mongoDB

Introducción a MongoDB

¡Bienvenidos!

Fernando Marín

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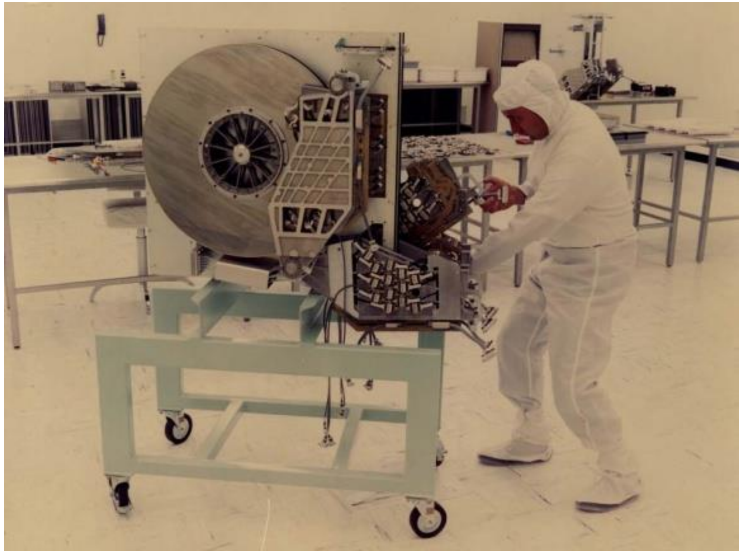
@fmarinperez

Agenda de hoy

- ¿Porqué existe NoSQL?
- Tipos de bases de datos NoSQL
- Características clave de MongoDB
- Tolerancia a fallos y persistencia de datos en MongoDB
- Escalabilidad en MongoDB
- Preguntas

El origen de SQL (70’s)



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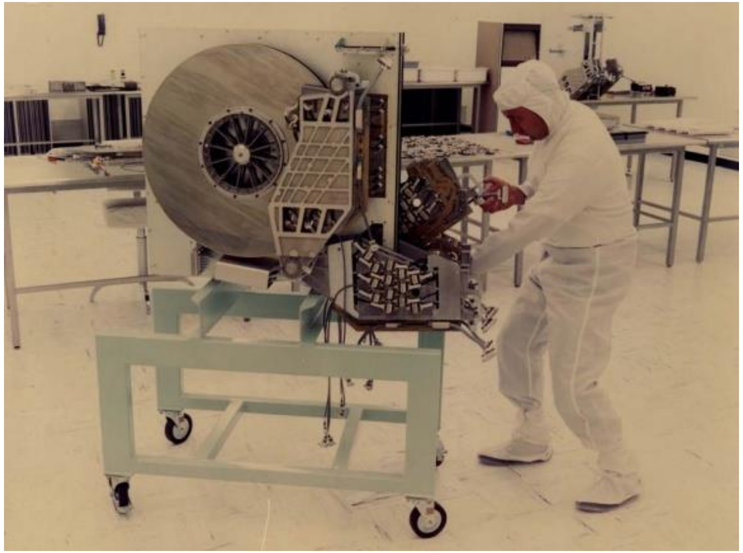
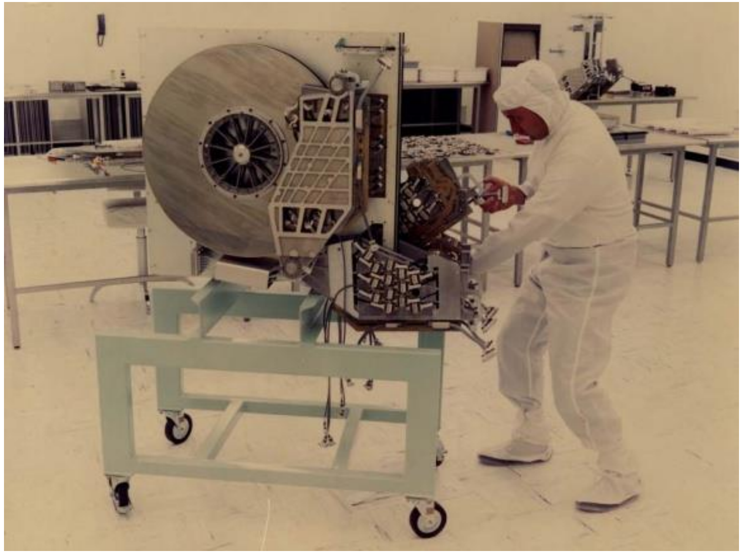


250 Mb

$ 81.000

El origen de SQL (70's)



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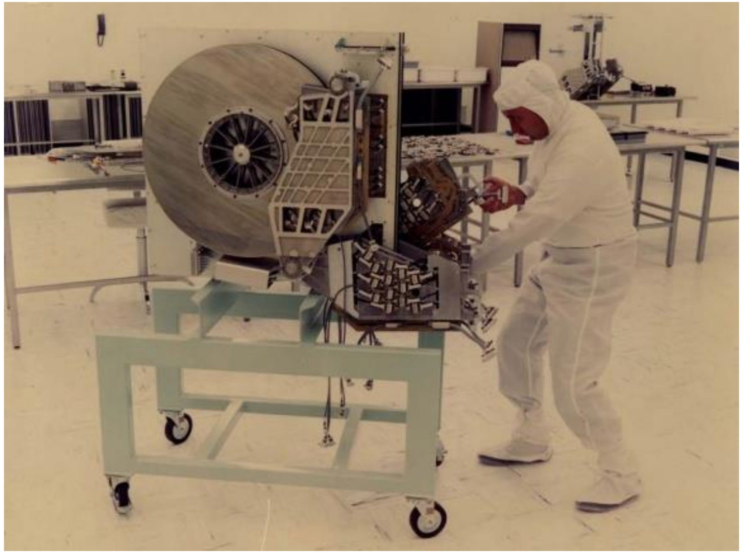
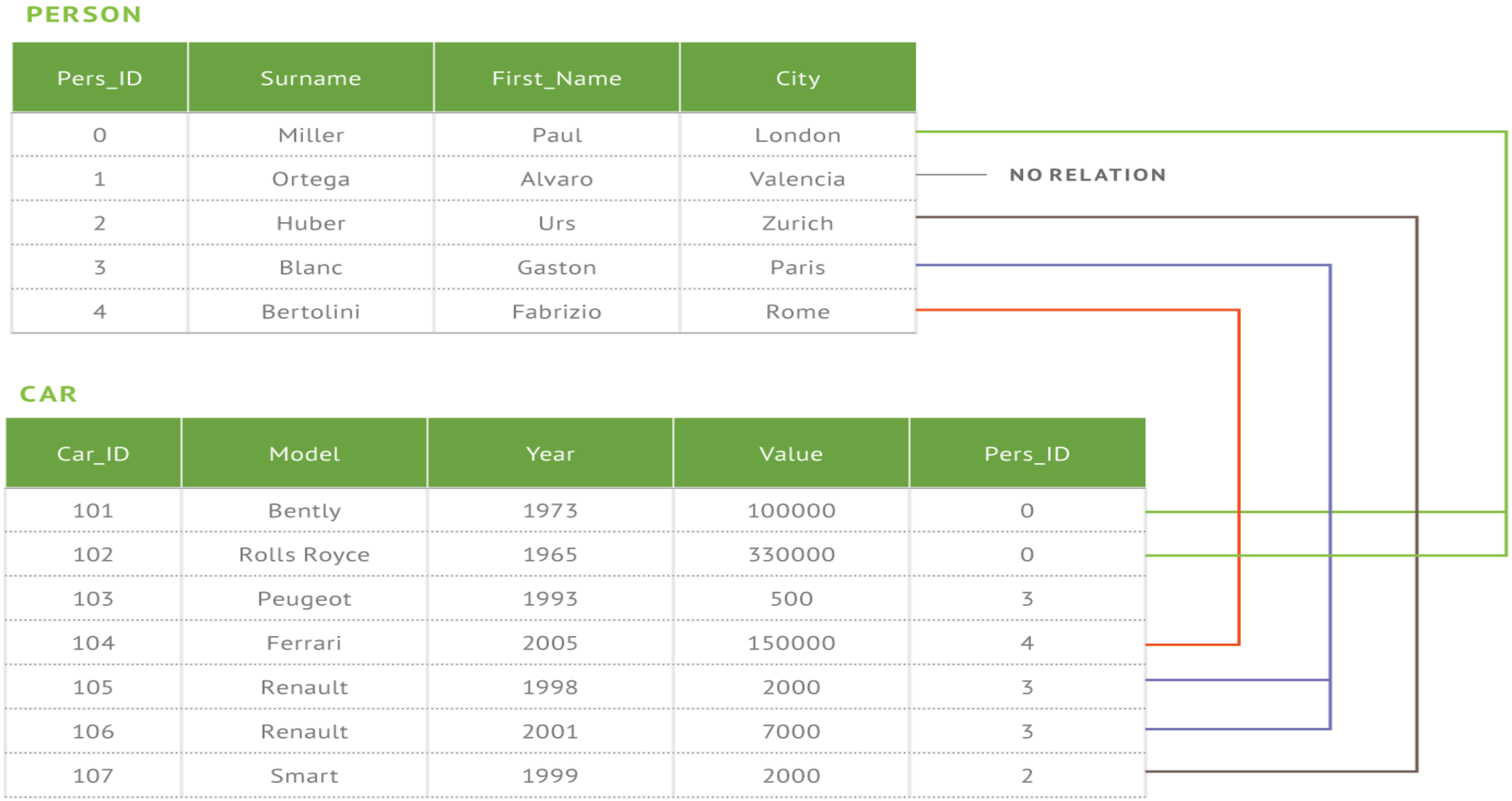


250 Mb
$ 81.000

Dennis Ritchie
Brian Kernighan
$ 8.000/año … (los dos)

Relational: RDBMS



PERSON

Pers_ID	Surname	First_Name	City
0	Miller	Paul	London
1	Ortega	Alvaro	Valencia
2	Huber	Urs	Zurich
3	Blanc	Gaston	Paris
4	Bertolini	Fabrizio	Rome

CAR

Car_ID	Model	Year	Value	Pers_ID
101	Bently	1973	100000	0
102	Rolls Royce	1965	330000	0
103	Peugeot	1993	500	3
104	Ferrari	2005	150000	4
105	Renault	1998	2000	3
106	Renault	2001	7000	3
107	Smart	1999	2000	2

Relational: RDBMS

Relational: RDBMS

Relational: RDBMS → Row Stores

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El origen de NoSQL (2000’s)

- Google y Amazon
  - Sistemas distribuídos
  - Open source
  - No relacionales

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- Mayo 2009 → twitter hashtag #nosql

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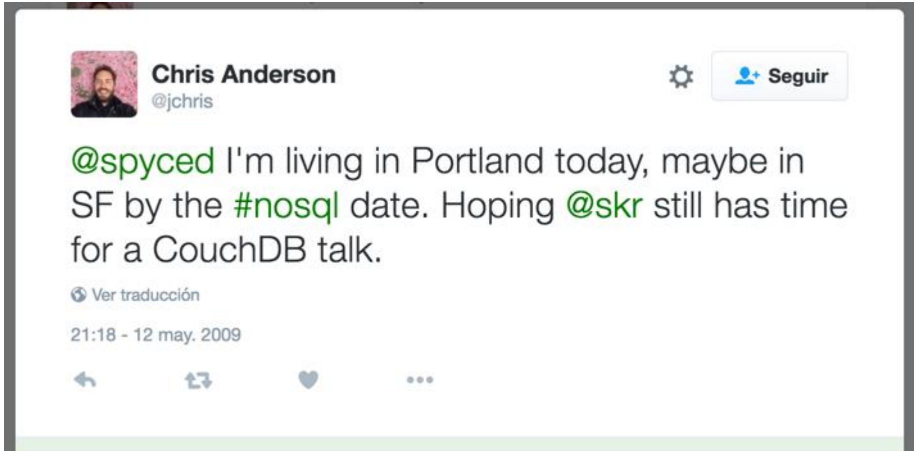


Chris Anderson
@jchris

@spyced I'm living in Portland today, maybe in SF by the #nosql date. Hoping @skr still has time for a CouchDB talk.

21:18 - 12 may. 2009

- Mayo 2009 → twitter hashtag #nosql

Tipos de Bases de Datos NoSQL

- Key-Value
- Wide Column
- Graph
- Document

Key Value Stores

Key Value Stores

Key Value Stores

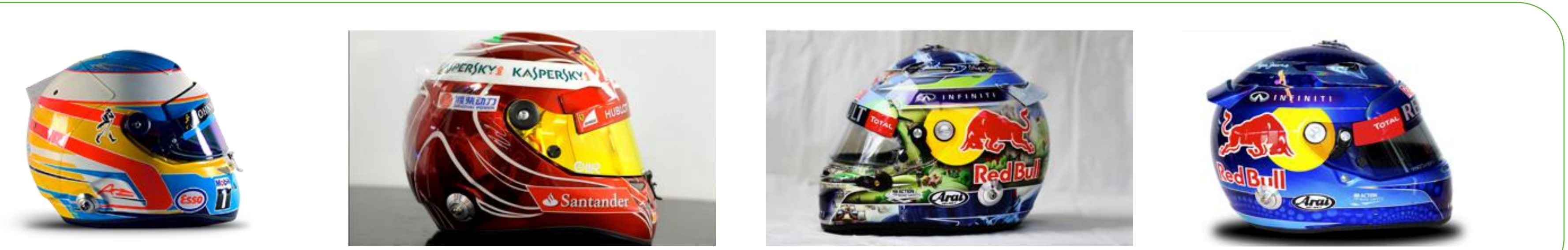
- An associative array
- Single key lookup
- Very fast single key lookup

Key	Value
12345	4567.3456787
12346	{ addr1 : “The Grange”, addr2: “Dublin” }
12347	“top secret password”
12358	“Shopping basket value : 24560”
12787	12345

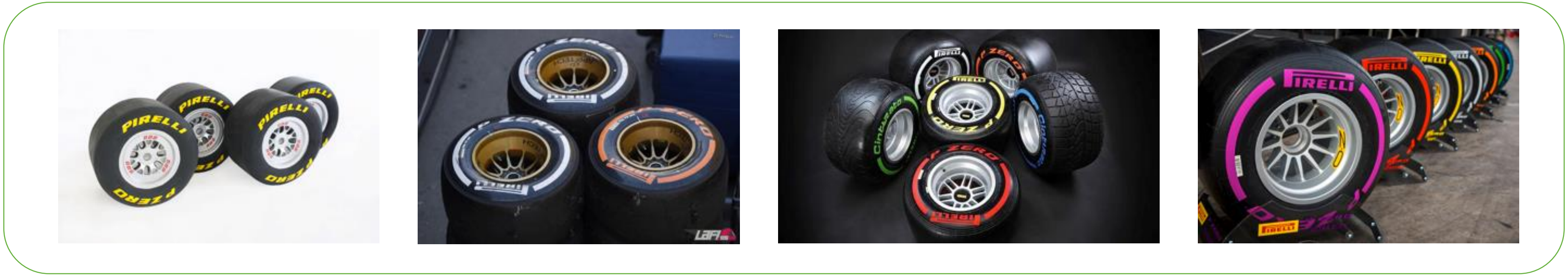
Wide-Column Stores

Wide-Column Stores

Wide-Column Stores



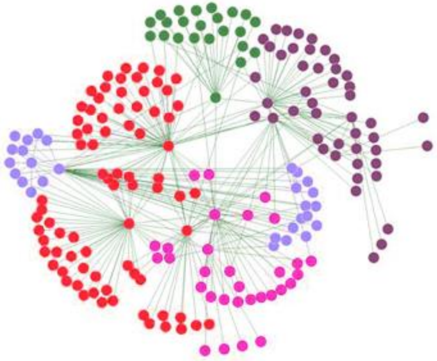
Wide-Column Stores



Wide-Column Stores

- A series of consecutive seeks can retrieve a column efficiently
- Compressing similar data is super efficient
- So reads can grab more data off disk in a single seek
- How do I align my rows? By order or by inserting a row ID
- IF you just need a small number of columns you don’t need to read all the rows
  - But → Updating and deleting by row is expensive
- Append only is preferred
- Better for OLAP than OLTP

