Data Infrastructure at LinkedIn

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Outline

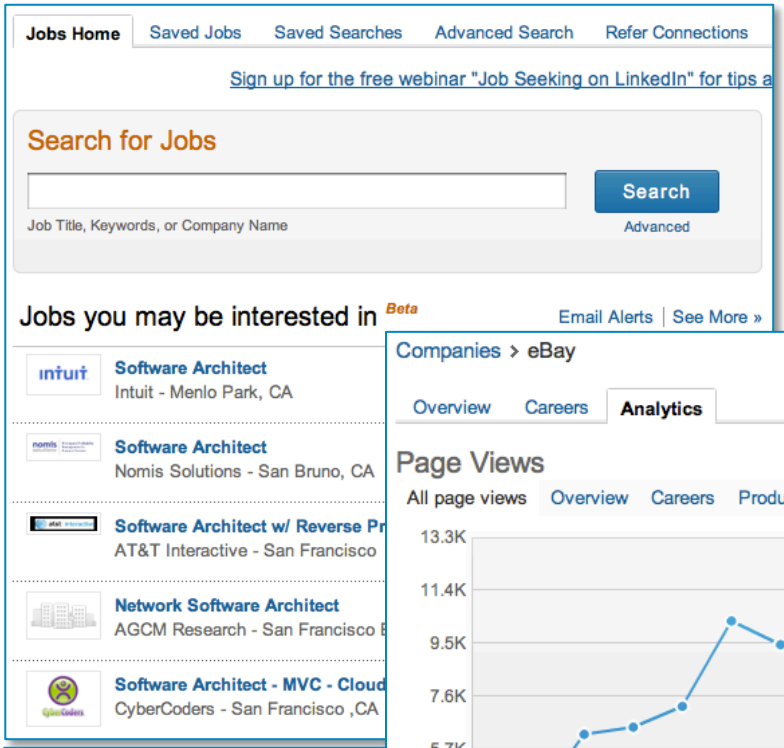
- LinkedIn Products
- Data Ecosystem
- LinkedIn Data Infrastructure Solutions
- Next Play

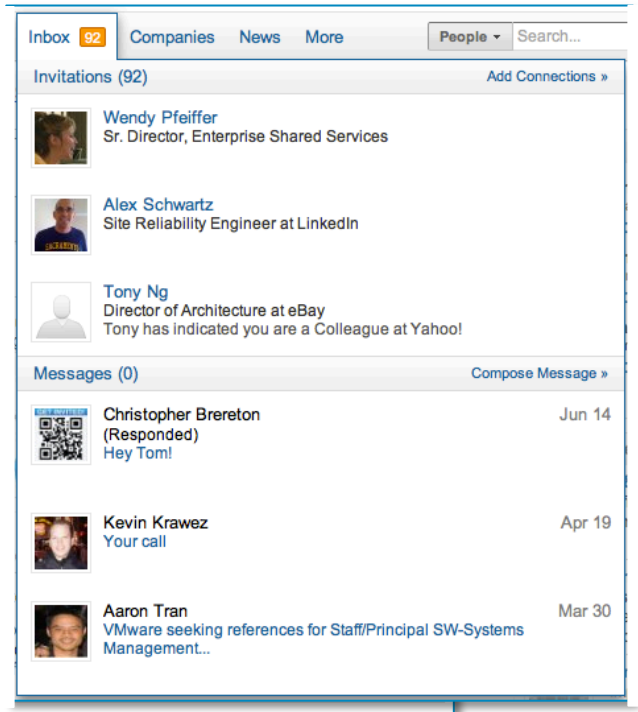
LinkedIn By The Numbers

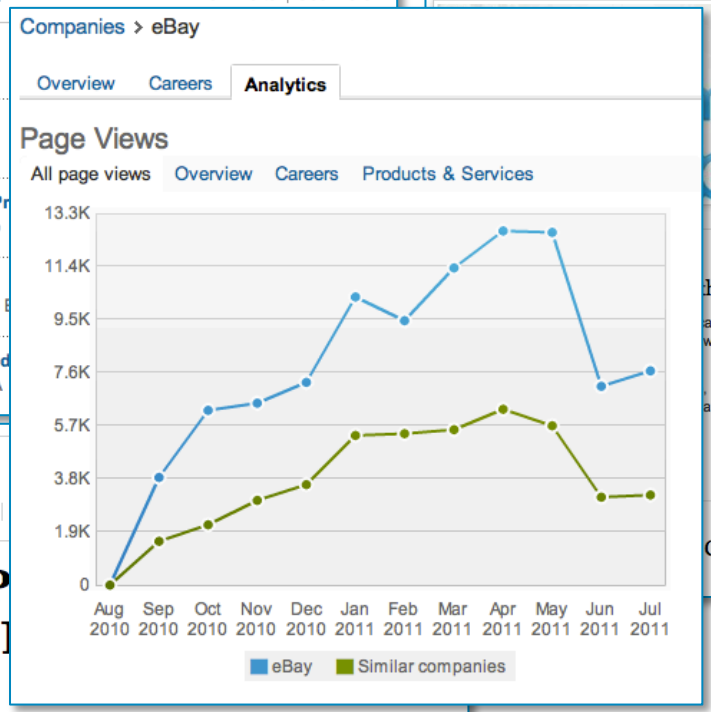
- 150M + users*
- ~ 4.2B People Searches in 2011**
- >2M companies with LinkedIn Company Pages**
- 16 languages
- 75% of Fortune 100 Companies use LinkedIn to hire***

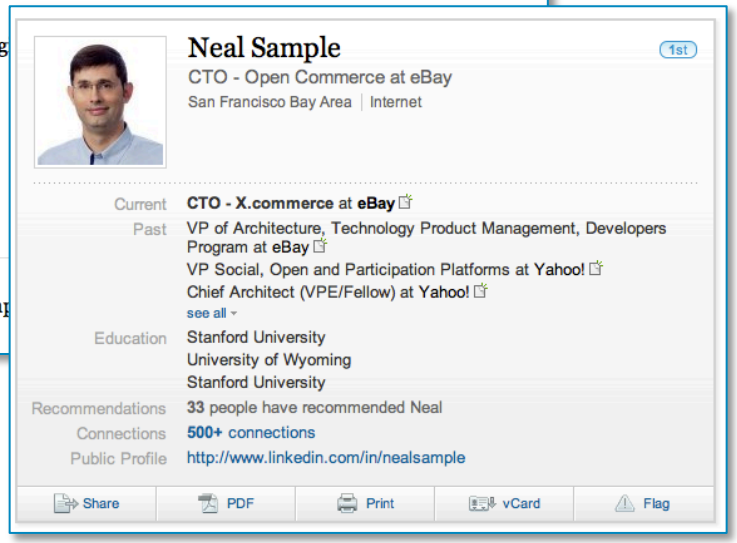
* As of February 9th 2012
** As of December 31st 2011
*** As of September 30th 2011

