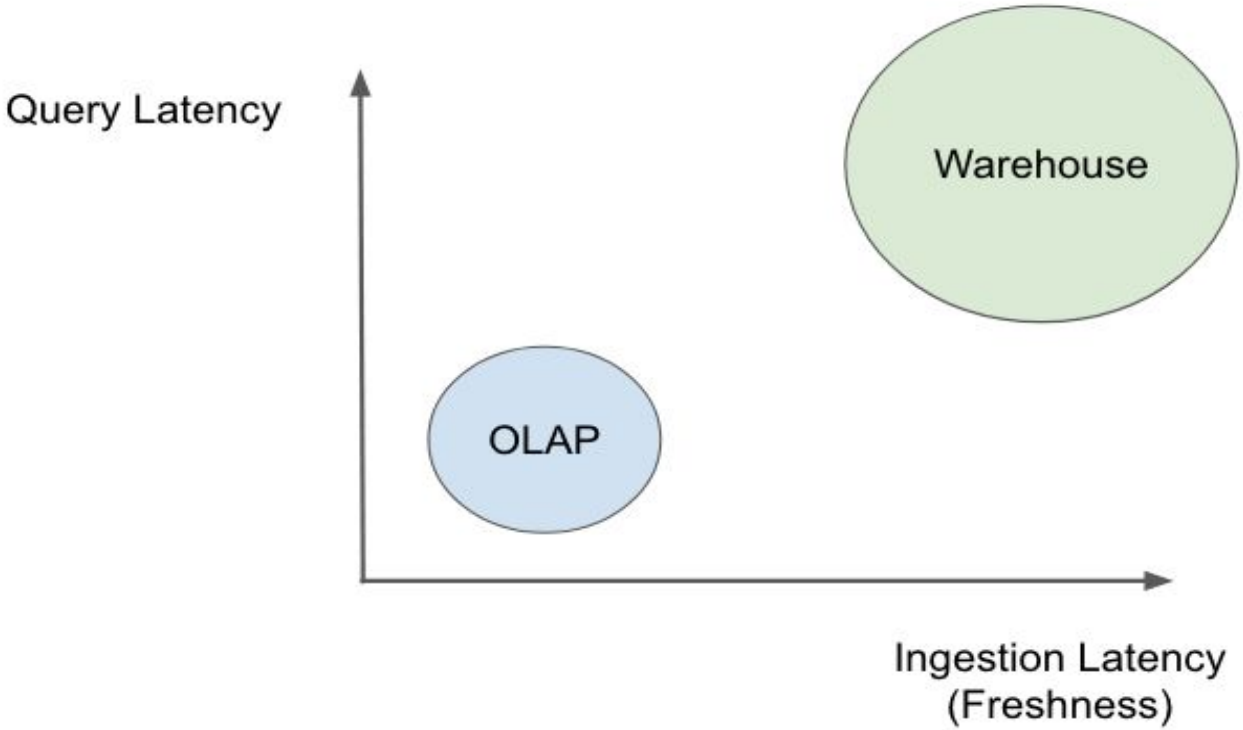
Analytics Landscape



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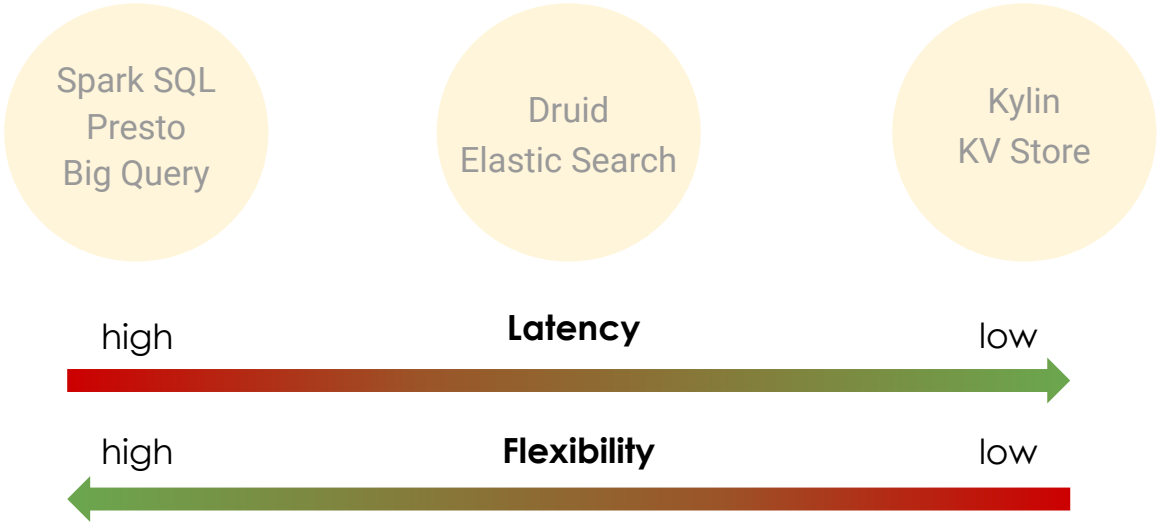
Analytics Landscape