Graph Stores



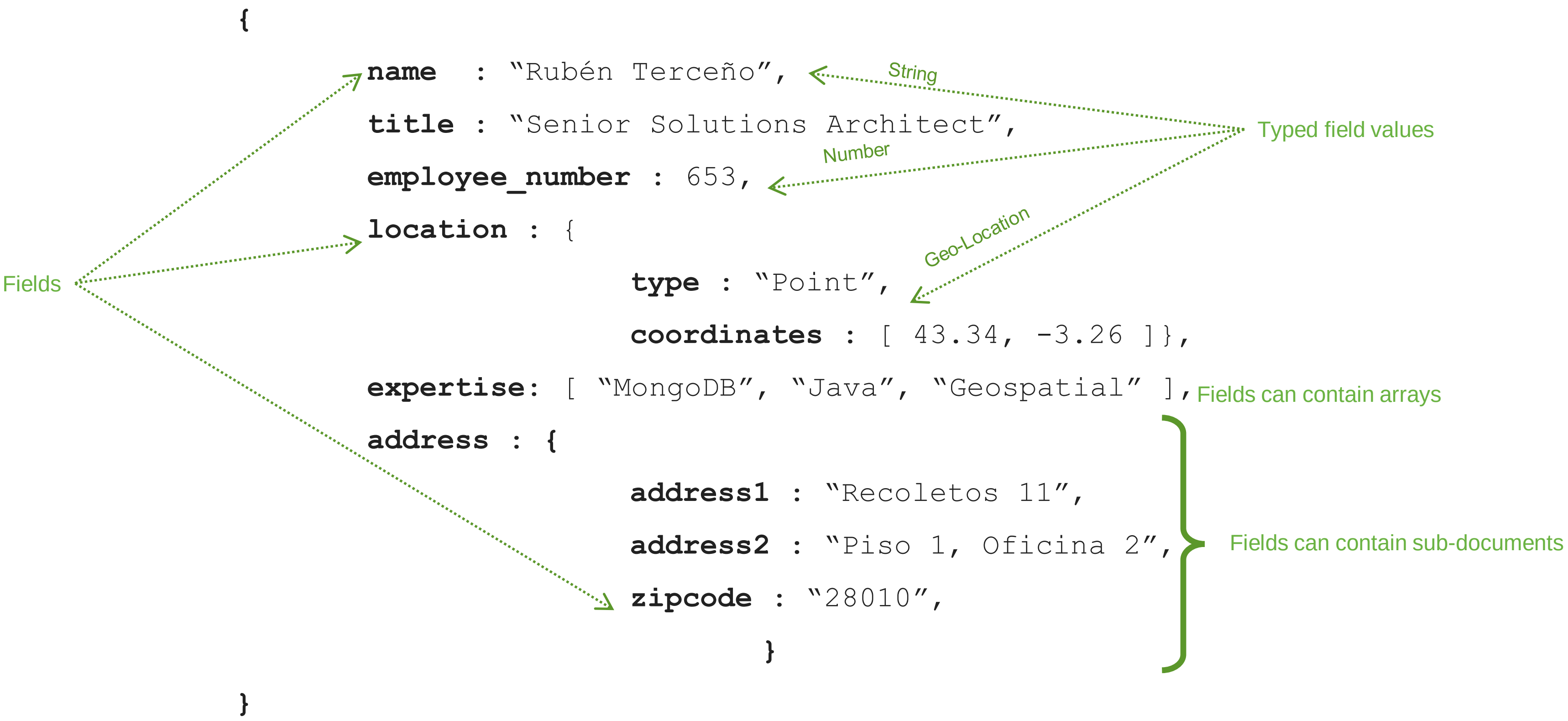
- Store graphs (edges and vertexes)
- E.g. social networks
- Designed to allow efficient traversal
- Optimised for representing connections
- Can be implemented as a key value stored with the ability to store links
- If your use case is not a graph you don’t need a graph database

Document Store

- Not PDFs or Microsoft Word.
- Documents are rich structures like XML or Javascript Object Notation (JSON)

```
{
    name  : “Rubén Terceño”,
    title : “Senior Solutions Architect”,
    employee_number : 653,
    location : {
                     type : “Point”,
                     coordinates : [ 43.34, -3.26 ]},
    expertise: [ “MongoDB”, “Java”, “Geospatial” ],
    address : {
                              address1 : “Recoletos 11”,
                              address2 : “Piso 1, Oficina 2”,
                              zipcode : “28010”,
                              }
}
```