Broad Range of Products & Services

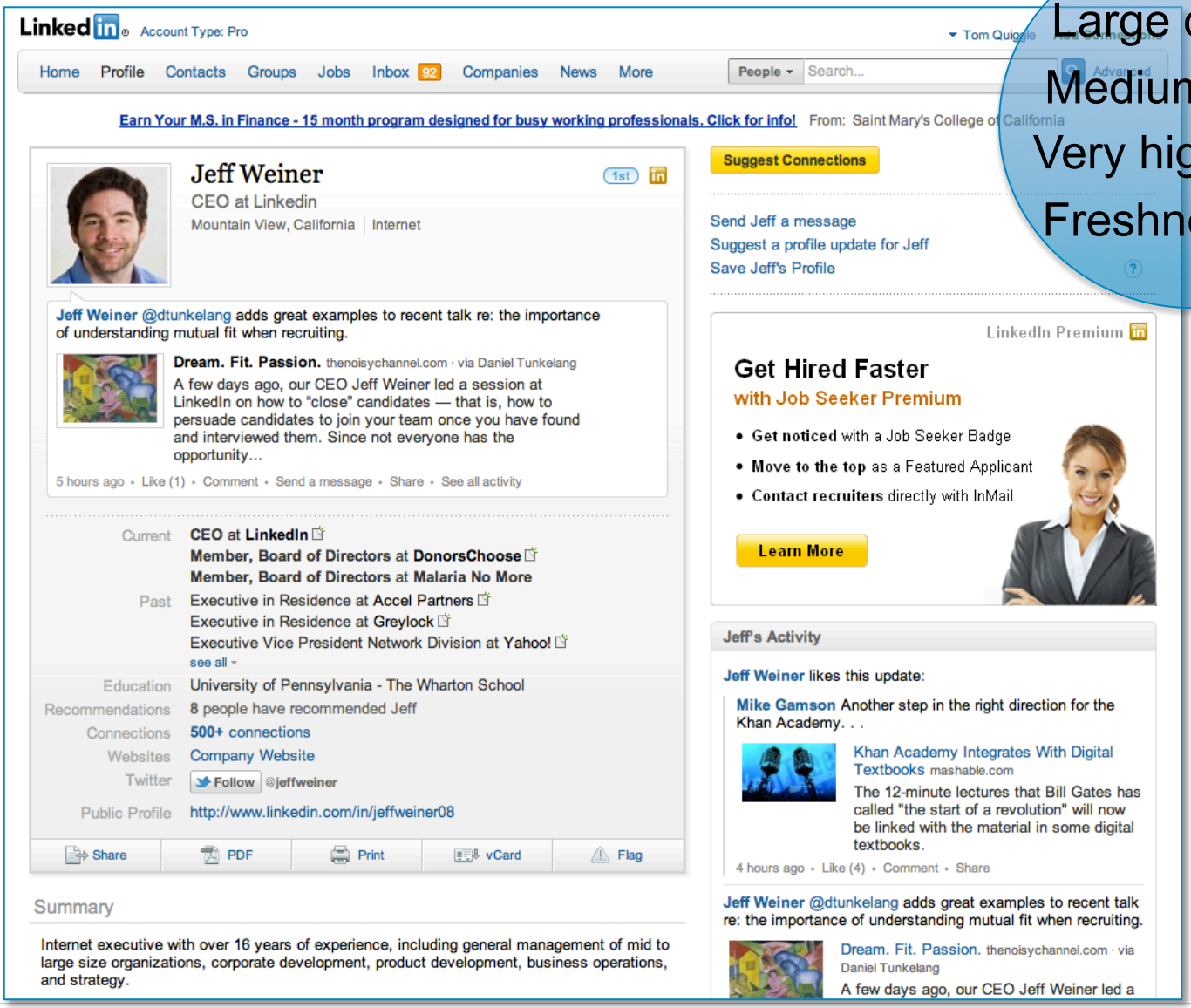








User Profiles



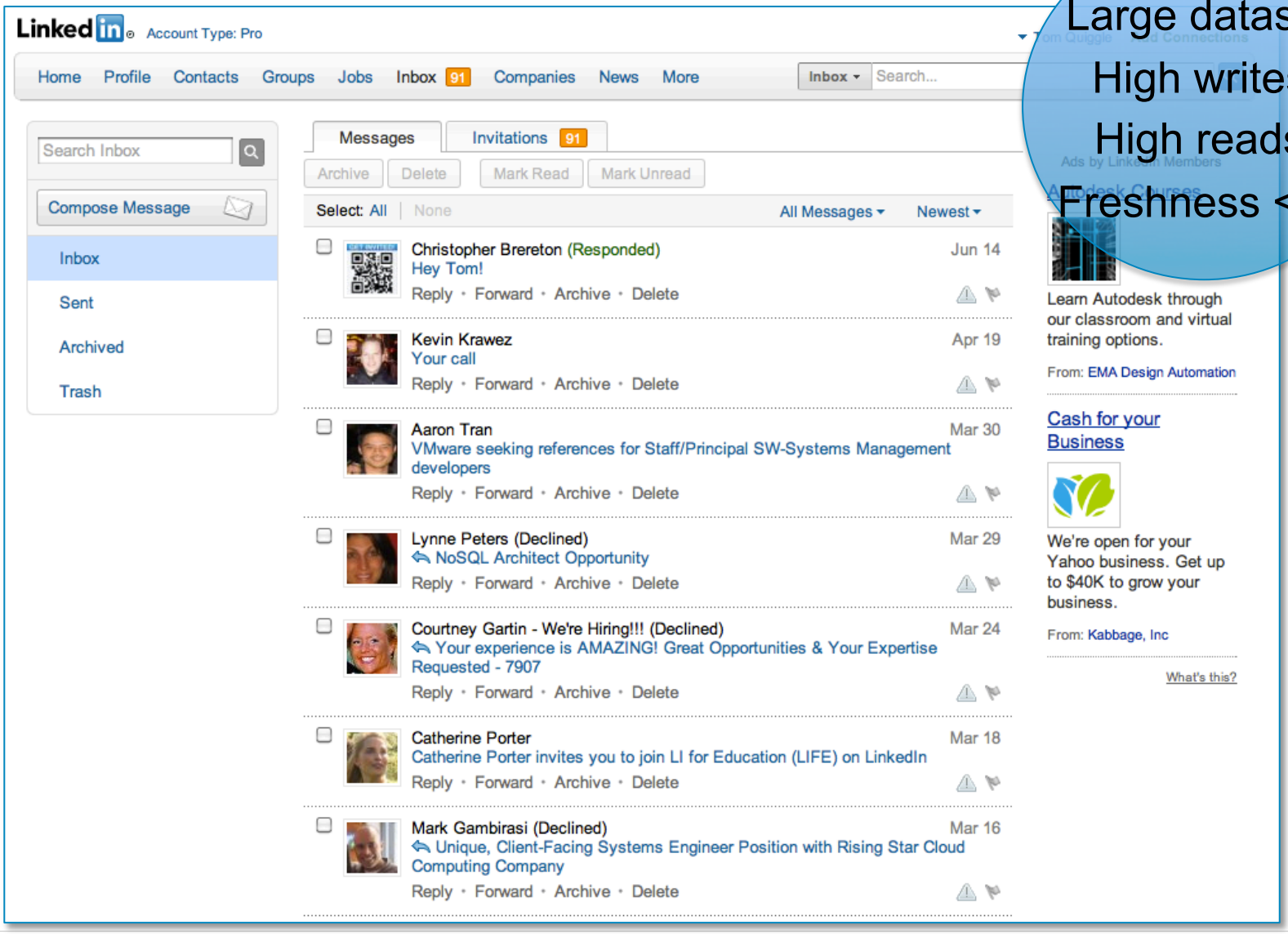
Large dataset

Medium writes

Very high reads

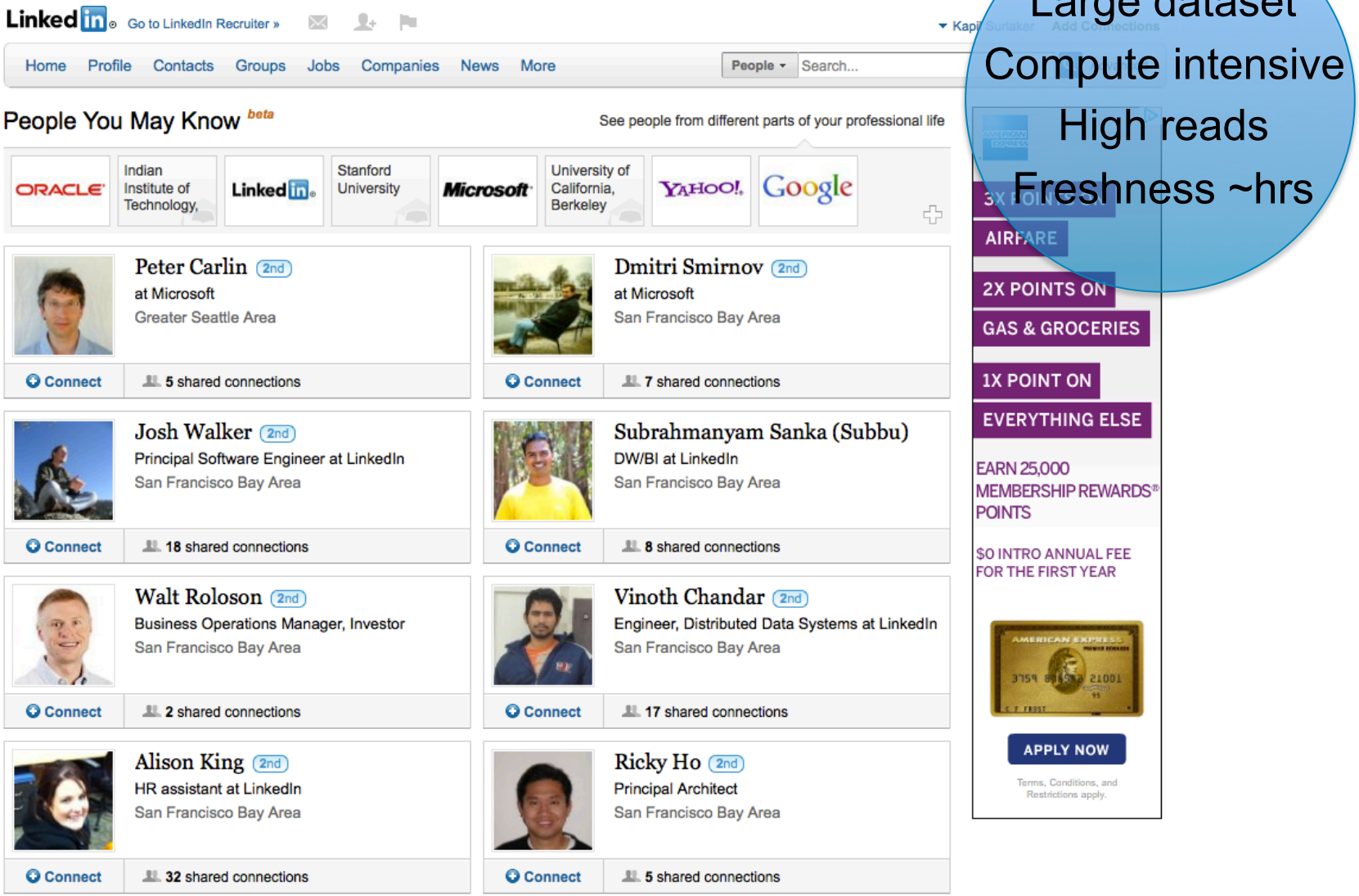
Freshness <1s

Communications



Large dataset
High writes
High reads
Freshness <1s

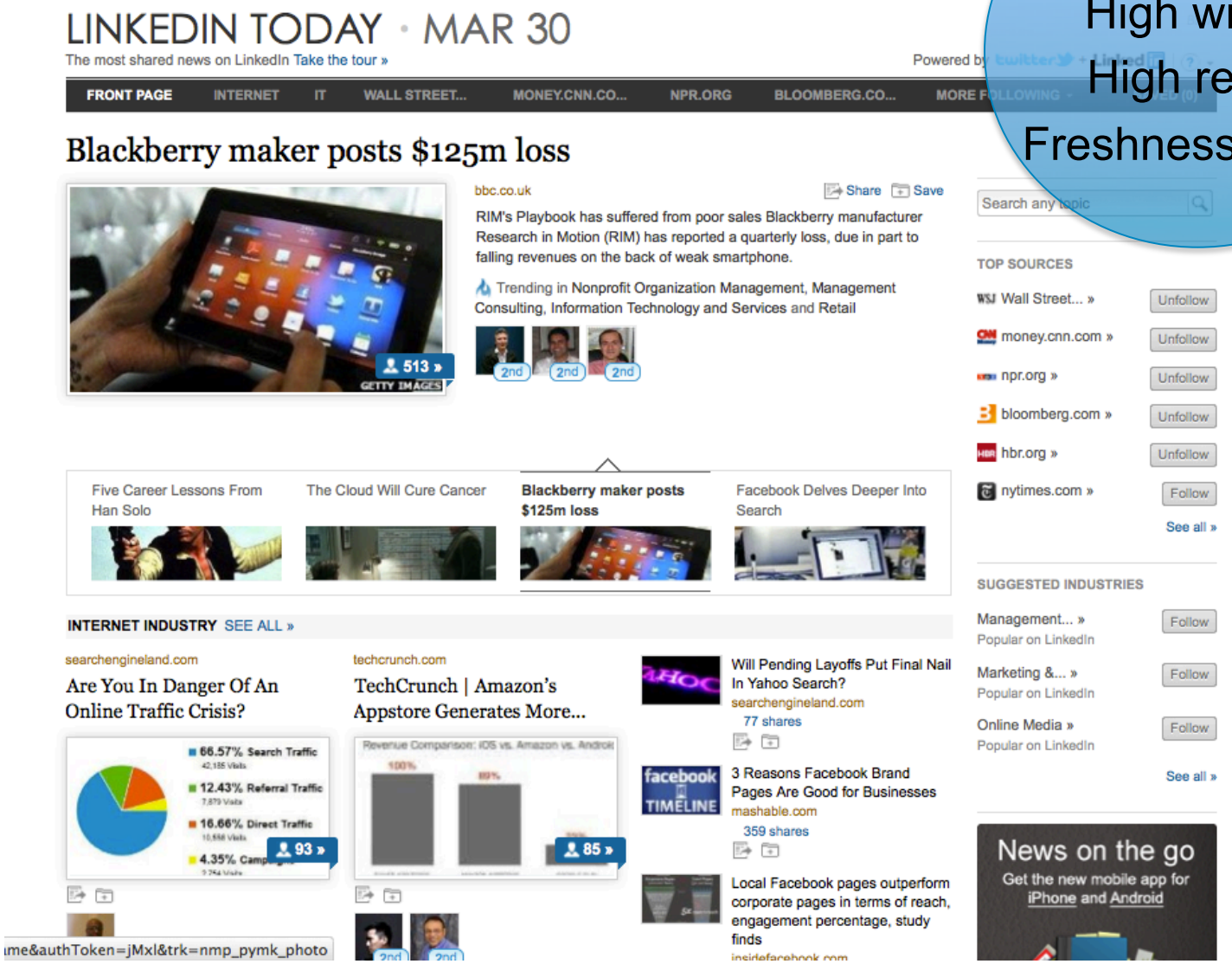
People You May Know



Large dataset
Compute intensive
High reads
Freshness ~hrs

LinkedIn Today

Moving dataset
High writes
High reads
Freshness ~mins



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Three Paradigms : Simplifying the Data Continuum

- **Member Profiles**
- Company Profiles
- Connections
- Communications

Online

Activity that should be reflected immediately

- **Linkedin Today**
- Profile Standardization
- News
- Recommendations
- Search
- Communications