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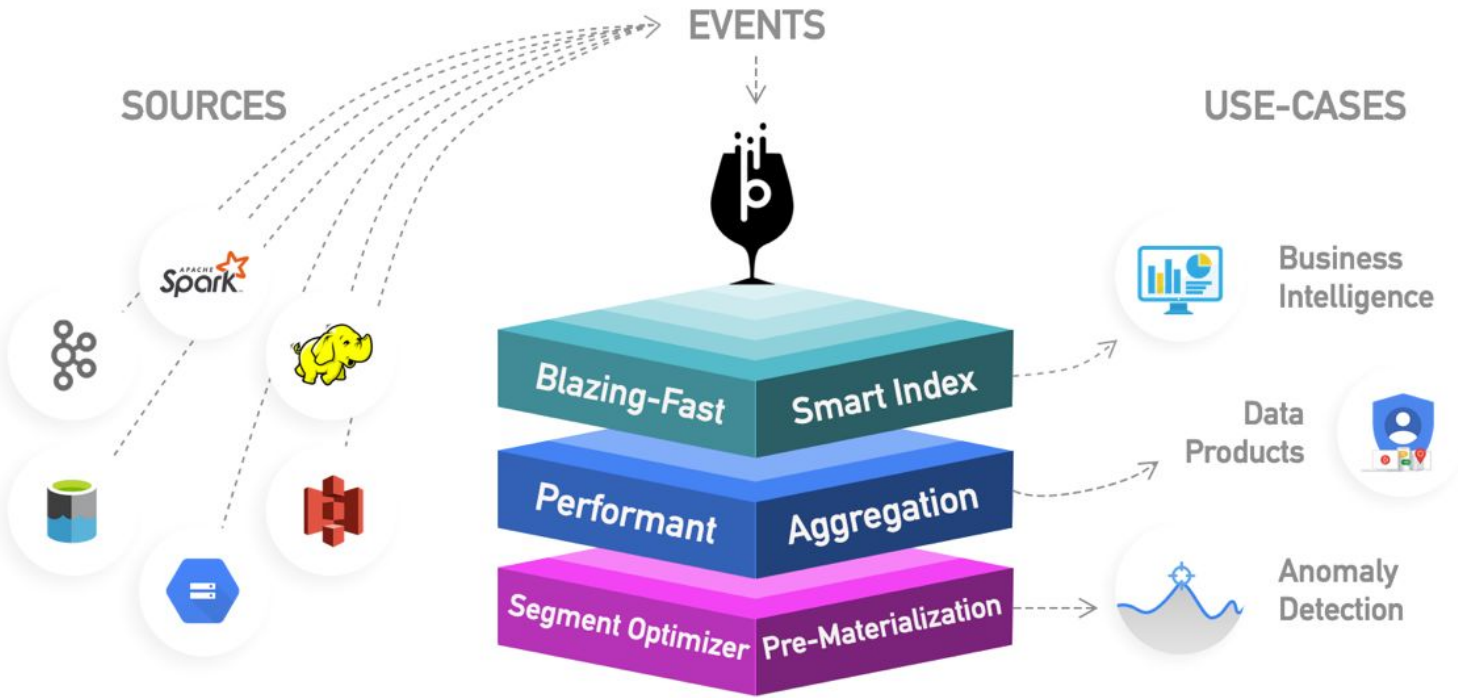
Apache Pinot



Apache Pinot Community

100+

Companies

2500+

Slack Users

4k

Github Stars

Apache Pinot Community

1M+

Events/sec

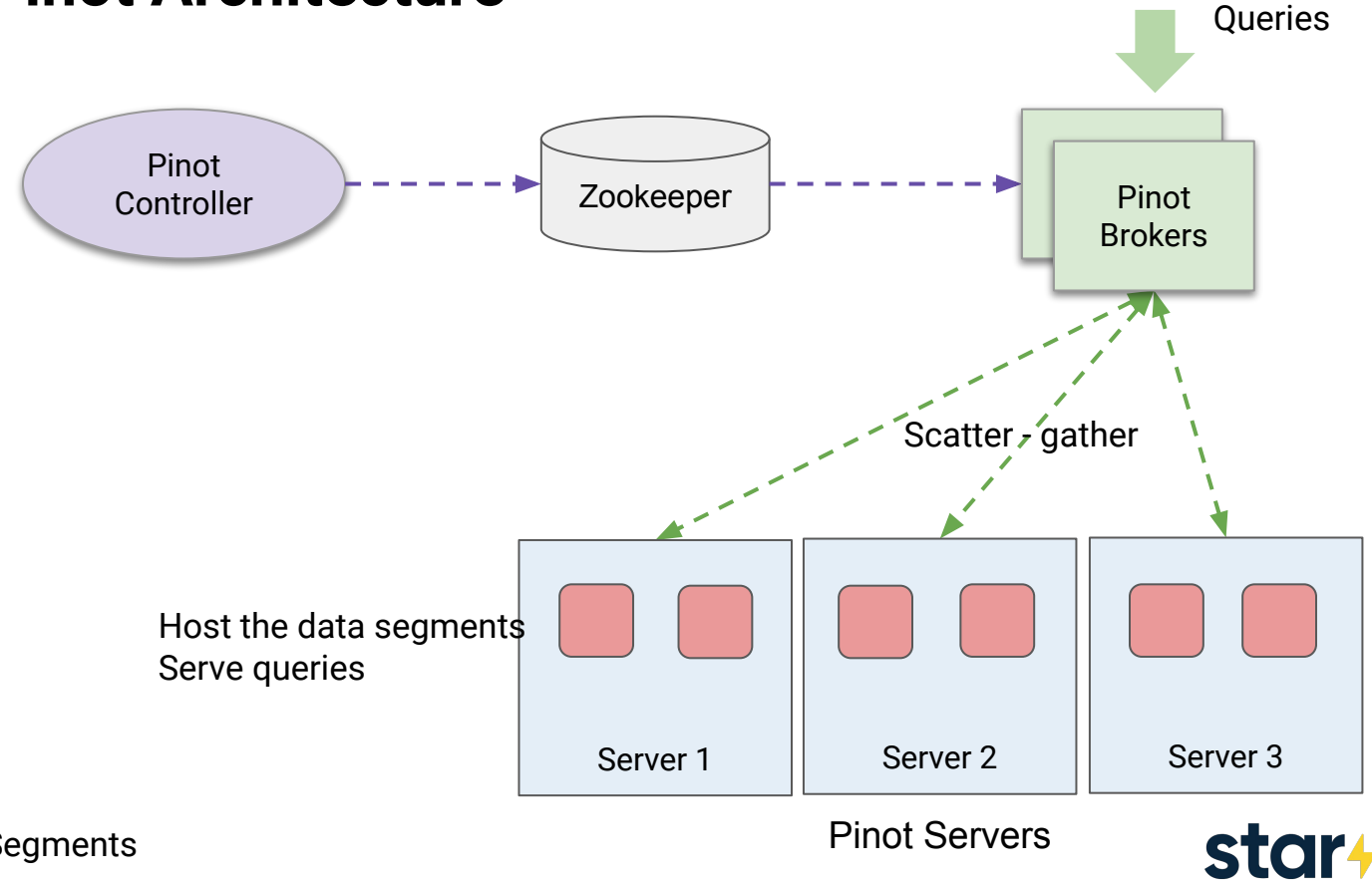
250k+

Peak QPS

ms

Query Latency

Apache Pinot Architecture



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Speed of Apache Pinot

See more details in:

https://www.startree.ai/blogs/what-makes-apache-pinot-fast-chapter-1

https://www.startree.ai/blogs/what-makes-apache-pinot-fast-chapter-ii

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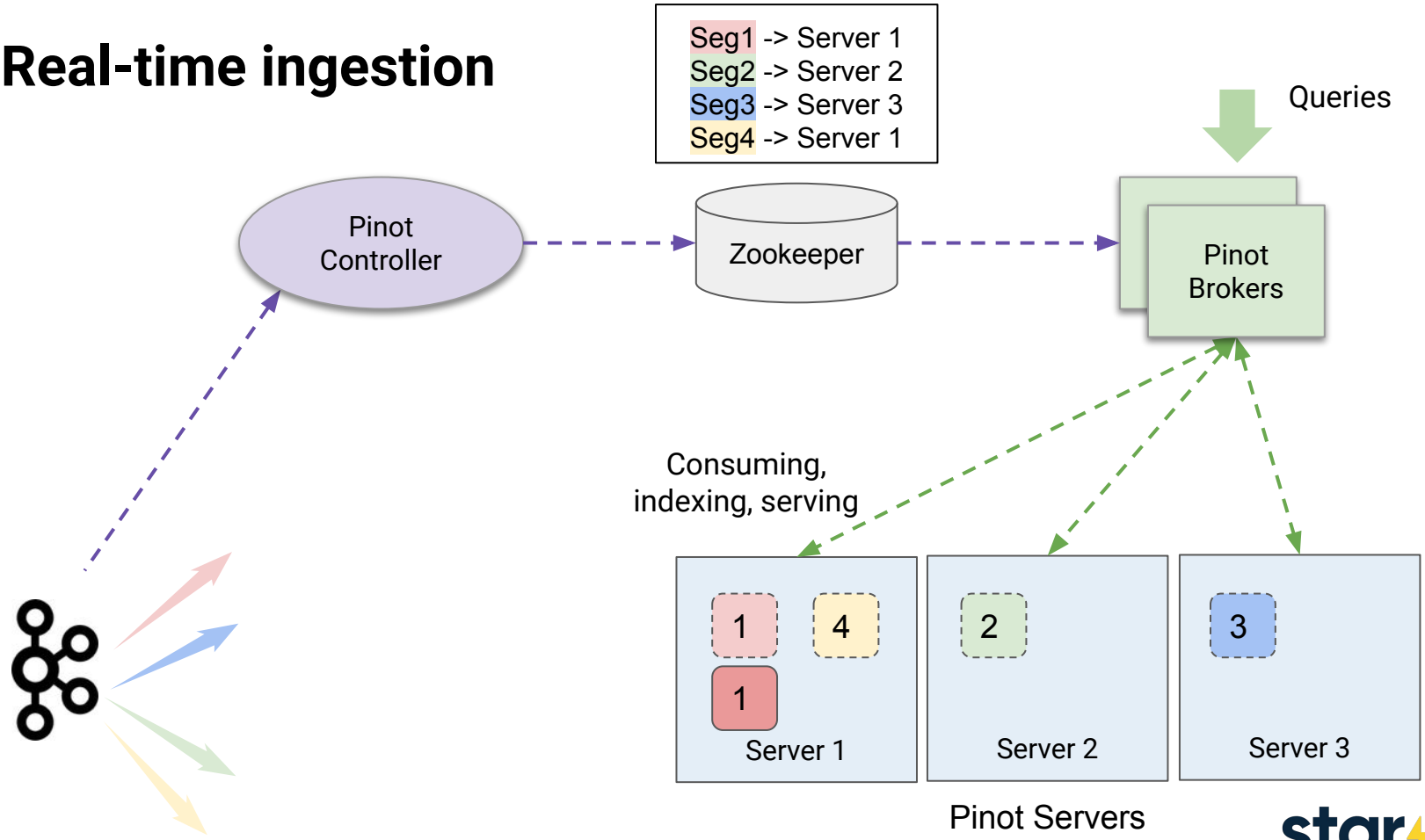
Real-time ingestion



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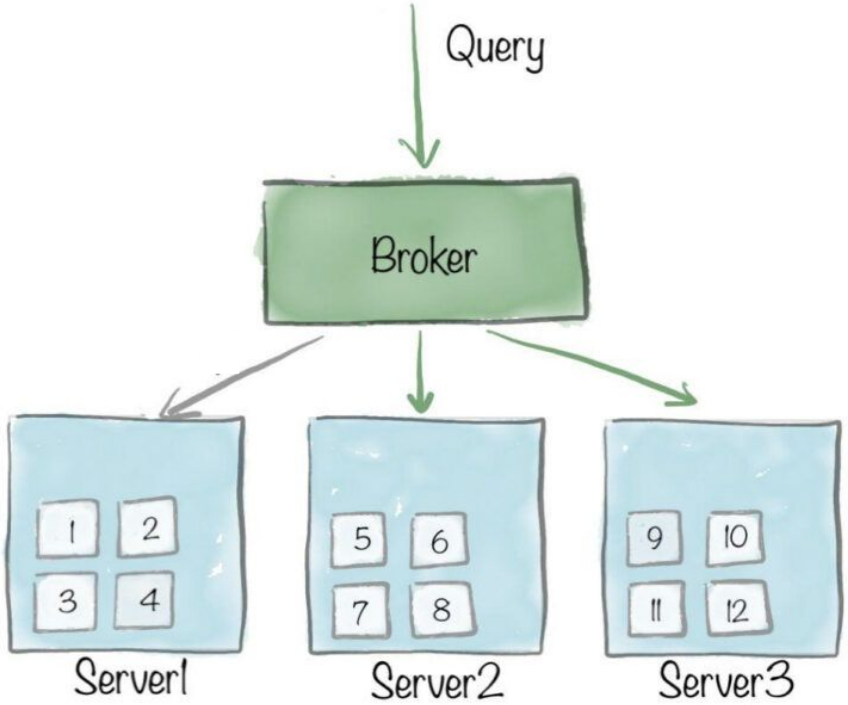
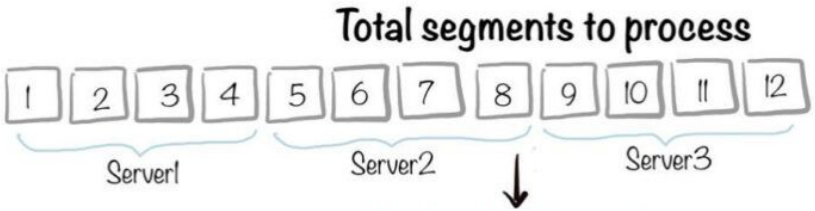
Fast Queries



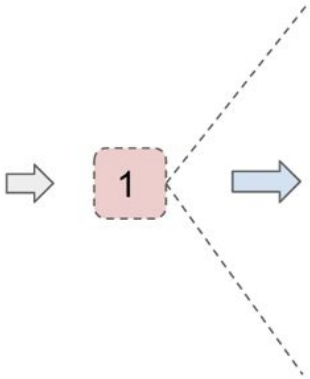


Segments

```
select count(*) from X
where country = us
```

Raw Data

country	browser	...
us	chrome	...
ca	firefox	...
jp	ie	...
us	firefox	...
ca	ie	...
...	...	...



country
us
ca
jp
us
ca
...

browser
chrome
firefox
ie
firefox
ie
...