Documents are Rich Structures



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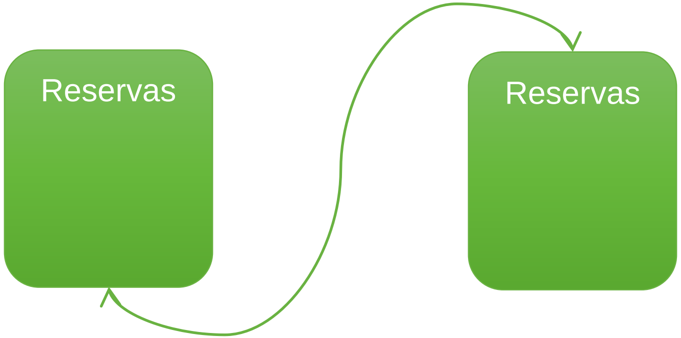
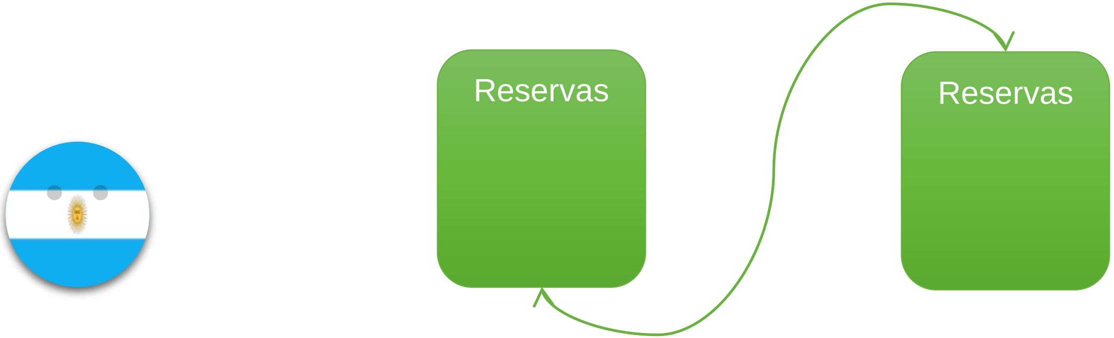
```

Document Stores

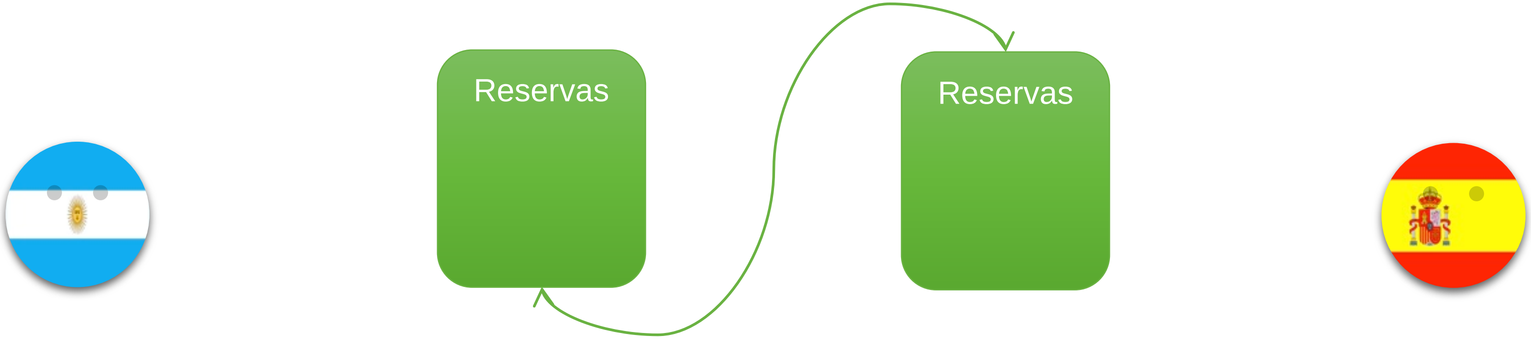
Consistency vs. Availability



Consistency vs. Availability



Consistency vs. Availability



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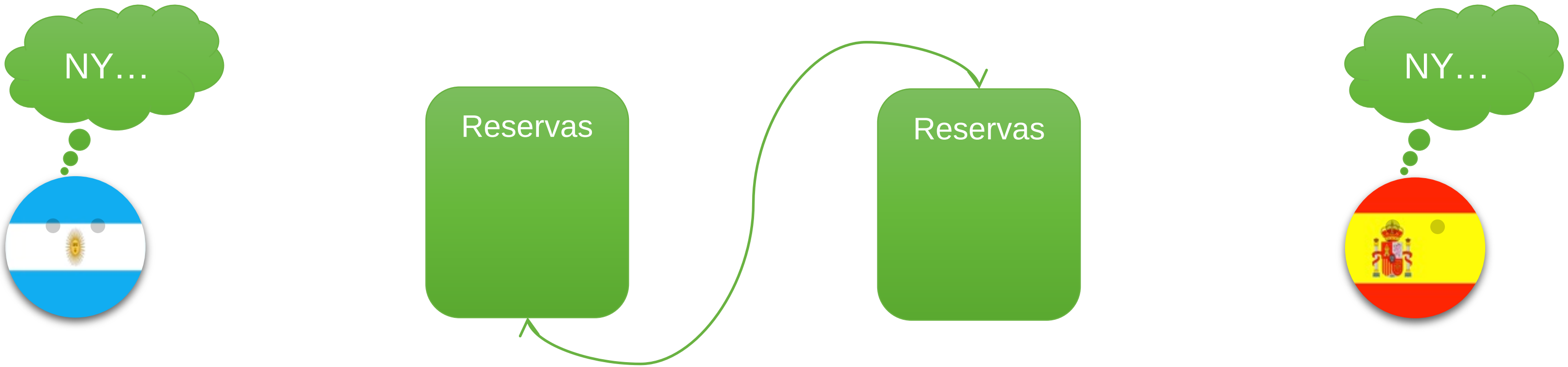

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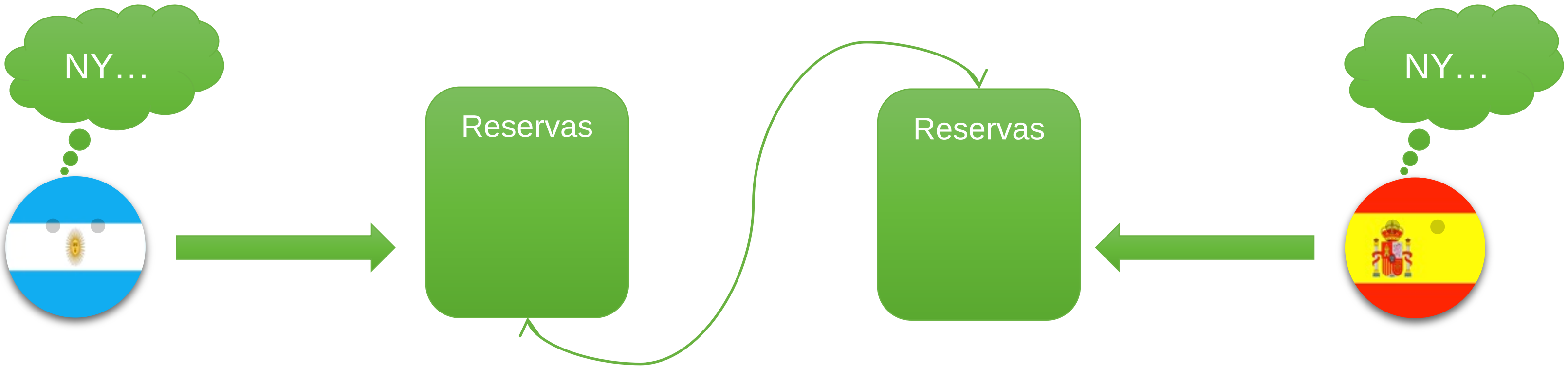

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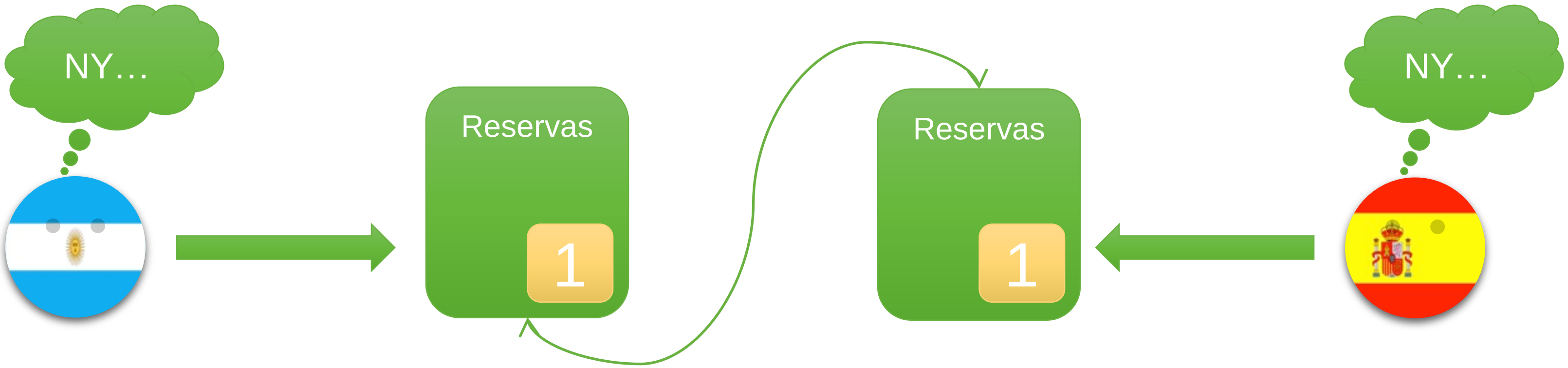

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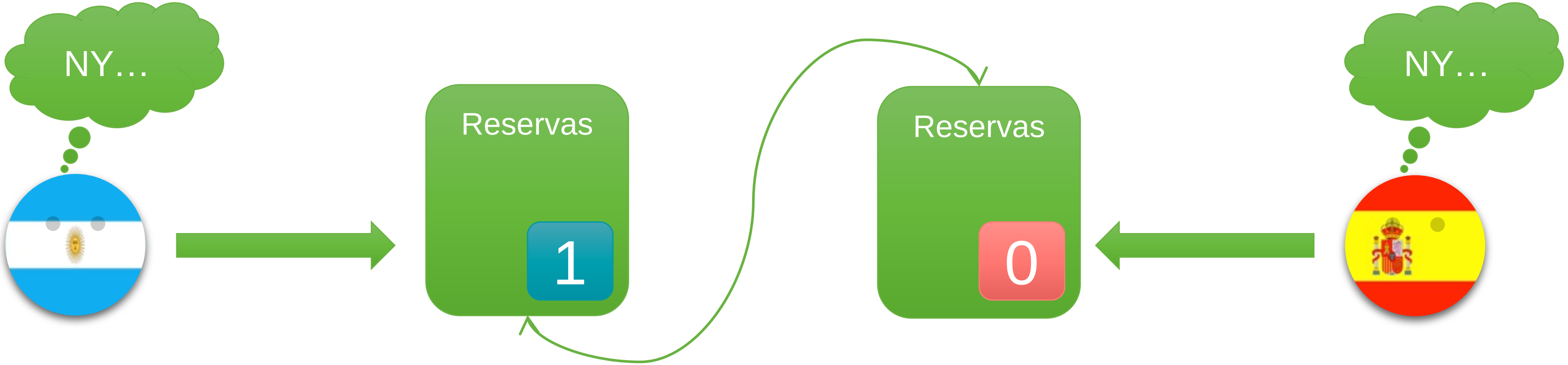

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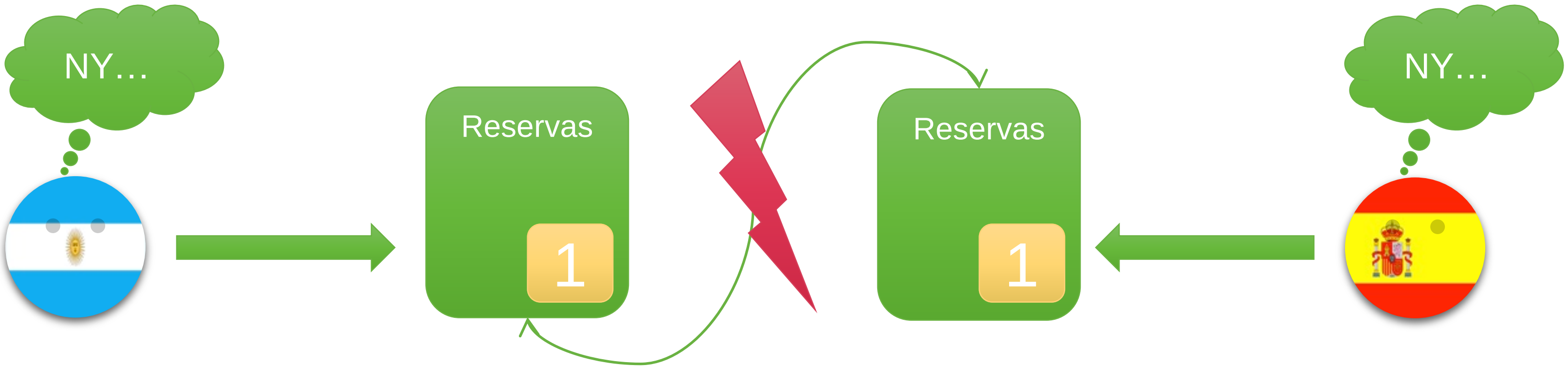

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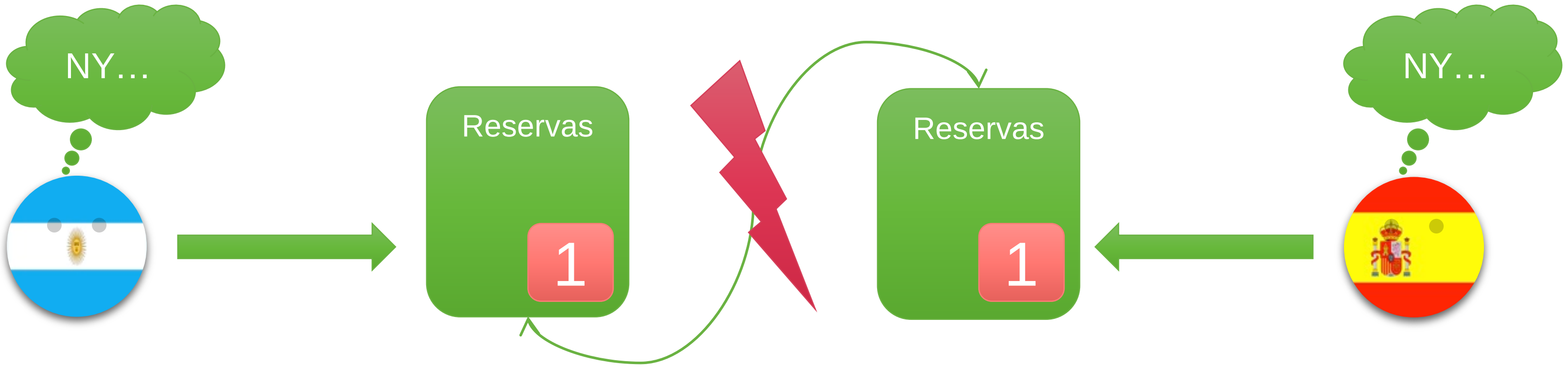

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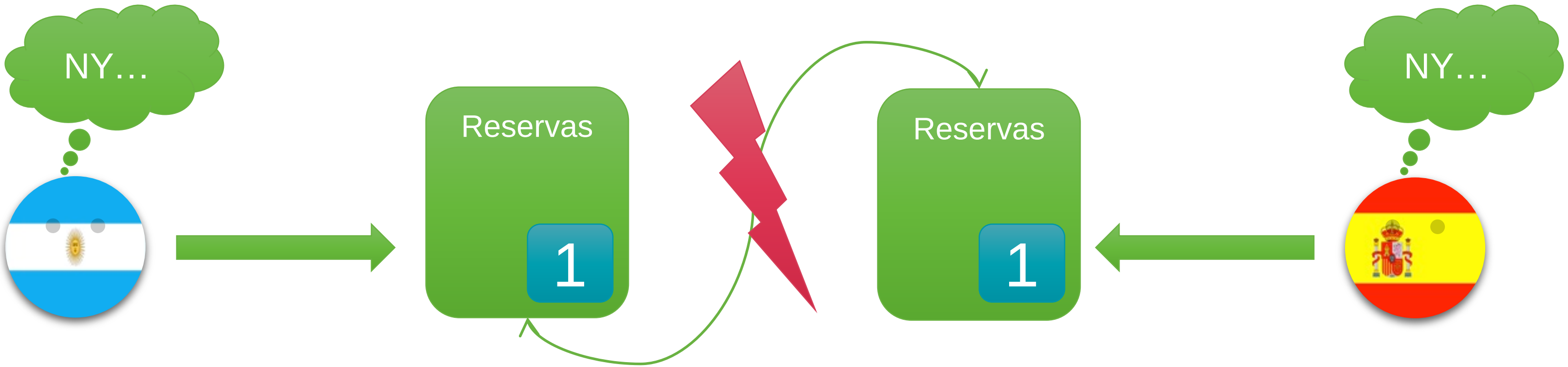
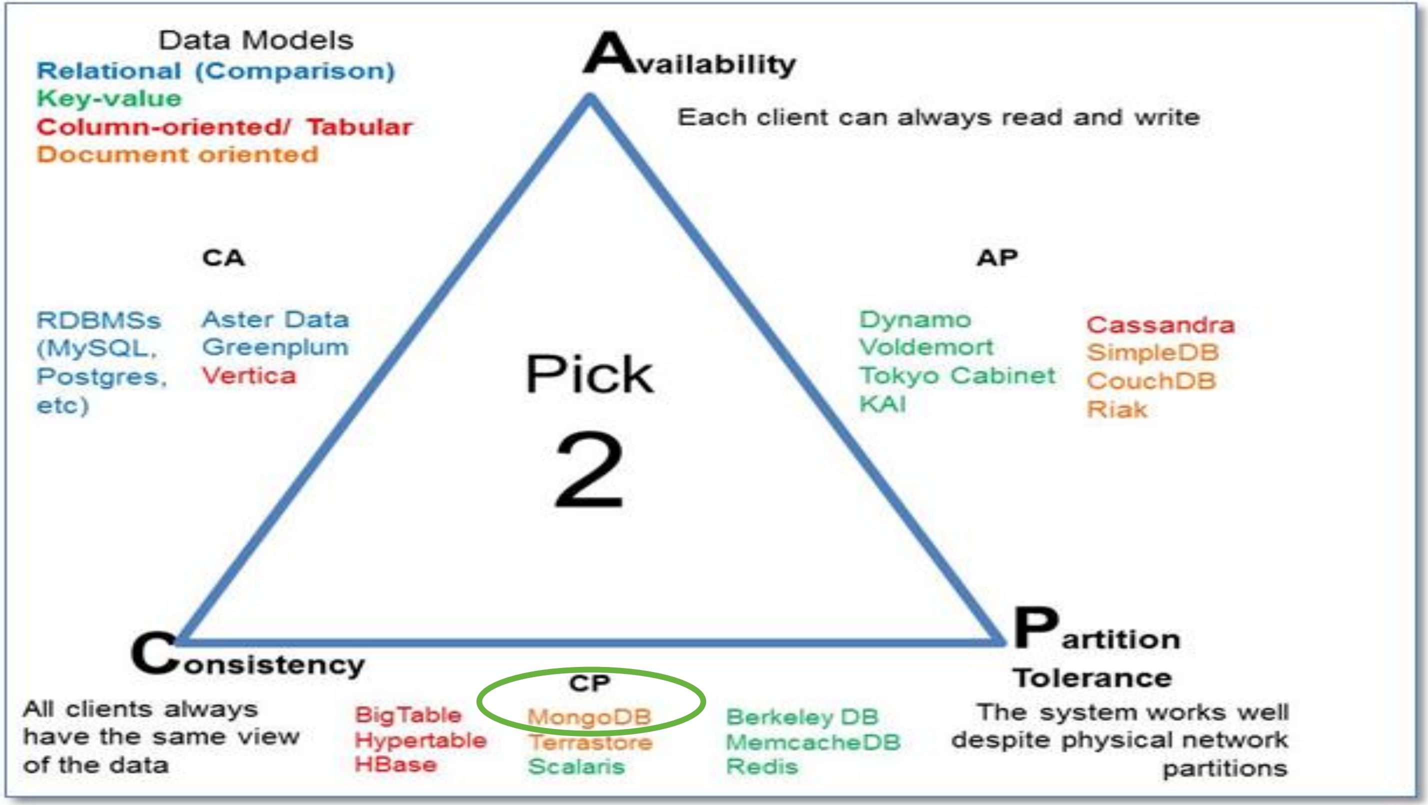


The CAP theorem



Data Models
Relational (Comparison)
Key-value
Column-oriented/ Tabular
Document oriented

Availability

Each client can always read and write

CA

RDBMSs (MySQL, Postgres, etc)

Aster Data
Greenplum
Vertica

Pick 2

AP

Dynamo
Voldemort
Tokyo Cabinet
KAI

Cassandra
SimpleDB
CouchDB
Riak

Consistency

All clients always have the same view of the data

CP

BigTable
Hypertable
HBase

MongoDB
Terrastore
Scalaris

Berkeley DB
MemcacheDB
Redis

Partition Tolerance

The system works well despite physical network partitions

Agenda de hoy

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Relational

Expressive Query Language