Nearline

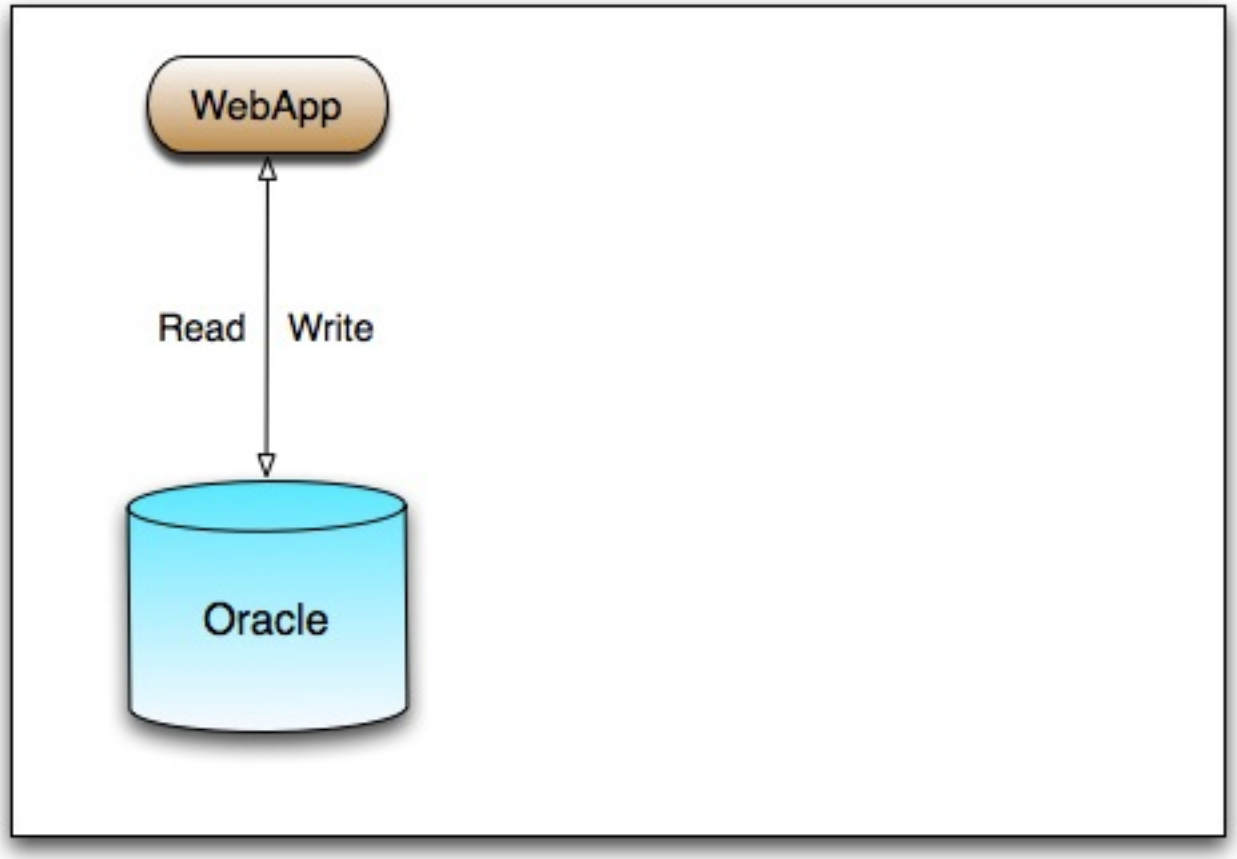
Activity that should be reflected soon

- **People You May Know**
- Connection Strength
- News
- Recommendations
- Next best idea

