



Couchbase

# Architecture and Administration Basics

## Introduction



1

# Interactions vs Transactions

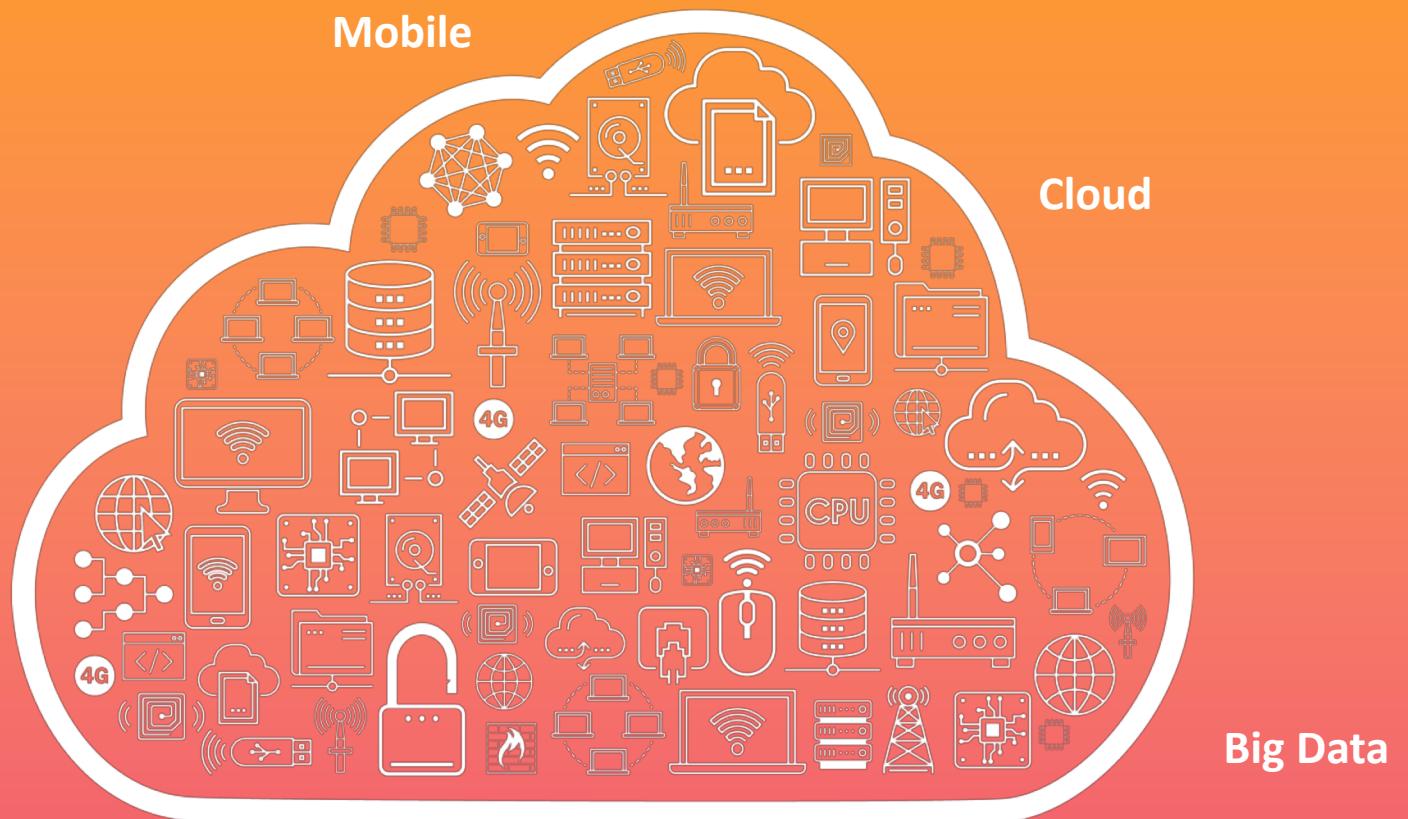
A young child with dark hair, wearing a light-colored cable-knit sweater, is shown from the side and back, looking up and to the left towards a bright screen. The screen displays a colorful, abstract pattern of geometric shapes. The background is a warm, out-of-focus yellow-orange.

**CHANGE IS  
HAPPENING: THE  
WAY WE ENGAGE  
HAS EVOLVED**



# Technology is Further Driving Digital Innovation

Internet of Things





# Customers now expect exceptional digital experiences



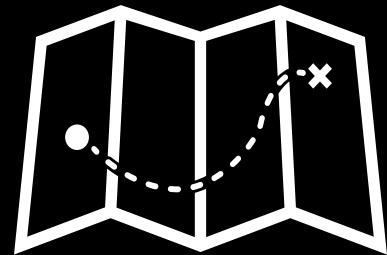


Customers spend  
more time interacting  
than transacting...



INTERACTIONS

TRANSACTIONS



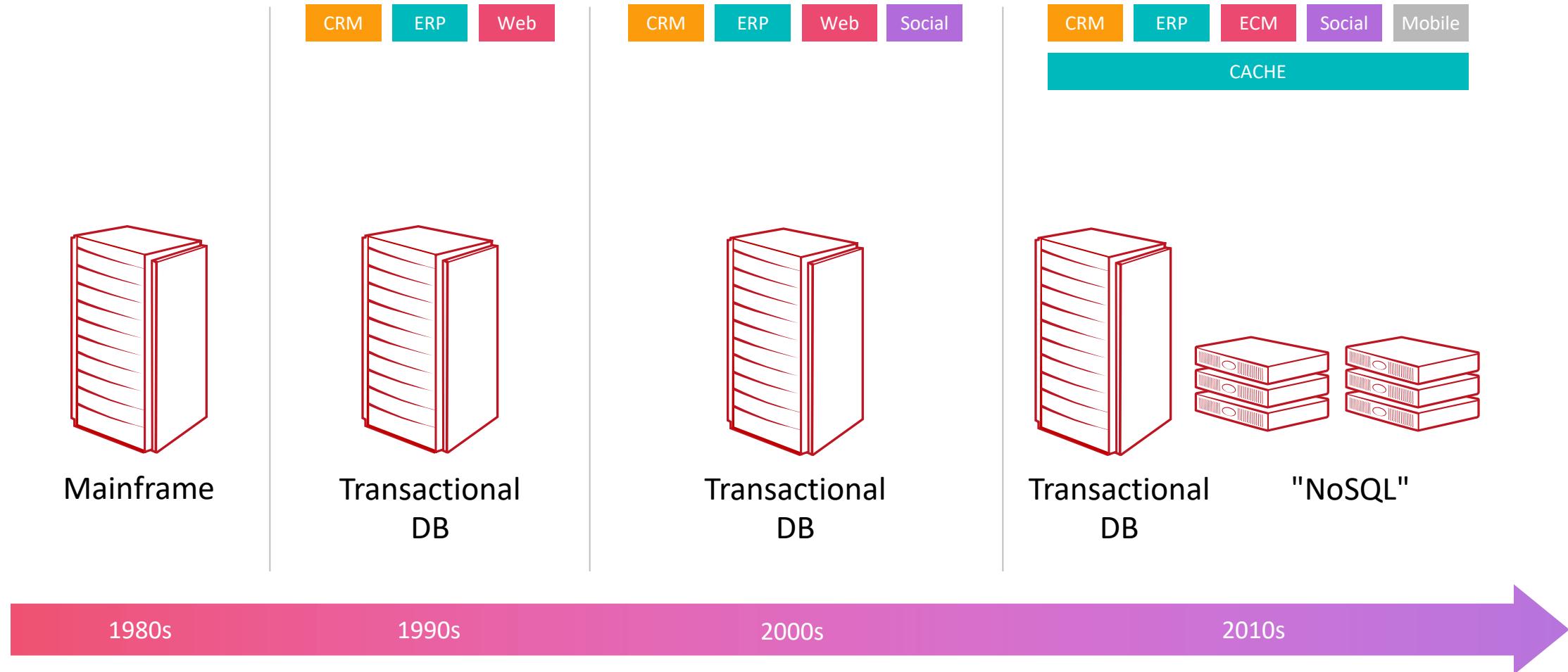
## Look

Searching for a flight or hotel room  
Comparing deals  
Personalizing the experience



## Book

# The Beginnings of Digital Engagement

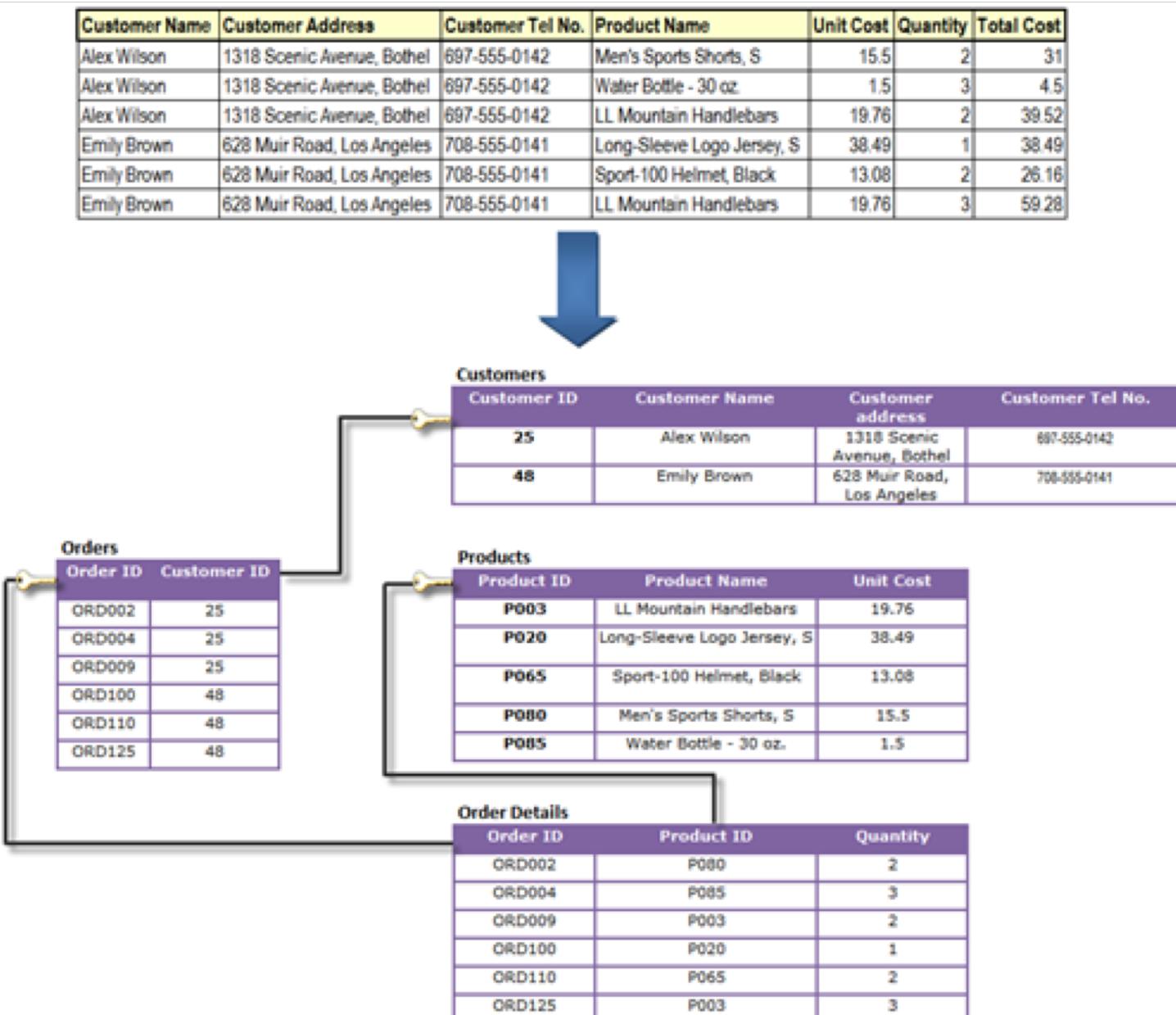




2

## From RDBMS to NoSQL

# RDBMSs "normalize" the data



# What was the key driver behind the RDBMS?

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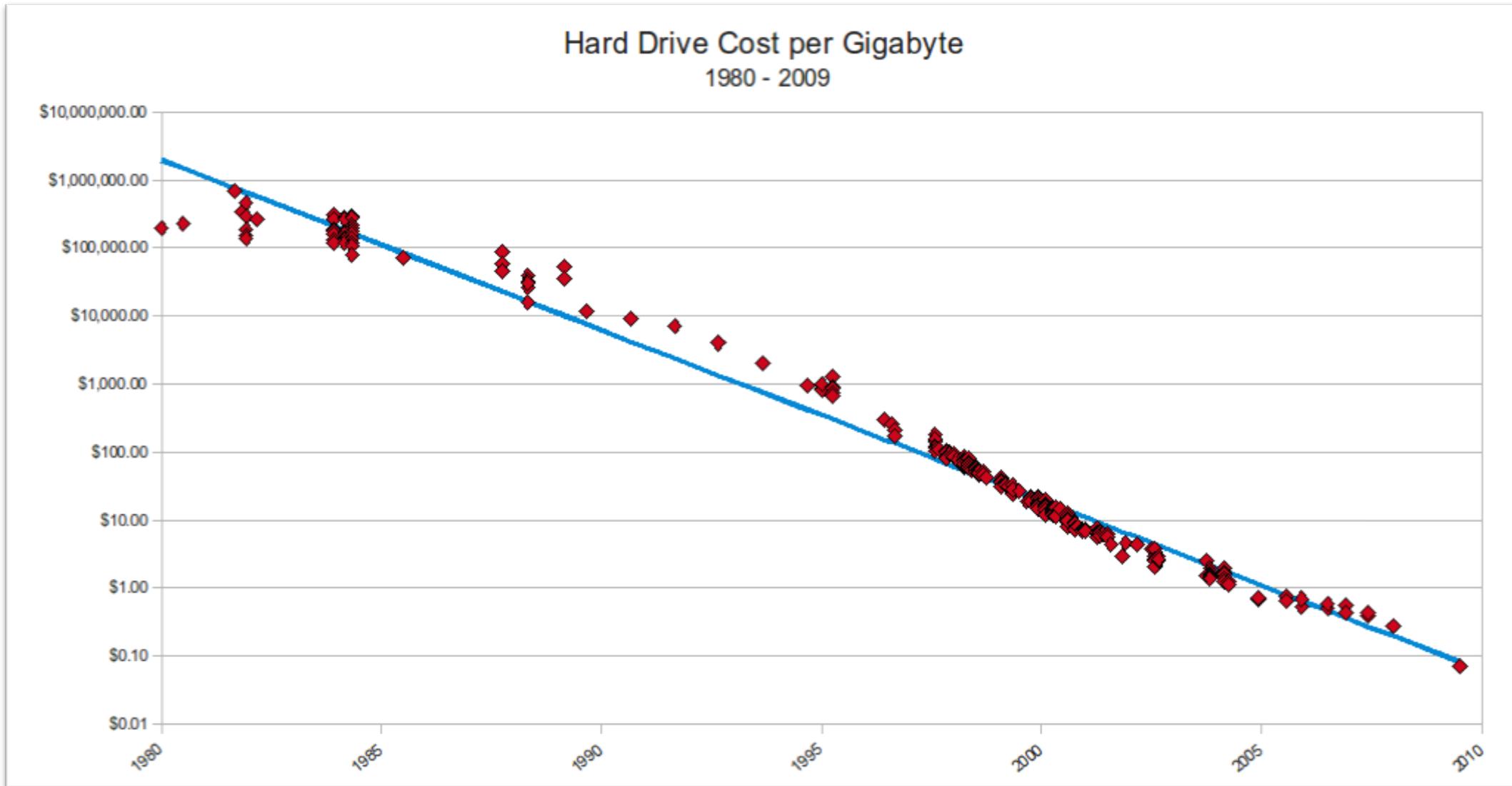
- The number “967” takes 10 bits to store
- The word “computer” takes 64 bits to store