& Secondary Indexes

Strong Consistency

Enterprise Management
& Integrations

Relational / Expressive Query Language & Secondary Indexes

- Queries to access data in sophisticated ways
- Indexes for efficient access to data for reads/writes
- Table stakes for a database

Relational / Strong Consistency

- Provide the most up-to-date copy of the data
- Complicated to build an application around eventually consistent model, even for the most sophisticated teams

Relational / Enterprise Management & Integrations

Database is just one piece of the puzzle and it needs to fit into the enterprise IT stack:

- Streamline ops according to best practices
- Visualize data / schema to make informed decisions and ensure data integrity
- Encrypt data & restrict access to database in accordance with existing security infrastructure
- Employ standard BI and visualization tools

The World Has Changed

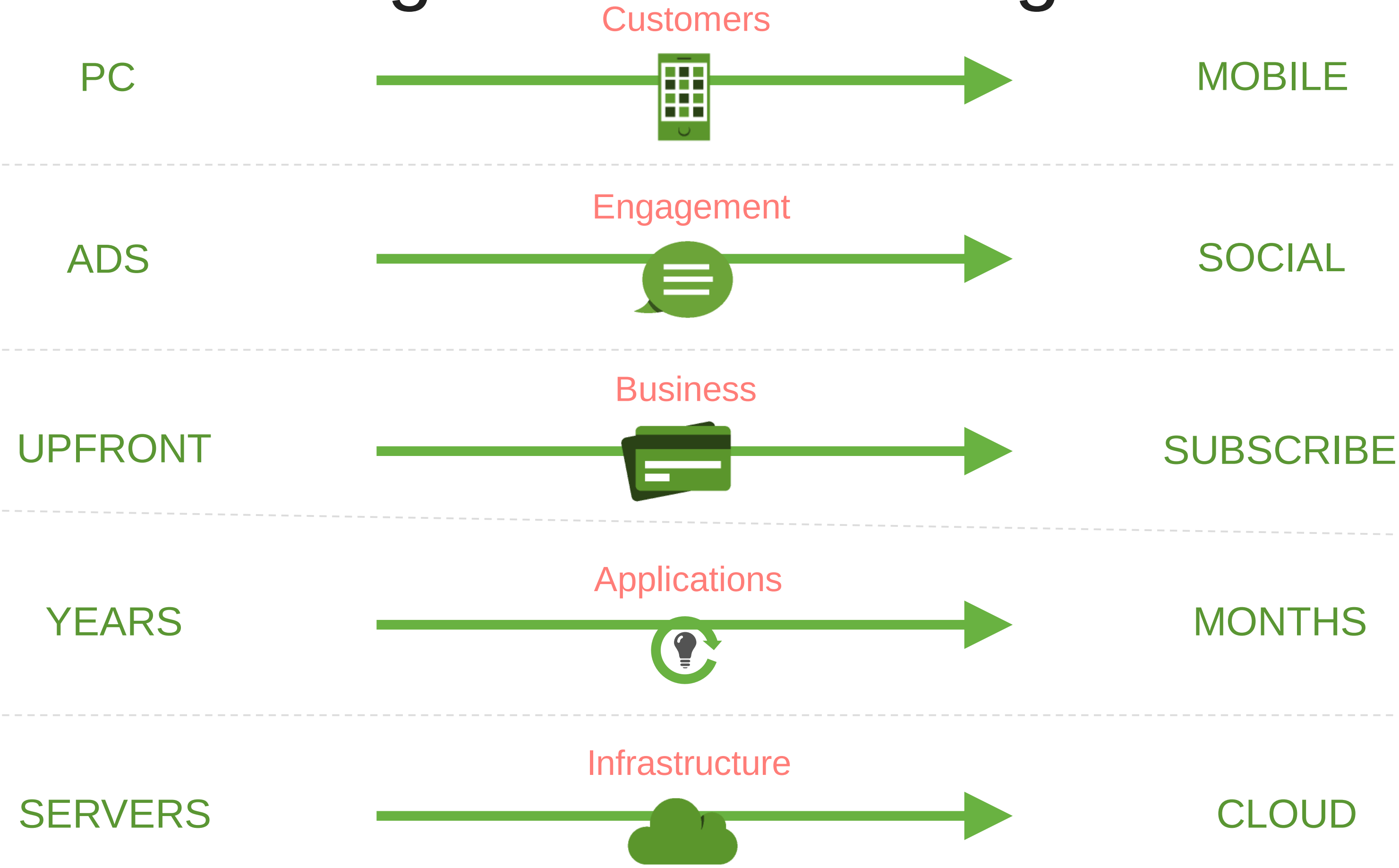
Data Risk

↑

Time Cost

↓

Information Management Has Changed



Customers

PC → MOBILE

Engagement

ADS → SOCIAL

Business

UPFRONT → SUBSCRIBE

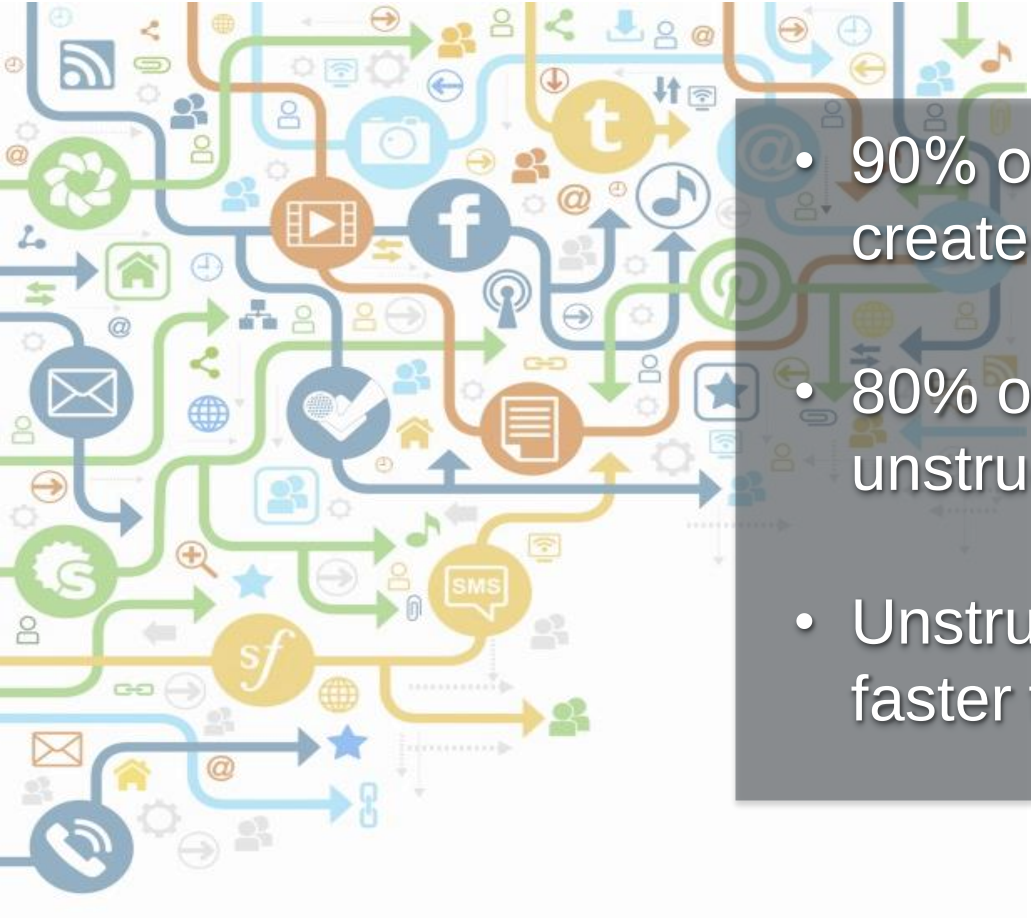
Applications

YEARS → MONTHS

Infrastructure

SERVERS → CLOUD

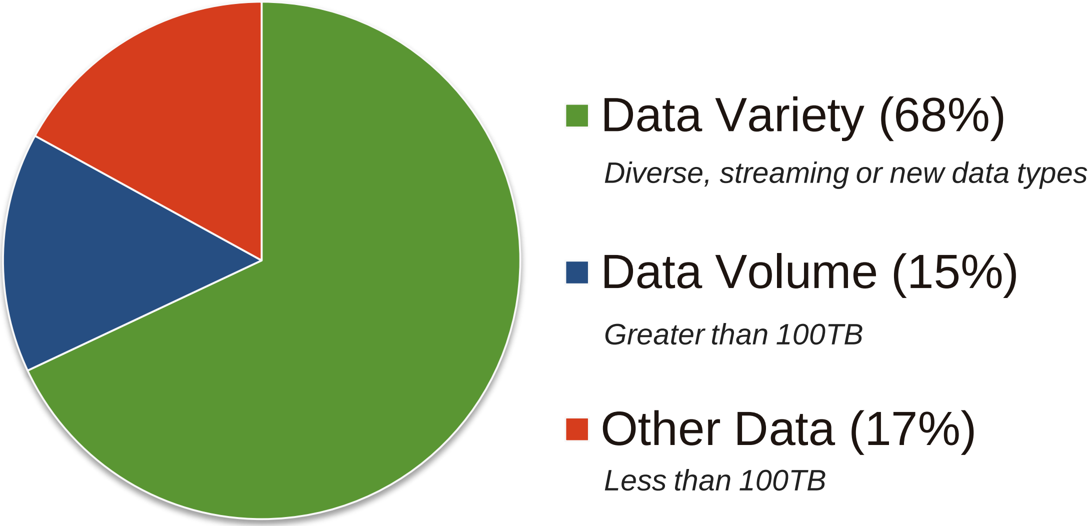
Your Data Has Changed



- 90% of the world’s data was created in the last two years
- 80% of enterprise data is unstructured
- Unstructured data growing 2x faster than structured

Big Data Driving Factors

*What are the primary data issues driving you to consider Big Data?**



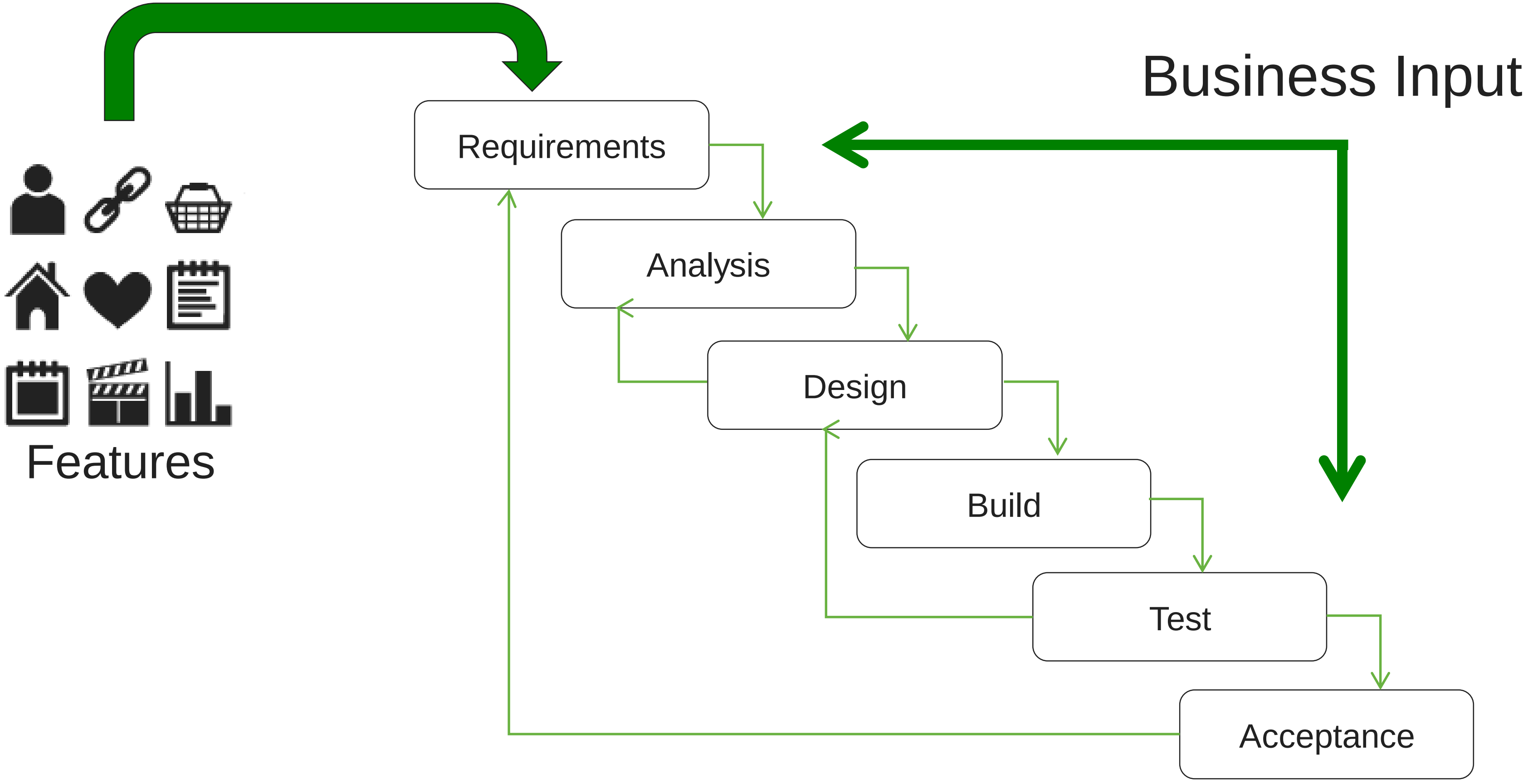
*“Of Gartner's "3Vs" of big data (volume, velocity, variety), the **variety of data sources** is seen by our clients as both the greatest challenge and **the greatest opportunity**.”*