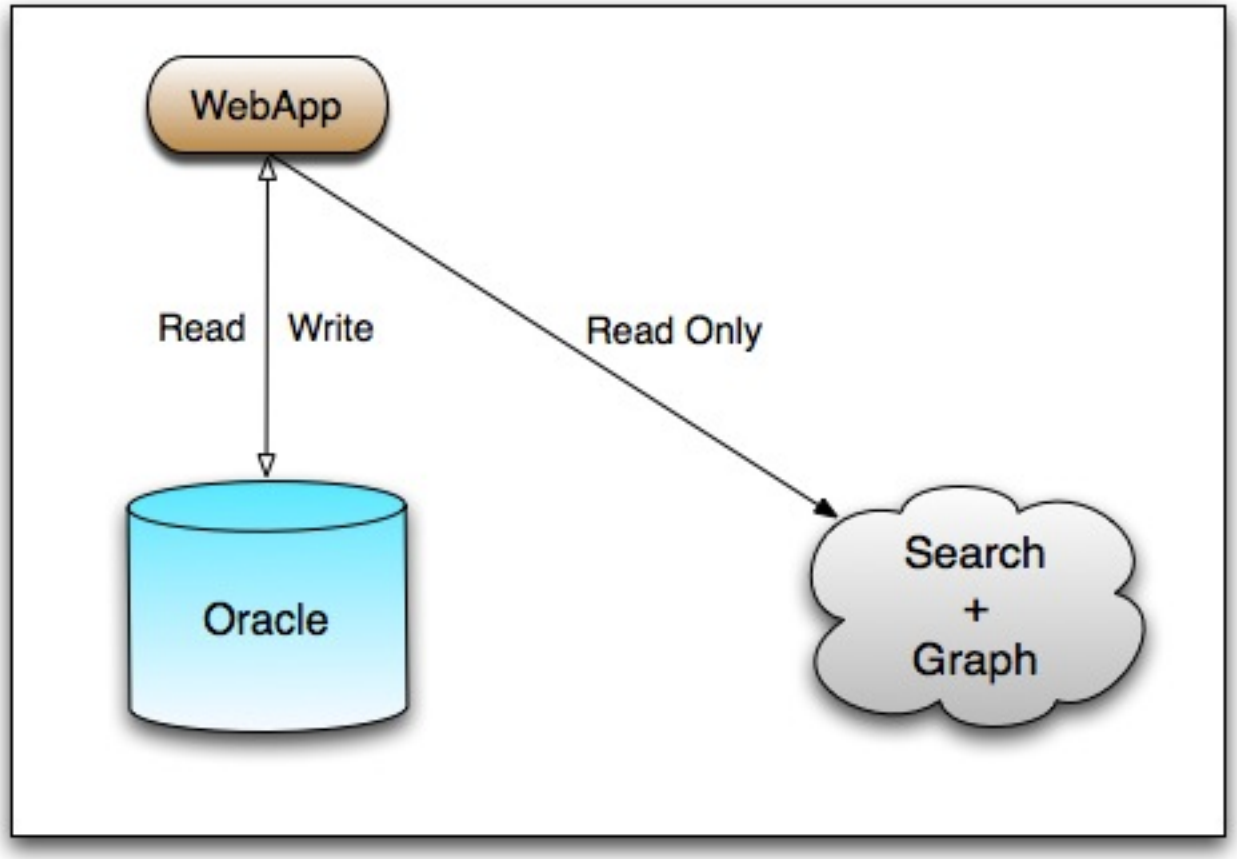
Offline

Activity that can be reflected later

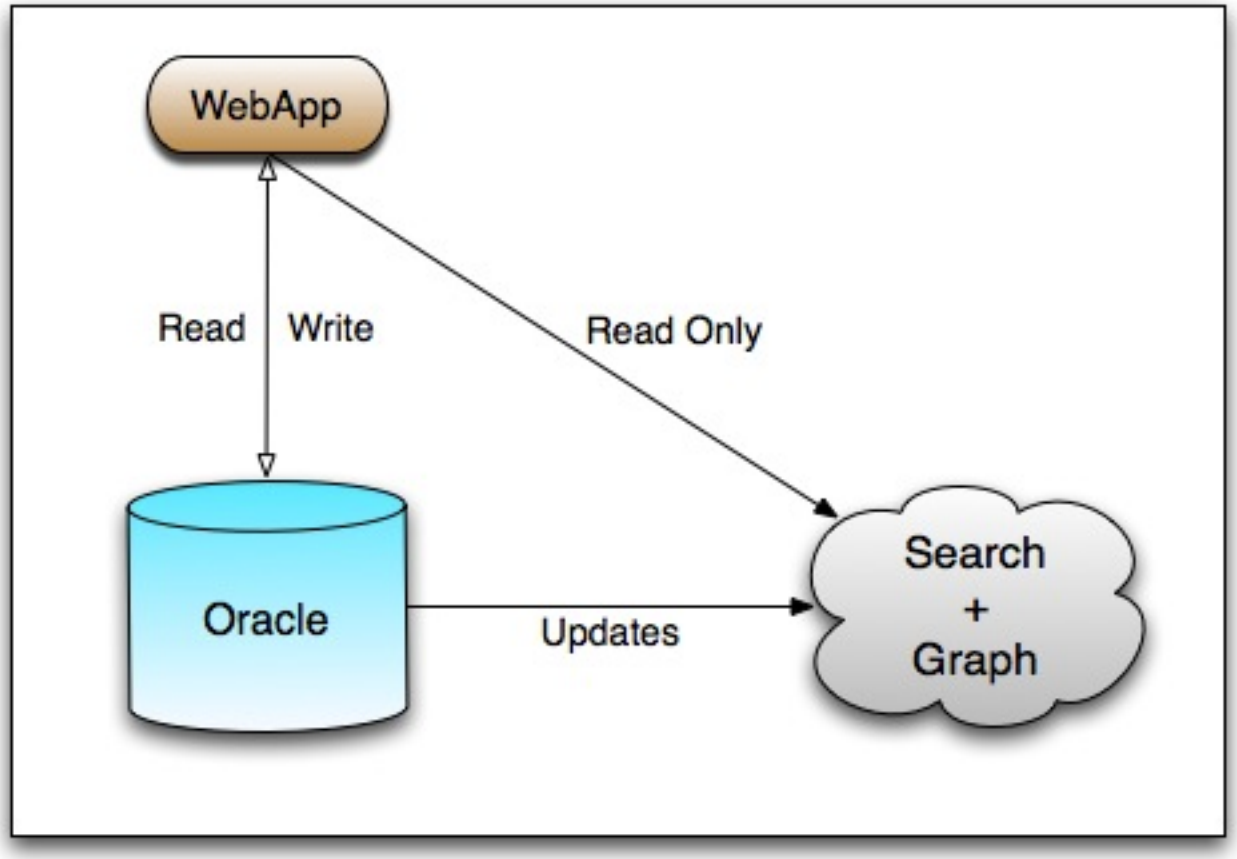
LinkedIn Product Architecture



LinkedIn Product Architecture



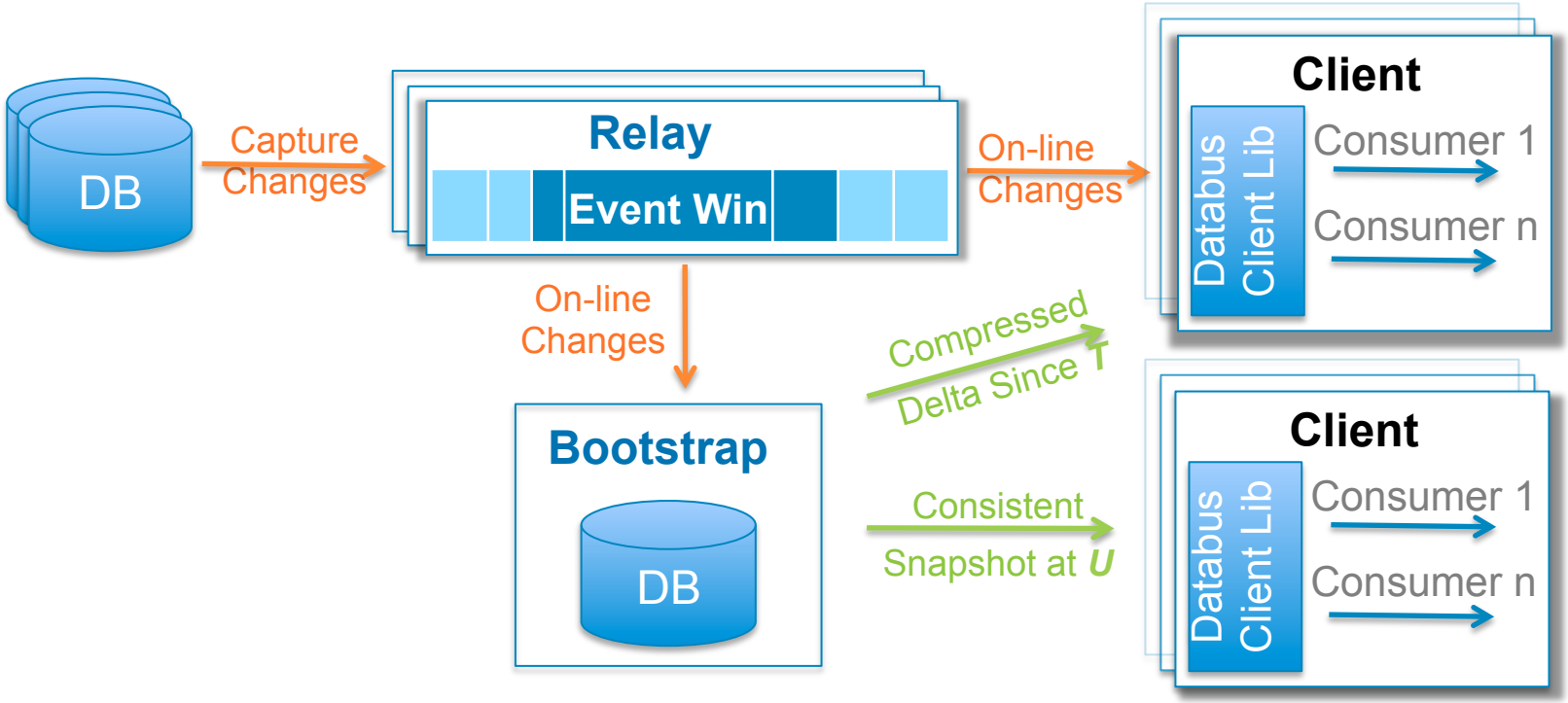
LinkedIn Product Architecture



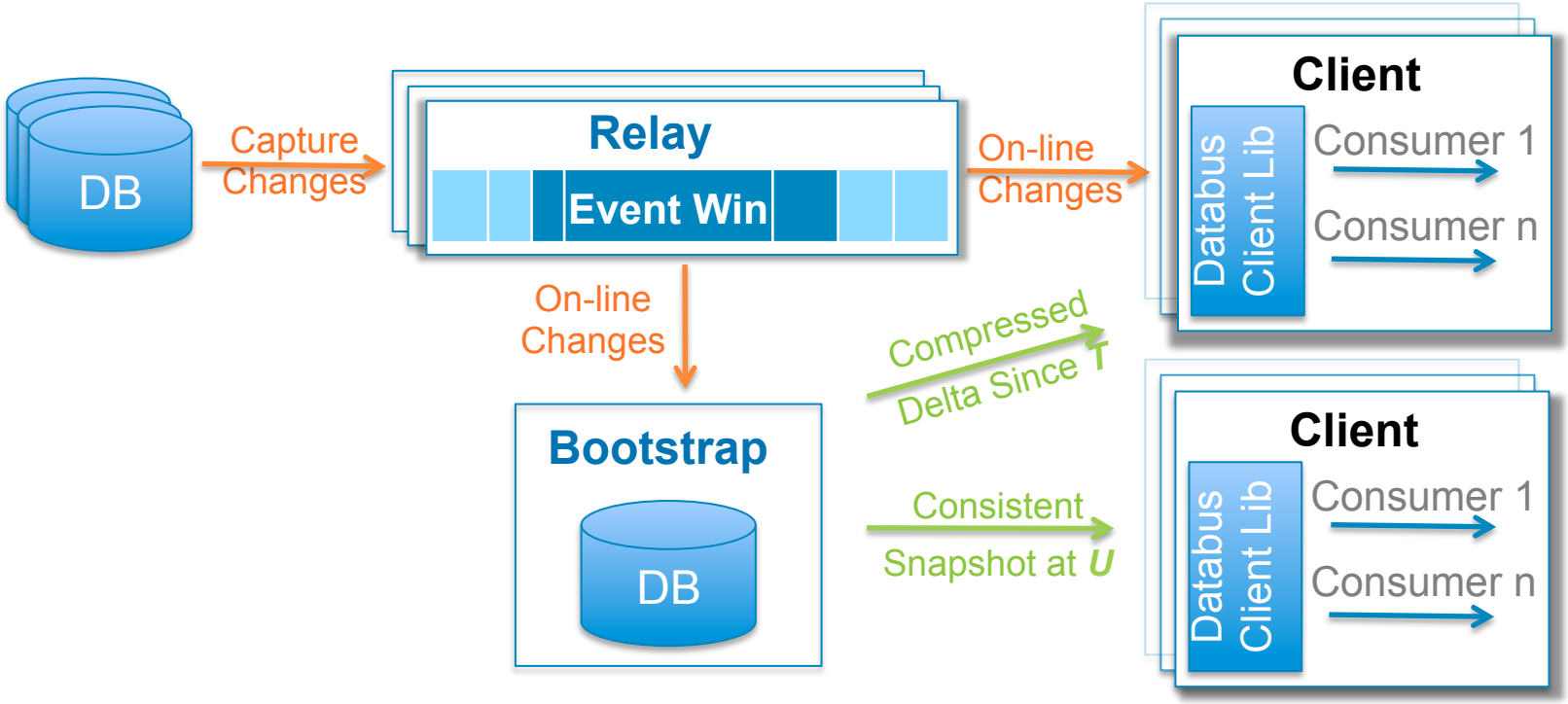
LinkedIn Data Infrastructure Solutions

Databus : Timeline-Consistent Change Data Capture

Databus at LinkedIn



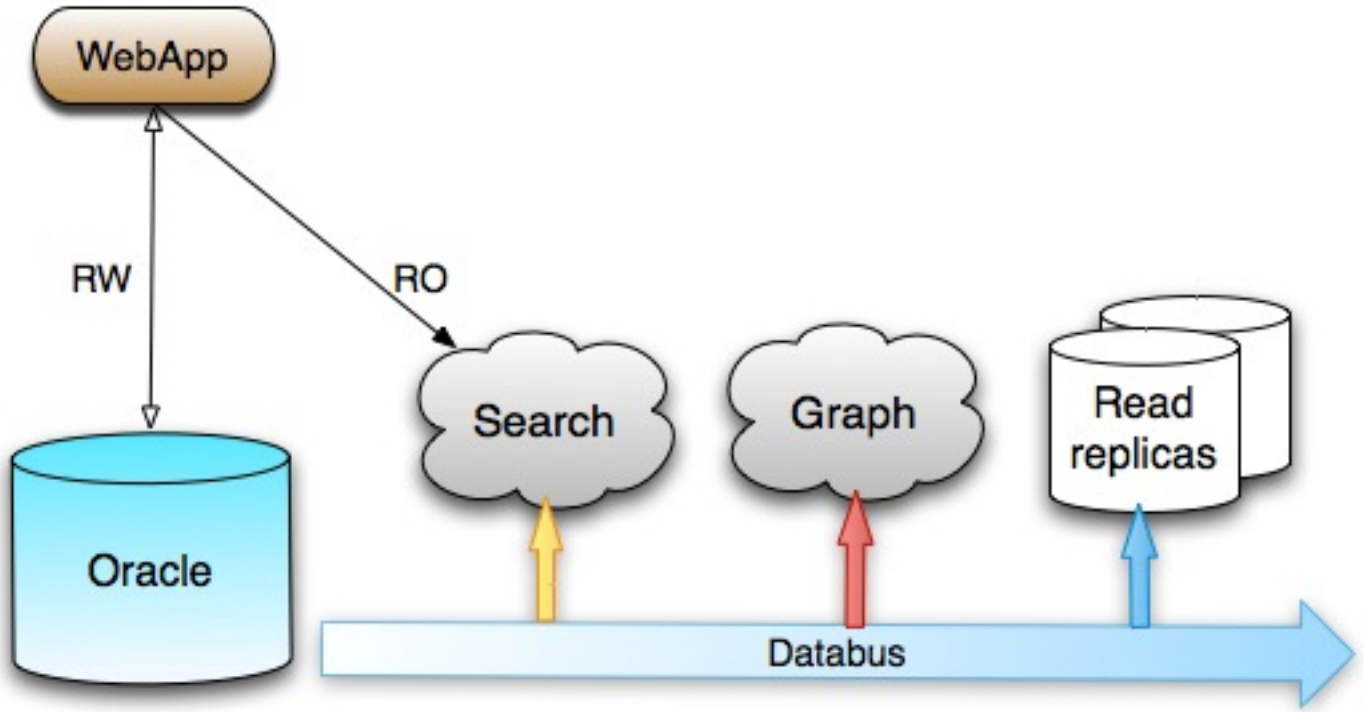
Databus at LinkedIn



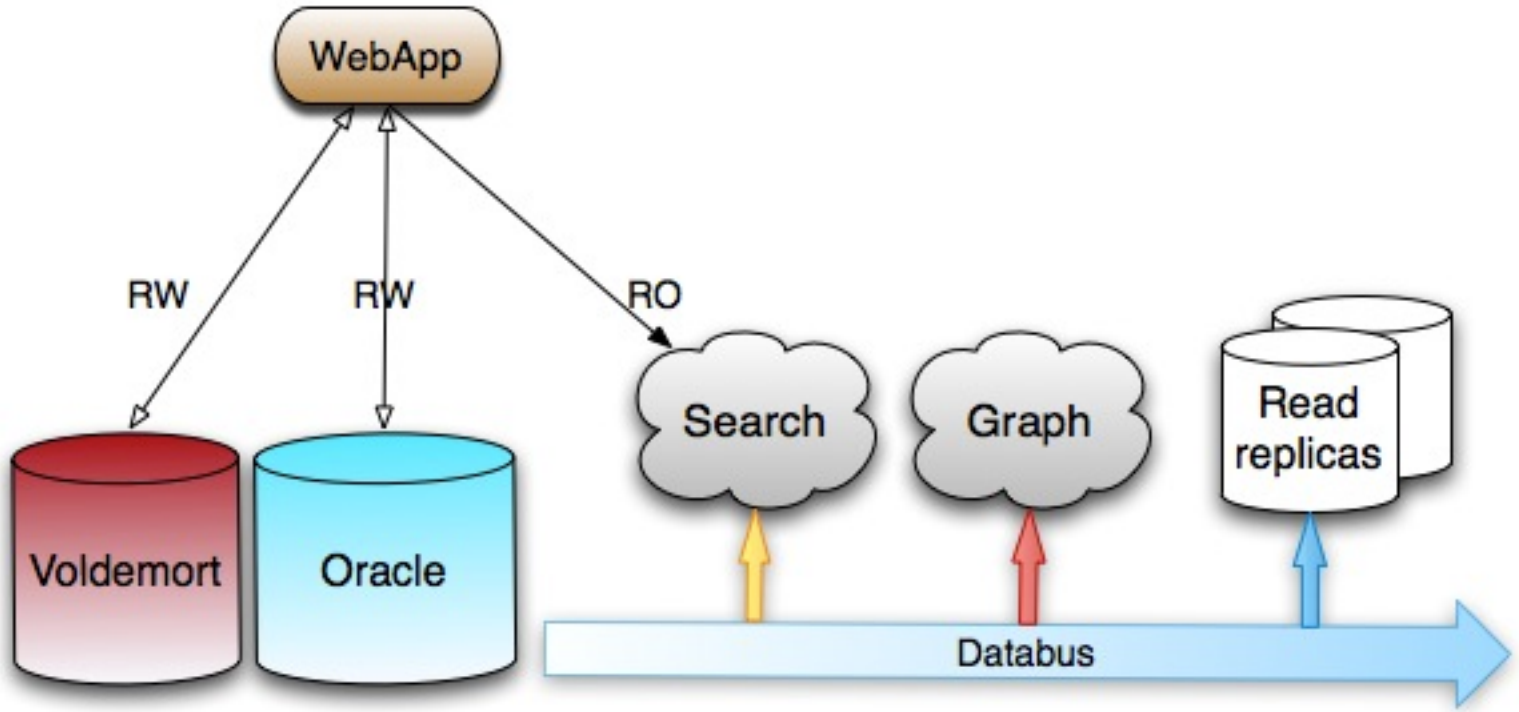
- Transport independent of data source: Oracle, MySQL, …
- Transactional semantics
- In order, at least once delivery