(01100011 01101111 01101101 01110000 01110101  
01110100 01100101 01110010)

# How much was 1 Gig of Storage in 1980?



# The Cost of Disk



# The Cost of 1 Gigabyte of Disk – Yesterday vs. Today



1980

\$500,000

2016

\$.06

# Relational vs. NoSQL – The 6 Reasons

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- **Joins are EXPENSIVE and don't scale well**
- RDBMSs are *complex* to scale and operate
- RDBMSs are strict with schema
- RDBMSs are not reliable enough
- Developing against an RDBMS is NOT agile
- RDBMSs are expensive to license



## Quora

In summary, joins are "bad" because (1) they are inherently computationally expensive, (2) the unsophisticated implementations in typical big data environments make them even \*more\* expensive, and (3) the lack of effective parallelization for those implementations means that you can't increase throughput simply by adding more hardware.

# Relational vs. NoSQL – The 6 Reasons

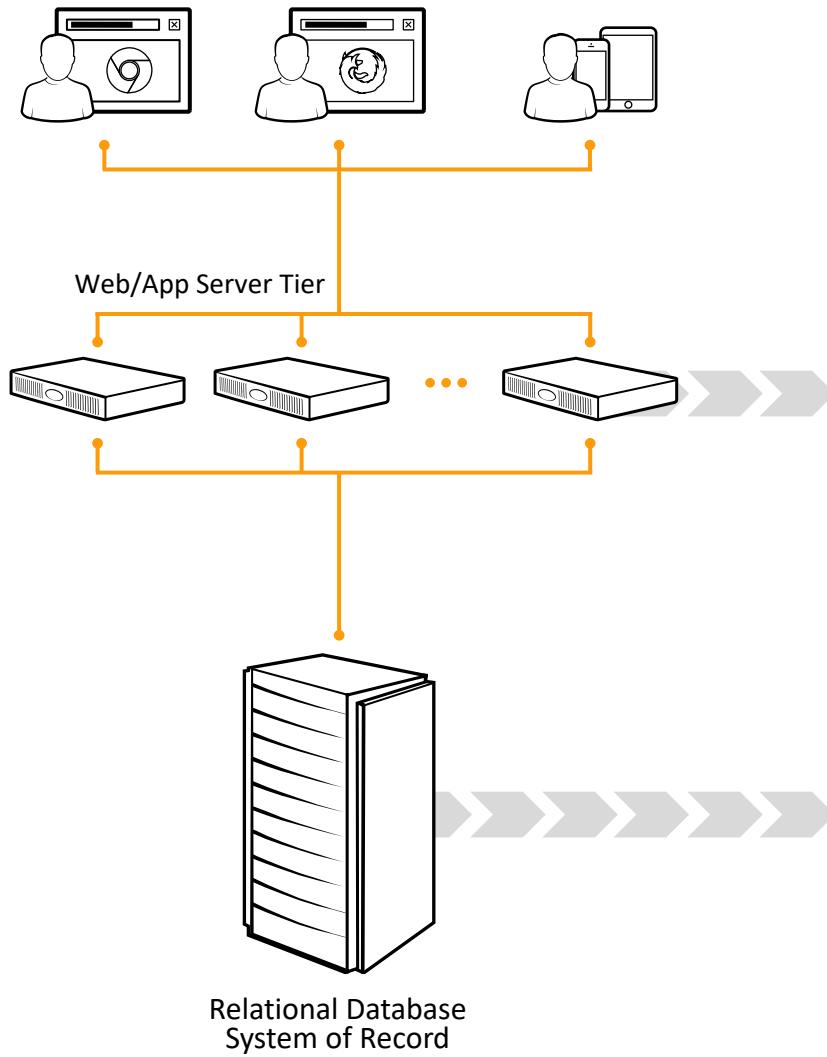
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# Relational Technology Scales Up



APPLICATION SCALES OUT

— SYSTEM COST  
— APPLICATION PERFORMANCE

USERS

RDBMS SCALES UP

Get a bigger, more expensive server

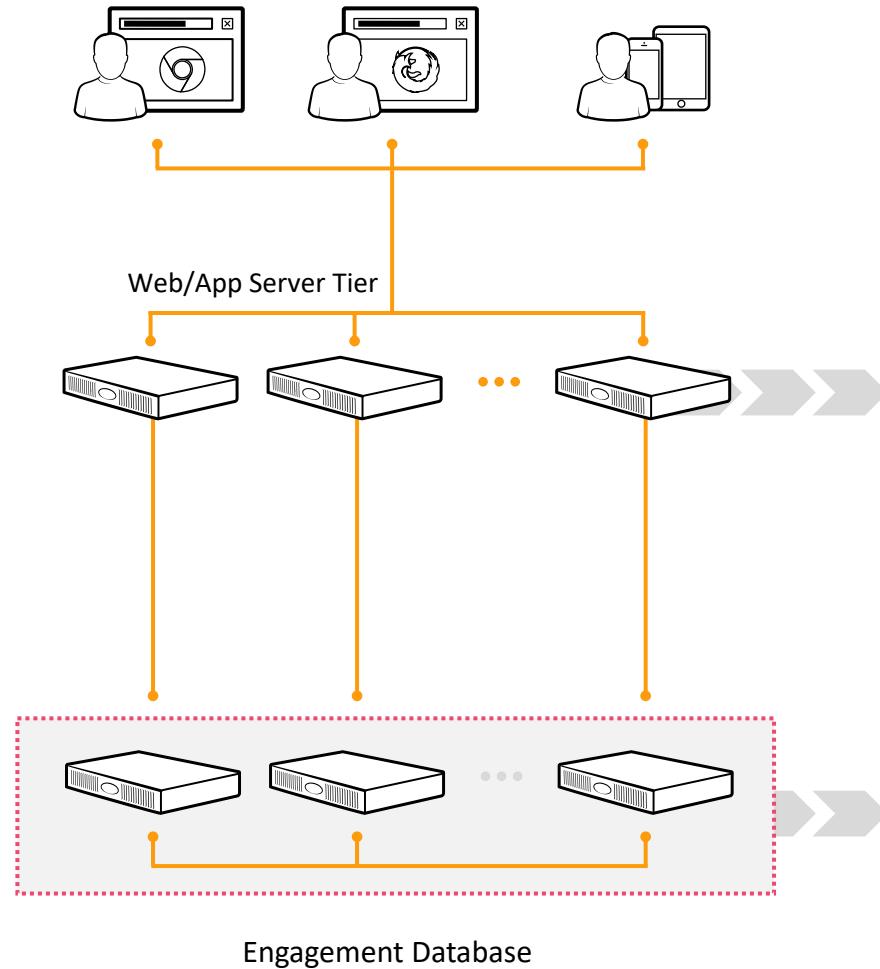
— SYSTEM COST  
— APPLICATION PERFORMANCE

USERS

← WON'T SCALE BEYOND A POINT



A different approach is needed to power engaging experiences



#### APPLICATION SCALES OUT

- SYSTEM COST
- APPLICATION PERFORMANCE

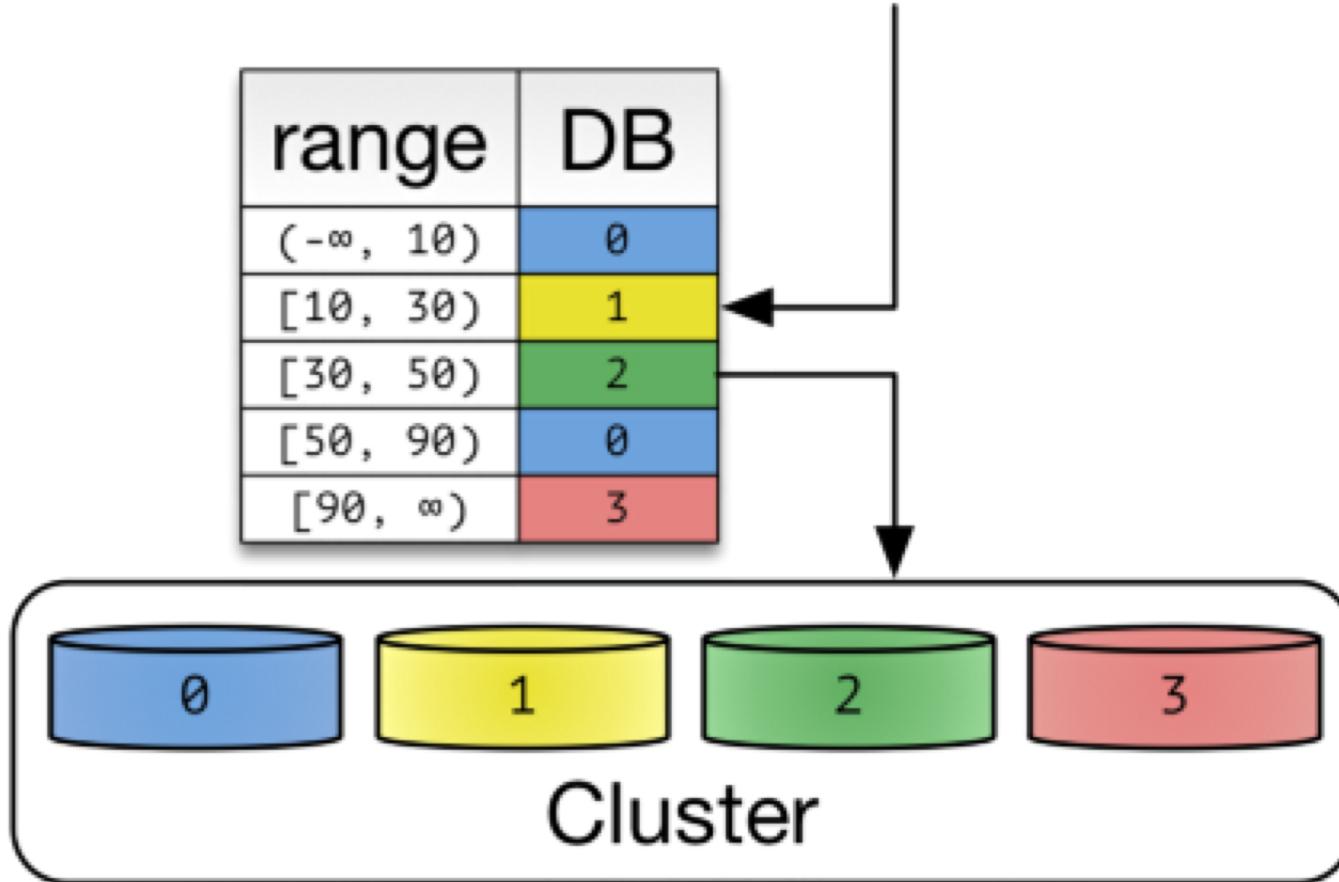
USERS

#### COUCHBASE SCALES OUT

- SYSTEM COST
- APPLICATION PERFORMANCE

USERS

# The Problem With Sharding



- Disruptive
- Manual
- Inefficient

# Sharding in Oracle 12c R2

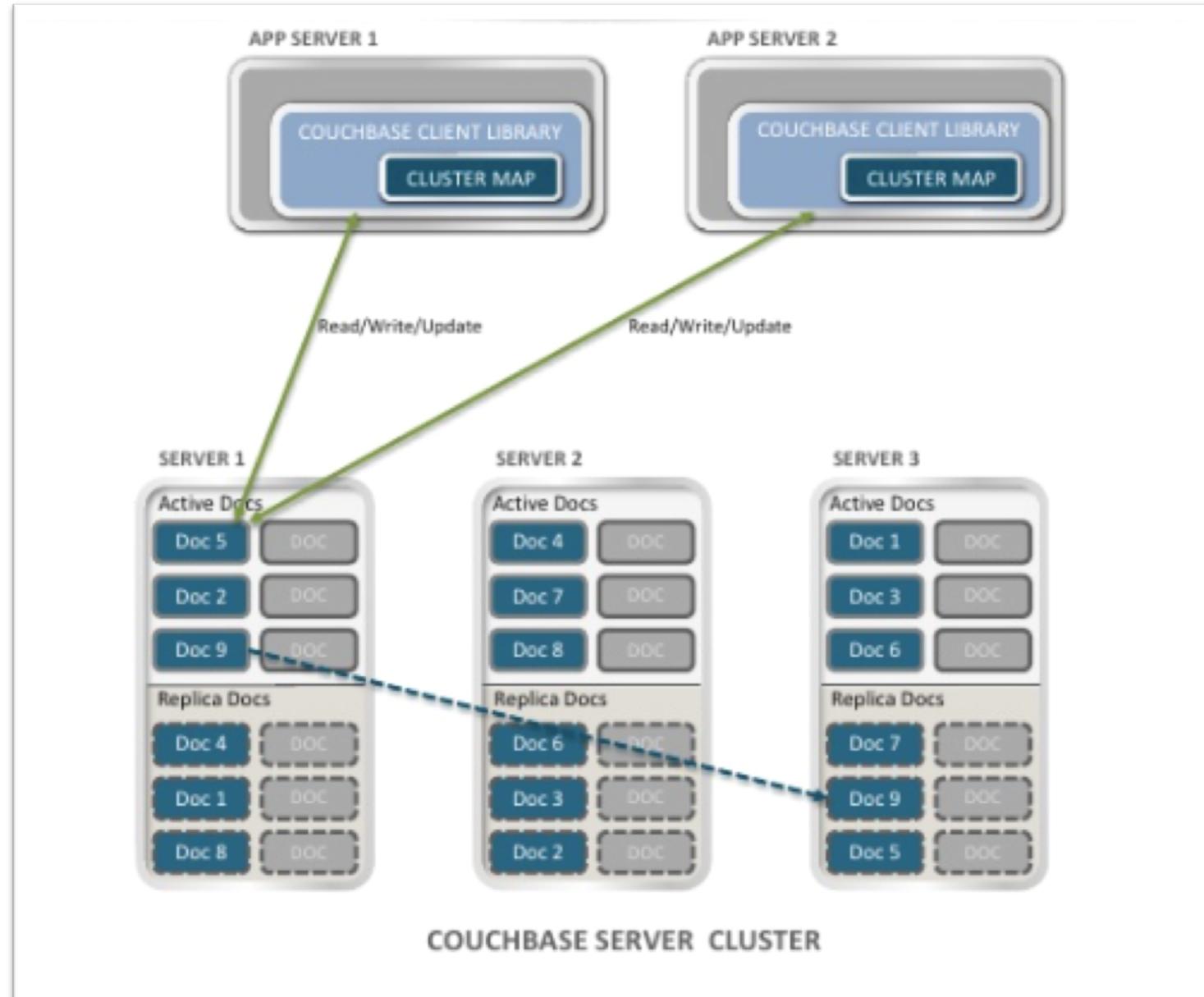
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*“Sharding in Oracle 12c Release 2....is a feature aimed to the ‘top 5%’ of Oracle customers where price isn’t the issue but they want Oracle to scale to the size of clusters supported by Hadoop and NoSQL. Time will tell how well it’ll work and what it’ll cost.”*



