Crossing the chasm with {"no":"SQL"}

Akmal B. Chaudhri
(艾克摩 曹理)

Abstract

This presentation will discuss the reasons for the rise and development of NoSQL technology, and compare and contrast the alternative approaches. It will also look back at previous generations of database systems over the past 20 years and assess how they have fared commercially and whether NoSQL vendors can learn anything from history to avoid the same mistakes and pitfalls. Looking ahead, this presentation will also discuss some future directions for NoSQL technology.

Agenda

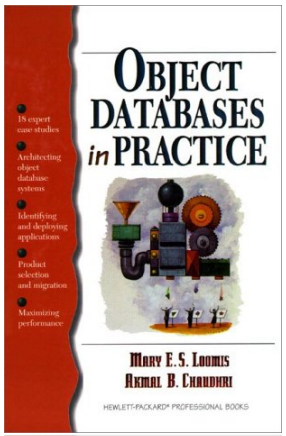
In a packed program ...

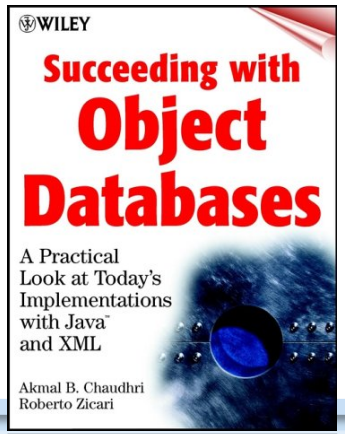
- Introduction
- NoSQL
- History repeats itself
- Market analysis
- Polyglot persistence
- NoSQL alternatives
- Summary
- Resources