- Tens of relays
- Hundreds of sources
- Low latency - milliseconds

LinkedIn Product Architecture



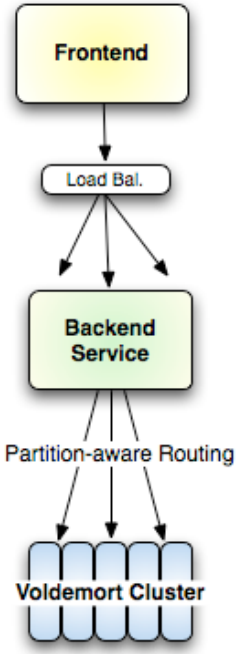
LinkedIn Product Architecture

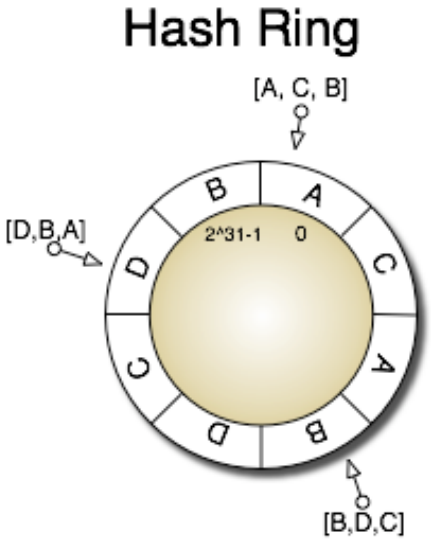


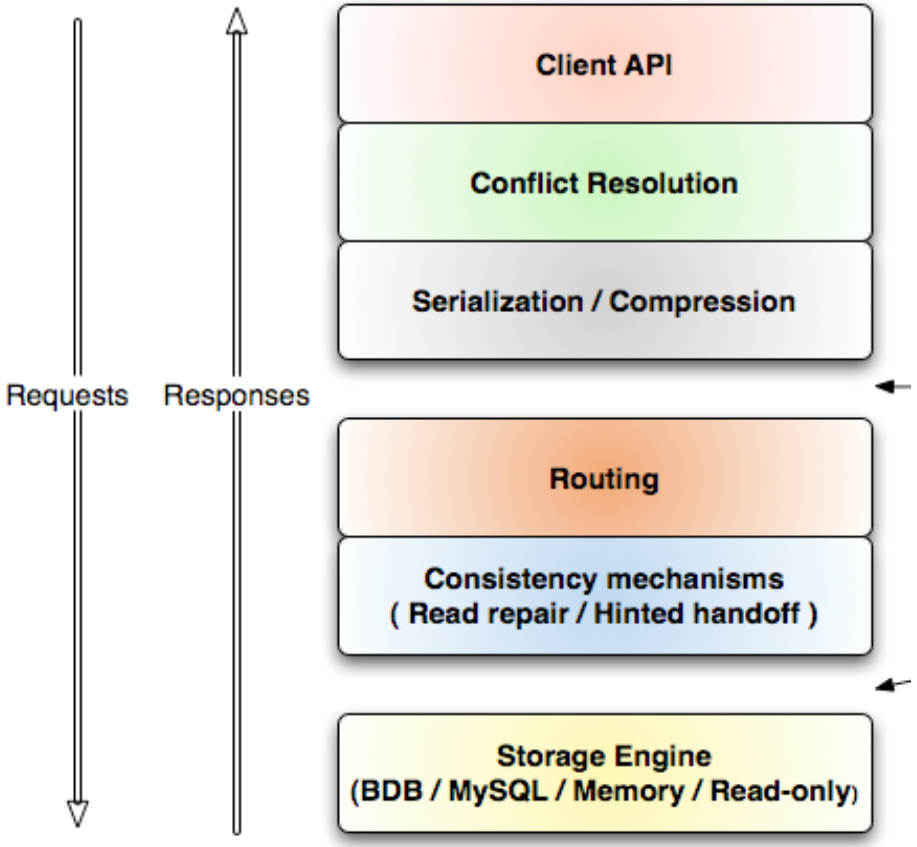
LinkedIn Data Infrastructure Solutions

Voldemort: Highly-Available Distributed KV Store

Voldemort: Architecture



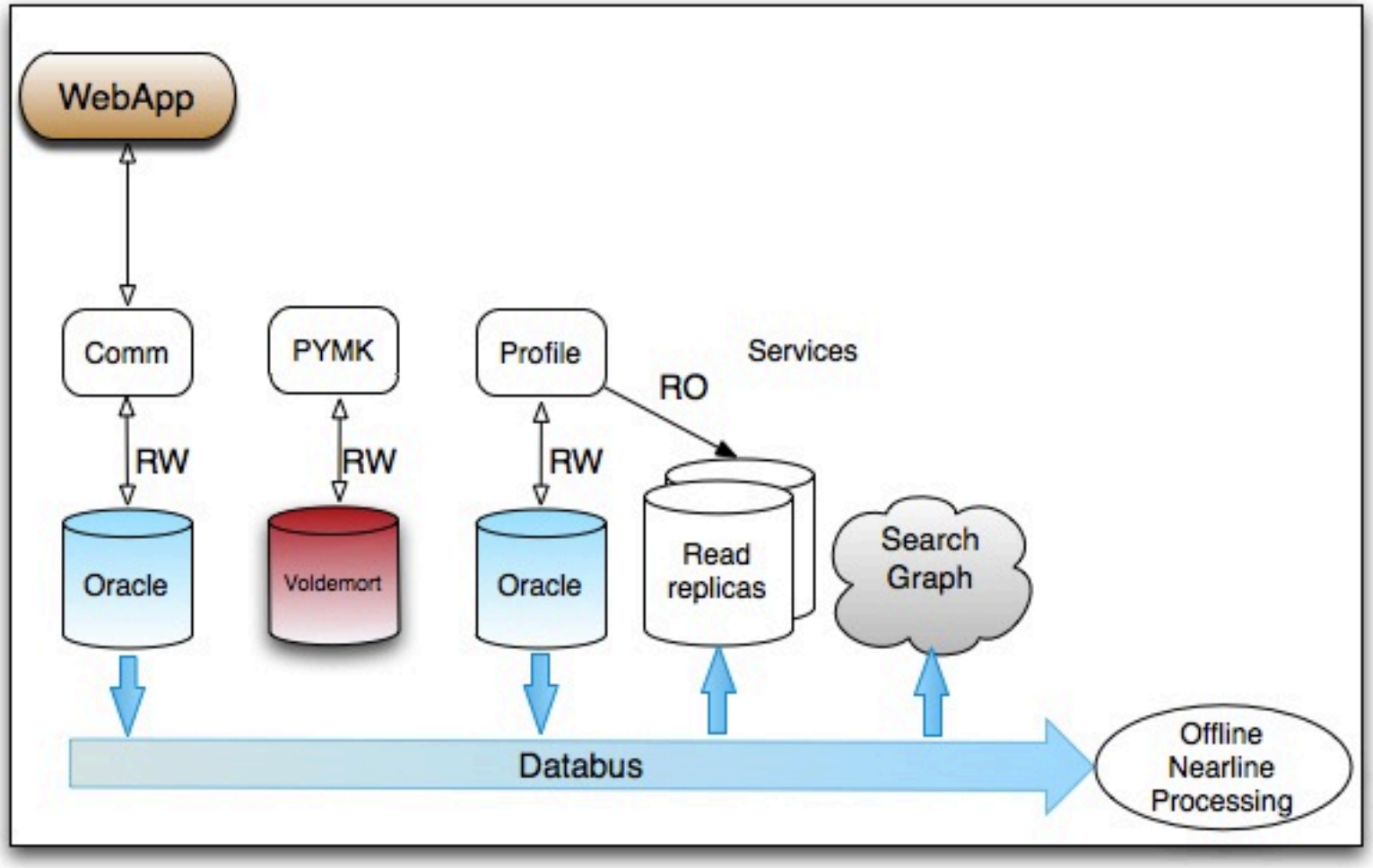




- Pluggable components
- Tunable consistency / availability
- Key/value model, server side “views”

- 10 clusters, 100+ nodes
- Largest cluster – 10K+ qps
- Avg latency: 3ms
- Hundreds of Stores
- Largest store – 2.8TB+