# In NoSQL, data is “sharded” by design



# Relational vs. NoSQL – The 6 Reasons

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# RDBMSs are Strict with Schema



Iteration 1 — First, Last

Schema Utilized

USERS

| ID | First | Last |
|----|-------|------|
|----|-------|------|

Brendan Bond

USERS

|   |         |      |
|---|---------|------|
| 0 | Brendan | Bond |
|---|---------|------|

Iteration 2 — First, Last, Twitter

Schema Utilized

USERS

| ID | First | Last |
|----|-------|------|
|----|-------|------|

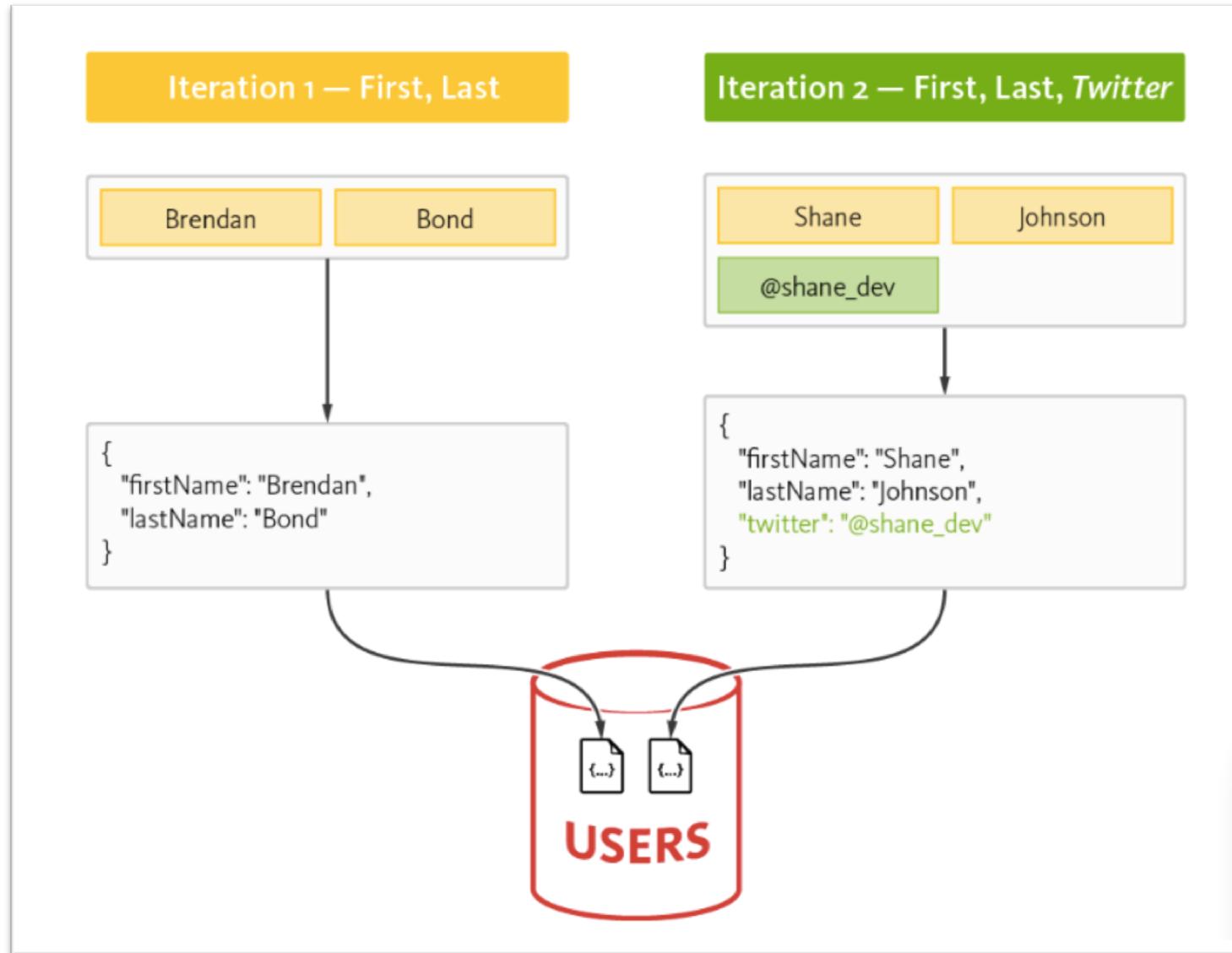
Shane Johnson @shane\_dev

USERS

|   |         |         |
|---|---------|---------|
| 0 | Brendan | Bond    |
| 1 | Shane   | Johnson |

- Disruptive
- Time-consuming
- Change impact on apps?

# NoSQL offers Schema Flexibility



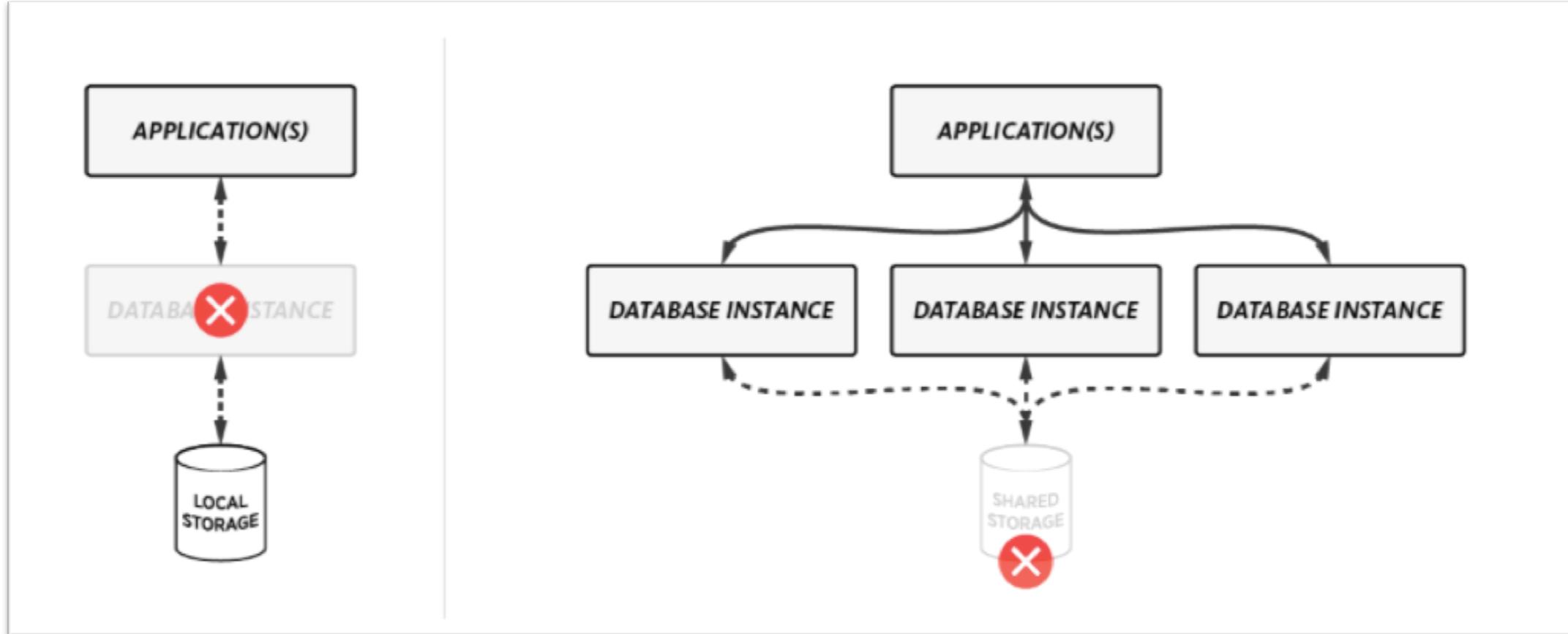
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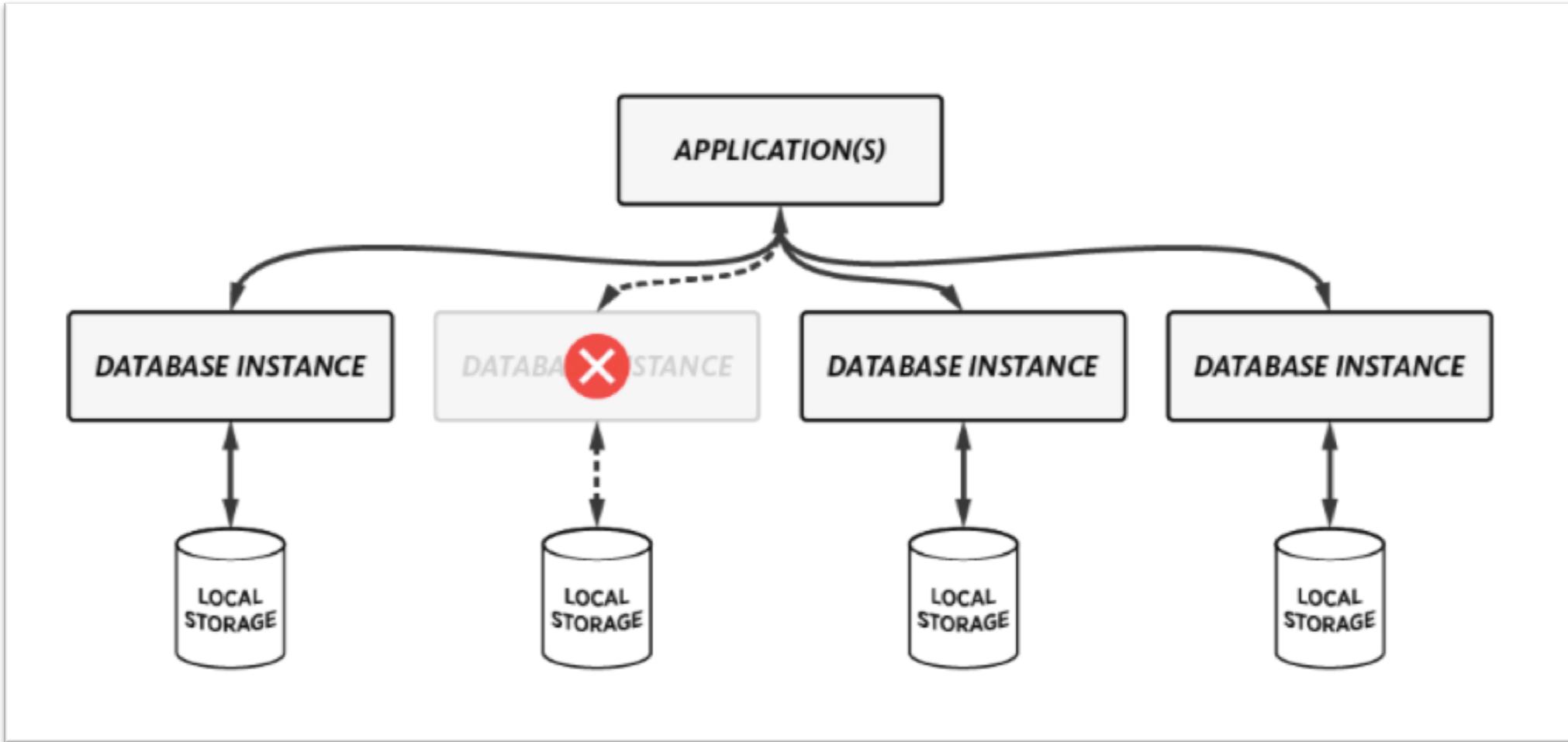


- Joins are EXPENSIVE and don't scale well
- RDBMSs are *complex* to scale and operate
- RDBMSs are *brittle*
- **RDBMSs are not reliable enough**
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# RDMBSs introduce single points of failure