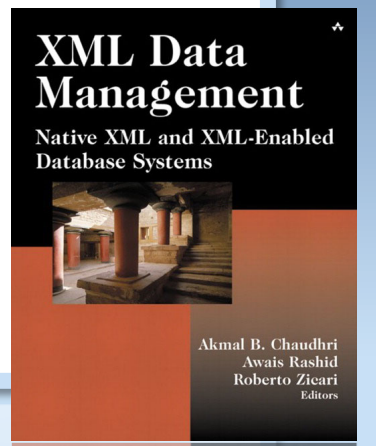
Introduction

My background

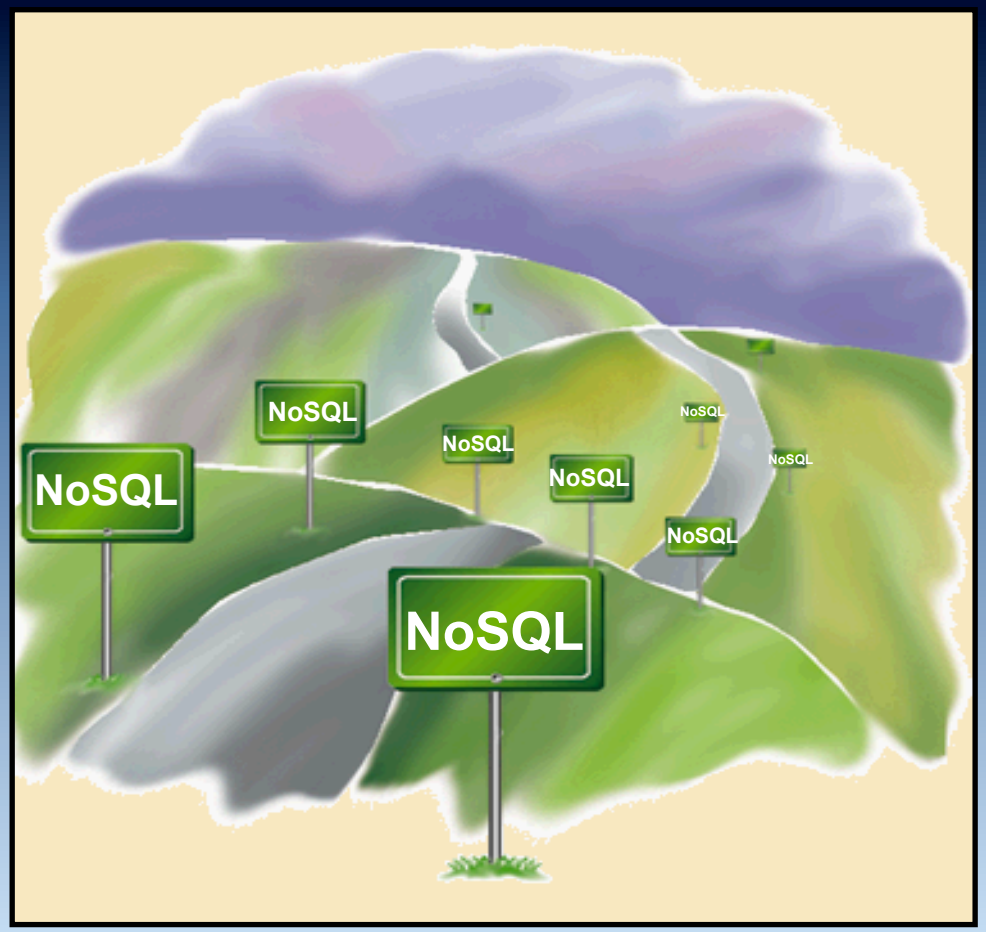
- ~25 years experience in IT
  - Developer (Reuters)
  - Academic (City University)
  - Consultant (Logica)
  - Technical Architect (CA)
  - Senior Architect (Informix)
  - Senior IT Specialist (IBM)
  - TI (Hortonworks)
- Broad industry experience
- Worked with various technologies
  - Programming languages
  - IDE
  - Database Systems
- Client-facing roles
  - Developers
  - Senior executives
  - Journalists
- Community outreach
- 10 books, many presentations