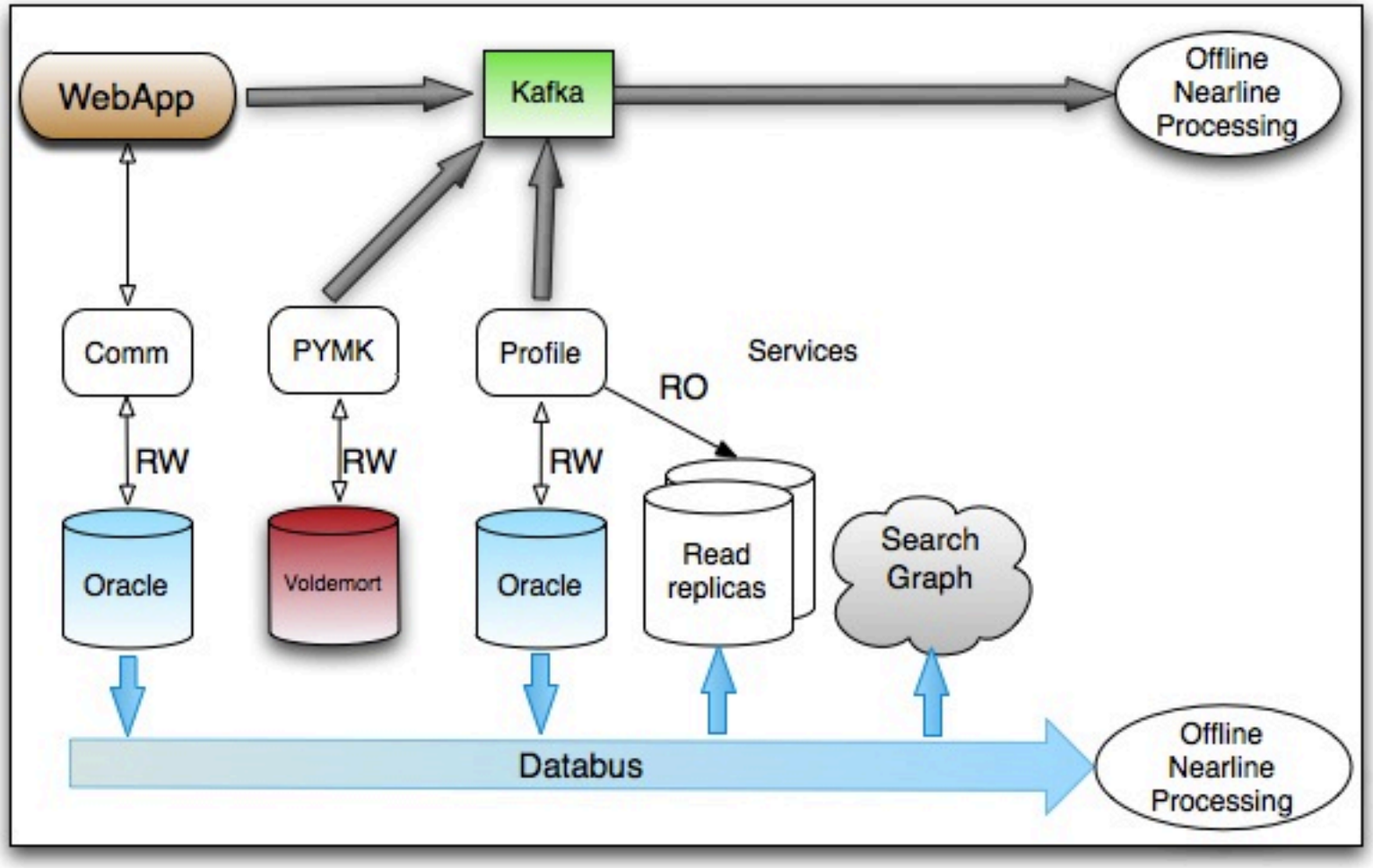
LinkedIn Product Architecture



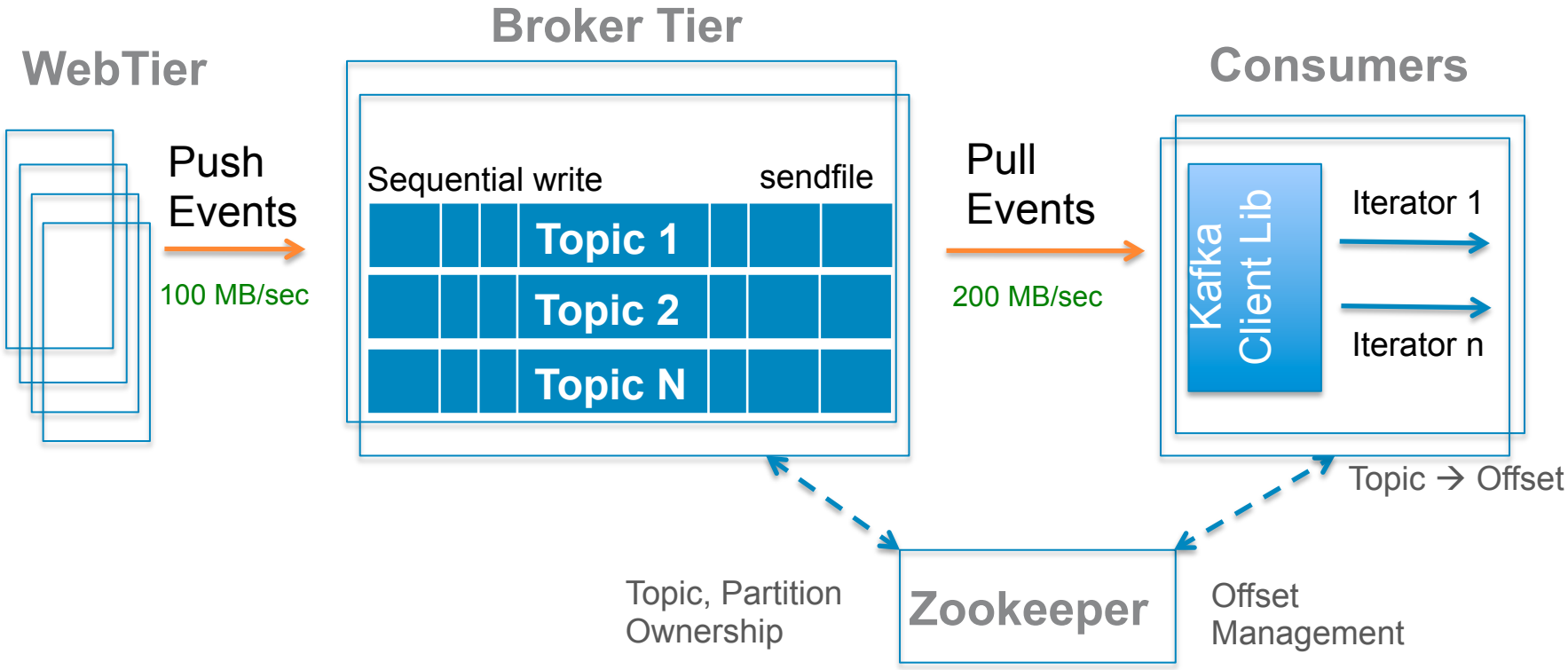
LinkedIn Data Infrastructure Solutions

Kafka: High-Volume Low-Latency Messaging System

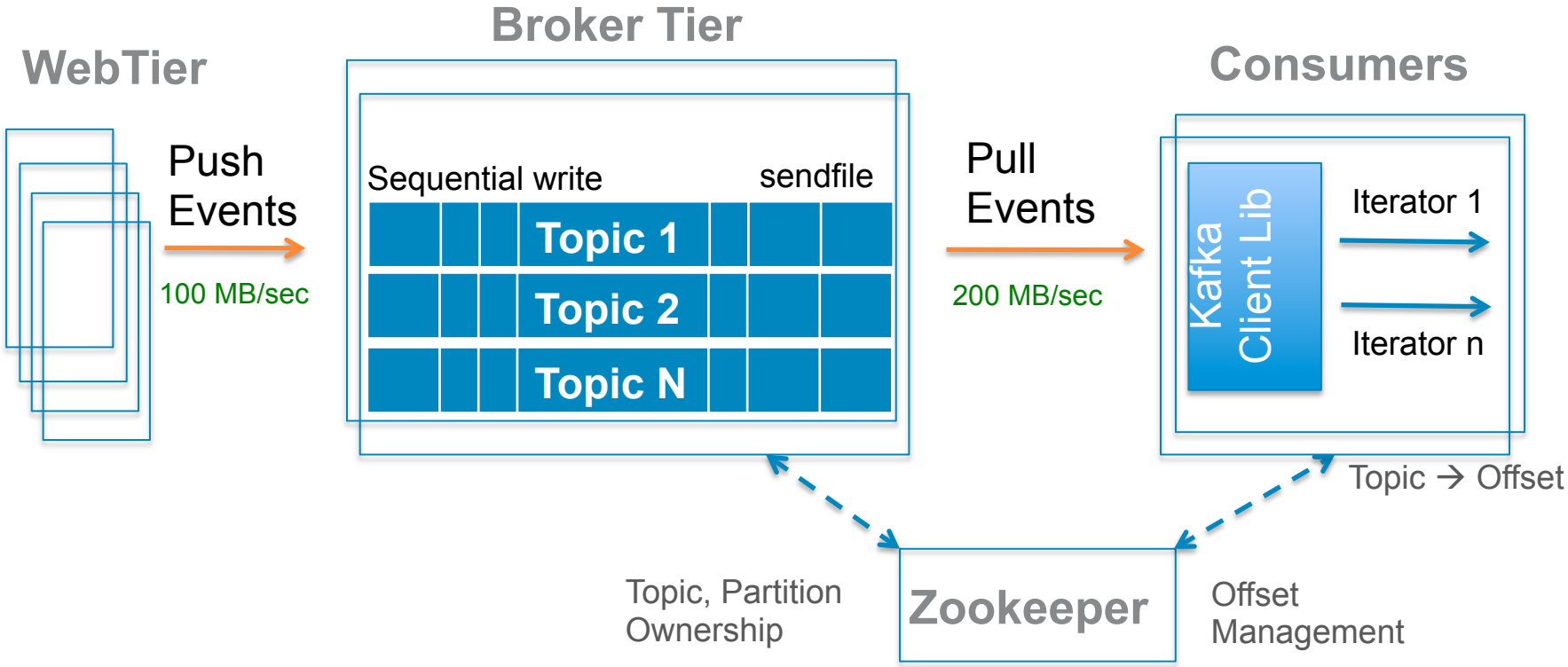
LinkedIn Product Architecture



Kafka: Architecture



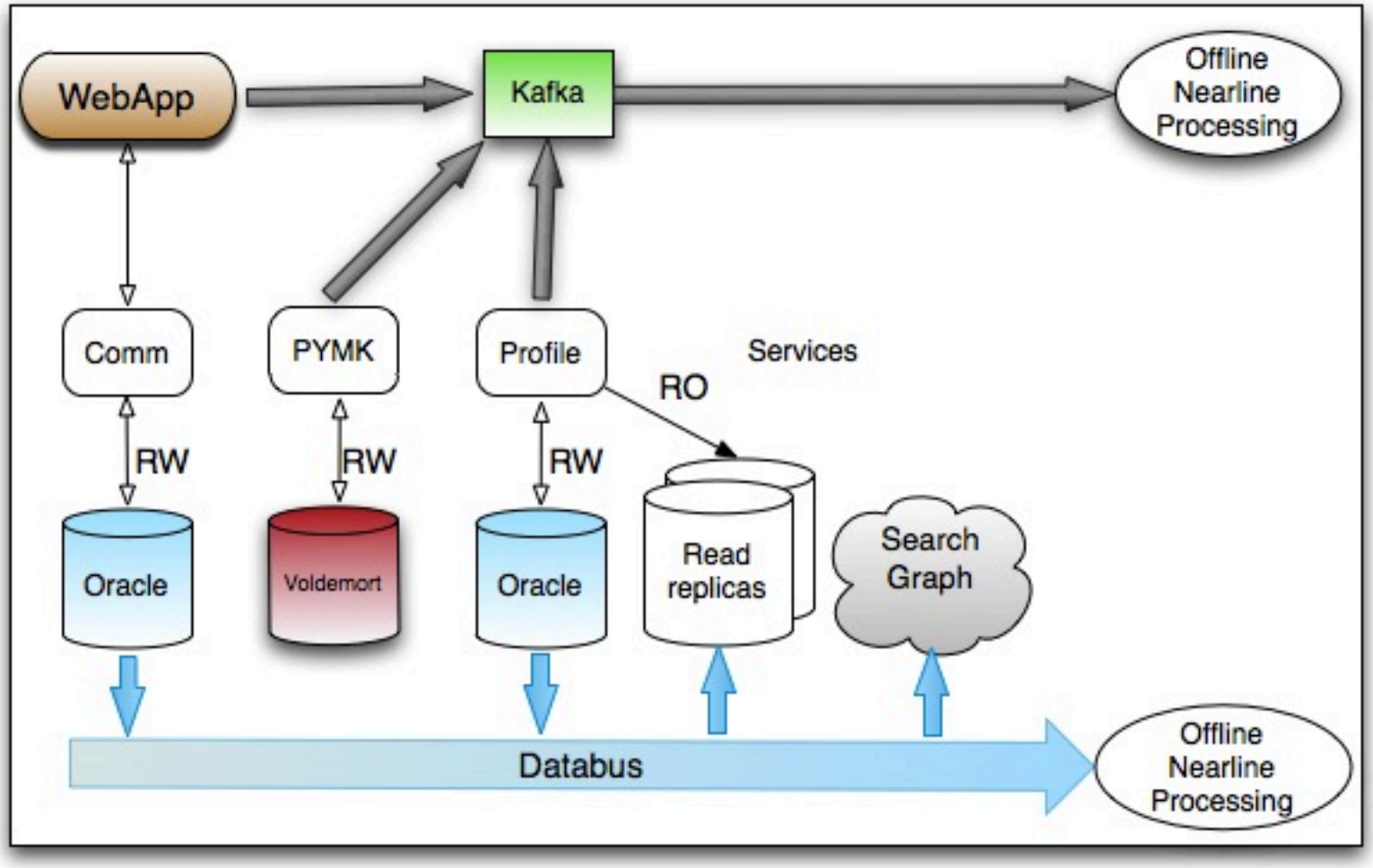
Kafka: Architecture



- At least once delivery
- Very high throughput
- Low latency
- Durability

- Billions of Events, TBs per day
- 50K+ per sec at peak
- Inter and Intra-cluster replication
- End-to-end latency: few seconds