# NoSQL = RELIABLE



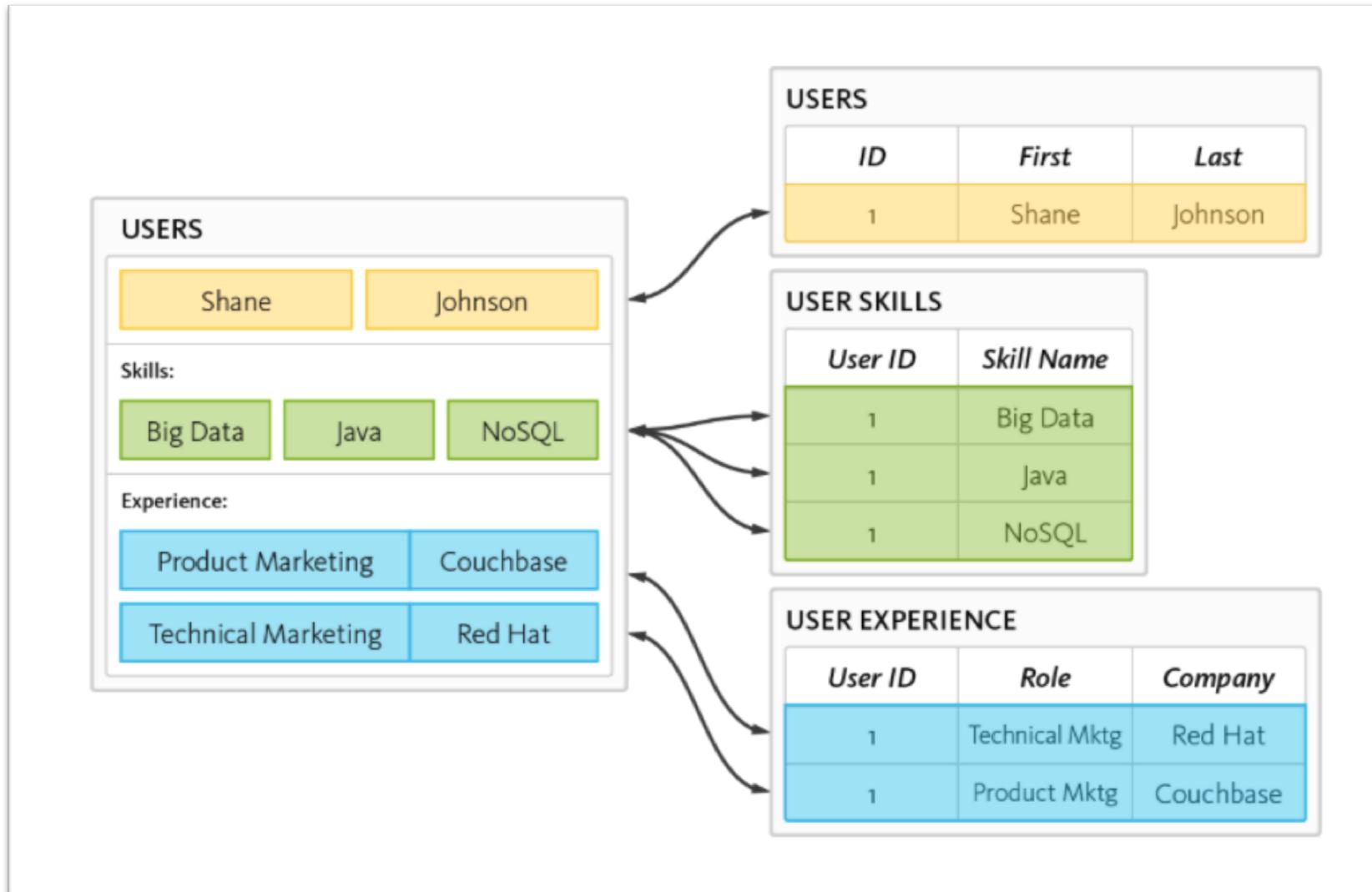
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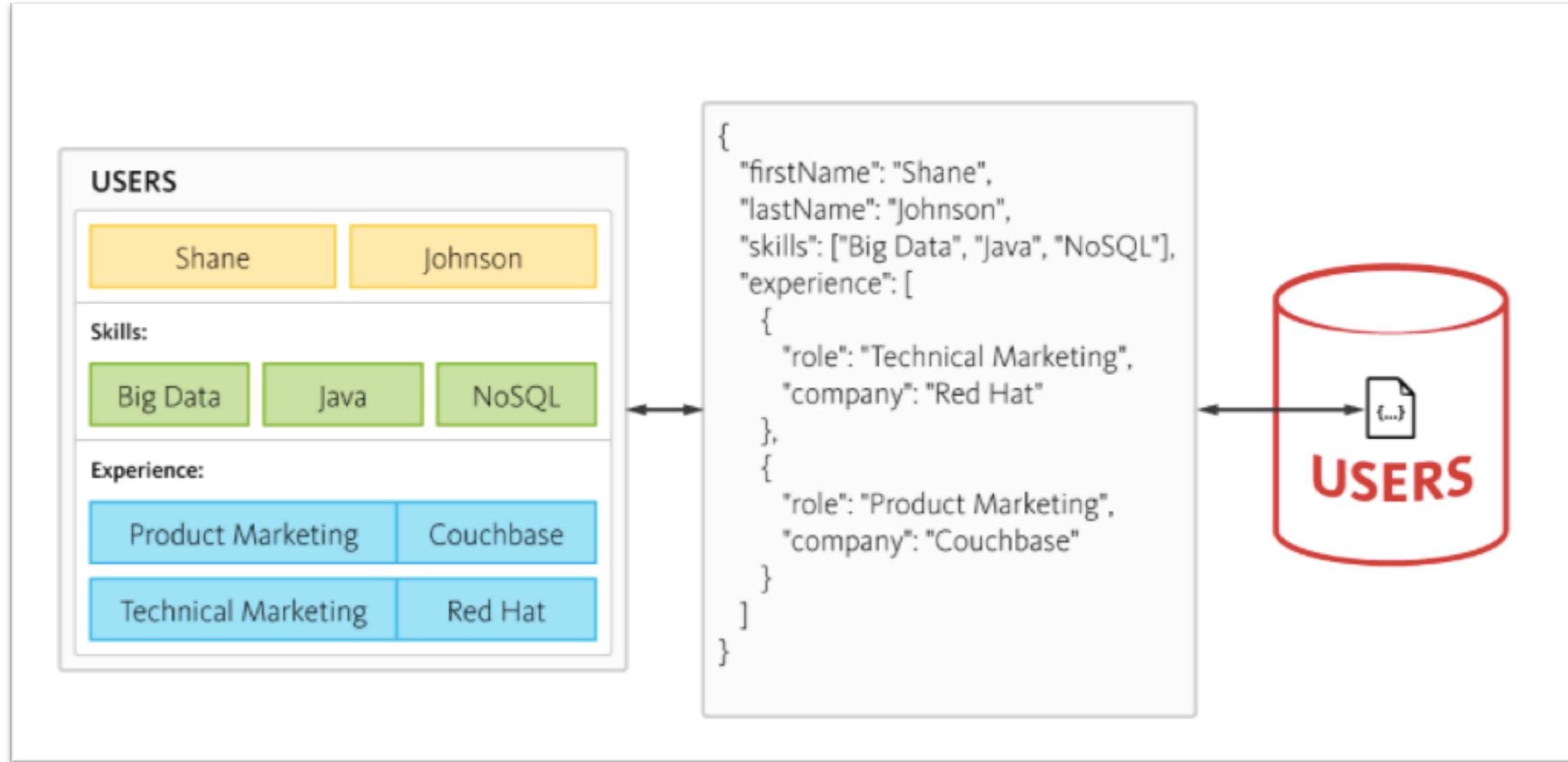


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# RDBMSs = Impedance Mismatch



# NoSQL matches application with data



# Relational vs. NoSQL – The 6 Reasons

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# Oracle vs. Couchbase Feature Comparison



| Capability Provided       | Oracle Option             | Couchbase                         |
|---------------------------|---------------------------|-----------------------------------|
| Clustered DB deployments  | Real App Clusters         | <i>Included</i> in CE & EE        |
| Standby DB                | Data Guard & Partitioning | XDCR <i>included</i> in CE and EE |
| Encryption                | Advanced Security         | <i>Included</i> in EE             |
| Role Based Access Control | Database Vault            | <i>Included</i> in EE             |
| High performance          | In Memory/Cache           | <i>Included</i> in CE and EE      |

# Example – Oracle List Pricing



|   | Named User Plus | Software Update License & Support | Processor License | Software Update License & Support |           |
|---|-----------------|-----------------------------------|-------------------|-----------------------------------|-----------|
| <b>Database Products</b>                  |                 |                                   |                   |                                   |           |
| <b>Oracle Database</b>                    |                 |                                   |                   |                                   |           |
| Standard Edition 2                        | 350             | 77.00                             | 17,500            | 3,850.00                          |           |
| Enterprise Edition                        | 950             | 209.00                            | 47,500            | 10,450.00                         | \$47,500  |
| Personal Edition                          | 460             | 101.20                            | -                 | -                                 |           |
| Mobile Server                             | -               | -                                 | 23,000            | 5,060.00                          |           |
| NoSQL Database Enterprise Edition         | 200             | 44                                | 10,000            | 2,200.00                          |           |
| <b>Enterprise Edition Options:</b>        |                 |                                   |                   |                                   |           |
| Multitenant                               | 350             | 77.00                             | 17,500            | 3,850.00                          | \$70,500  |
| Real Application Clusters                 | 460             | 101.20                            | 23,000            | 5,060.00                          |           |
| Real Application Clusters One Node        | 200             | 44.00                             | 10,000            | 2,200.00                          |           |
| Active Data Guard                         | 230             | 50.60                             | 11,500            | 2,530.00                          | \$93,500  |
| Partitioning                              | 230             | 50.60                             | 11,500            | 2,530.00                          |           |
| Real Application Testing                  | 230             | 50.60                             | 11,500            | 2,530.00                          |           |
| Advanced Compression                      | 230             | 50.60                             | 11,500            | 2,530.00                          | \$108,500 |
| Advanced Security                         | 300             | 66.00                             | 15,000            | 3,300.00                          |           |
| Label Security                            | 230             | 50.60                             | 11,500            | 2,530.00                          |           |
| Database Vault                            | 230             | 50.60                             | 11,500            | 2,530.00                          | \$120,000 |
| OLAP                                      | 460             | 101.20                            | 23,000            | 5,060.00                          |           |
| Advanced Analytics                        | 460             | 101.20                            | 23,000            | 5,060.00                          |           |
| Spatial and Graph                         | 350             | 77.00                             | 17,500            | 3,850.00                          |           |
| TimesTen Application-Tier Database Cache  | 460             | 101.20                            | 23,000            | 5,060.00                          |           |
| Database In-Memory                        | 460             | 101.20                            | 23,000            | 5,060.00                          |           |
| Retail Data Model                         | 800             | 176.00                            | 40,000            | 8,800.00                          |           |
| Communications Data Model                 | 1,500           | 330.00                            | 50,000            | 11,000.00                         |           |
| Airlines Data Model                       | 800             | 176.00                            | 40,000            | 8,800.00                          |           |
| Utilities Data Model                      | 800             | 176.00                            | 40,000            | 8,800.00                          |           |
| <b>Database Enterprise Management</b>     |                 |                                   |                   |                                   |           |
| Diagnostics Pack                          | 150             | 33.00                             | 7,500             | 1,650.00                          |           |
| Tuning Pack                               | 100             | 22.00                             | 5,000             | 1,100.00                          |           |
| Database Lifecycle Management Pack        | 240             | 52.80                             | 12,000            | 2,640.00                          |           |
| Data Masking and Subsetting Pack          | 230             | 50.60                             | 11,500            | 2,530.00                          |           |
| Cloud Management Pack for Oracle Database | 150             | 33.00                             | 7,500             | 1,650.00                          |           |
| <b>In-memory/Cache</b>                    |                 |                                   |                   |                                   | \$166,000 |

# Example – Oracle List Pricing cont'd



|   | Oracle Database |                                   |                   |                                   |
|---|-----------------|-----------------------------------|-------------------|-----------------------------------|
|   | Named User Plus | Software Update License & Support | Processor License | Software Update License & Support |
| <b>Database Products</b>                  |                 |                                   |                   |                                   |
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| Cloud Management Pack for Oracle Database | 150             | 33.00                             | 7,500             | 1,650.00                          |