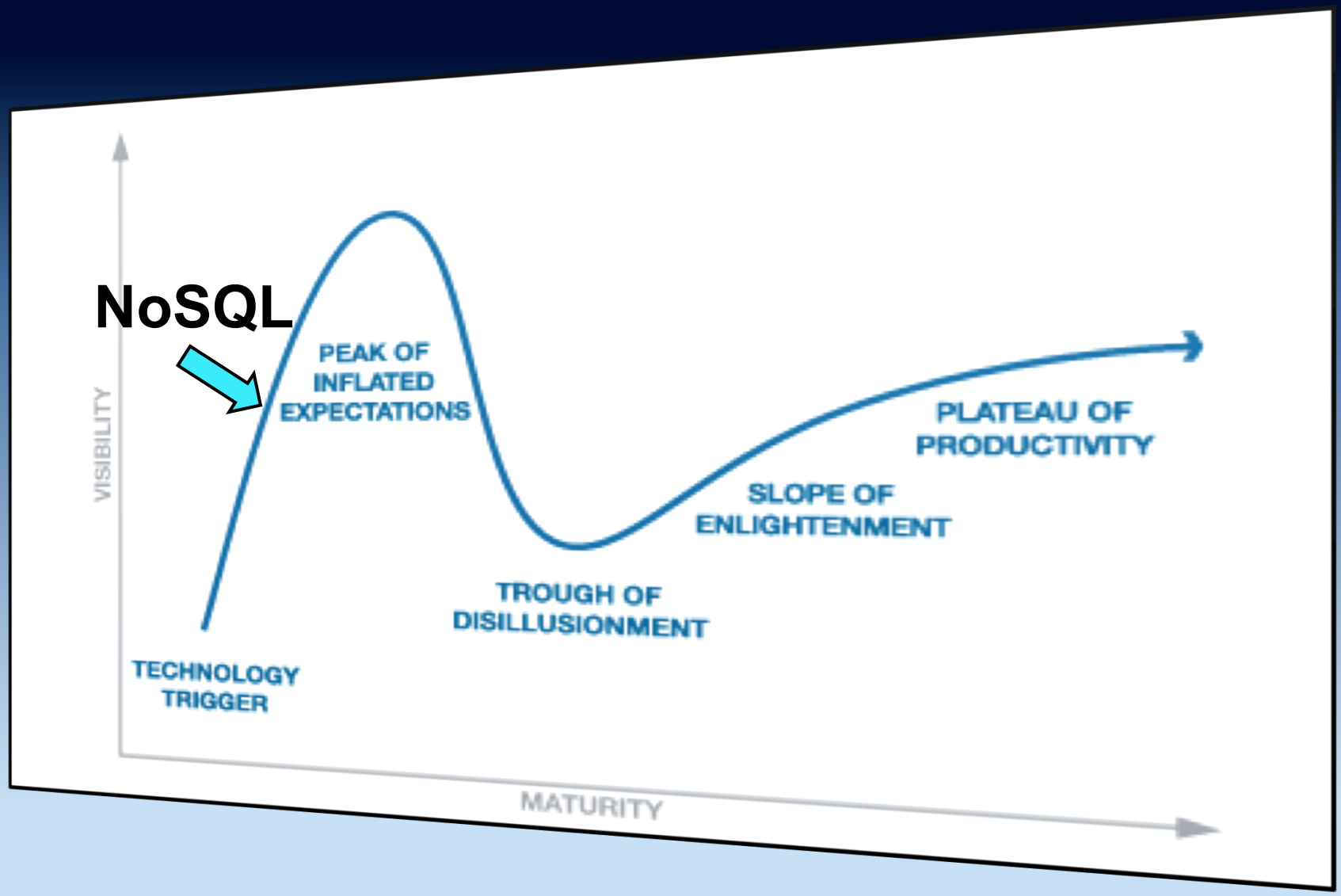