...
...
...
...
...
...
...

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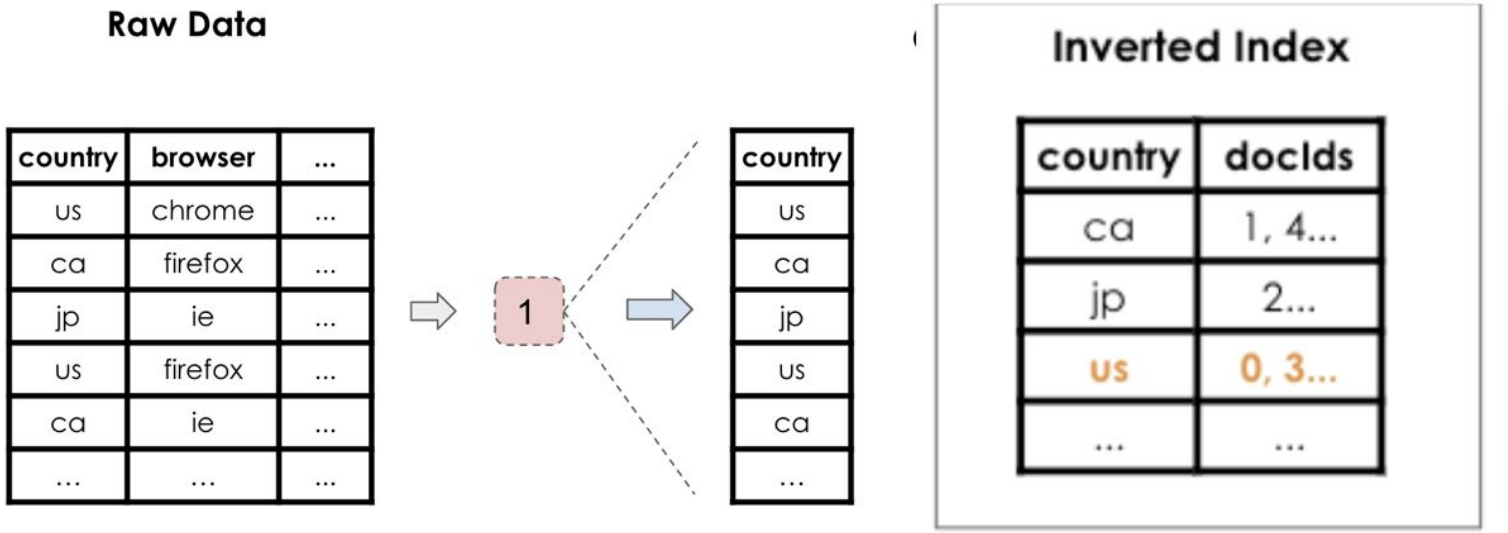
Inverted Index

```
select count(*) from X
where country = us
```



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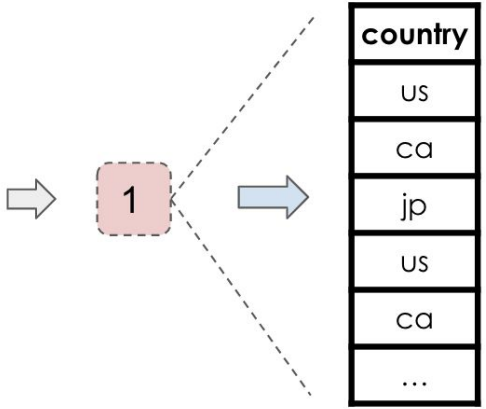
Sorted Index

```
select count(*) from X
where country = us
```

Raw Data

country	browser	...
us	chrome	...
ca	firefox	...
jp	ie	...
us	firefox	...
ca	ie	...
...	...	...



Column Based

Sorted Index

country	start docId	end docId
ca	0	80
jp	81	100
us	101	300
...	...	...

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Indexes: All supported index optimization in Pinot

Filtering Optimizations

- Inverted Index
- Sorted Index
- Range Index
- JSON Index
- Text Index
- Geo Index

Aggregation Optimizations

- Theta Sketches
- HyperLogLog

- StarTree Index

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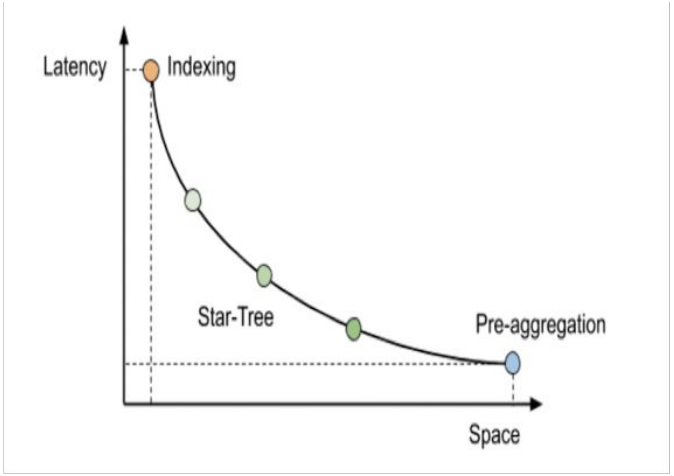
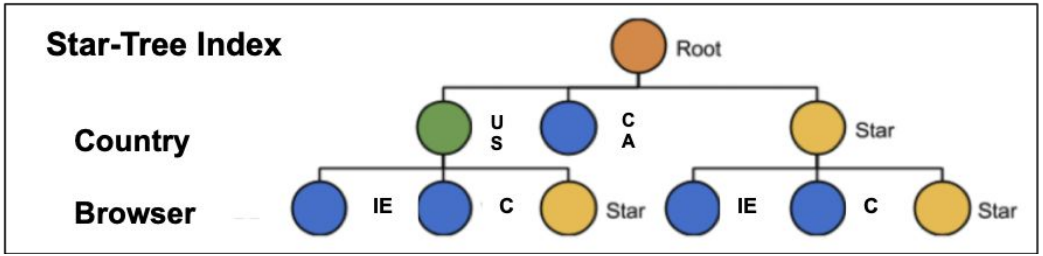
Star-Tree Index

country	browser	device	os	clicks
us	chrome	...	...	...
ca	firefox	...	...	...
jp	ie	...	...	...
us	firefox	...	...	...
ca	ie	...	...	...
...	...	...	...	...