\$200,000



3

# Couchbase as Engagement Database



# ATTRIBUTES OF AN ENGAGEMENT DATABASE



Hello cloud,  
hello world



Seamlessly  
mobile



Built-in  
smarts



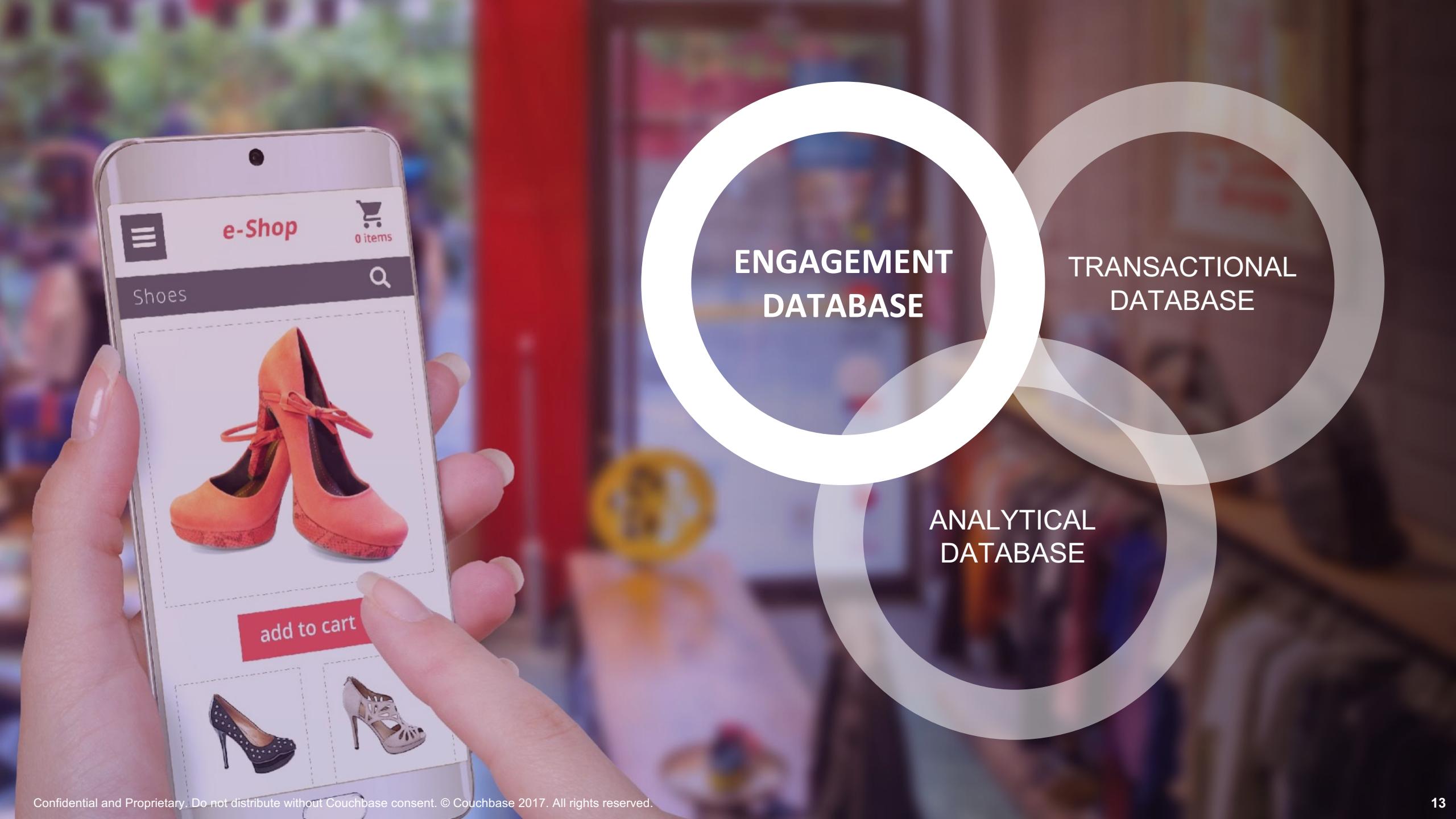
Built for change  
- at scale



Always on,  
always fast



Secure, secure,  
secure



ENGAGEMENT  
DATABASE

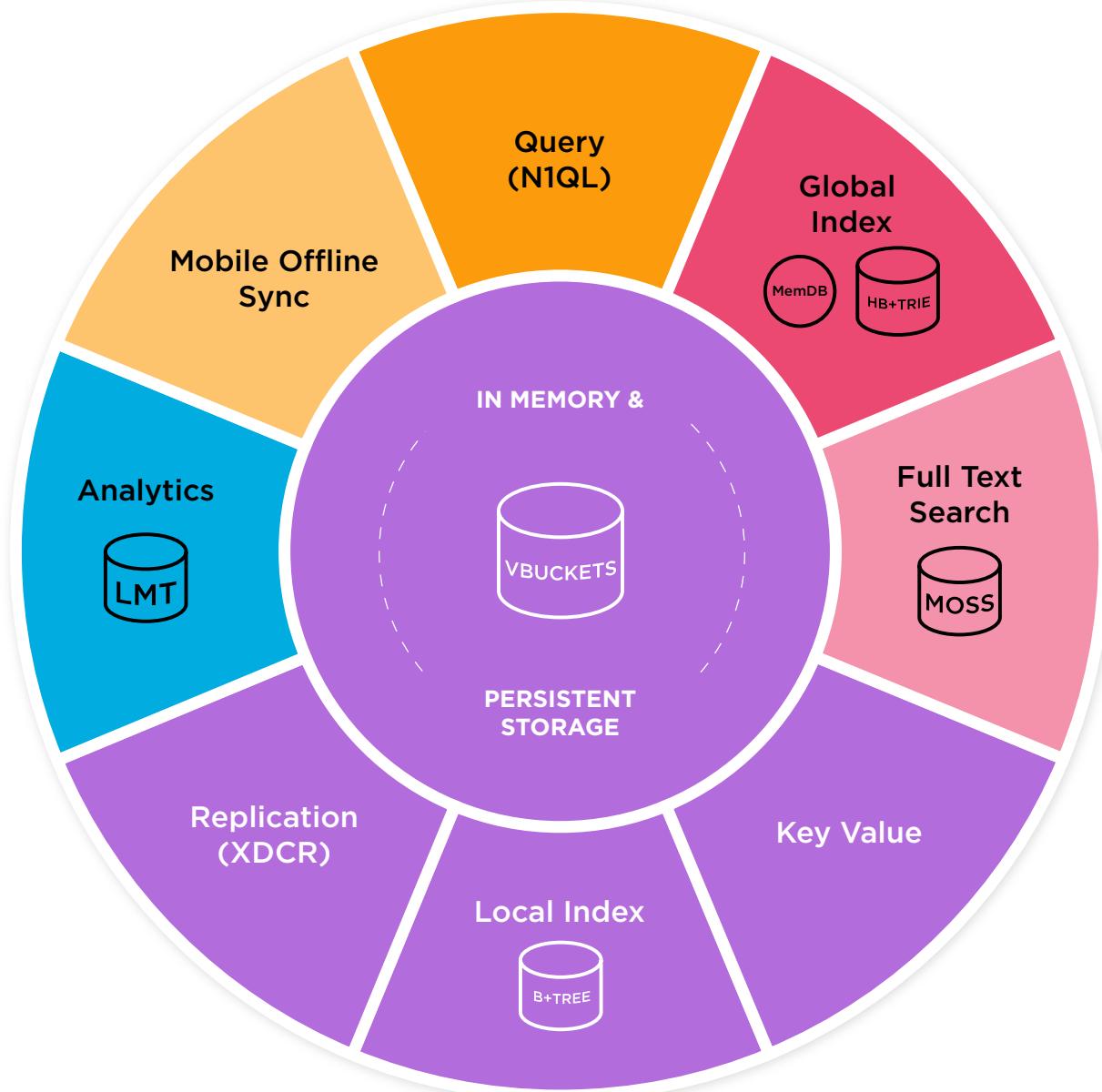
TRANSACTIONAL  
DATABASE

ANALYTICAL  
DATABASE



# Couchbase Data Platform

- Service-Centric Clustered Data System
  - Multi-process Architecture
  - Dynamic Distribution of Facilities
  - Cluster Map Distribution
  - Automatic Failover
  - Enterprise Monitoring/Management
  - Security
- Offline Mobile Data Integration
- Streaming REST API
- SQL-like Query Engine for JSON
- Clustered\* Global Indexes
- Lowest Latency Key-Value API
- Active-Active Inter-DC Replication
- Local Aggregate Indexes
- Full-Text Search\*
- Operational Analytics\*

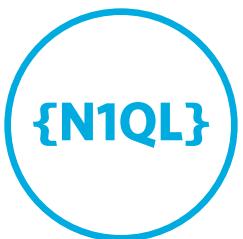




## Why Customers Choose Couchbase?



Mobile



Full SQL Query  
Language



Active-Active Global  
Data Replication



Multi-dimensional  
scaling



Memory-first  
Architecture



# Developing with Couchbase

Couchbase supports a wide range of frameworks, languages, platforms and infrastructure choices.

## FRAMEWORKS



## MOBILE



## LANGUAGES



## php

## PLATFORMS



## MOBILE



## INFRASTRUCTURE





# How does Couchbase fit with Big Data?

Couchbase and Hadoop  
are complementary.



EXAMPLES:





# 4

## Couchbase – Who are we?

# Couchbase, by the Numbers



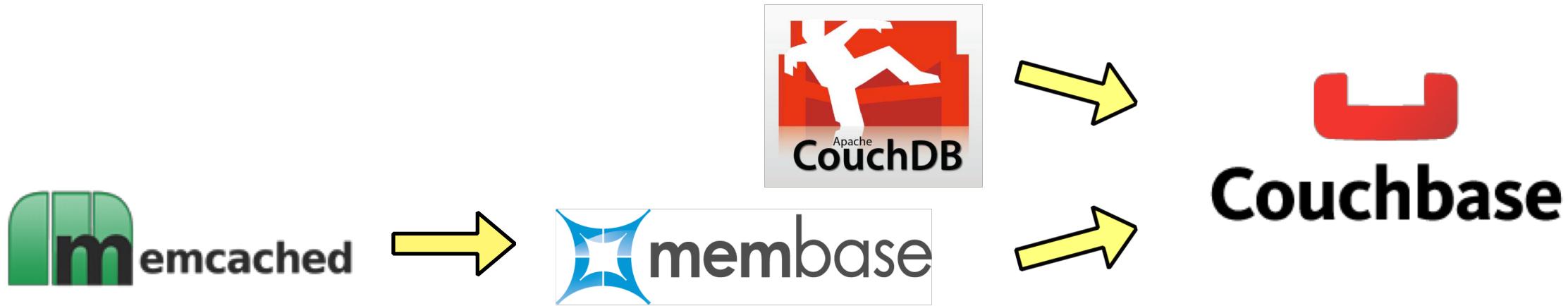
**300+**  
EMPLOYEES

**100%**  
OPEN SOURCE

**500+**  
CUSTOMERS



## Evolution from Memcached and CouchDB

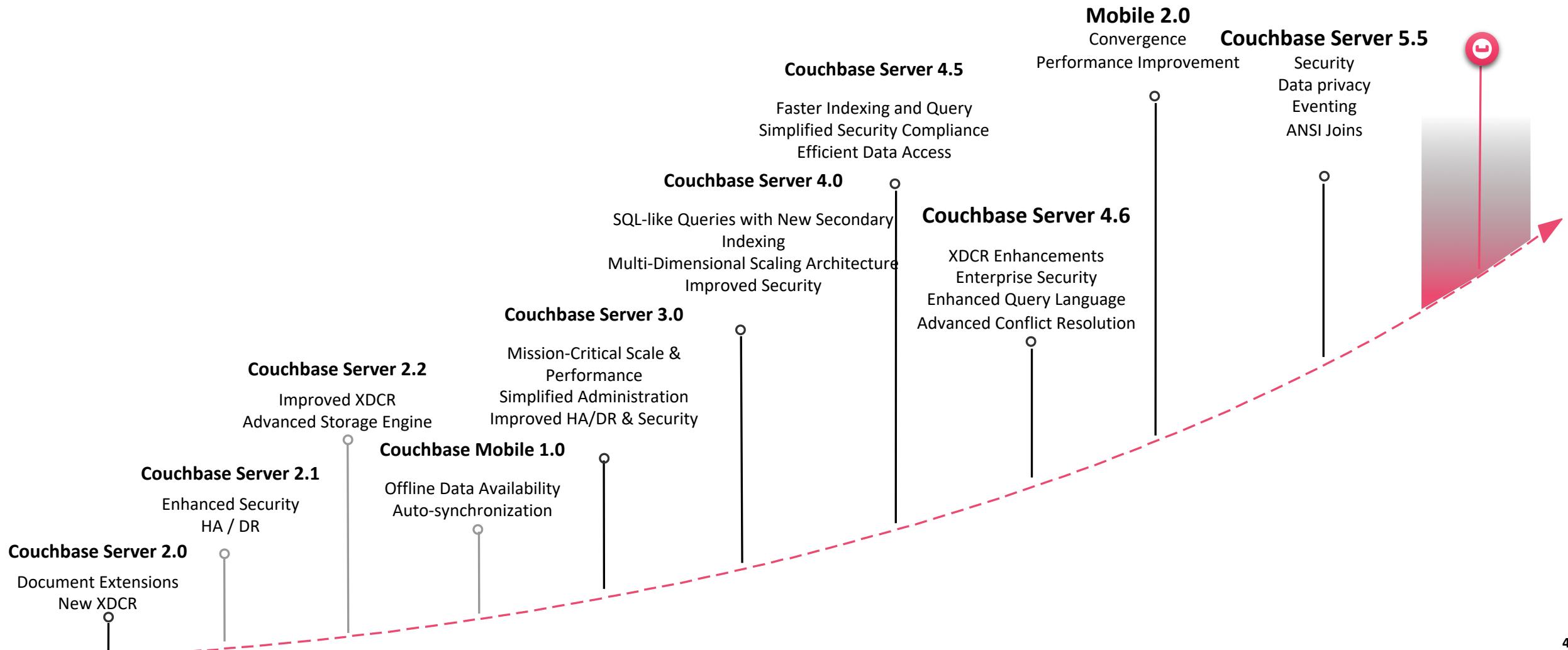


- Founders were key contributors to memcached, CouchDB
- Memcached evolved into Membase, a distributed and *persisted* key-value store
- Merge with CouchDB to evolve into Couchbase Document Store with JSON support and Map-Reduce Indexes, Elastic Search Integration, and Cross-Data Center Replication
- N1QL continues the evolution with SQL data access



# The Journey thus Far

Focused on Technical Innovation





# Performance

**KV:** 2 M ops/s/node. 60% > 4.5

**Import/Export:** 2X to 14X > 4.5

## N1QL-GSI:

10X better than 4.5 on average  
New YCSB-SOE workload  
Pagination: 125X > MongoDB

## XDCR:

45% better throughput than 4.5  
50% lower latency than 4.5  
2X faster replication over SSL

## FTS (vs. Dev Preview)

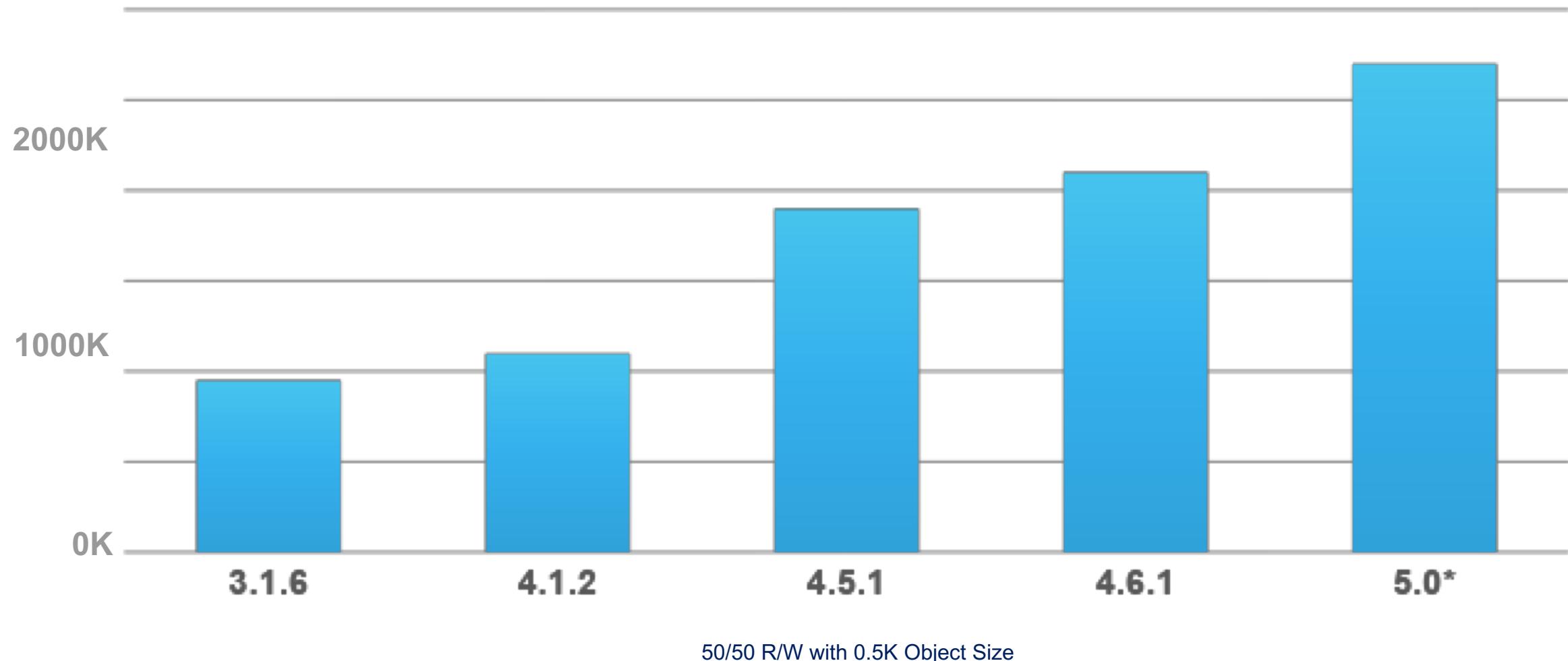
Throughput 5x > 4.6 DP

## Fast Failover:

KPI: 10 seconds  
Actual: ~7 seconds



## Even at its CORE - Key-Value Keeps Getting Faster





# 5 | Use Cases



# Customers across every industry embracing digital



1 billion+ user profiles  
7 DCs  
740 nodes  
300K reads,  
20K writes/sec sustained