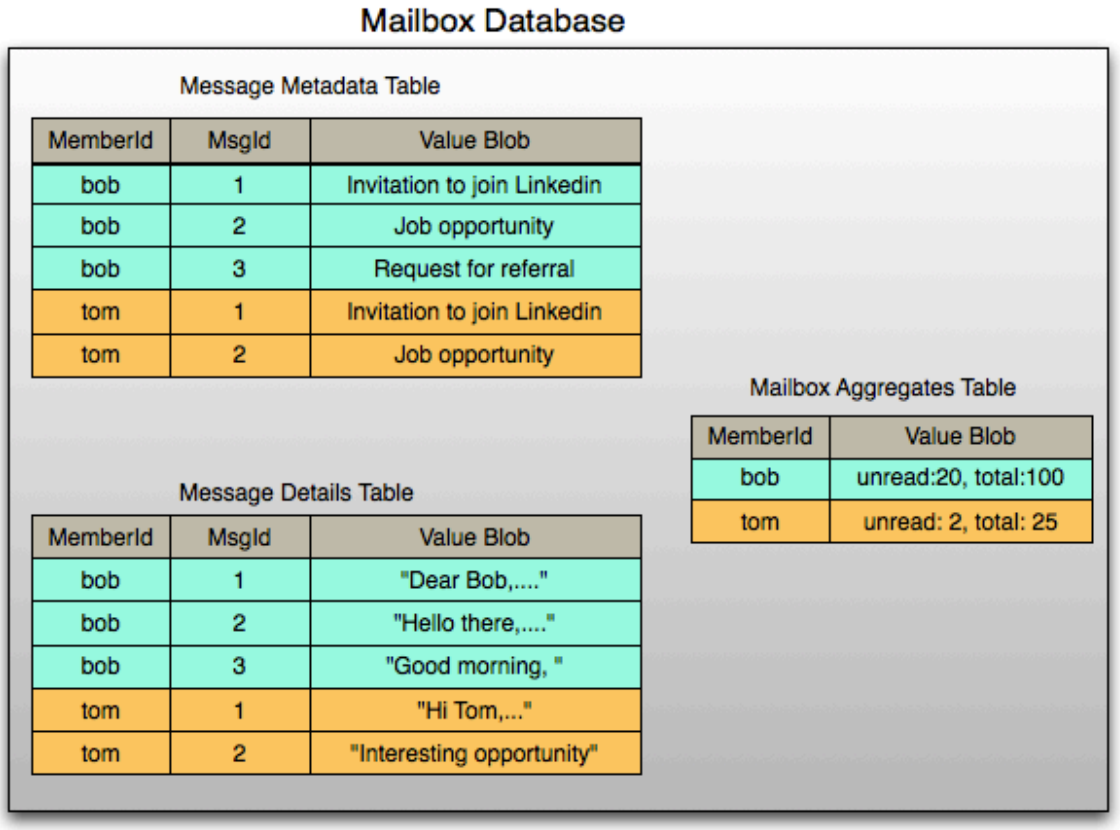
LinkedIn Product Architecture



LinkedIn Data Infrastructure Solutions

Espresso: Indexed Timeline-Consistent Distributed Data Store

Application View



Hierarchical data model

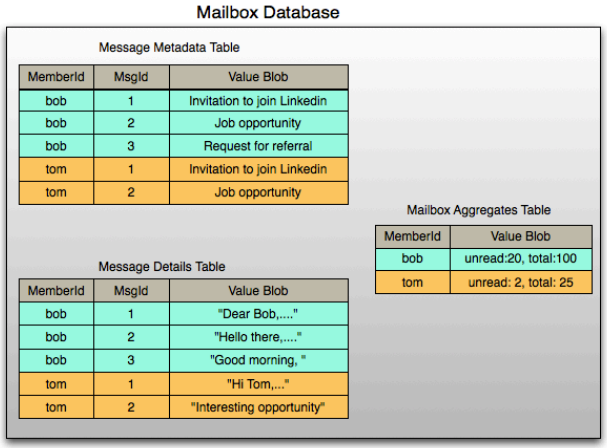
Rich functionality on resources

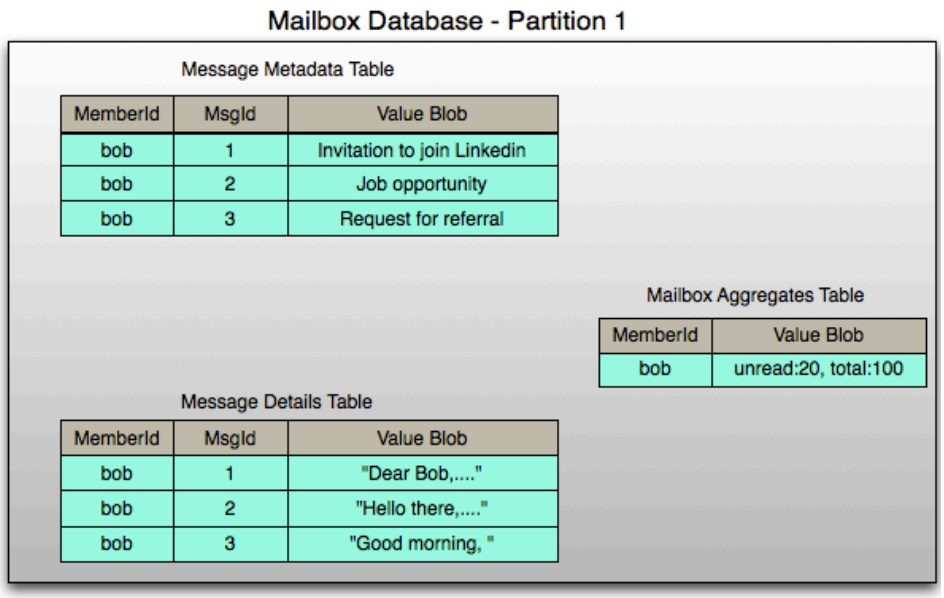
- ✓ Conditional updates
- ✓ Partial updates
- ✓ Atomic counters

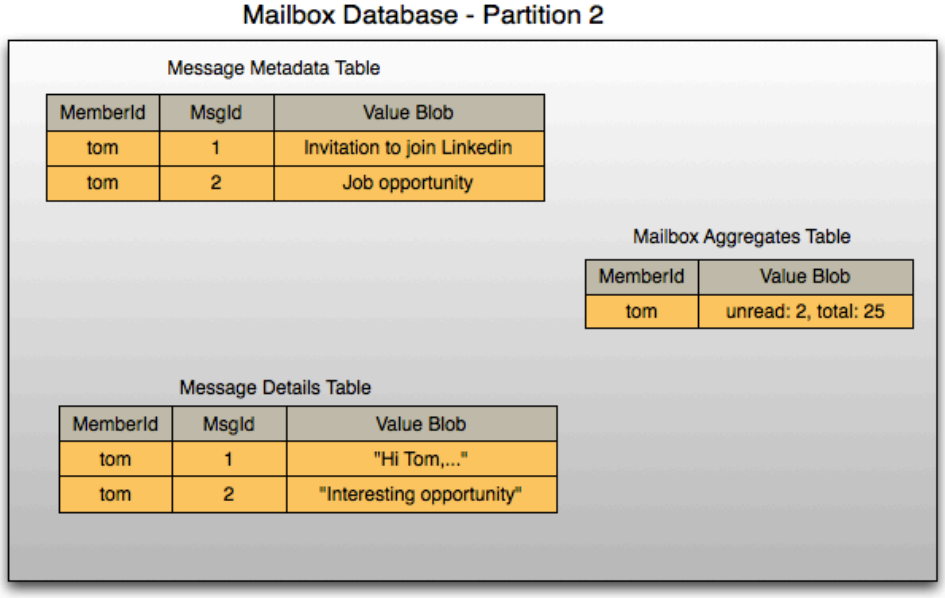
Rich functionality within resource groups