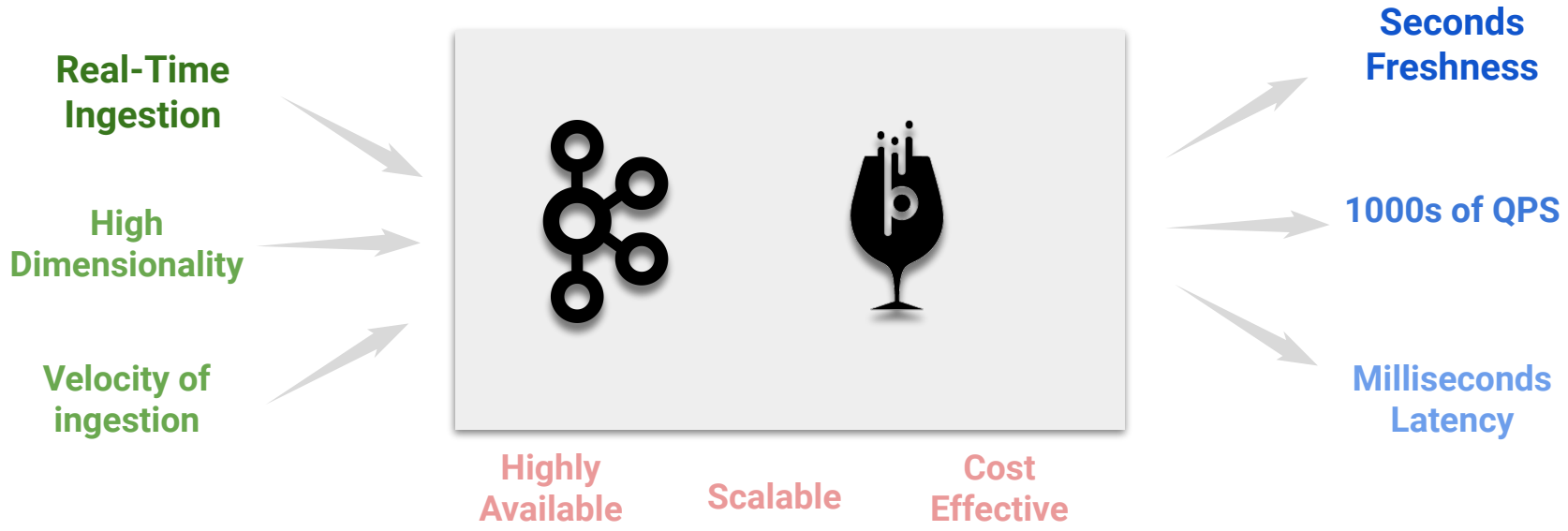





```
select count(*) from X
where country = us and
browser = chrome
```

star-tree

Building a User-facing Real-Time Analytics System



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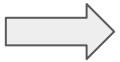
Pushing the Boundaries of Real-time Analytics

- Real-Time analytics landscape is rapidly changing.
- Pinot evolving with these trends

Internal-Facing Analytics	User-Facing Analytics
Structured Data	Semi-Structured Data
Approximate Data / Query Consistency	Strong Data / Query Consistency
Slice-and-Dice Queries	Full-SQL semantics
GB-to-TB of Data	TB-to-PB of Data



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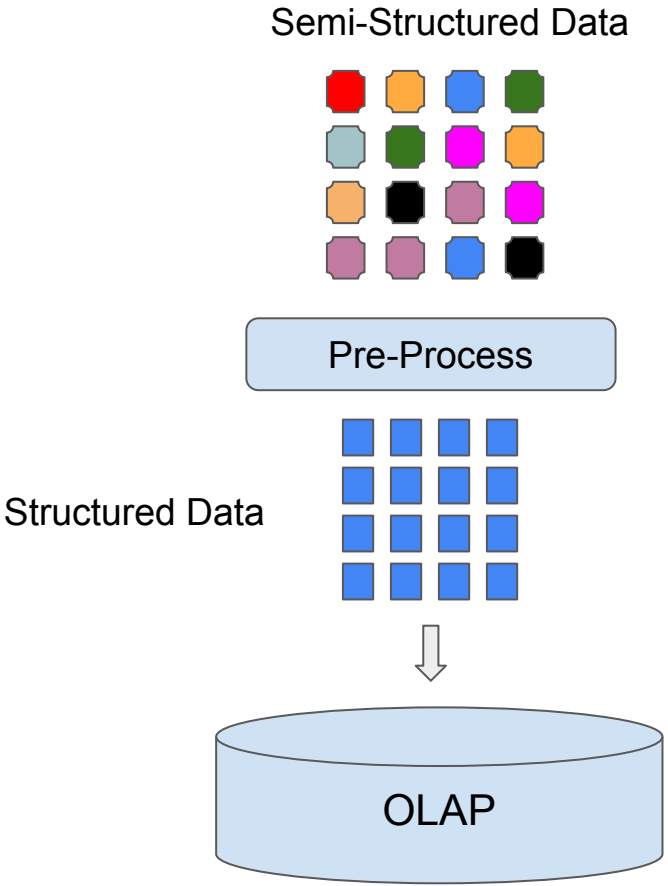
Semi-Structured Data Support