FORRESTER

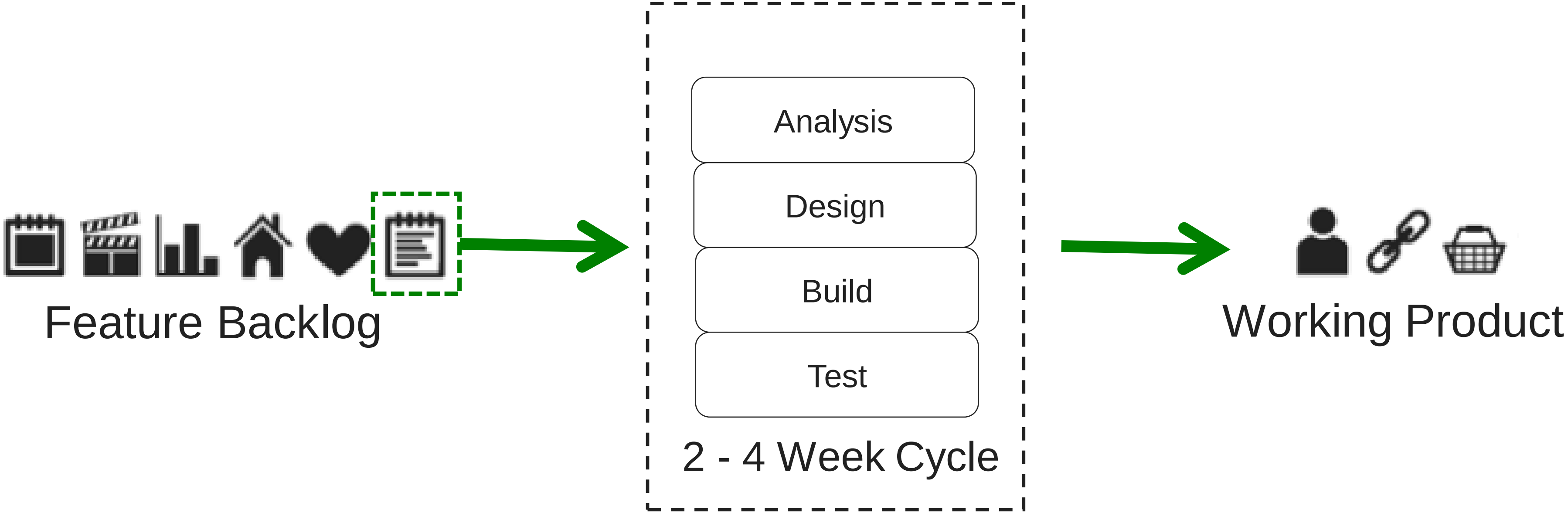
2014

* From Big Data Executive Summary of 50+ execs from F100, gov orgs

Development – Methods are Changing



Development – Agile Methodology



Feature Backlog

Analysis

Design

Build

Test

2 - 4 Week Cycle

Working Product

Software Has Changed

SAP®

Microsoft

ORACLE®

- Higher up-front costs
- Higher TCO

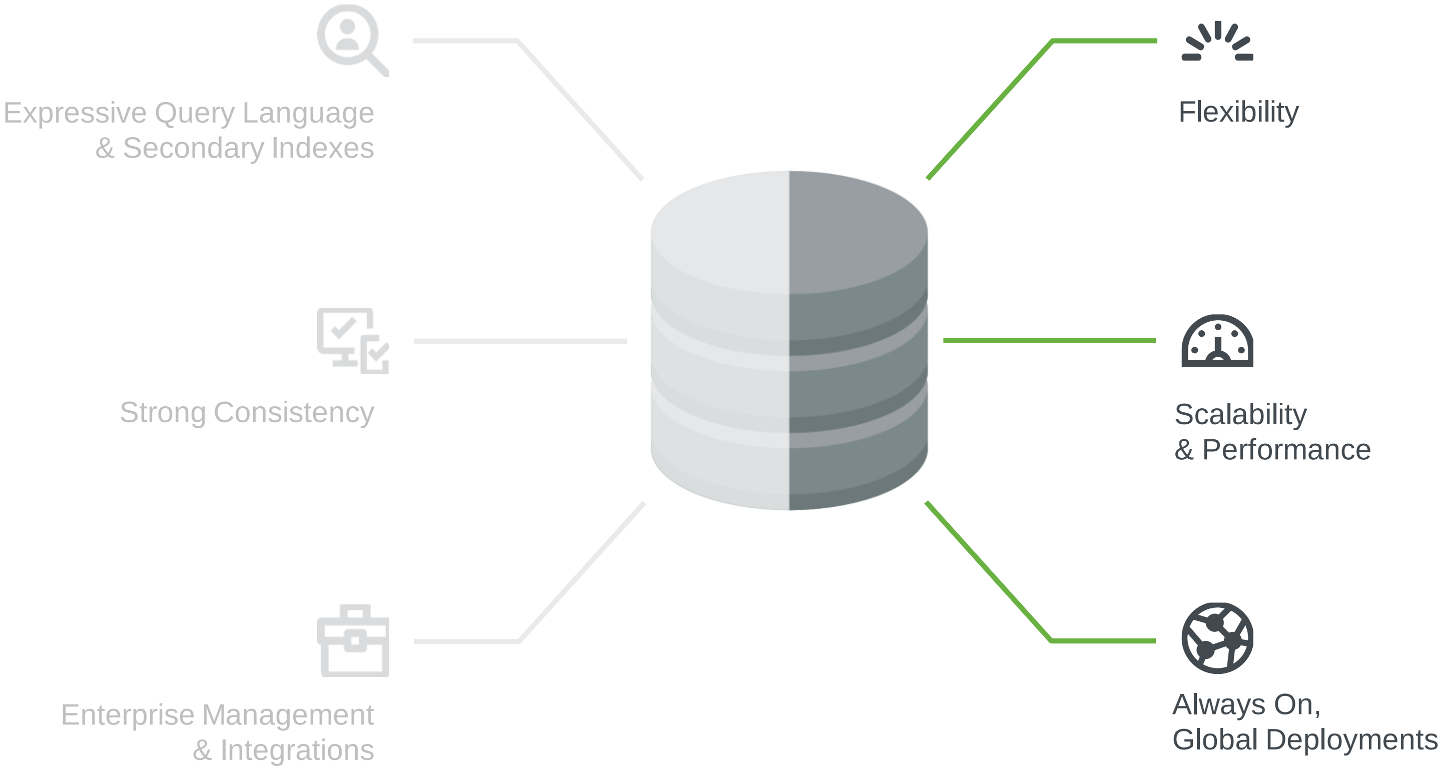
salesforce

mongoDB

redhat

- Lower up-front costs
- Lower TCO

NoSQL



Expressive Query Language & Secondary Indexes

Strong Consistency

Enterprise Management & Integrations

Flexibility

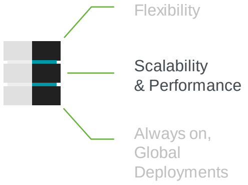
Scalability & Performance

Always On, Global Deployments

NoSQL / Flexibility

- Allows faster iteration
- Accommodates various data types
- Data models include document, key-value, wide column

NoSQL / Scalability & Performance



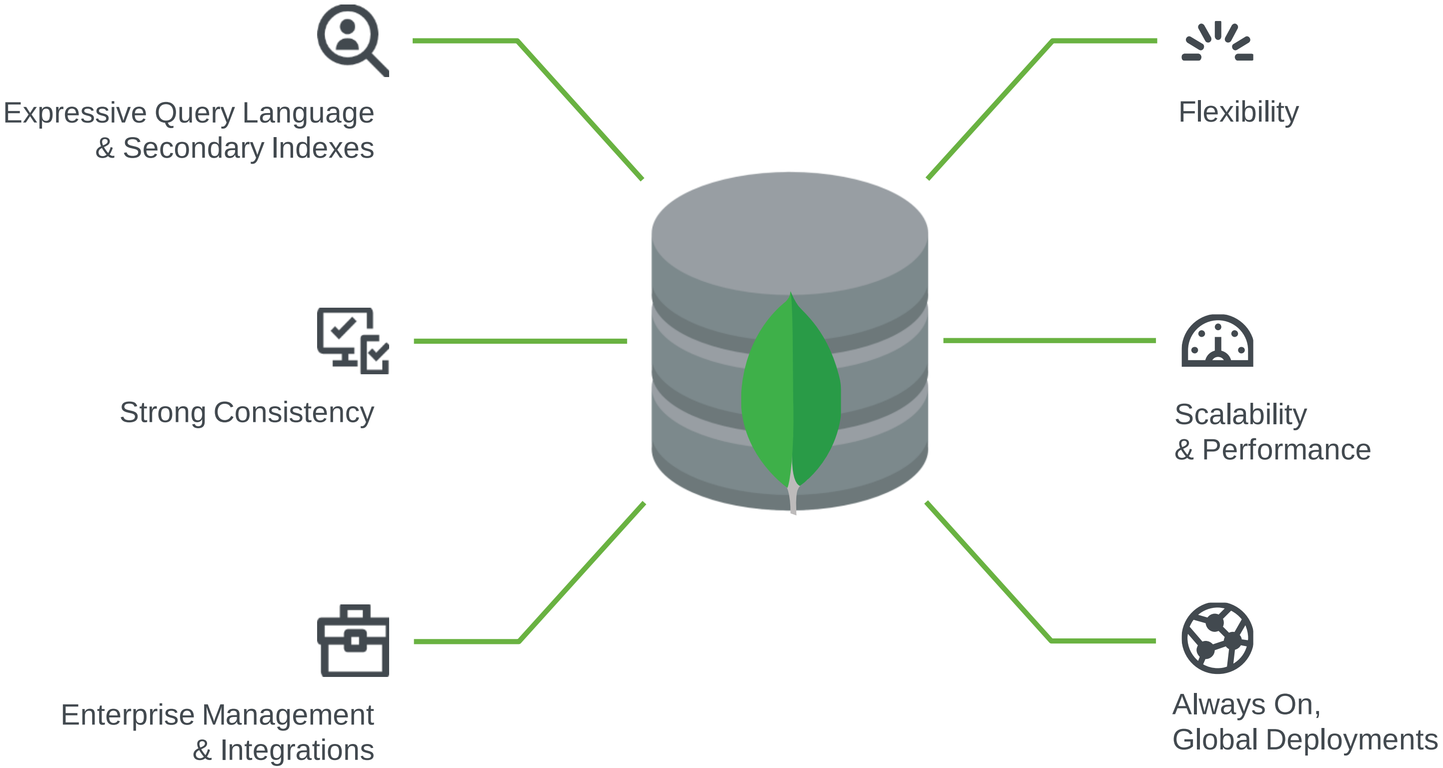
- Scalability through partitioning / sharding
- NoSQL databases designed to deliver better performance than a relational database

NoSQL / Always On, Global Deployments

Support highly available systems that provide a consistent, high-quality experience to end users around the world with:

- Run across many computers
- Automatically synchronize data across servers, racks, data centers

Nexus Architecture



Expressive Query Language
& Secondary Indexes

Strong Consistency

Enterprise Management
& Integrations

Flexibility

Scalability
& Performance

Always On,
Global Deployments

Introducción a MongoDB

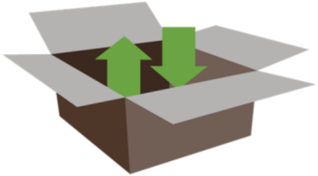
MongoDB

The leading NoSQL database

General Purpose