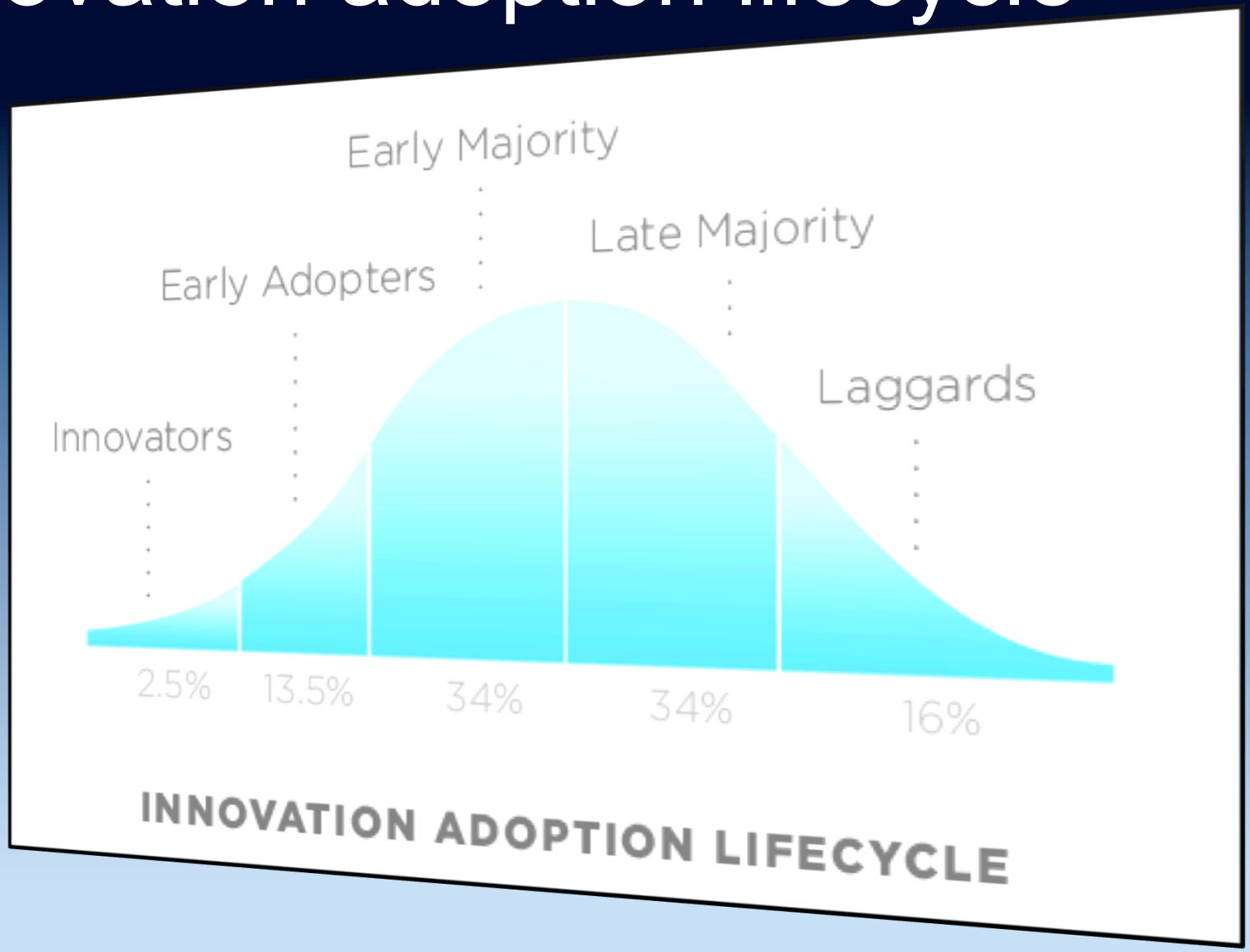
Your road leads to NoSQL?