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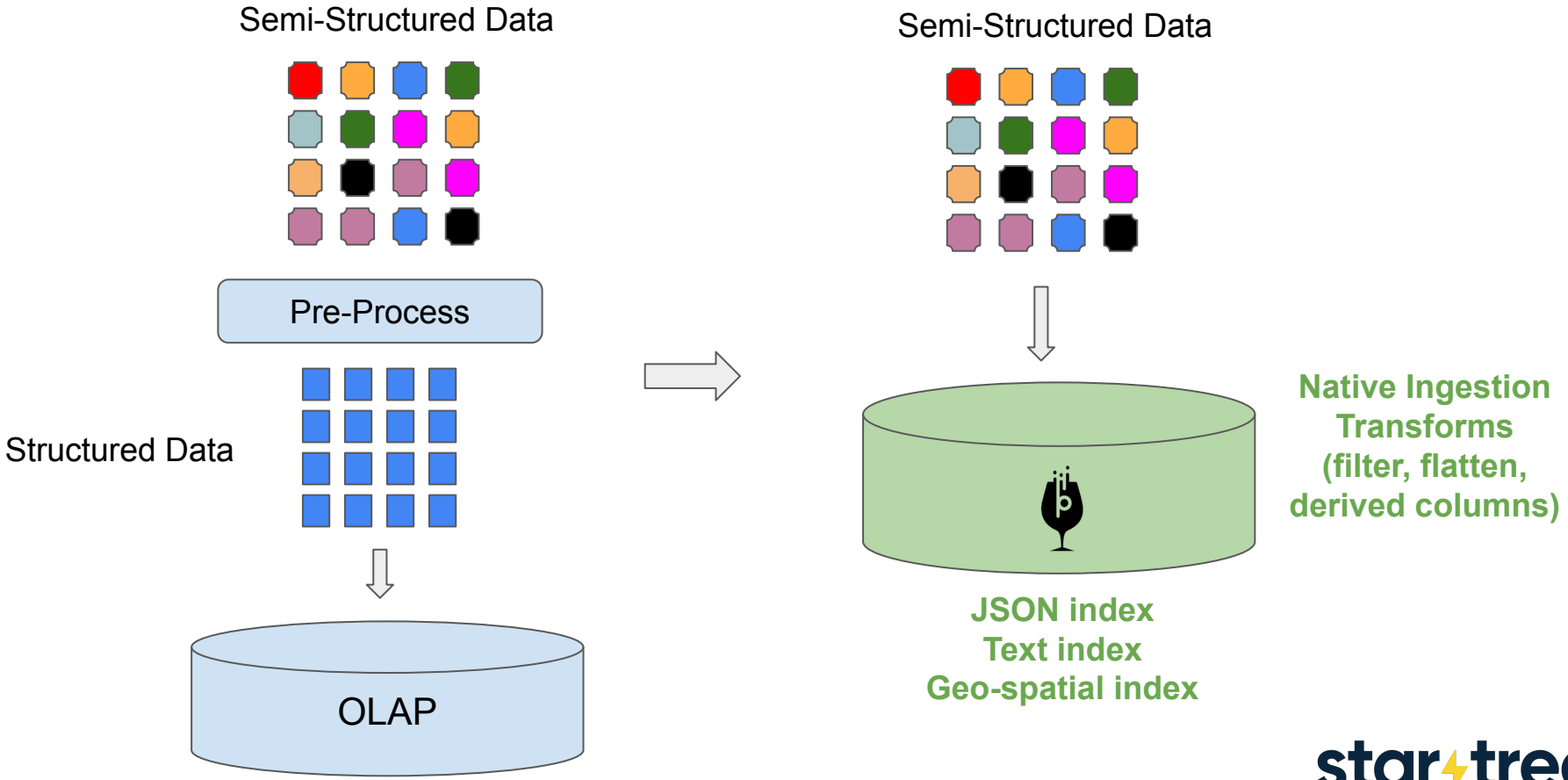
Semi-Structured Data Support



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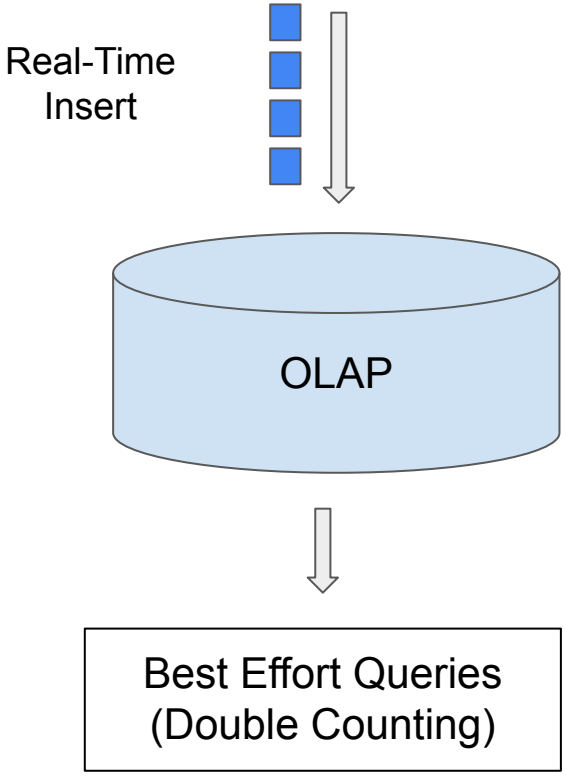
Strong Data/Query Consistency