```
{
   name: “John Smith”,
   pfxs: [“Dr.”,”Mr.”],
   address: “10 3rd St.”,
   phone: {
home: 1234567890,
            mobile: 1234568138 }
}
```

Document Data Model



Open-Source

MongoDB Business Value

Enabling New Apps

Better Customer Experience

Faster Time to Market

Lower TCO

Fortune 500 & Global 500

40 of the Top Financial Services Institutions

15 of the Top Retailers

15 of the Top Telcos

15 of the Top Technology Companies

15 of the Top Healthcare Companies

10 of the Top Electronics Companies

10 of the Top Media and Entertainment Companies

About MongoDB, Inc.

500+ employees

13 offices worldwide

2,000+ customers

$311M in funding

MongoDB Use Cases

Single View

MetLife

CERN

stripe

Telefonica

Internet of Things

ENERNOC

BOSCH

Silver Spring NETWORKS

Tech Mahindra

Mobile

FOURSQUARE

O_2

ADP

Parse

Real-Time Analytics

McAfee An Intel Company

salesforce

CRITTERCISM

Catalog

CARFAX VEHICLE HISTORY REPORTS

UNDER ARMOUR

orange

OTTO

Personalization

ticketmaster

intuit

Expedia

eHarmony

Content Management

VIACOM

Forbes

ebay

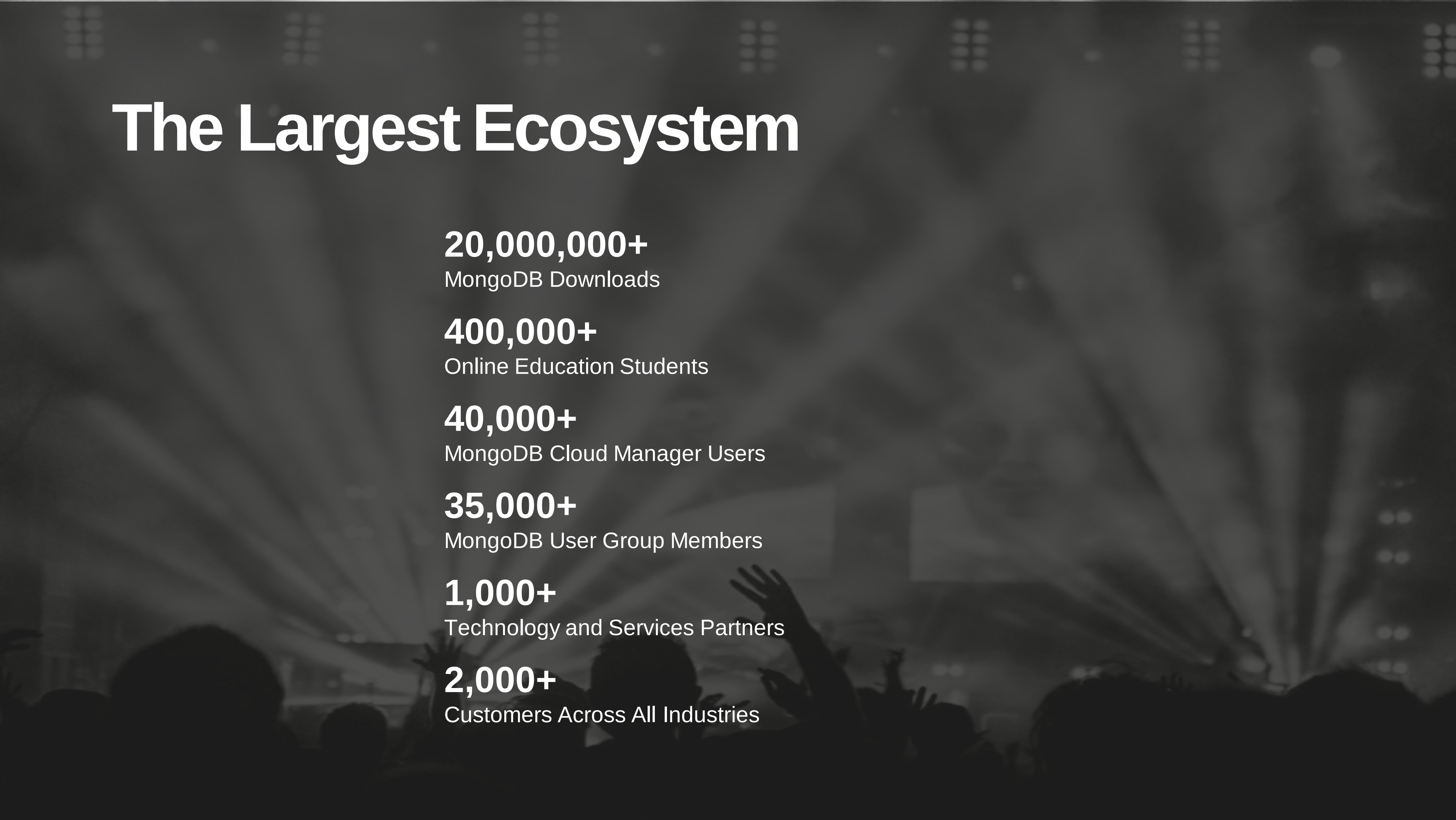
The National Archives

amazon web services
vmware
VIACOM
UNITED
T-Mobile
The Washington Post
asos discover fashion online
ebay
SQUARESPACE
BOSCH
Aer Lingus
apervita
verizon
Saks Fifth Avenue
The New York Times
HACK NY
hp
CRITTERCISM
backcountry.com
Elance
GitHub
hudl
PEARSON
NBCUniversal
eHarmony
AUTODESK
City of Chicago
SAILTHRU
NOKIA
TARGET
Telefónica
MTV MUSIC TELEVISION
Data hug
Google
MetLife
sears
chico's
Shutterfly
ENERNOC
Met Office
ERICSSON
The Weather Channel
BuzzFeed
McAfee
orange
UBERVU via HootSuite
Forbes
turbine
the knot
CERN
Videntity
X.
The National Archives
GAP
DVLA
GOV.UK
OTTO
UNDER ARMOUR
ADP
sprinklr
upwork formerly oDesk
craigslist
Expedia
FOURSQUARE
NOW TV
intuit
Parse The Cloud Application Platform
EA
GILT
f
stripe
APOLLO EDUCATION GROUP
theguardian

4th Most Popular, Fastest Growing

RANK	DBMS	MODEL	SCORE	GROWTH (20 MO)
1.	Oracle	Relational DBMS	1,442	-5%
2.	MySQL	Relational DBMS	1,294	2%
3.	Microsoft SQL Server	Relational DBMS	1,131	-10%
4.	**MongoDB**	**Document Store**	**277**	**172%**
5.	PostgreSQL	Relational DBMS	273	40%
6.	DB2	Relational DBMS	201	11%
7.	Microsoft Access	Relational DBMS	146	-26%
8.	Cassandra	Wide Column	107	87%
9.	SQLite	Relational DBMS	105	19%

Source: DB-engines database popularity rankings; May 2015



The Largest Ecosystem

20,000,000+
MongoDB Downloads

400,000+
Online Education Students

40,000+
MongoDB Cloud Manager Users

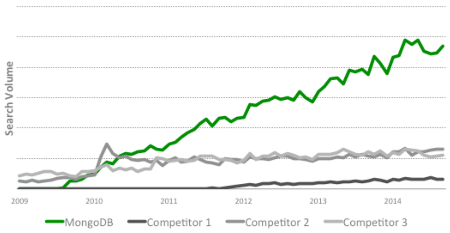
35,000+
MongoDB User Group Members

1,000+
Technology and Services Partners

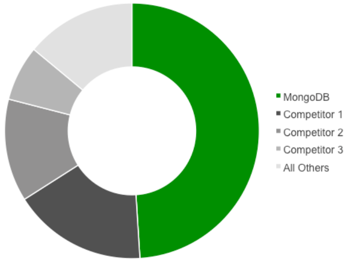
2,000+
Customers Across All Industries

Fastest-Growing Database