Gartner hype curve

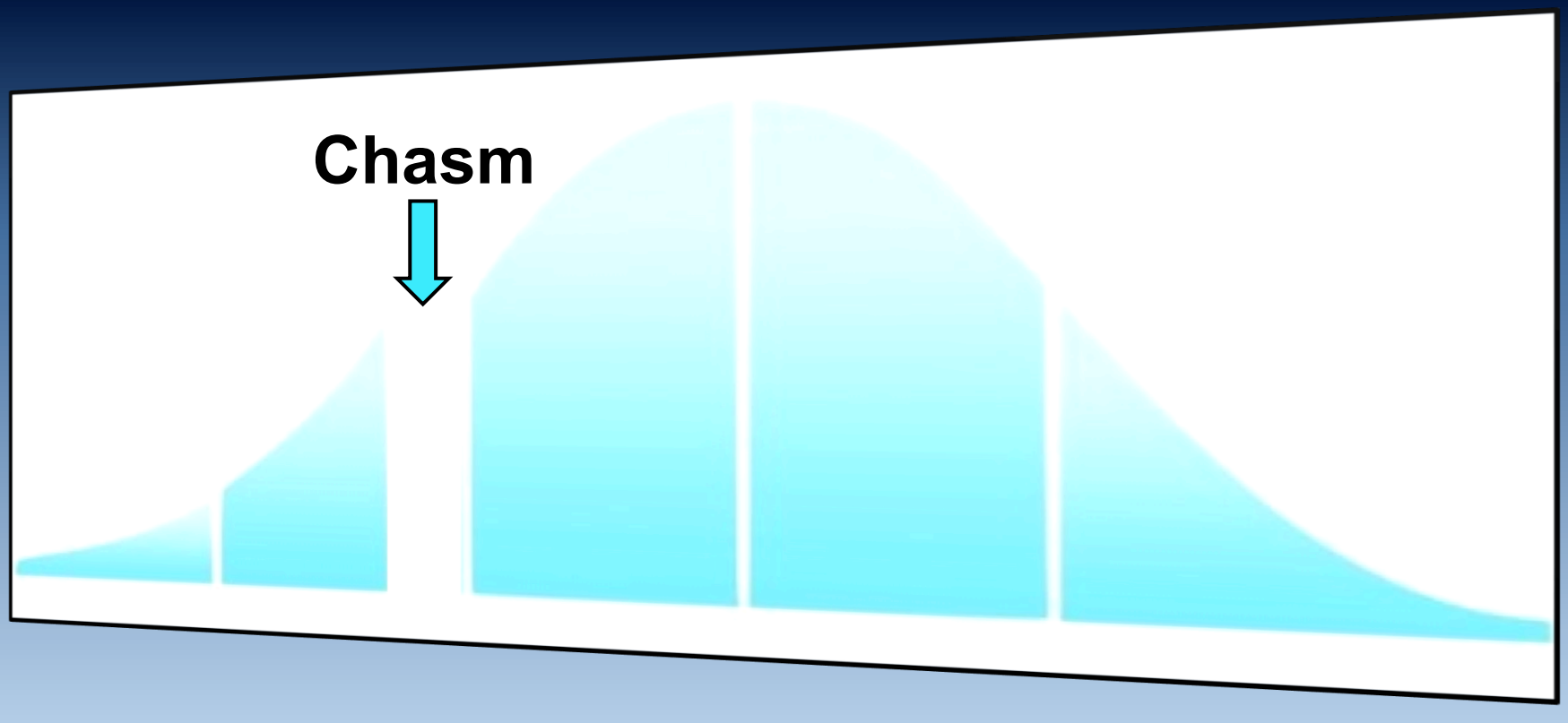


Innovation adoption lifecycle



Source: http://en.wikipedia.org/wiki/Technology_adoption_lifecycle

Crossing the chasm



Magic quadrant

LICENSED FOR DISTRIBUTION

Gartner

Magic Quadrant for Operational Database Management Systems

21 October 2013 ID:G00251780

Analyst(s): Donald Feinberg, Merv Adrian, Nick Heudecker

VIEW SUMMARY

The operational DBMS market (formerly OLTP) is evolving dramatically, with new, innovative entrants and incumbents supporting the growing use of unstructured data and NoSQL DBMS engines. Information management leaders must understand the market implications affecting DBMS technology decisions.