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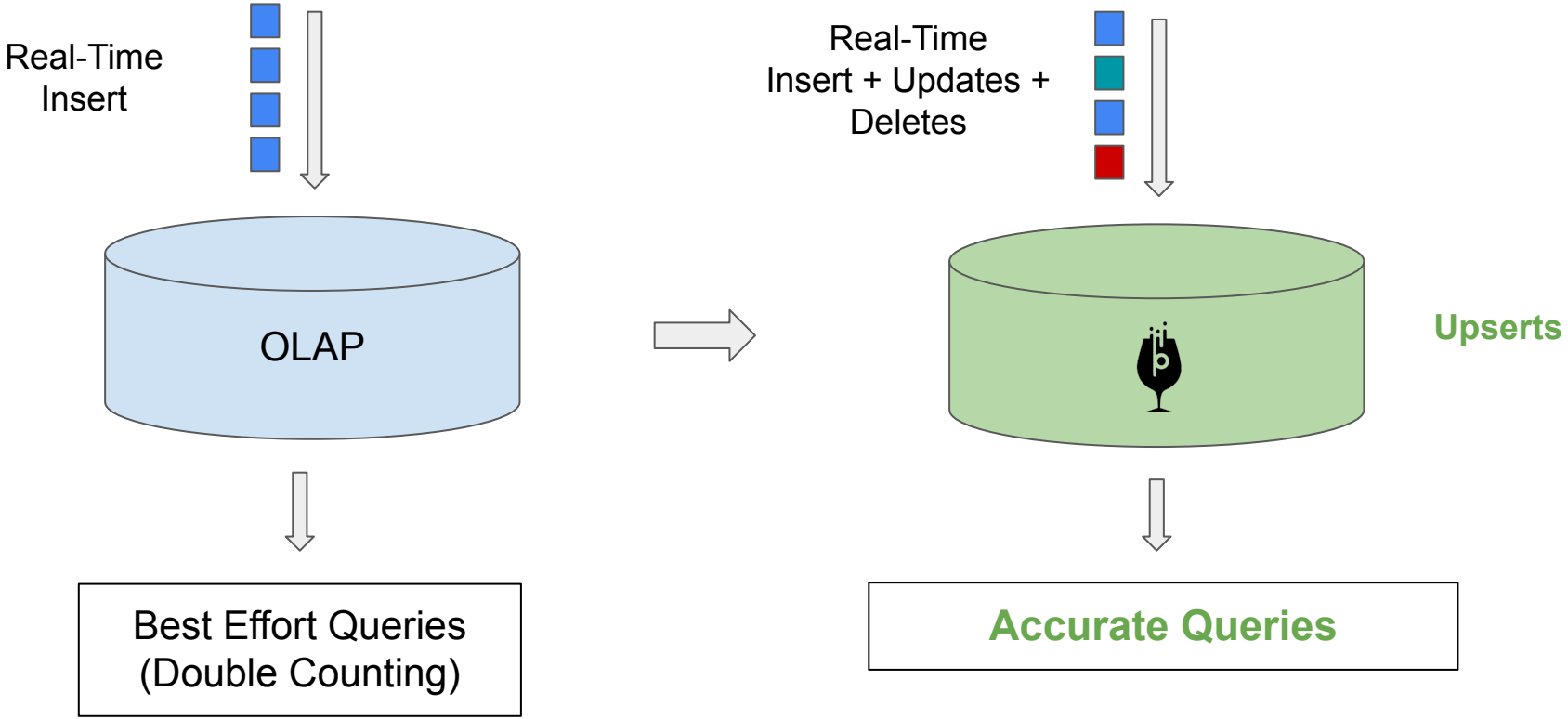
Strong Data/Query Consistency - Upserts



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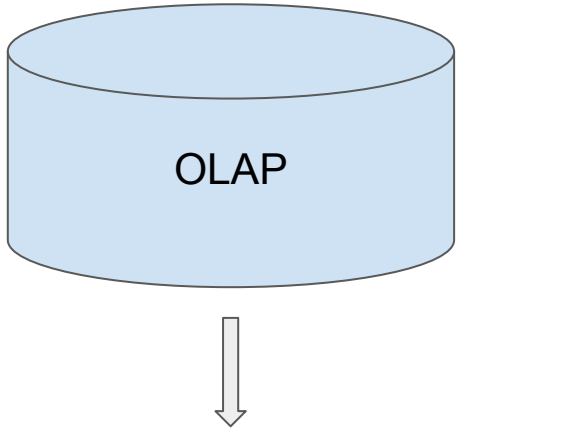
Full-SQL Semantics



OLAP Queries
(Aggregations, Order By, Group By, UDFs, …)

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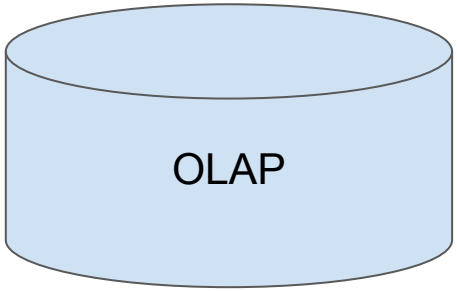
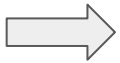
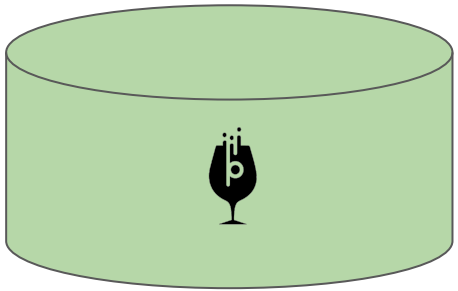
Full-SQL Semantics