## GANNETT

50M unique monthly visitors  
2.5B monthly page views  
Replaced MongoDB

## LinkedIn

2821 nodes,  
100+ clusters  
16M entries every 5 min  
2.5 million ops/sec. on a single cluster

## PayPal

1 billion+ documents  
10TB+ data  
Sub-20ms response time

### E-Commerce



### Travel



### Gaming



### Communications



### Financial Services



### Digital Health



### Digital Media



### Industrial IoT



# Technical use cases that power the business



User Profile Database



Session Database



Entitlement Management



Operational Dashboarding



Inventory & Availability



Asset/Resource Management



Catalog



Metadata



Customer 360



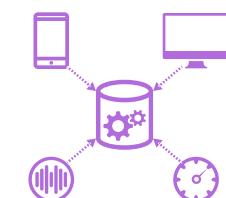
Field Service Enablement



Device User Data Management



Endpoint Data Management





## WHAT PROBLEMS ARE OUR CUSTOMERS SOLVING?



Improving customer experience & engagement



Faster innovation & time to market



Reducing infrastructure & operations costs



IMPROVING CUSTOMER  
EXPERIENCE &  
ENGAGEMENT



To improve user experience, eBay needed to be able to scale without expanding Oracle environment



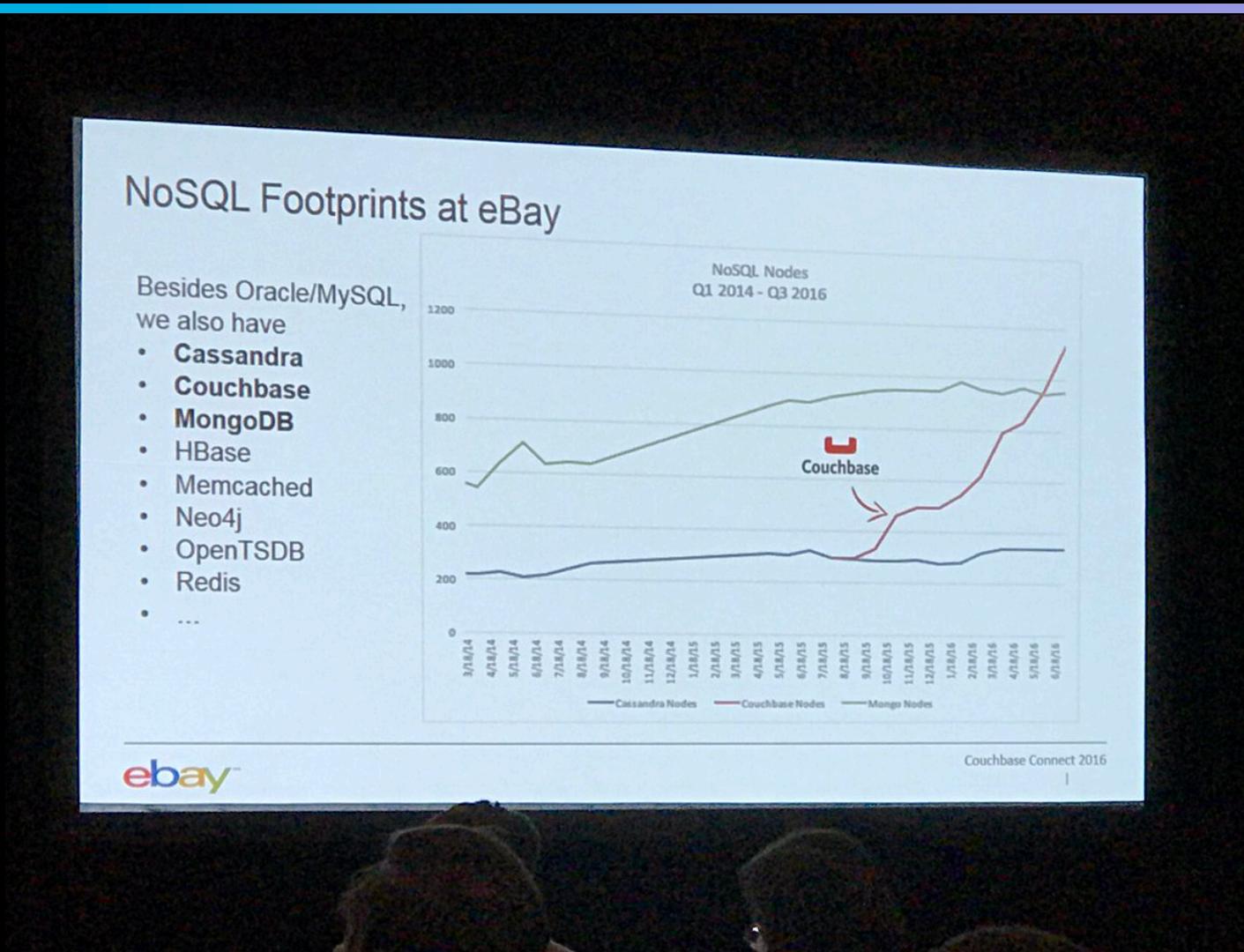
### Requirements

- Oracle licensing, hardware, and support costs made scaling difficult
- ACID led to performance penalty for advanced features
- Needed to increase performance, provide high availability

### Outcomes

- Linear scalability and very high throughput keep site responsive for users
- Flexible schema increases developer agility
- Active-active bi-directional **XDCR** keeps site online and available

# Couchbase XDCR made the difference at eBay



- Consistency – “read your own writes”
- Bidirectional replication across three data centers in the US
- Elastic scalability, add nodes to scale systems to meet SLAs
- Key feature when comparing against MongoDB and Cassandra

IMPROVING CUSTOMER  
EXPERIENCE &  
ENGAGEMENT

Couchbase Mobile stores semi-static data locally and syncs updates as they occur, providing a faster, better booking experience



### Requirements

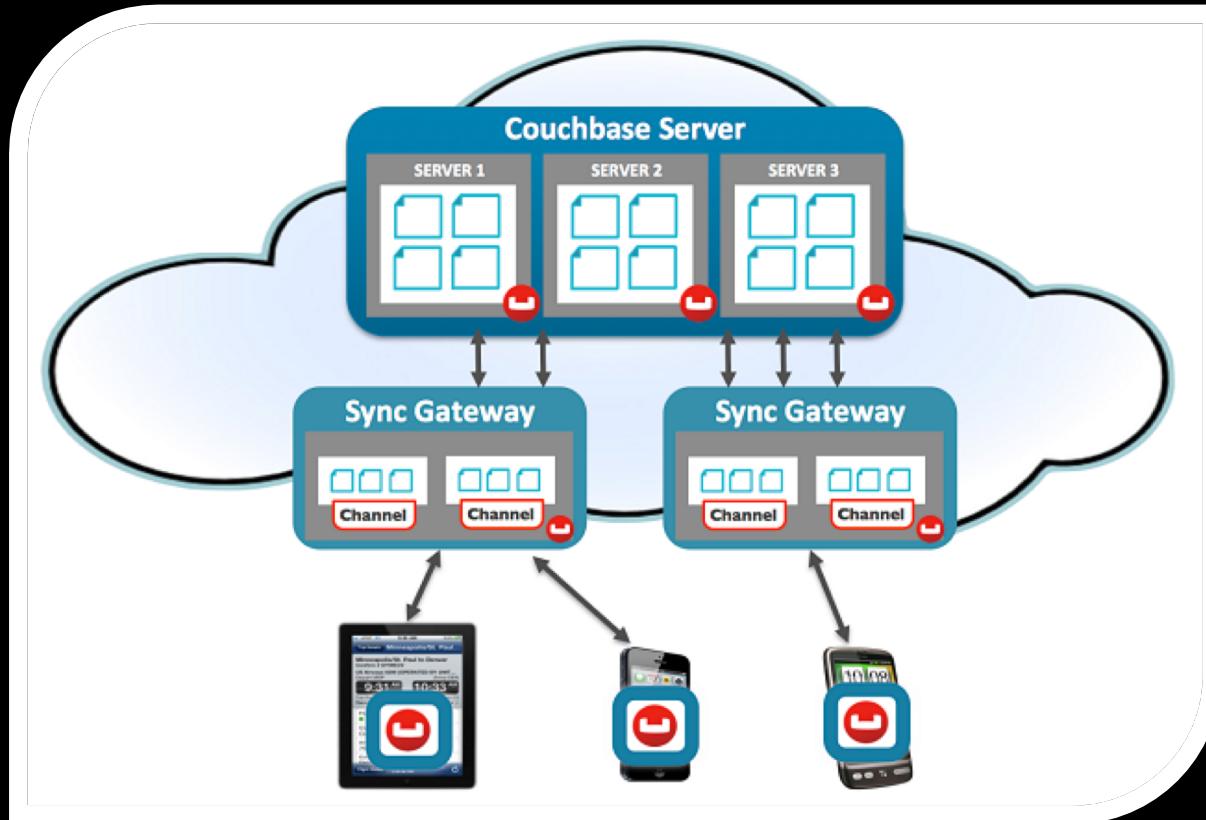
- Better booking experience for customers
- Improved management of cached data without mobile re-architecture
- Cross-platform support
- OOTB mobile sync

### Outcomes

- Better experience for customers: vastly improved app ratings
- 60%+ faster booking process
- Reduced infrastructure cost: reduced network traffic for bookings 87%



# Couchbase Sync Gateway at Ryanair



- Couchbase Lite is used as the on-device database for Ryanair's native iOS and Android applications
- Couchbase Sync-Gateway is used to push the latest revision of semi-static reference data used within the Ryanair application to all mobile clients

# Improving Customer Experience – Data Integration



What our customers tell us about this challenge



**“**We have data in disparate systems that we would like to integrate into our customer facing applications.

**”**



**“**We would like to aggregate data into a single customer view, for internal and customer facing functions.

**”**

IMPROVING CUSTOMER  
EXPERIENCE &  
ENGAGEMENT

Fast access to credit information, vehicle registrations and valuations with Couchbase as standardized distributed caching layer

## Requirements

- Support massive increase in workload due to price comparison websites
- Affordable alternative to scaling mainframes
- Help new, rich-functionality applications come online quickly and easily

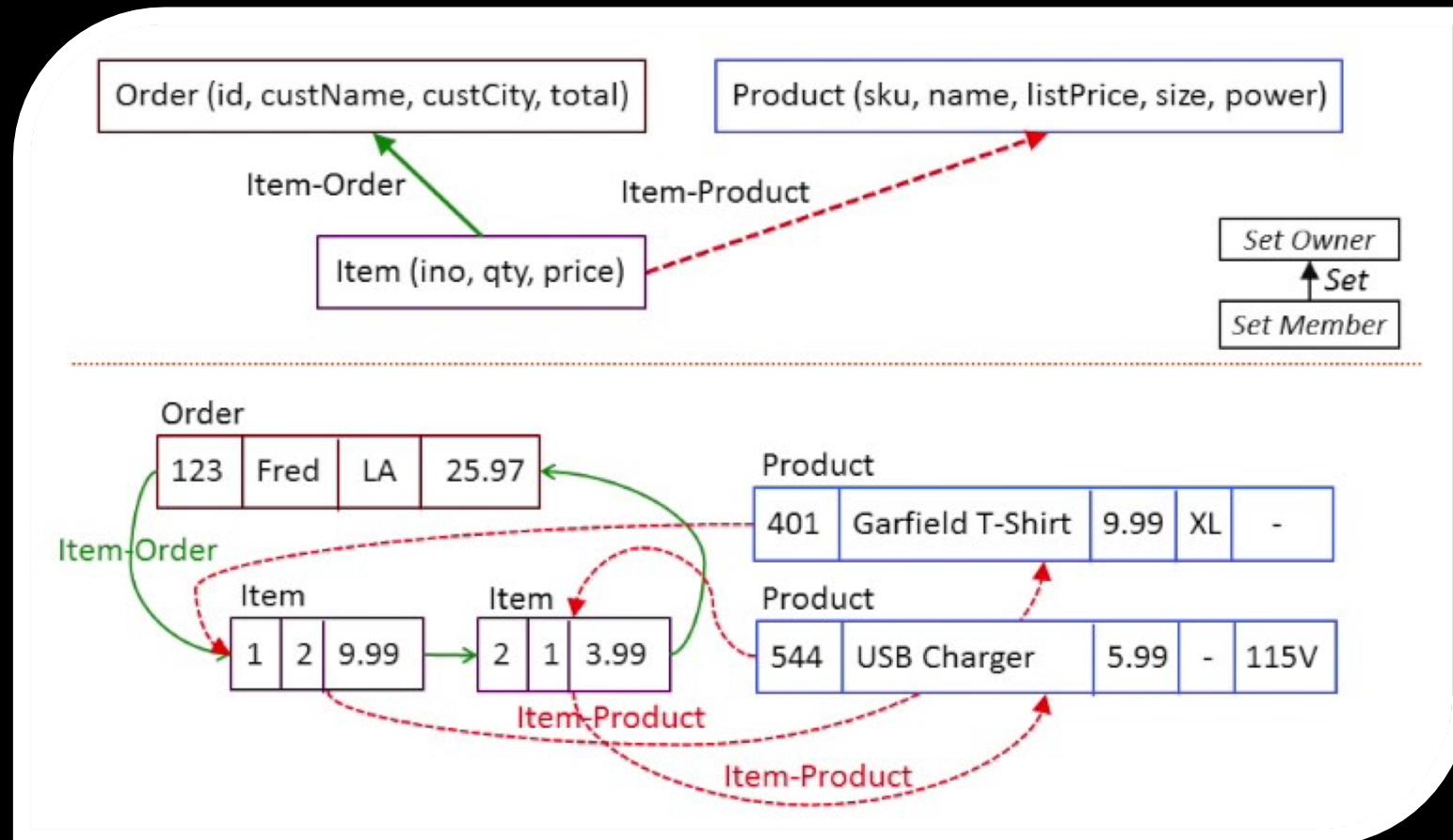
## Outcomes

- Lowered costs AND increased performance:
- reduced calls to mainframe by 60%
- Improved dev agility with support for JSON