Learn how Gartner can help you succeed

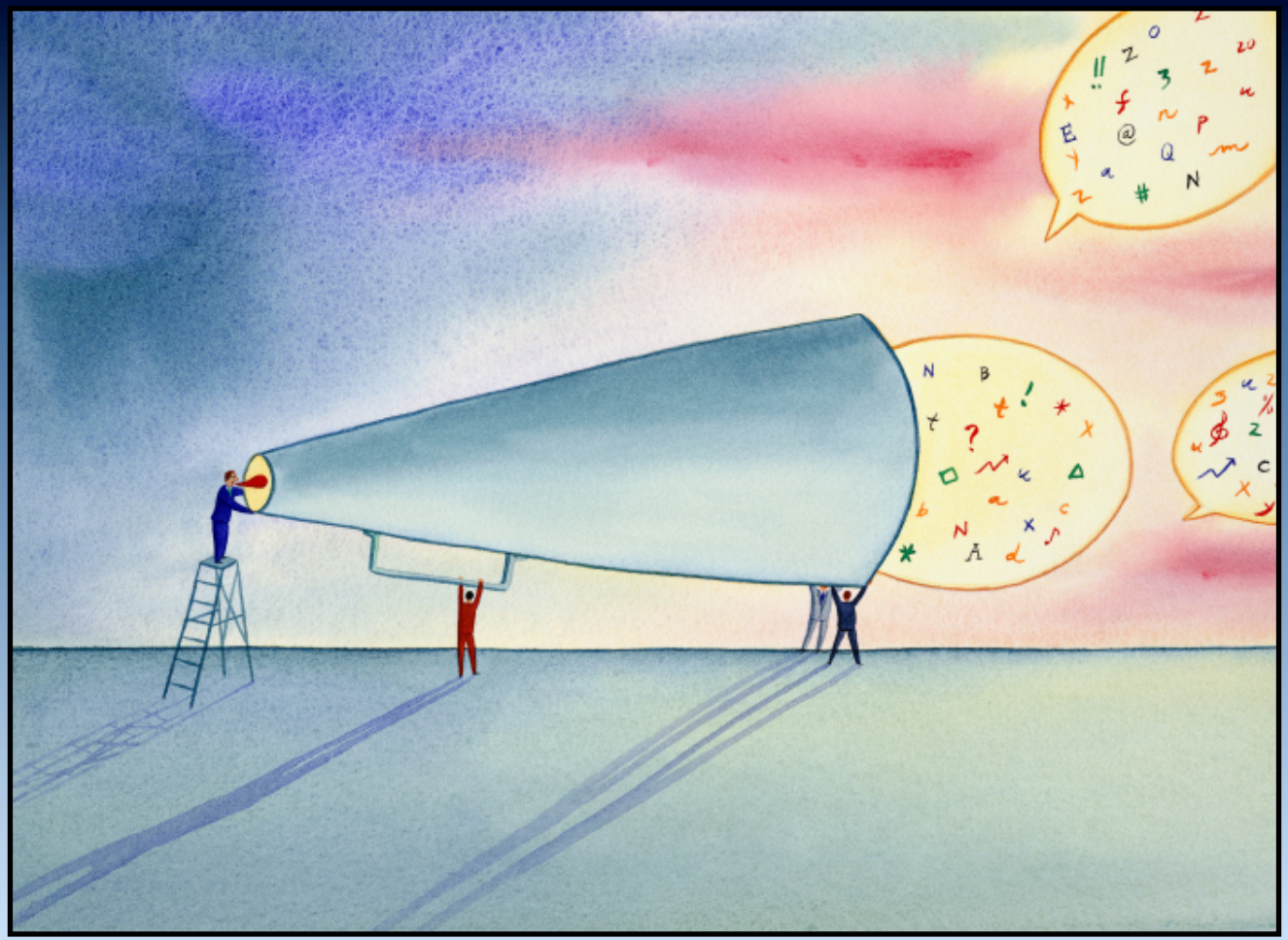
Become a Client now ▸

ACRONYM KEY AND GLOSSARY TERMS

ACID	atomicity, consistency, isolation and durability
ASE	Adaptive Server Enterprise
AWS	Amazon Web Services
DBMS	database management system

Source: Gartner (October 2013)

NoSQL hoopla and hype



Extra! extra! ...

Extra! extra! ...

Source: Inspired by "The Next Big Thing 2012" The Wall Street Journal 27 September 2012

Extra! extra! ...

EXAMINER
NOSQL: THE END OF RELATIONAL IS NIGH!
NEWS UPDATE
GOSSIP
ImageChef.com

Extra! extra! ...

EXAMINER
NOSQL ATE
ORACLE'S LUNCH
SHOCK! HORROR!
ImageChef.com

Extra! extra! ...

Source: Inspired by "MongoDB: Second Round" Thomas Jaspers 8 November 2012

Extra! extra! ...

Source: Inspired by "Why MongoDB is Awesome" John Nunemaker 15 May 2010 and "Why Neo4J is awesome in 5 slides" Florent Biville 29 October 2012

Extra! extra! ...

EXAMINER
SEXY NOSQL
MODEL
ON PAGE 3
NEWS UPDATE
GOSSIP
ImageChef.com

Extra! extra!

Source: Inspired by the movie “Airplane!” (1980)