OLAP Queries

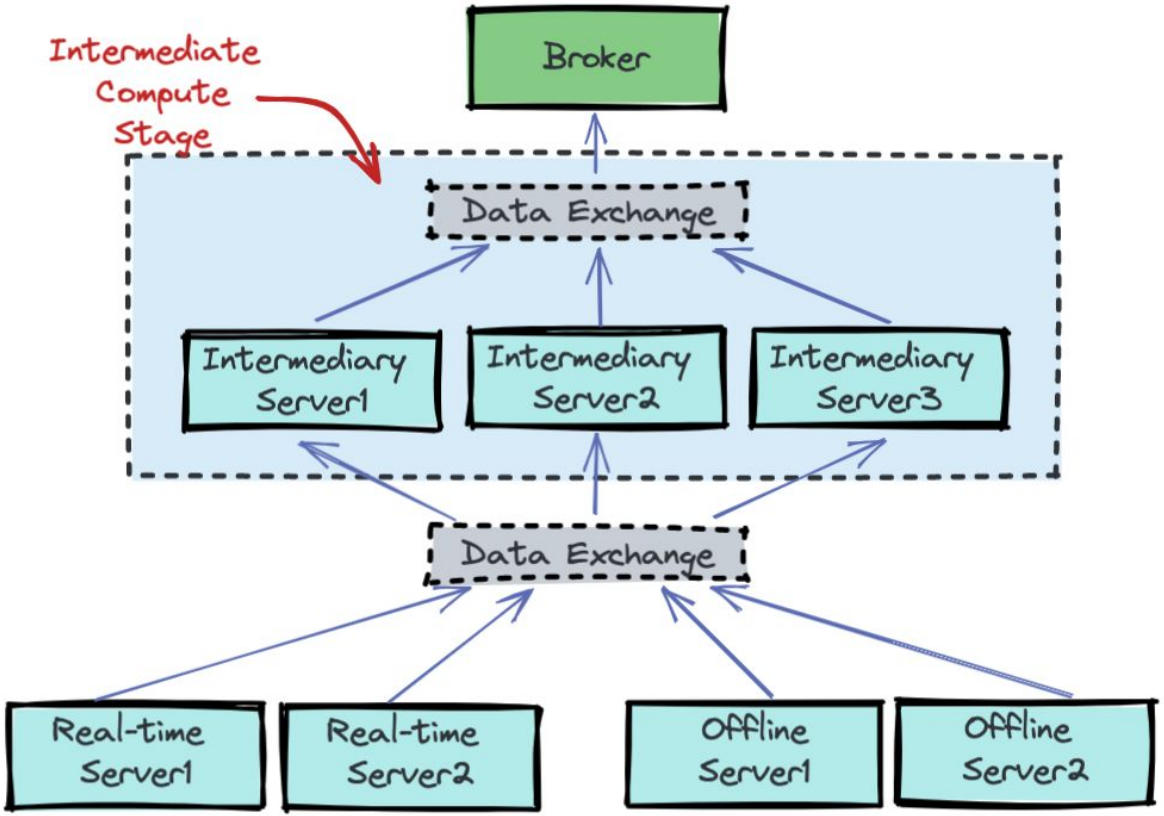
Alpha feature: JOINS

Future: Full SQL Semantics !

Nested Queries + Window functions + …

OLAP Queries
(Aggregations, Order By, Group By, UDFs, …)

Multi-stage query execution



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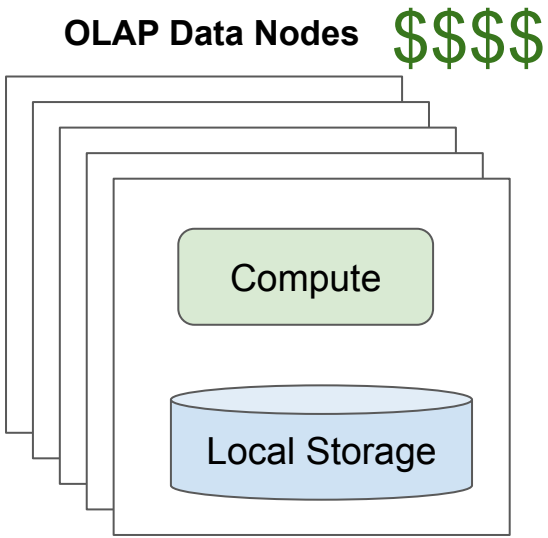
Data-Size Explosion



GBs - TBs of Data

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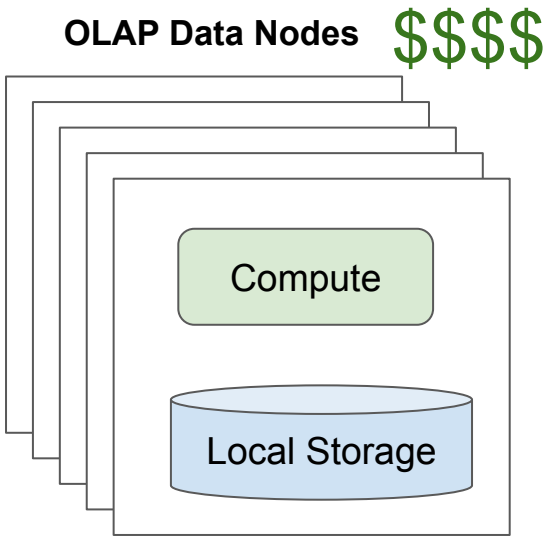
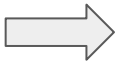
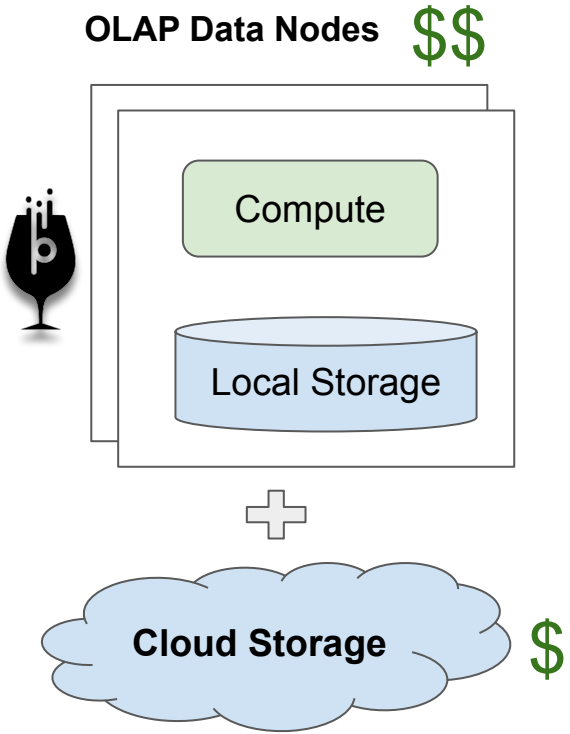
Data-Size Explosion - Tiered Storage



GBs - TBs of Data





TBs - PBs of Data

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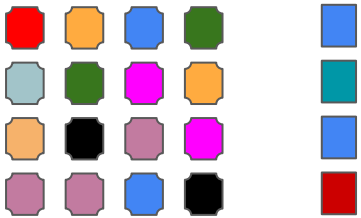
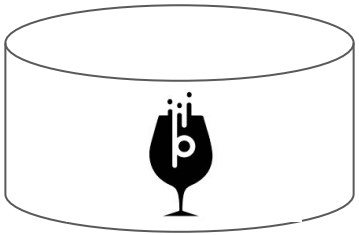
Apache Pinot - Summary

Semi-Structured Data

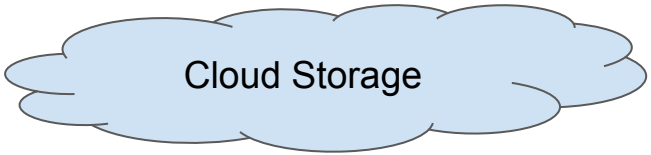


Real-Time Insert + Updates + Deletes

Latency: Milliseconds
Freshness: seconds
Concurrency: Millions of users



OLAP Queries + Joins (Single stage and multi-stage)



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Thank you!

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@NehaPawar18
#DataAISummit

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