# Couchbase JSON Support Critical at Experian



- JSON support meant apps could be built at a fraction of the time
- Avoided the dreaded “impedance mismatch”
- Support for any binary data type

# Improving Customer Experience – Legacy Tech



What our customers tell us about this challenge



**“***It takes a lot of money, time, and effort to get our legacy databases to perform at acceptable levels.*  
**”**



**“***Predictable performance is a key issue. If there is a surge of user activity or if we add a new data set, we struggle to keep up.*  
**”**



FASTER INNOVATION &  
TIME TO MARKET



Real-time intelligent  
data processing pipeline  
allows ingest of data  
from sensors/devices at  
scale and provides  
insight needed to take  
action



## Requirements

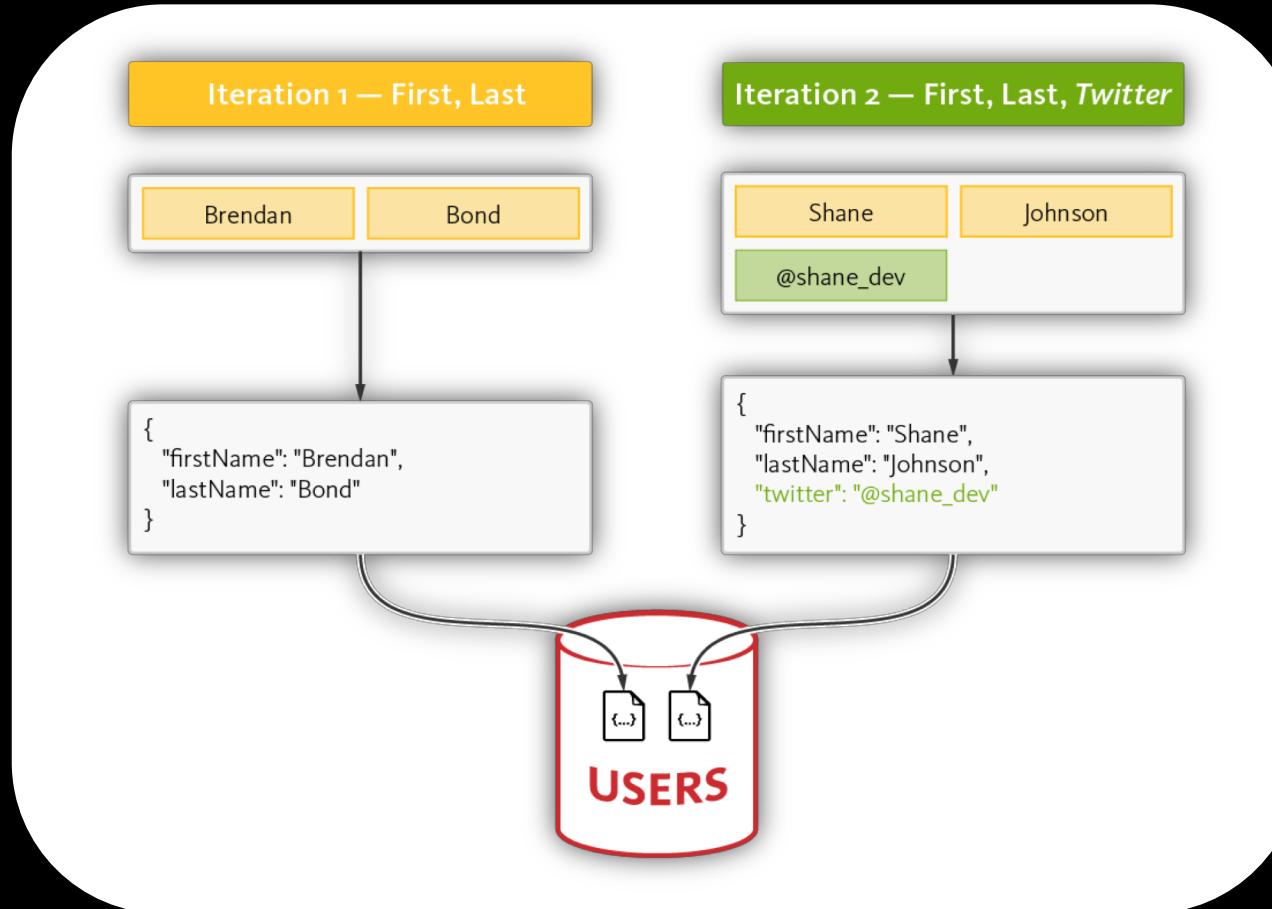
- Deliver new products and services easily
- Manage massive datasets and interact with devices, sometimes unconnected
- Capture new data types at high speed while providing near real-time analytics

## Outcomes

- Performance at scale, auto sync device/cloud
- **Rapidly evolve schema** as requirements change
- Push-button scalability
- Five 9s HA and DR (5min/year)



# Verizon Couldn't Waste Time on Schema Changes



- Schema flexibility was key in Verizon's comparison of Couchbase vs. Cassandra
- IoT use case drove many new and evolving datatypes that required total schema flexibility
- It was all about agility!



FASTER INNOVATION &  
TIME TO MARKET



Dynamic product catalog service, including near-real-time stock updates, product catalog, and price, stock and customer order information



## Requirements

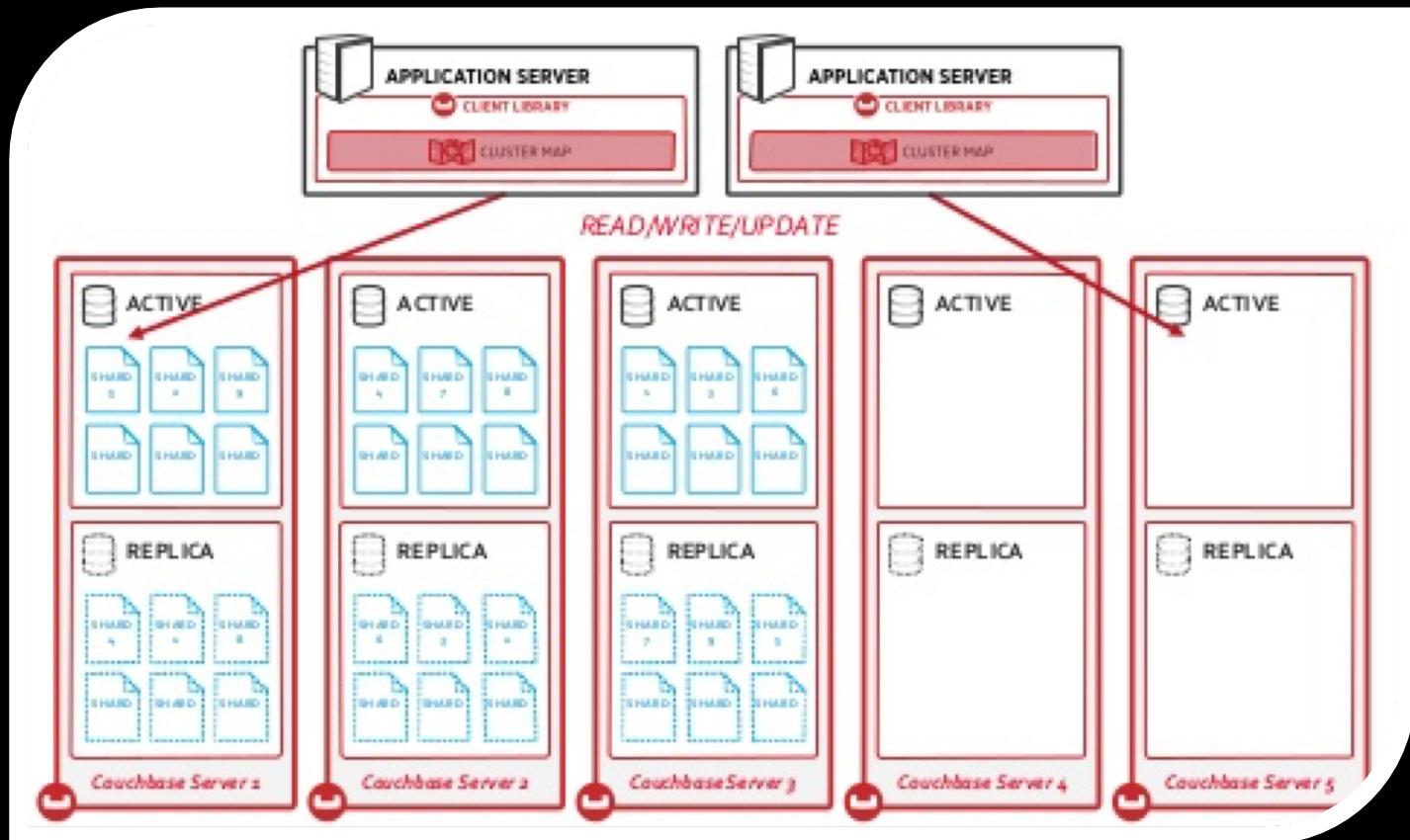
- Data stored in multiple relational databases
- Store, share and update product data for 10M items
- Support frequently changing data and multiple data structures

## Outcomes

- Easily **scale** to 10m products and 35k requests per second
- Flexible schema support fast-changing SKUs
- Low-latency access for great user experiences



# Tesco Needed Horizontal Scaling



- Critical to their Microservices-based approach
- Can't take any chances on Black Friday and during other spiky periods
- Ability to rapidly deploy compute without disruption or huge costs
- Critical in comparison vs. MongoDB



Couchbase acts as profile store, replacing traditional relational databases



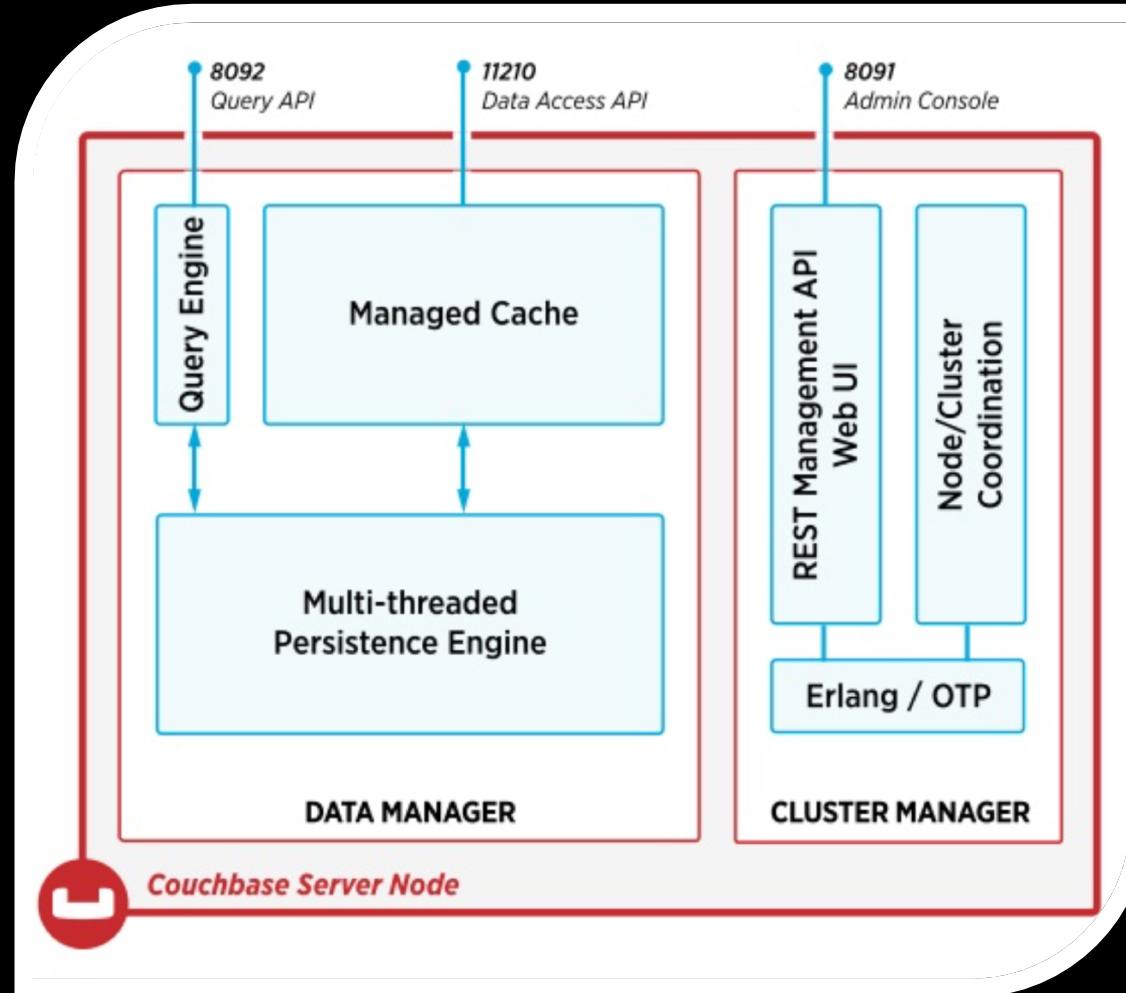
## Requirements

- Growing data needs to be tracked with <ms latency and high throughput
- Relational systems unable to scale
- HA/DR solutions needed custom development

## Outcomes

- **Memory-first architecture** for <1ms response times
- Complete HA/DR solution delivers 24x365 application uptime
- Neural networking algorithms