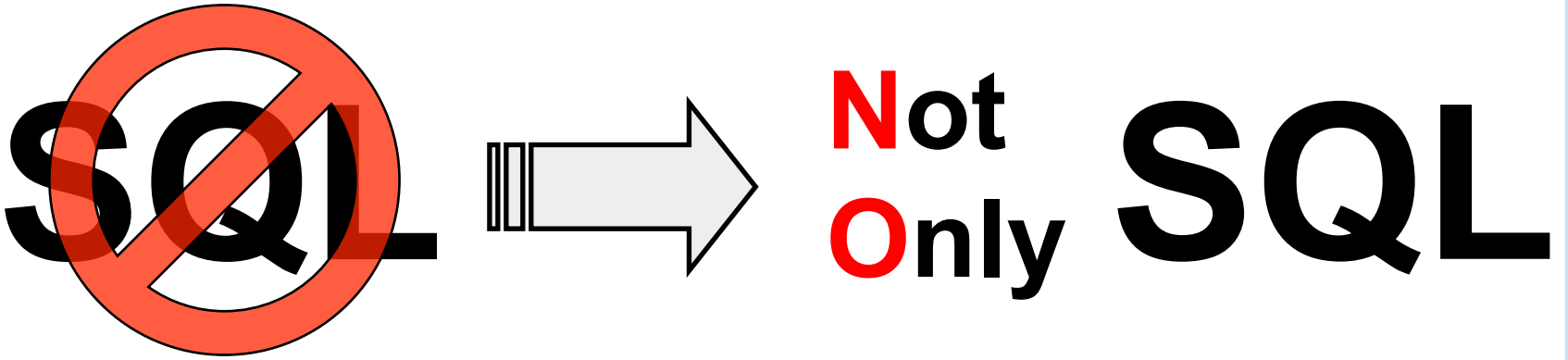
NoSQL

History

Have you run into limitations with traditional relational databases? Don't mind trading a query language for scalability? Or perhaps you just like shiny new things to try out? Either way this meetup is for you.

Join us in figuring out why these new fangled Dynamo clones and BigTables have become so popular lately.