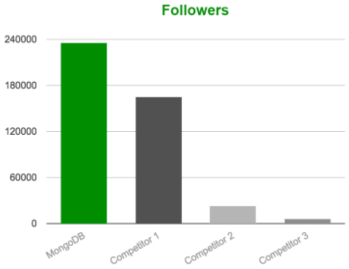
Google



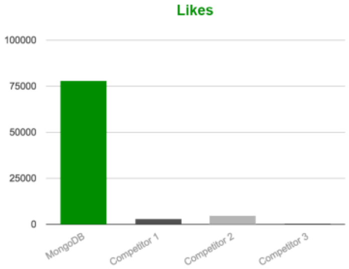
LinkedIn



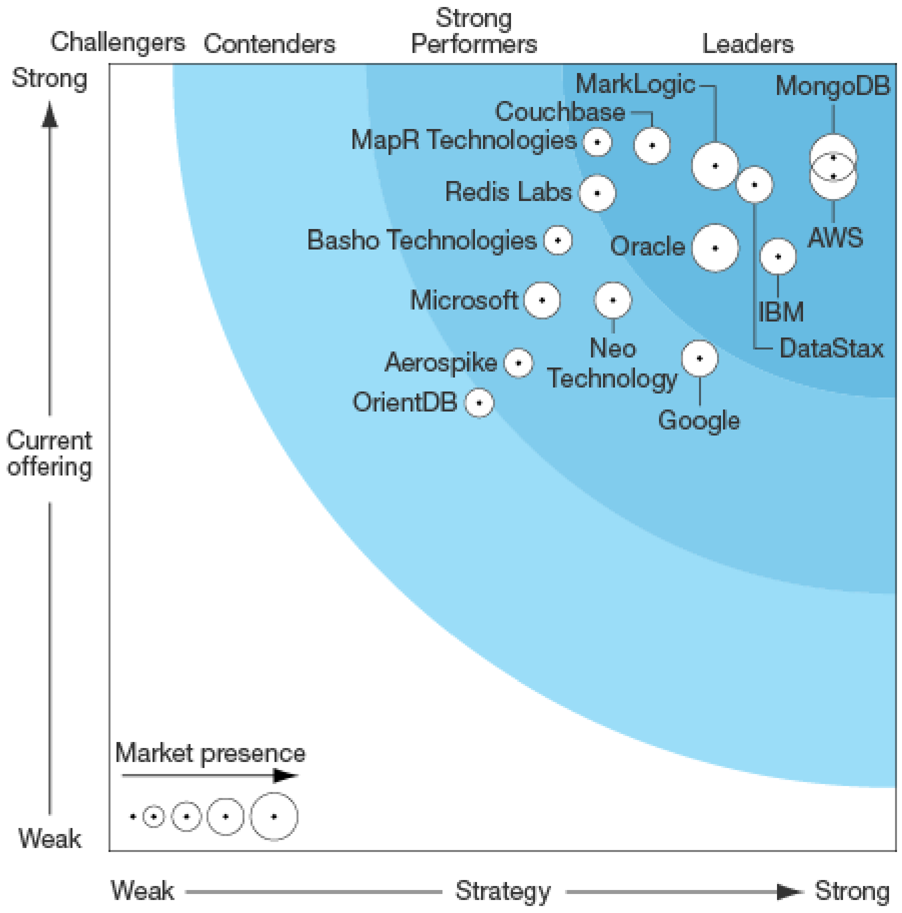
Twitter



Facebook



MongoDB named A LEADER in The Forrester Wave™: Big Data NoSQL, Q3 2016



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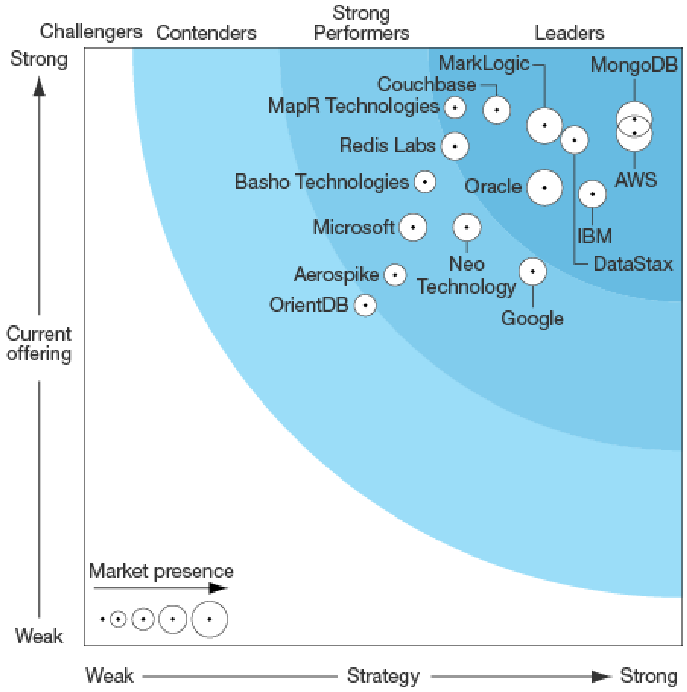

Achieving the highest possible scores in 19 of the 26 criteria, MongoDB believes that this report indicates its strength and versatility as an all-purpose database for a variety of mission-critical use cases.

5 out of 5 Points for:

- Data Types
- Streaming and Loading
- Big Data Support
- In-memory
- Performance
- Scalability
- High Availability & Disaster Recovery

- Tools
- Workloads
- Use Cases
- Ability to Execute
- Road Map
- Open Source and Licensing
- Support

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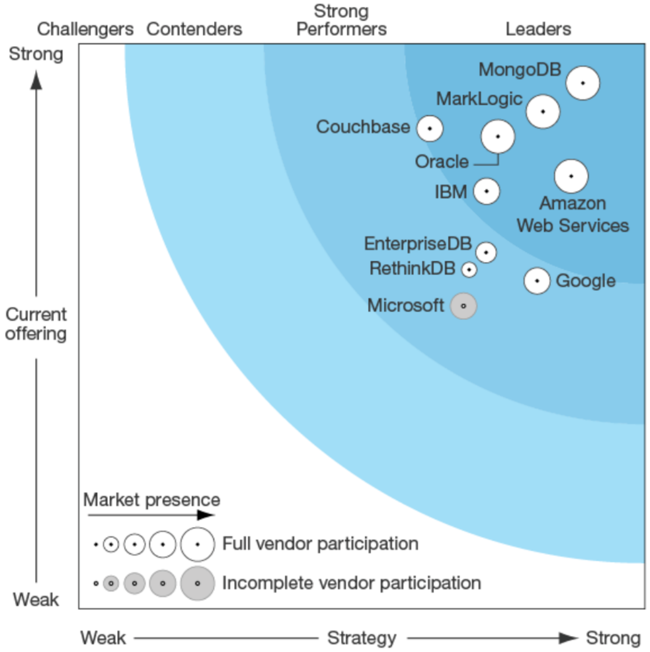

MongoDB received the highest scores possible in

20 of the 27

criteria evaluated, including performance, scalability, tooling, road map, support, product revenue and reach.

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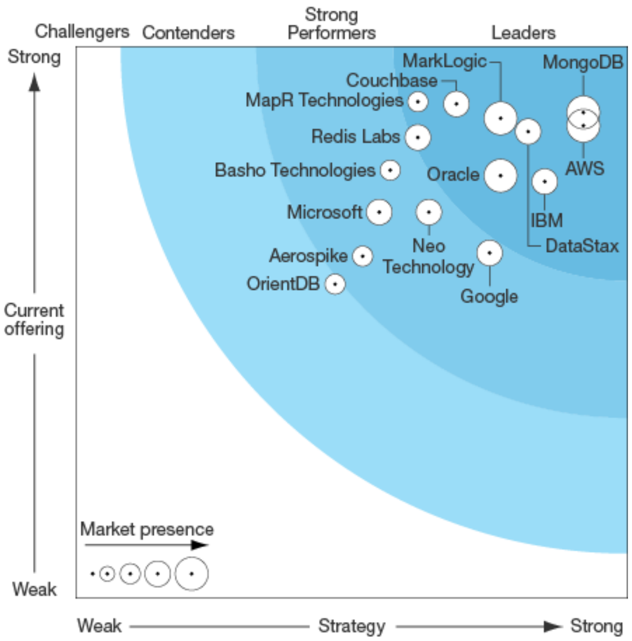
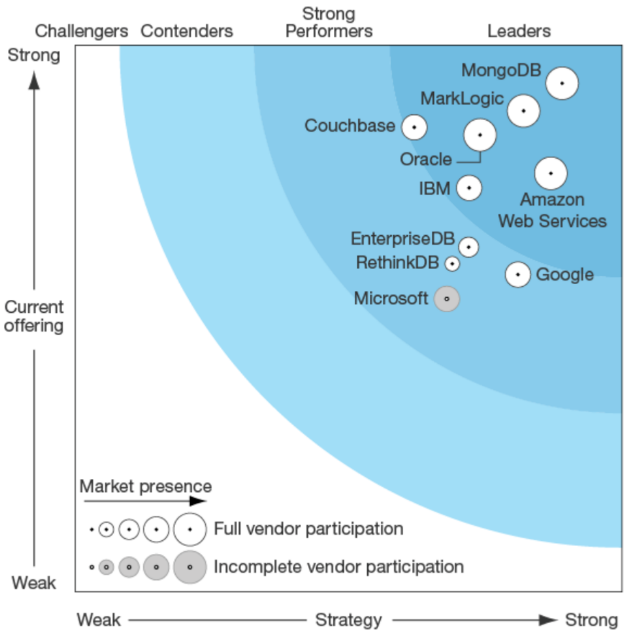
MongoDB named a LEADER in two key Forrester Waves:



The Forrester Wave™: Big Data NoSQL, Q3 2016



The Forrester Wave™: Document Stores, Q3 2016

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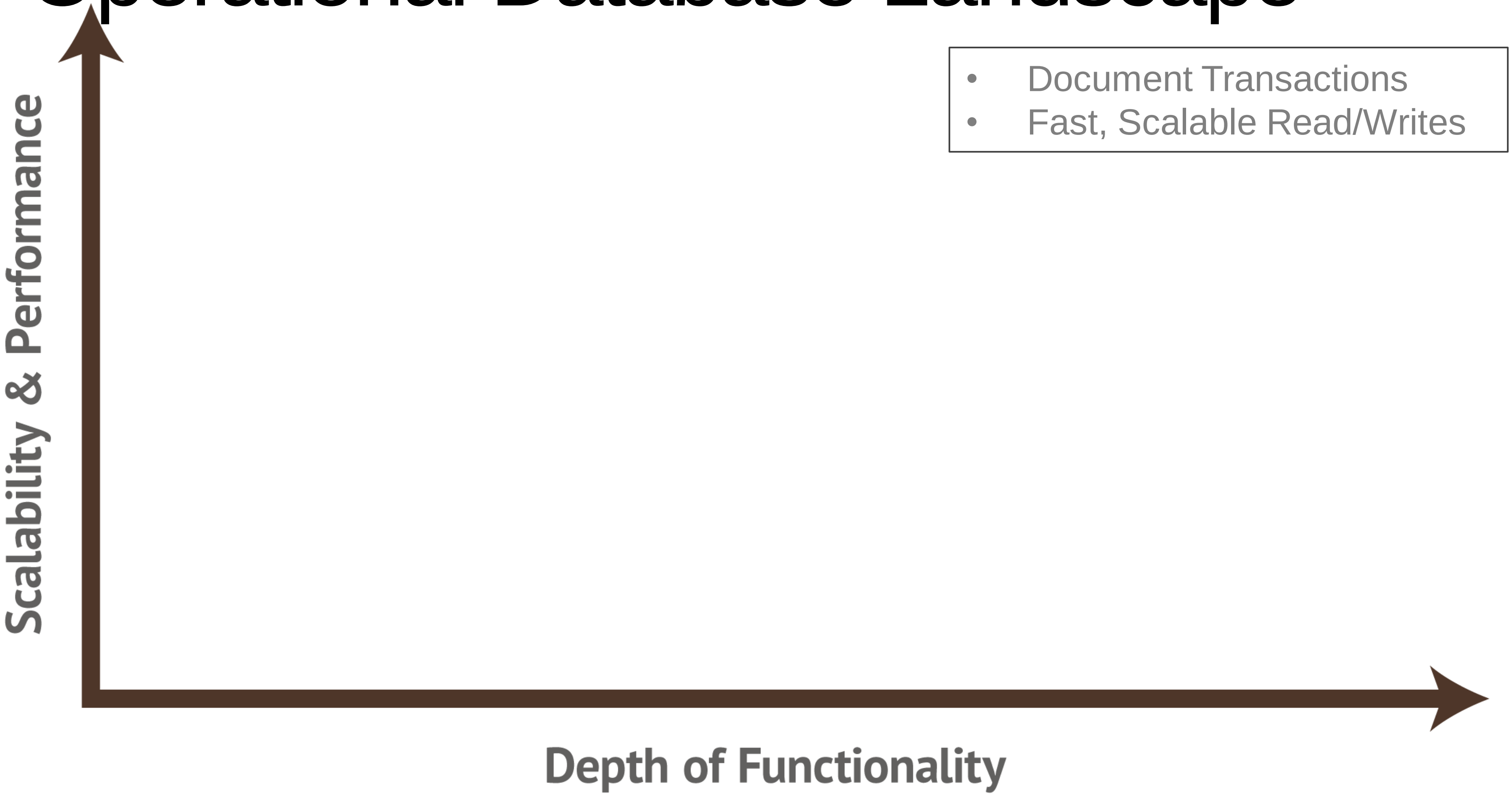
Operational Database Landscape

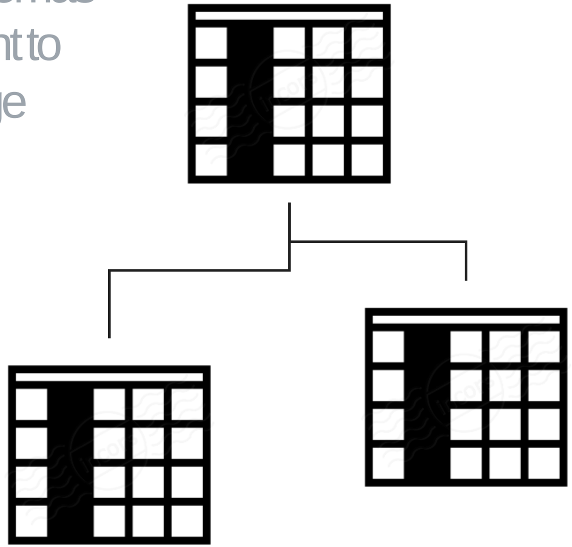


- Document Transactions
- Fast, Scalable Read/Writes

Why other Databases Fall Short

Relational Model

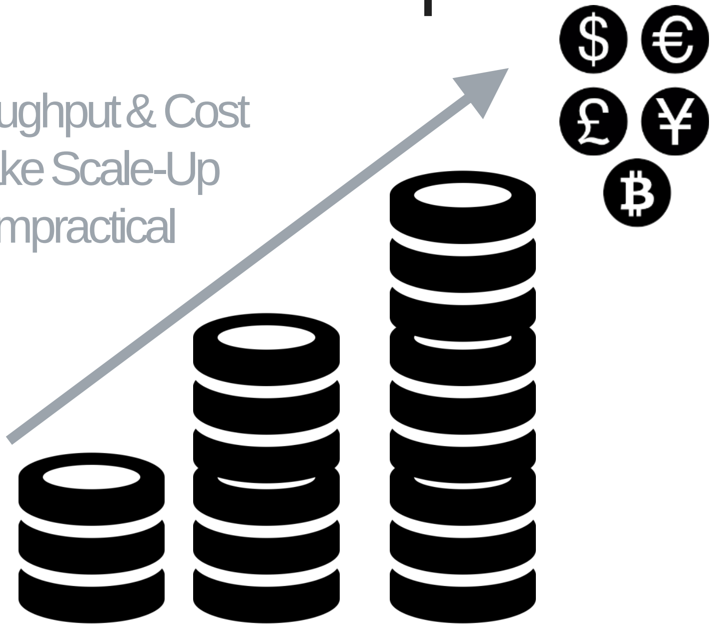
Rigid Schemas
Resistant to
change



Data changes constantly,
In many use cases it's designed to

Scale-up

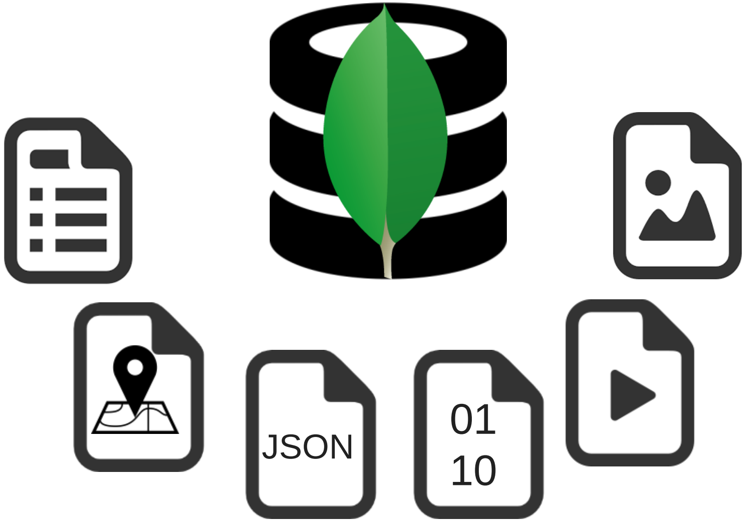
Throughput & Cost
make Scale-Up
Impractical



Scale-Up clusters were never meant
to handle today's volumes

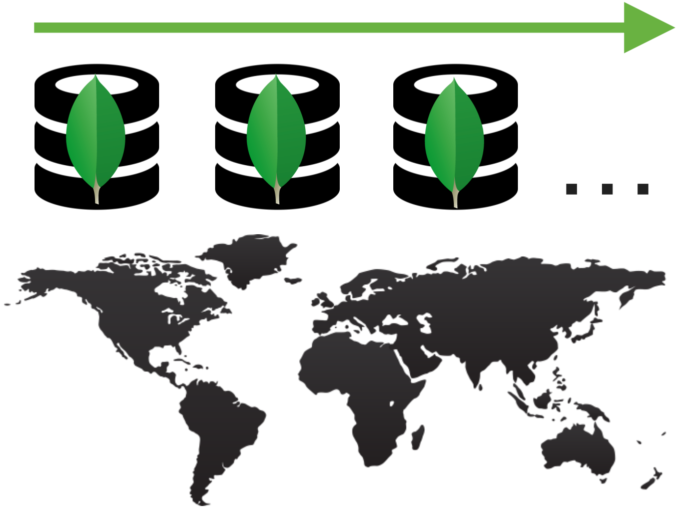
How MongoDB Makes it Easy

Document Model



Flexible Multi-Structured Schema is designed to adapt to changes

Scale-out



Scale-out to the end of The World and distribute data where it needs to be

Relational Model

EmpID	Name	Dept	Title	Manager	Payband
9950	Dunham, Justin	Marketing	Product Manager	Neray,Graham	C

EmpBenPlanID	EmpFK	PlanFK
1	9950	100
2	9950	200

PlanID	Benefit	Plan
100	Health	PPO Plus
200	Dental	Standard

BenID	Benefit
1	Health
2	Dental

TitleID	Title
1500	Product Manager

DeptID	Department
500	Marketing

We Denormalise & Materialize for Performance & Simplicity

Relational Model

Document Model

EmpID	Name	Dept	Title	Manager	Payband
9950	Dunham, Justin	Marketing	Product Manager	Neray,Graham	Health PPO Plus Dental Standard

PlanID	Benefit
100	Health
200	Dental