# Couchbase's Single Node Architecture – Key for FICO



- Rapid time-to-market and zero failure tolerance required a solution with integrated caching
- No need to bolt on 3rd party cache to get desired low-latency
- Key decision criteria vs. other NoSQL when moving off Oracle



Couchbase is used for online pricing, catalogs, Daily Deals, customer profiles, mobile apps, and much more



## Requirements

- Better management of personalized catalogs, 1.6 billion real-time rules
- Inability to scale MongoDB, DB2, and many other DBs easily/affordably
- Simplified replication, easy scalability

## Outcomes

- Simplified management with **N1QL** and JSON, less tech sprawl
- Enhanced experience by boosting performance, scalability, reliability
- Improved responsiveness and availability



# N1QL Absolutely Critical to Staple's Choice

SQL STATEMENT

```
SELECT b.name, YEAR(a.year) AS year, a.name AS award
FROM awards a INNER JOIN books b
ON a.book_id = b.id
WHERE a.year > 1969
ORDER BY name, year, award
```

SQL RESULTS (ROWS)

| name        | year | award  |
|-------------|------|--------|
| Gateway     | 1978 | Hugo   |
| Gateway     | 1978 | Nebula |
| Neuromancer | 1984 | Philip |
| Neuromancer | 1985 | Hugo   |
| Neuromancer | 1985 | Nebula |
| -           | -    | -      |

N1QL STATEMENT

```
SELECT b.name, DATE_PART_STR(a.year, "year") as year, a.
FROM awards a INNER JOIN books b
ON KEYS a.book_id
ORDER BY b.name, year, award
```

N1QL RESULTS (DOCUMENT)

```
{
  "results": [
    {"name": "Gateway", "year": "1978", "award": "Hugo"},
    {"name": "Gateway", "year": "1978", "award": "Nebula"},
    {"name": "Neuromancer", "year": "1984", "award": "Philip"},
    {"name": "Neuromancer", "year": "1985", "award": "Hugo"},
    {"name": "Neuromancer", "year": "1985", "award": "Nebula"}
  ]
}
```

- Heavy N1QL users
- CRUD is a quick and easy way for them to manage complex product catalogs
- Key in their decision when comparing against MongoDB (complex query API)

## REDUCING INFRASTRUCTURE & OPERATIONS COSTS



Needed to move reservations off mainframe / away from Oracle to deploy new applications faster and more reliably



### Requirements

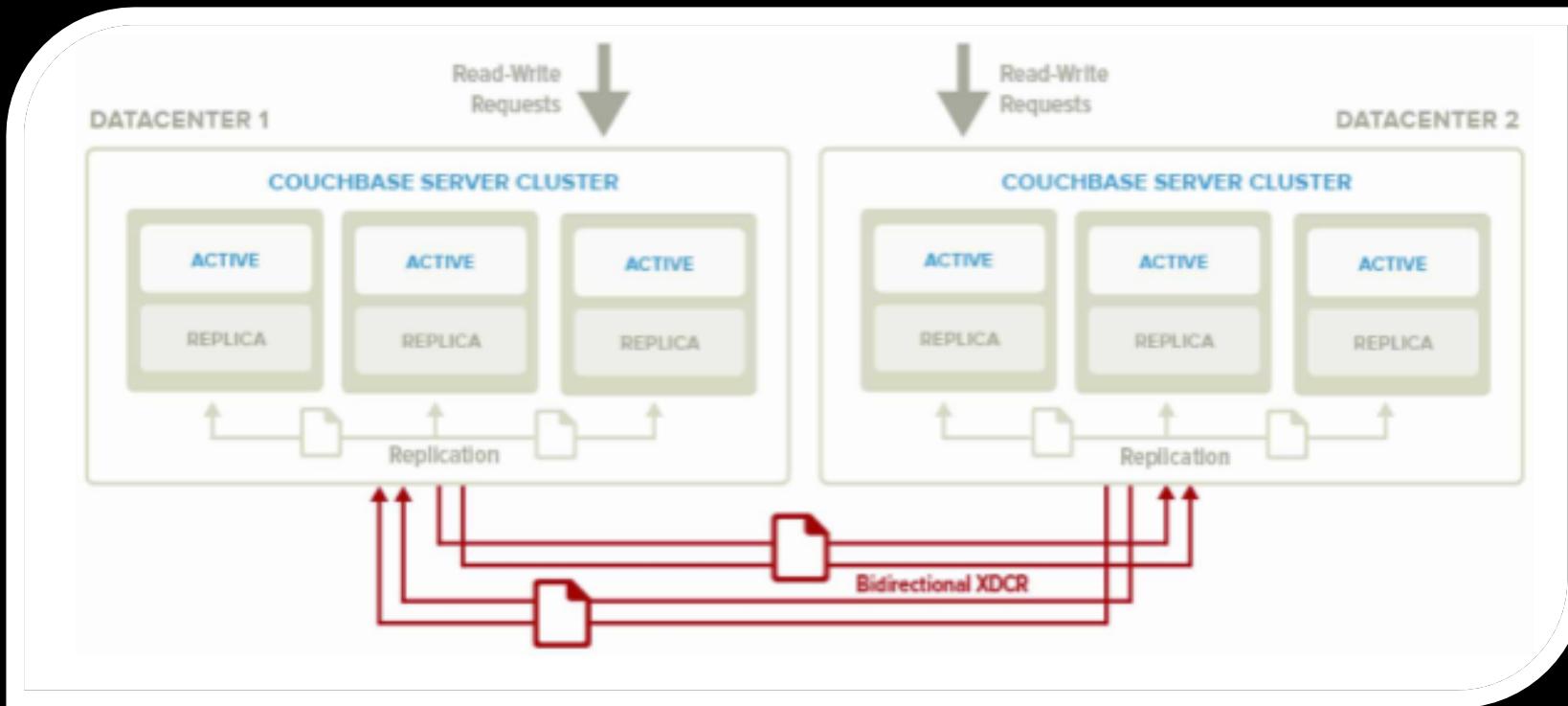
- Single central mainframe – outage could cost millions in lost booking revenue
- Needed to increase performance, distribute data
- Support cloud strategy with commodity hardware

### Outcomes

- Scalable, flexible cloud-based model reduces dev costs, improves speed
- N1QL delivers customized hospitality experiences
- **Highest levels of availability without extra add-ons, \$\$\$**



# Marriott needed “OOTB” High Availability



- No need for extra add-ons, code, or additional configuration to get HA/DR
- Bidirectional replication across global datacenters
- Elastic scalability, add nodes to scale systems to meet SLAs
- Key feature when comparing against other NoSQL

## REDUCING INFRASTRUCTURE & OPERATIONS COSTS



As user base skyrocketed, more and more Couchbase was replacing Oracle. But CE nodes were proliferating too fast, causing H/W costs to soar.



### Requirements

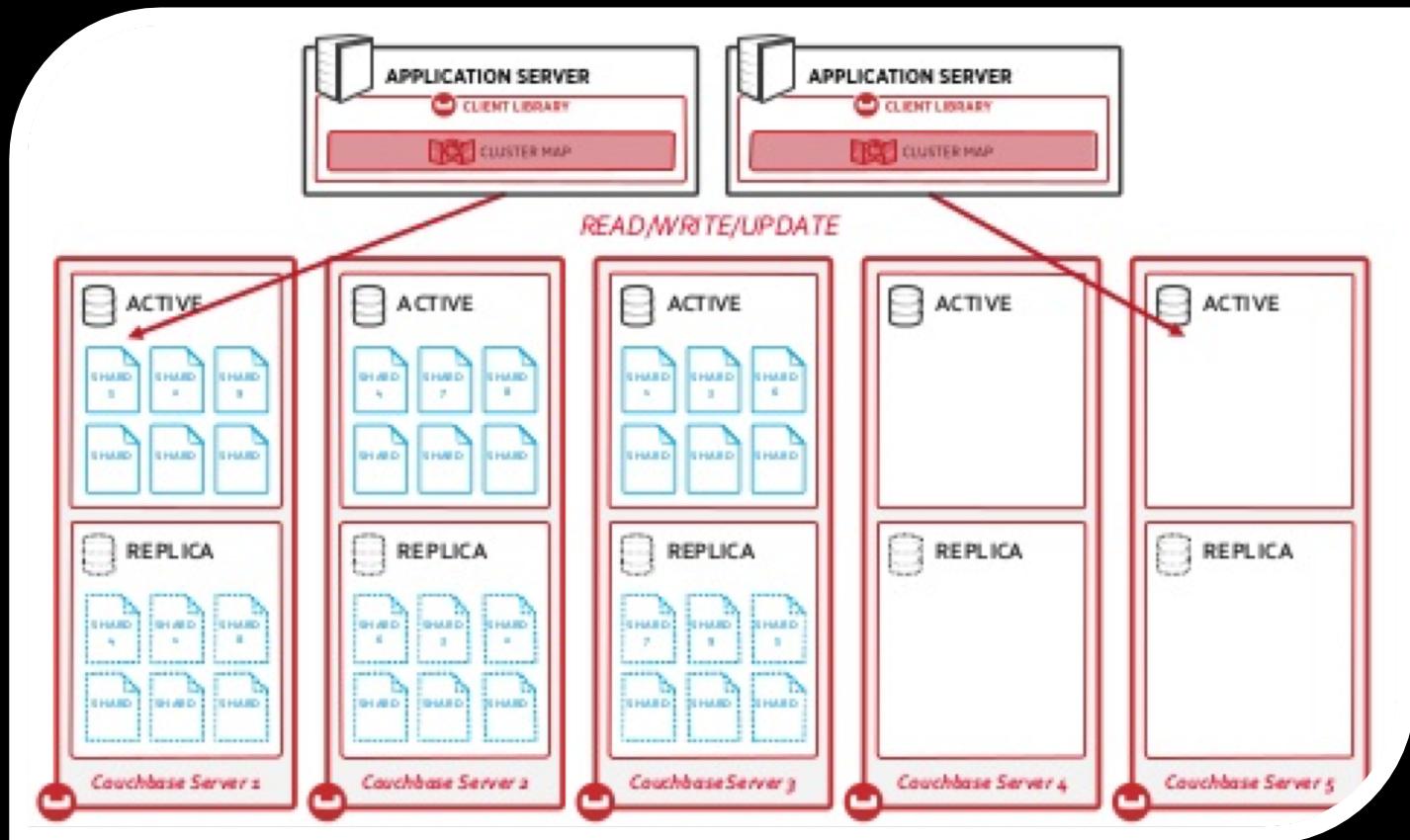
- Ability to scale reads
- Memcached caused manageability and reliability problems
- Needed to balance performance with eased load on ops team

### Outcomes

- Tremendous performance at scale, <4ms latency for over 2.5 billion items
- 10+ million queries per second across all servers and clusters
- Reduced ops costs with simple scaling



# LinkedIn Needed Easy, Horizontal Scaling



- Just add a node and do a “one-button” rebalance
- Dramatically simplified scale out compared to RDBMS and other NoSQL
- Ability to rapidly deploy compute without disruption or huge costs
- Upgraded from Couchbase CE after 2000 nodes deployed



## REDUCING INFRASTRUCTURE & OPERATIONS COSTS



Couchbase supports United's crew management platform, streamlining and modernizing crew scheduling and resources

### Requirements

- Identify truly scalable NoSQL solution
- Streamline and improve crew scheduling
- Support flexible schema and complex queries

### Outcomes

- Achieved NoSQL Standardization
- Allow highly mobile workforce to resolve issues from the field
- Out of the box DR and protection for critical ops
- Cloud-enabled: can be run in AWS and Azure





# United: “Mobile, XDCR, AND Horizontal Scaling!”

The screenshot shows a mobile application interface titled "Pairing D6700/02 - #5 Segments". The screen displays five completed activities with their respective times and details:

- Flight 440 IAH-JFK**: Report time 09/02/14 10:30, Gate # B22, Scheduled time 09/02/14 11:30, Arrival time 09/02/14 13:30, Dispatcher # +1 44319870. A "View flight" button is present.
- Shuttle**: Shuttle name Shuttle Chicago, Location Next to exit E2 outside, Pick-up time 09/02/14 14:00, Telephone +1 44319870.
- Hilton Hotel**: Reservation # 44455677, Telephone +1 44319870, Check-in 09/02/14 15:00, Check-out 09/04/14 11:30, Address 890 Adams St. Chicago, IL.
- Flight 670 JFK-IAH**: Report time 09/04/14 12:30, Gate # B22, Scheduled time 09/04/14 13:00, Arrival time 09/04/14 14:30, Dispatcher # +1 44319870. A "View flight" button is present.
- Layover**: Flight 344 IAH-LAX, Scheduled time 09/04/14 18:30, Arrival time 09/04/14 20:00.

A "UNITED" logo is at the bottom left. A black overlay at the bottom right contains the text "Enabling new tools for pilots".

- Enterprise Architect Team at UA did an extensive evaluation of all major NoSQL vendors
- Teams couldn't scale MongoDB and DynamoDB
- Couchbase is now the NoSQL standard at United



# Couchbase Solves Problems!



Improving customer experience & engagement

1. Increasing personalization means sacrificing performance ([eBay](#))
2. Mobile apps lag web versions in features and usability ([Ryanair](#))
3. Difficulty integrating data from disparate systems into consumer apps ([Experian](#))
4. Difficulty aggregating data into a single view of customer ([Comcast](#))
5. Takes too much time, money and effort to get legacy DBs to perform at acceptable levels ([Nielsen](#))
6. It is difficult to ensure *predictable* performance ([Sky](#))



Faster innovation & time to market

1. Backend schema changes delay application dev cycles ([Verizon](#))
2. NoSQL implementations need to be mission critical ([DirecTV](#))
3. Requirements change faster than the backend database can keep up ([Tesco](#))
4. Mobile apps just take too long to develop and integrate with backend systems ([GE](#))
5. The latest and greatest database technology isn't being leveraged ([Fico](#))
6. Too many technology piece parts tends to stifle innovation ([Staples](#))



Reducing infrastructure & operations costs

1. The database layer is too costly and time consuming to scale effectively ([eBay](#))
2. Frequent mainframe access is too costly and slow ([Marriott](#))
3. NoSQL "sprawl" is leading to increased operational and H/W costs ([LinkedIn](#))
4. Scaling up certain NoSQL solutions is far to costly and time consuming ([Nuance](#))
5. It's a struggle to operationalize so many different database technologies ([BT](#))
6. It's hard to rationalize paying multiple DB vendors for marginally-differentiated technology ([United](#))

# Thank you



Couchbase