- ✓ Transactions
- ✓ Secondary index
- ✓ Text search

Partitioning

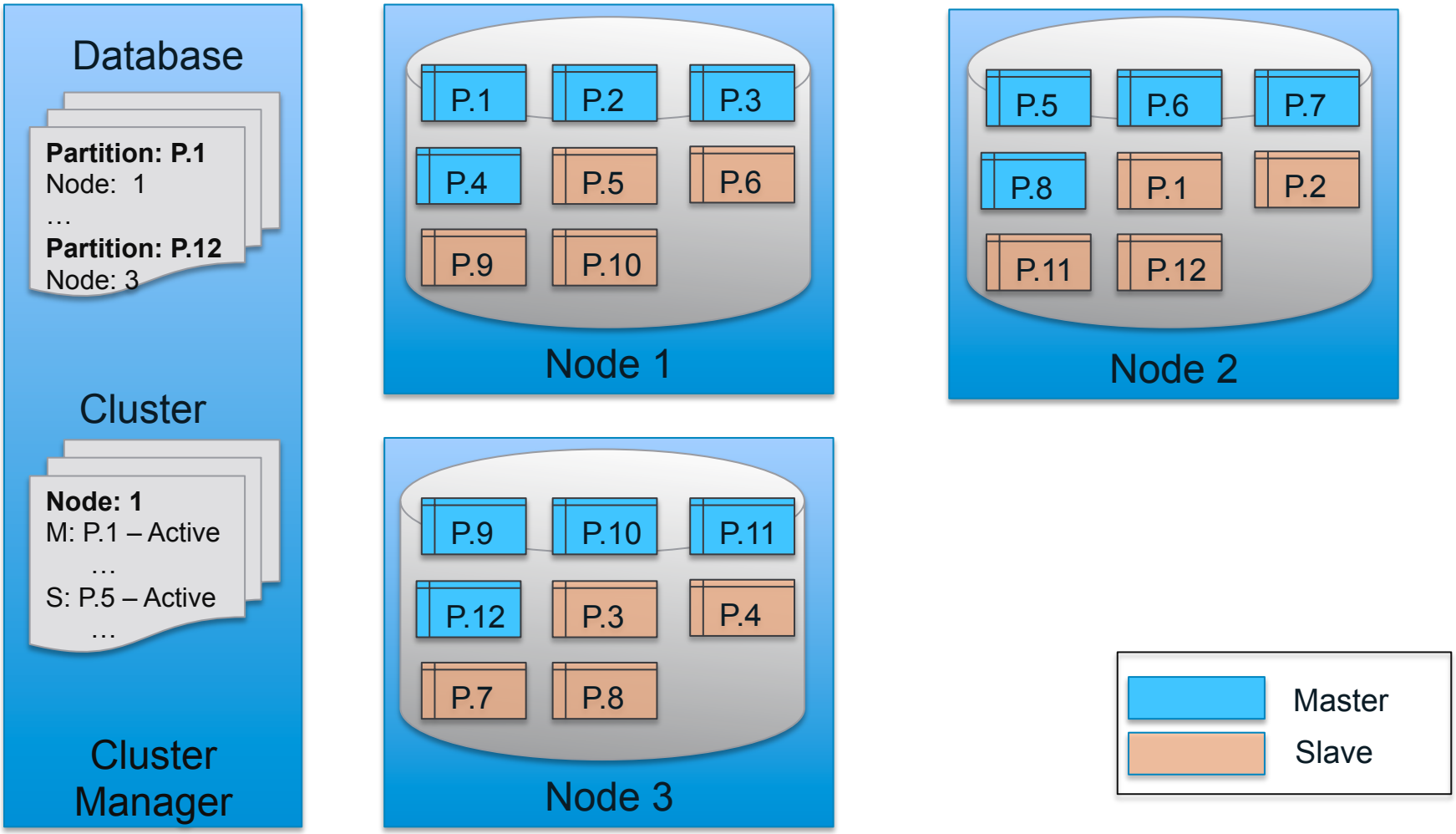




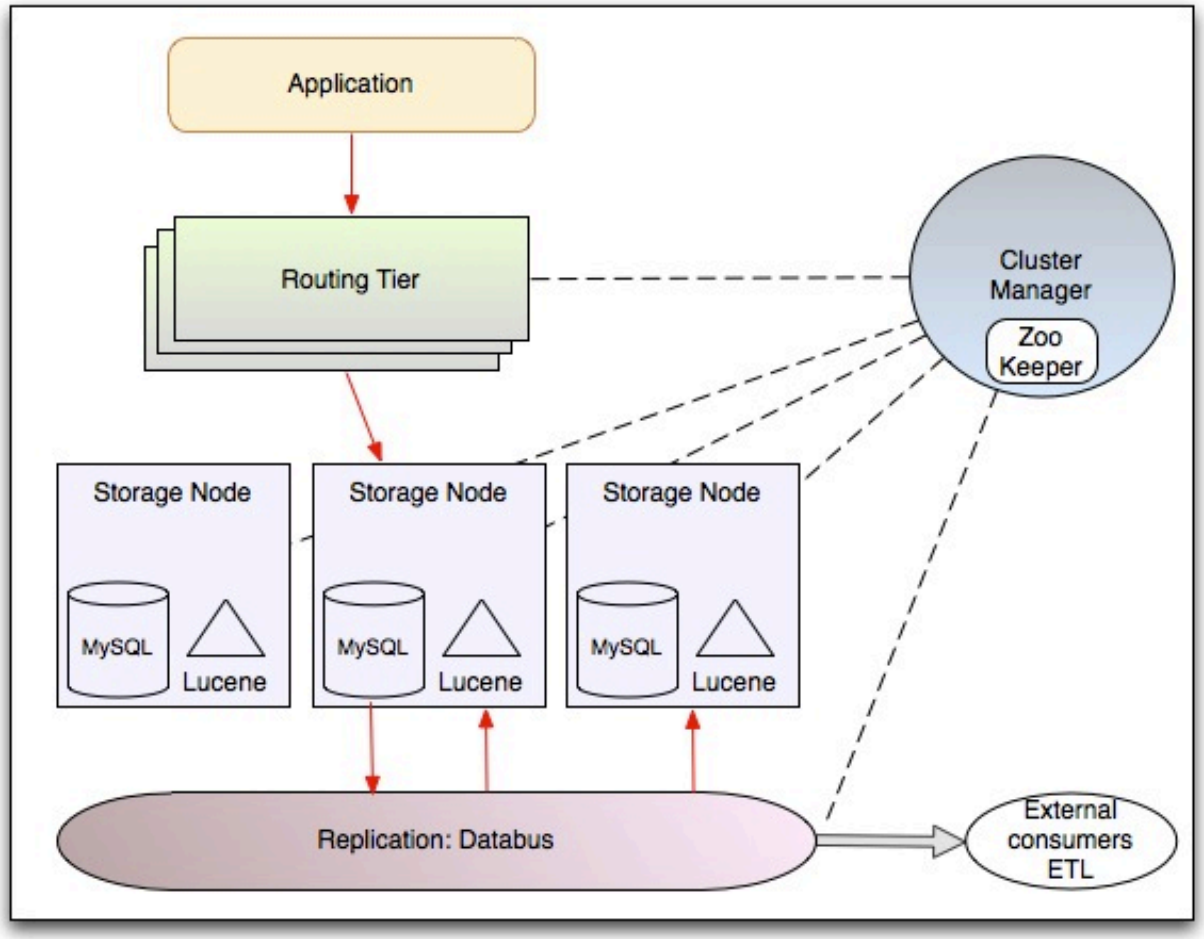


Espresso Partition Layout: Master, Slave

3 Storage Engine nodes, 2 way replication

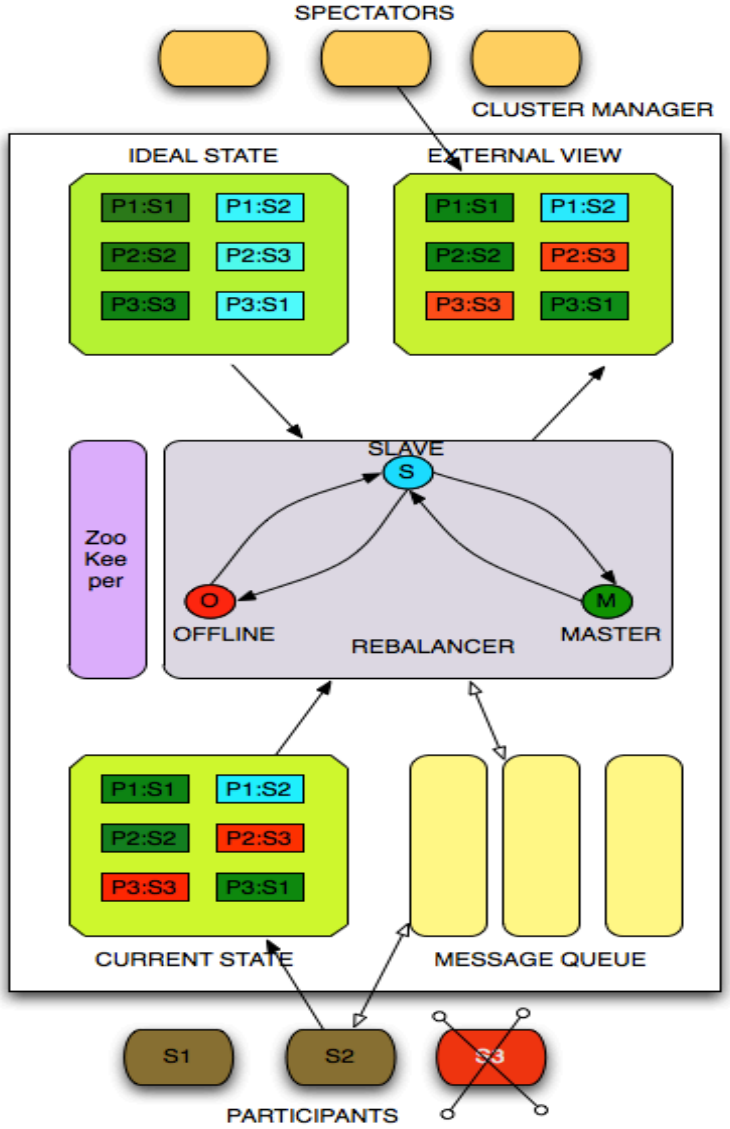


Espresso: System Components



Generic Cluster Manager: Helix

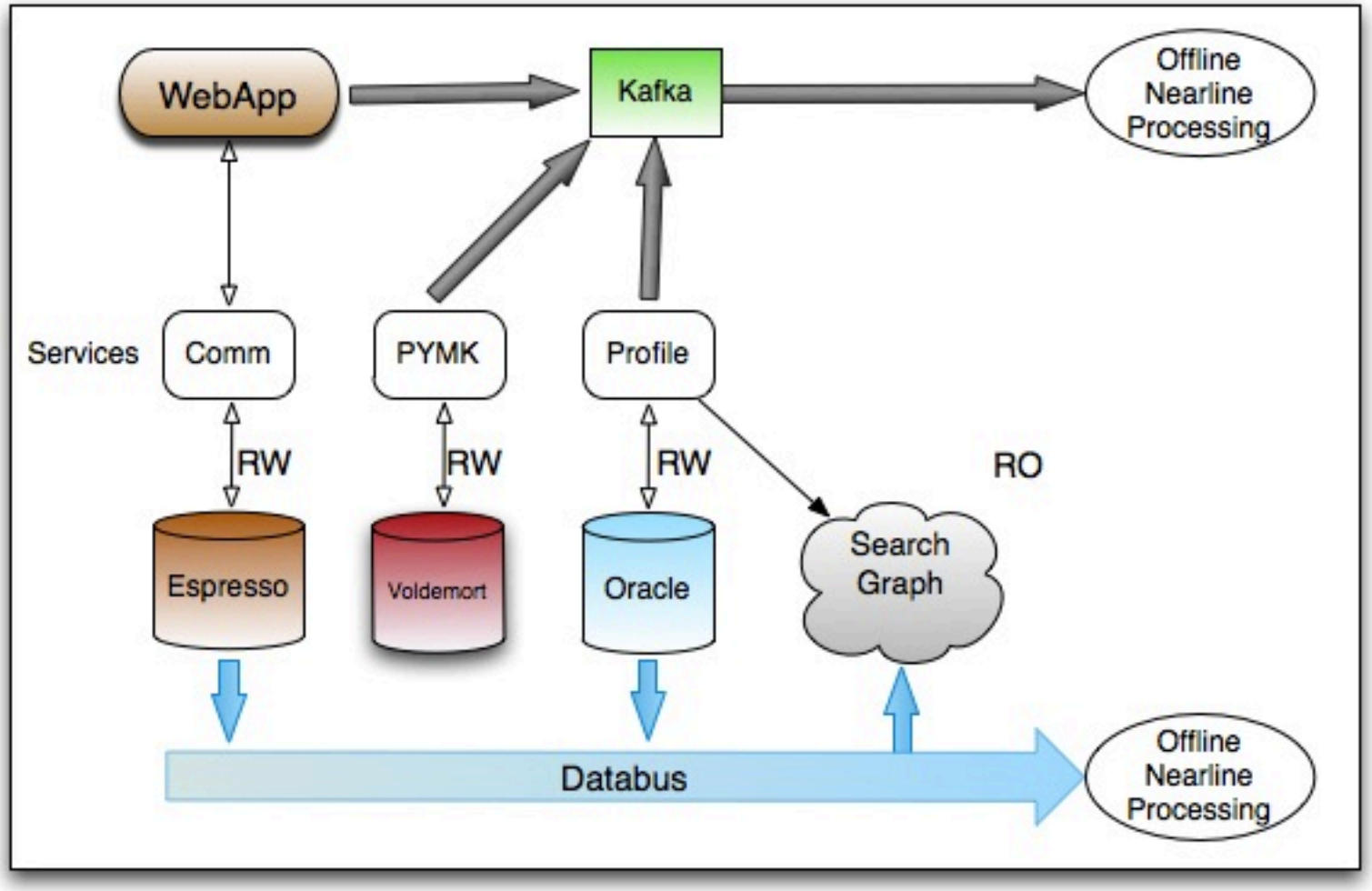
- Generic Distributed State Model
- Centralized Config Management
- Automatic Load Balancing
- Fault tolerance
- Health monitoring
- Cluster expansion and rebalancing
- Espresso, Databus and Search
- Open Source Apr 2012
- https://github.com/linkedin/helix



Espresso@Linkedin

- Launched first application Oct 2011
- Open source 2012
- Future
  - Multi-Datacenter support
  - Global secondary indexes
  - Time-partitioned data

LinkedIn Product Architecture



Acknowledgments

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Questions?