```
{
     _id : 9950,
     employee_name: "Dunham, Justin",
     department : "Marketing",
     title : "Product Manager, Web",
     report_up: "Neray, Graham",
     pay_band: “C",
     benefits : [
            {  type :  "Health",
               plan : "PPO Plus" },
            {  type :   "Dental",
               plan : "Standard" }
                        ]
}
```

We Denormalise & Materialize for Performance & Simplicity

01
10

JSON

No SQL But Still Flexible Querying

Rich Queries

- Find everybody who opened a special account last month in NY between $100 and $1000 OR last year more than $500

Aggregation

- What is the average P&L of the trading desks grouped by a set of date ranges

Text Search

- Find all tweets that mention the bank within the last 2 days

Geospatial

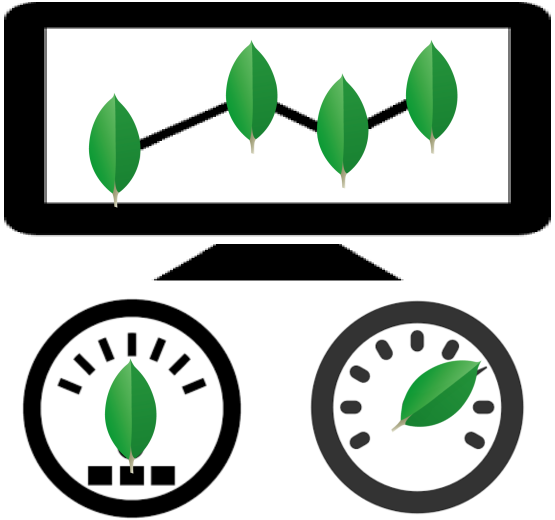
- Find all customers that live within 10 miles of NYC

Map Reduce

- Calculate total amount settled position by symbol by settlement venue

How MongoDB Makes it Easy

In-Place Analytics

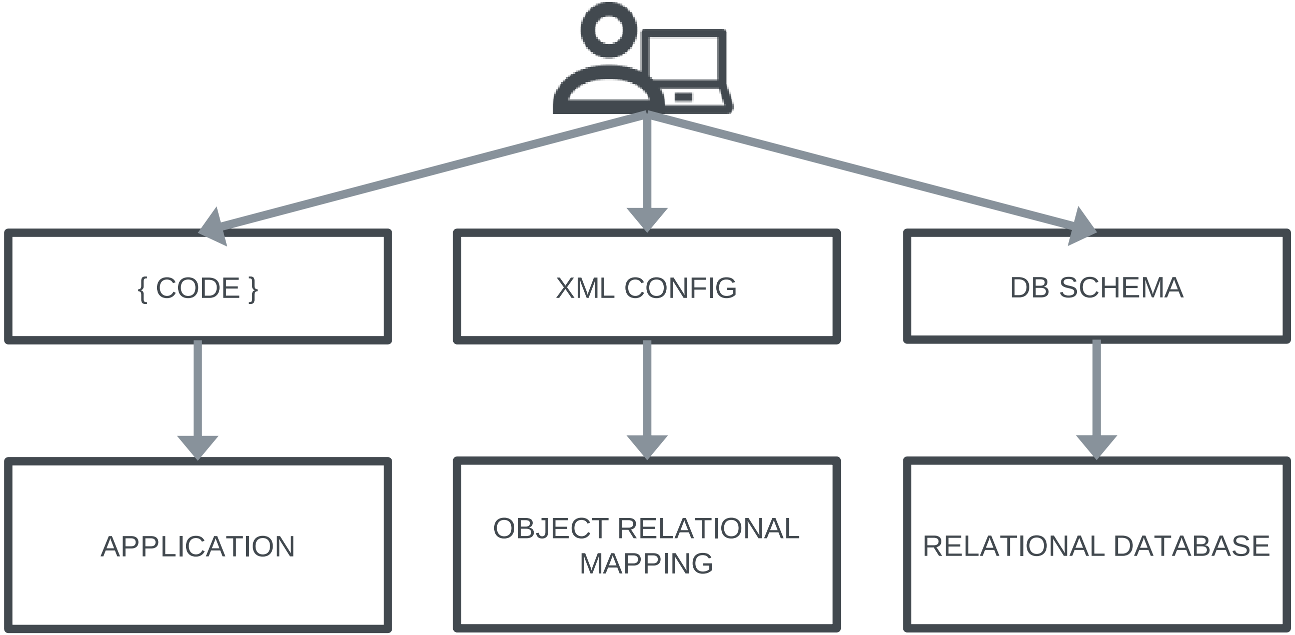


In Database Analytics provides application scalability

Security

Authentication, Authorization, Auditing and Encryption protect your data

Development – The Past



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XML CONFIG

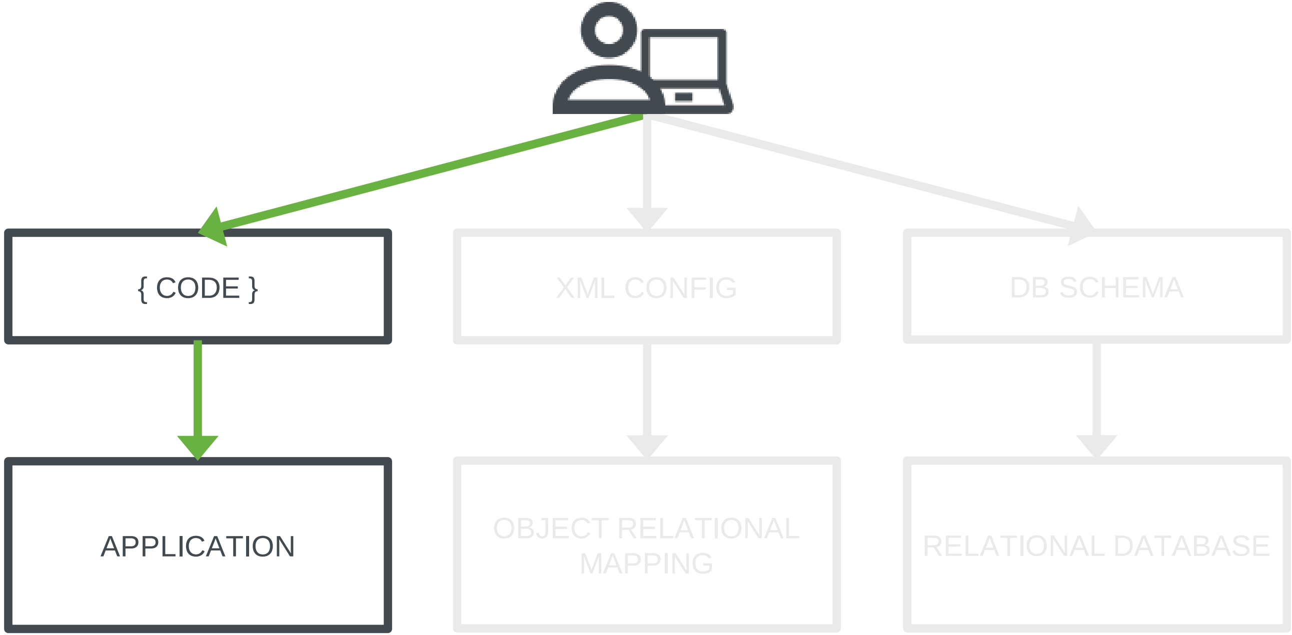
DB SCHEMA

APPLICATION

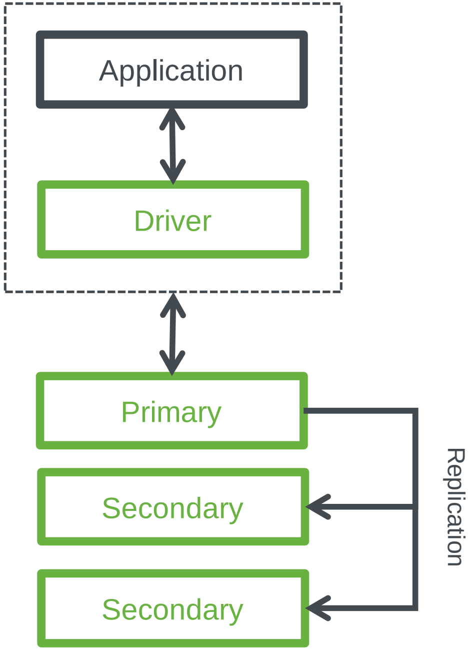
OBJECT RELATIONAL MAPPING

RELATIONAL DATABASE

Development – With MongoDB

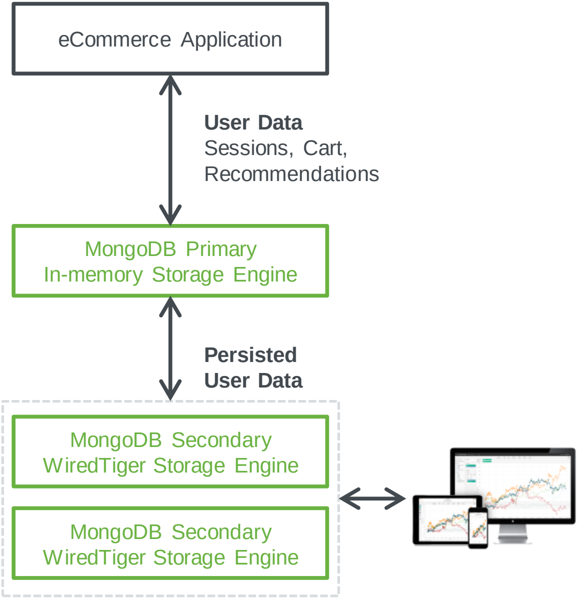


Replica Sets



- Replica set – 2 to 50 copies
- Replica sets make up a self-healing ‘shard’
- Data center awareness
- Replica sets address:
  - High availability
  - Data durability, consistency
  - Maintenance (e.g., HW swaps)
  - Disaster Recovery

Replica Sets – Workload Isolation



eCommerce Application

User Data
Sessions, Cart,
Recommendations

MongoDB Primary
In-memory Storage Engine

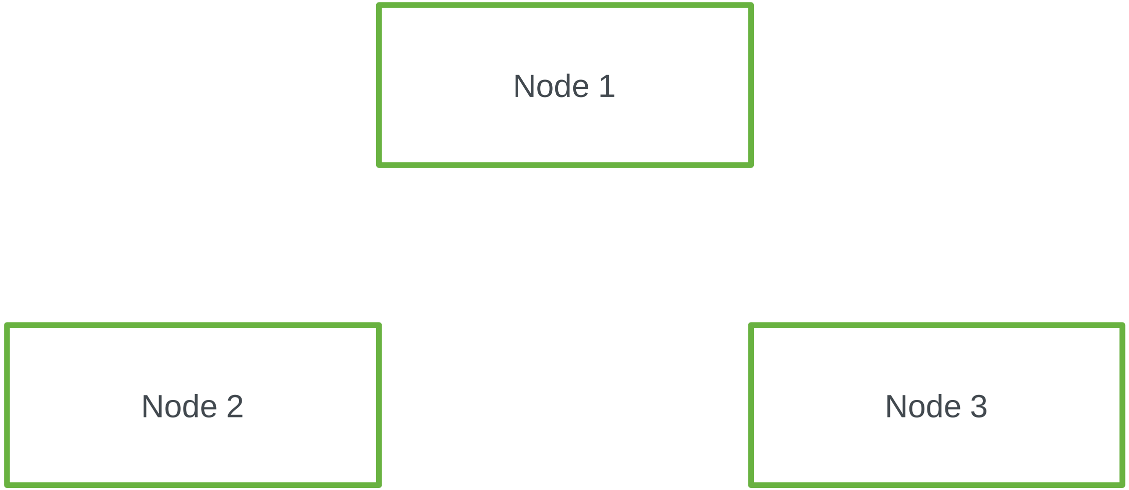
Persisted
User Data

MongoDB Secondary
WiredTiger Storage Engine

MongoDB Secondary
WiredTiger Storage Engine

- Replica sets enable workload isolation
- Example: Operational workloads on the primary node, analytical workloads on the secondary nodes

Replica Set Creation

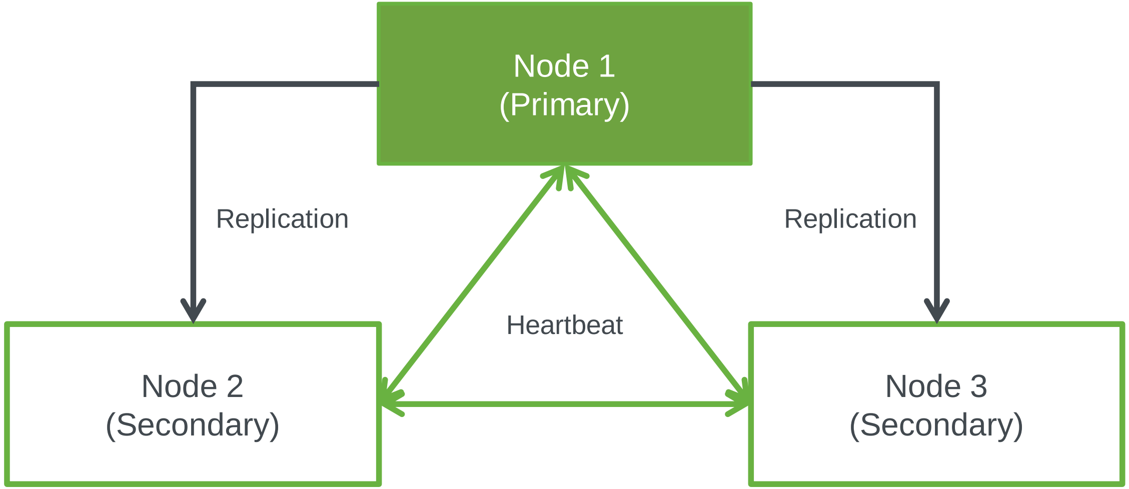


Node 1

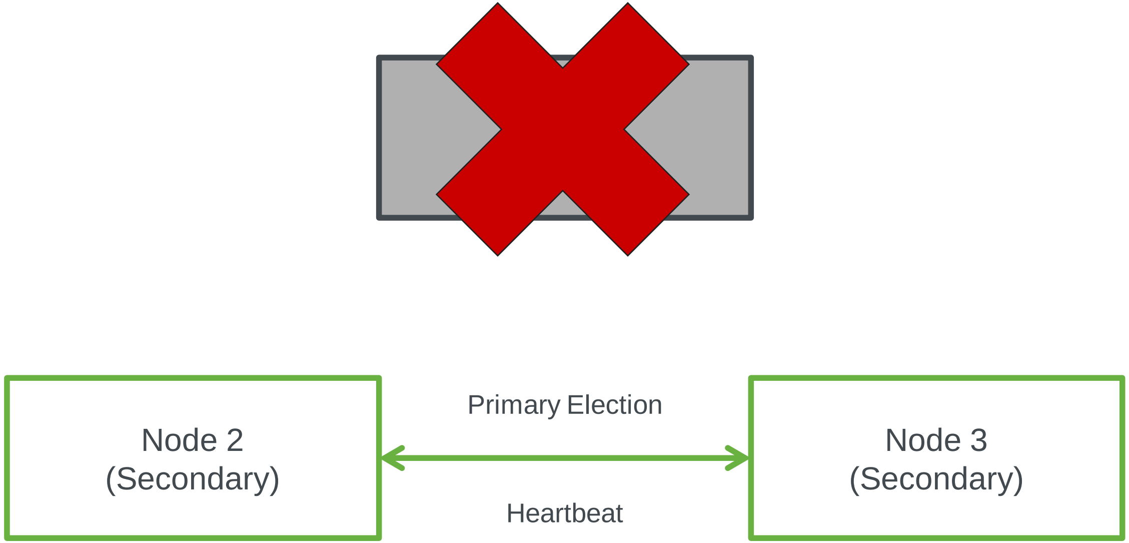
Node 2

Node 3

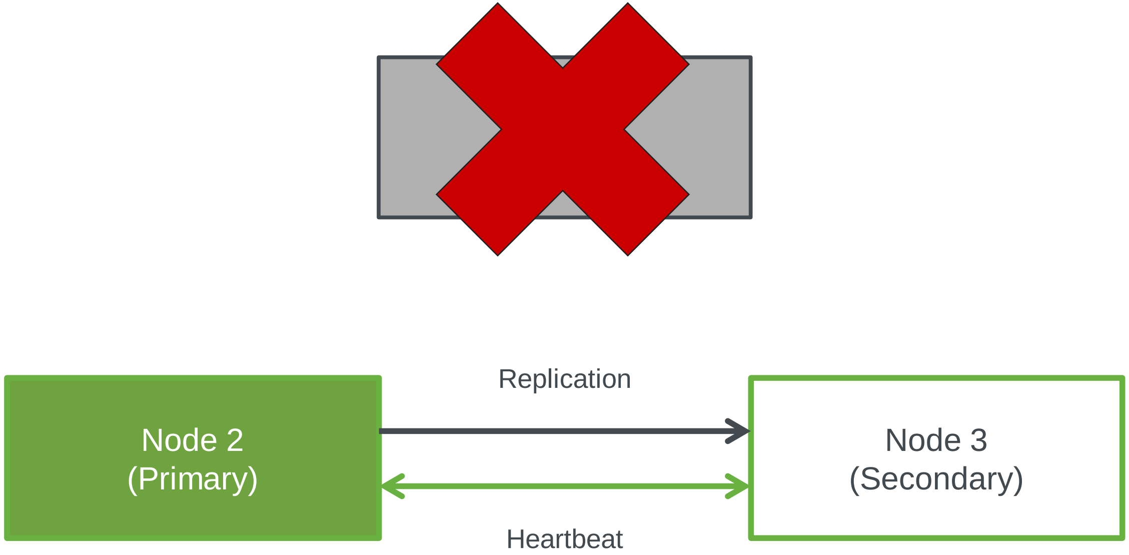
Replica Set - Initialize



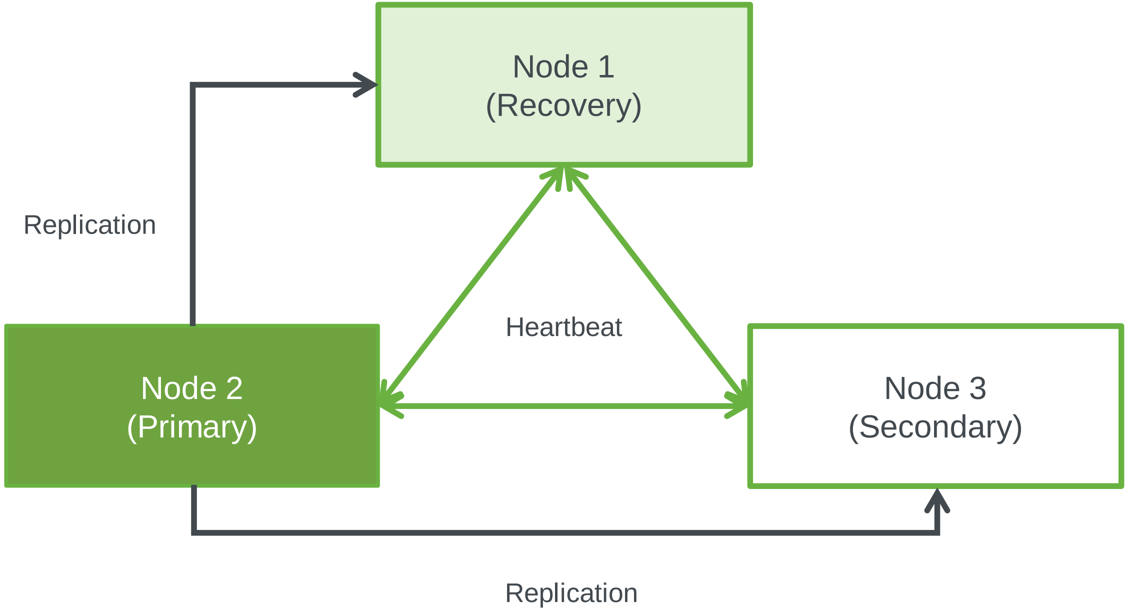
Replica Set - Failure



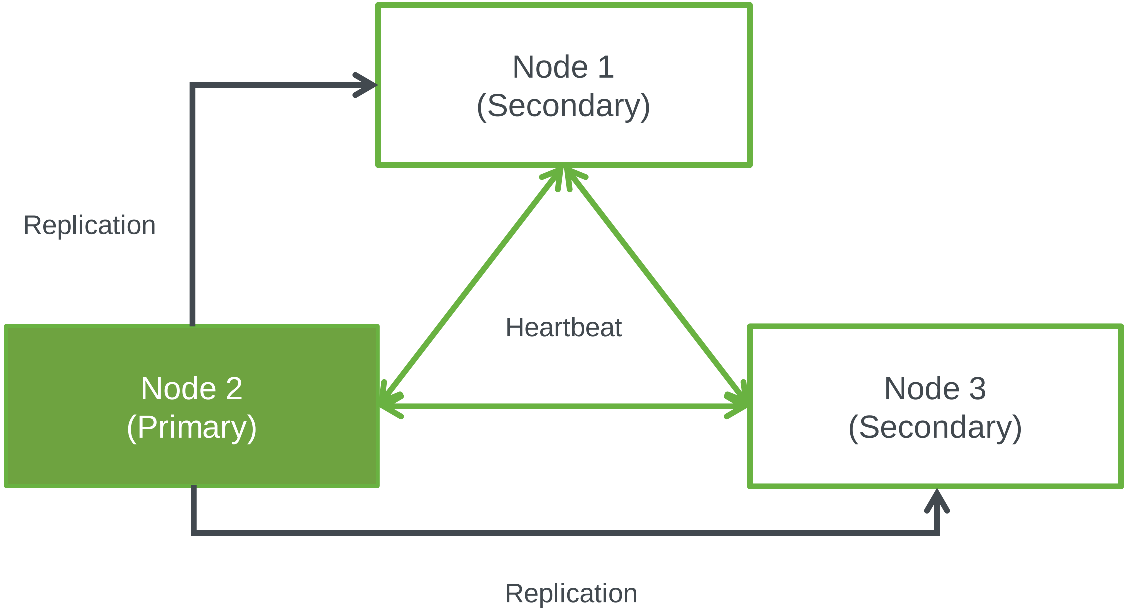
Replica Set - Failover



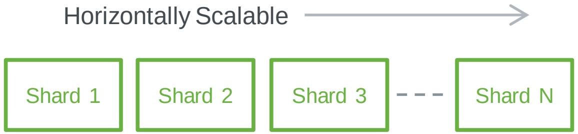
Replica Set - Recovery



Replica Set - Recovered



Elastic Scalability: Automatic Sharding



Horizontally Scalable

Shard 1

Shard 2

Shard 3

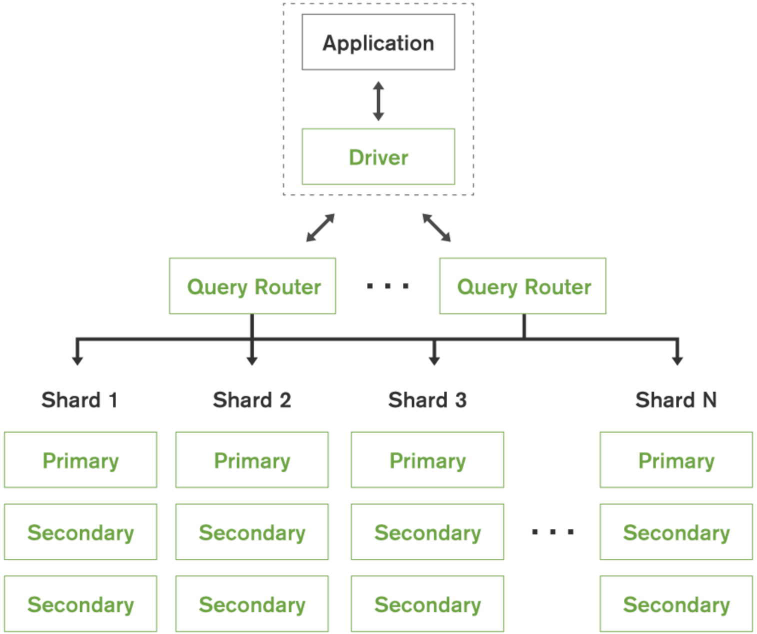
Shard N

- **Increase or decrease** capacity as you go
- Automatic load balancing
- Three types of sharding
  - Hash-based
  - Range-based
  - Tag-aware

Scalability with Sharding

- Shard key partitions the content
- MongoDB automatically balances the cluster
- Shards can be added dynamically to a live system
- Rebalancing happens in the background
- Shard key is immutable
- Shard key can route queries to a specific shard
- Queries without a shard key are sent to all members
  - Each member process its part in parallel.

Query Routing



- Multiple query optimization models
- Each of the sharding options are appropriate for different apps / use cases

Query Routing

- With a sharded cluster we use a routing layer to guide queries
- We use a daemon called MongoS (Mongo Shard Router)
- Daemon is stateless
- Can run as many as required
- Typically one per app server

Agenda de hoy

- ~~¿Porqué existe NoSQL?~~
- ~~Tipos de bases de datos NoSQL~~
- ~~Características clave de MongoDB~~
- ~~Tolerancia a fallos y persistencia de datos en MongoDB~~
- ~~Escalabilidad en MongoDB~~
- Preguntas

¿Preguntas?

mongoDB