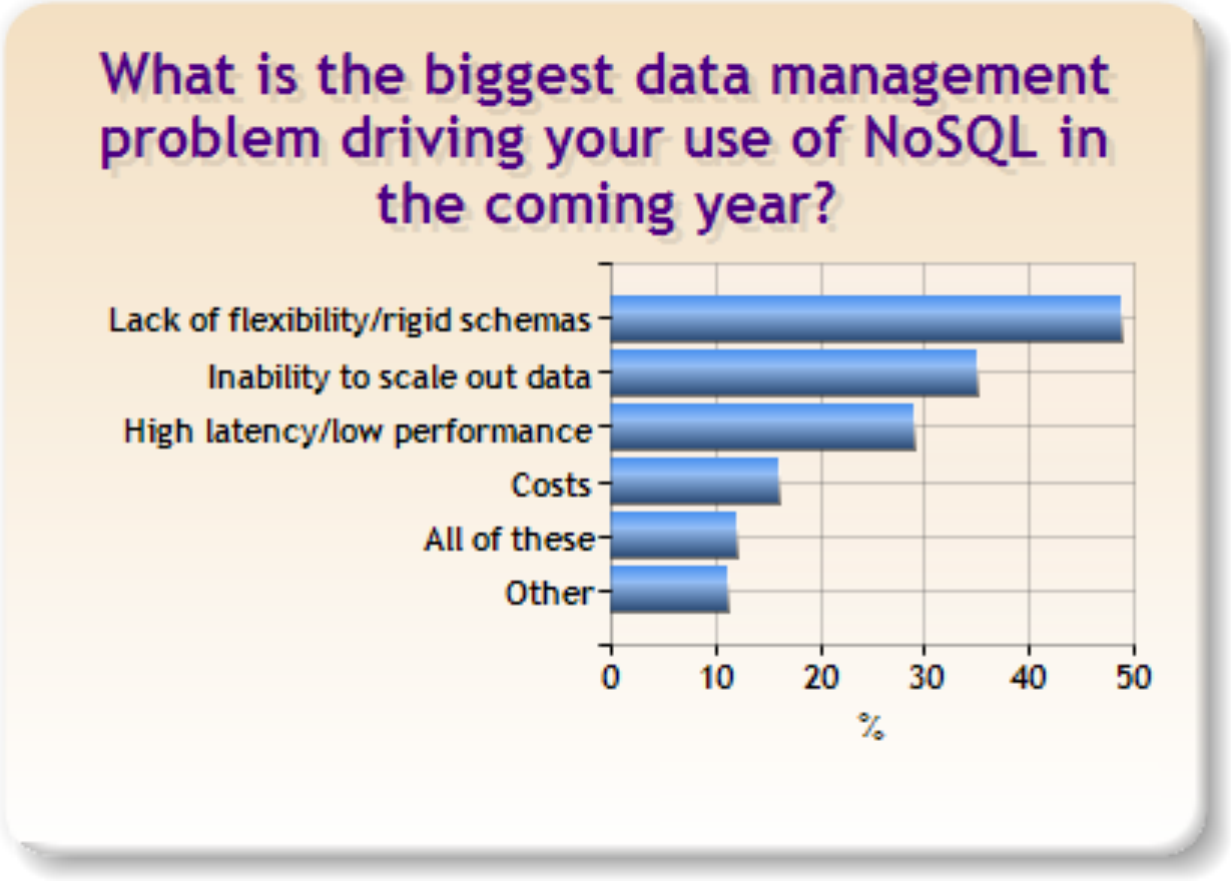
Source: http://nosql.eventbrite.com/


SQL
Not
Only
SQL

Why did NoSQL datastores arise?

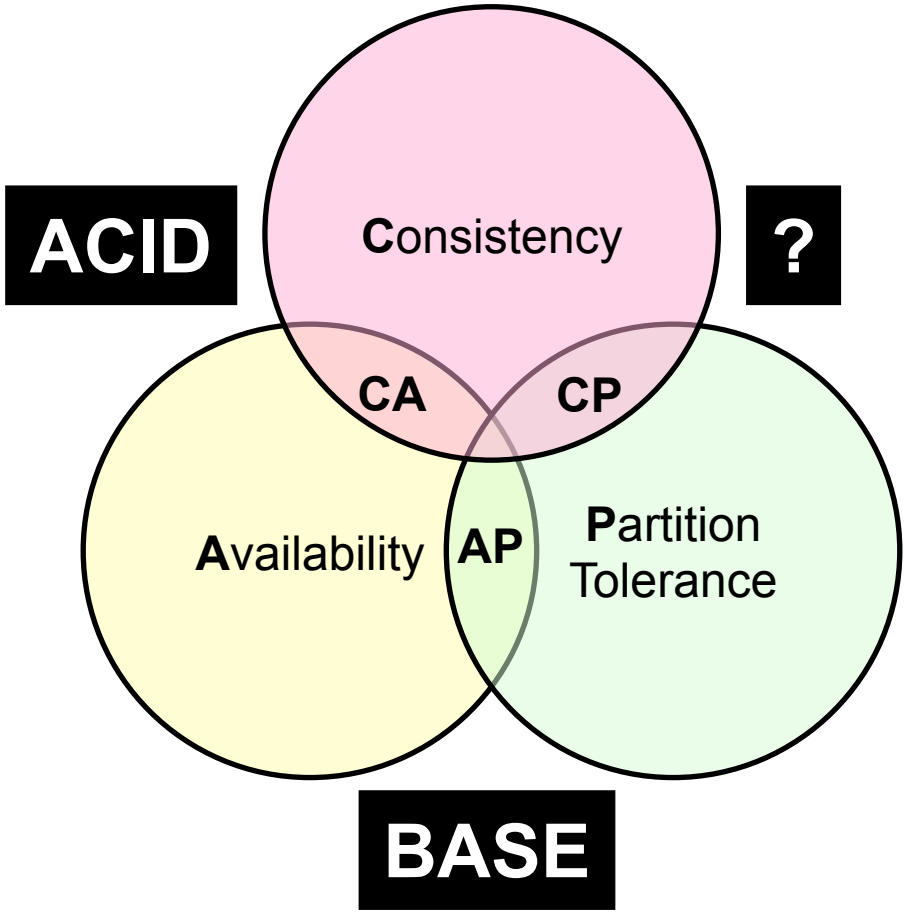
- Some applications need very few database features, but need high scale
- Desire to avoid data/schema pre-design altogether for simple applications
- Need for a low-latency, low-overhead API to access data
- Simplicity -- do not need fancy indexing -- just fast lookup by primary key

NoSQL drivers

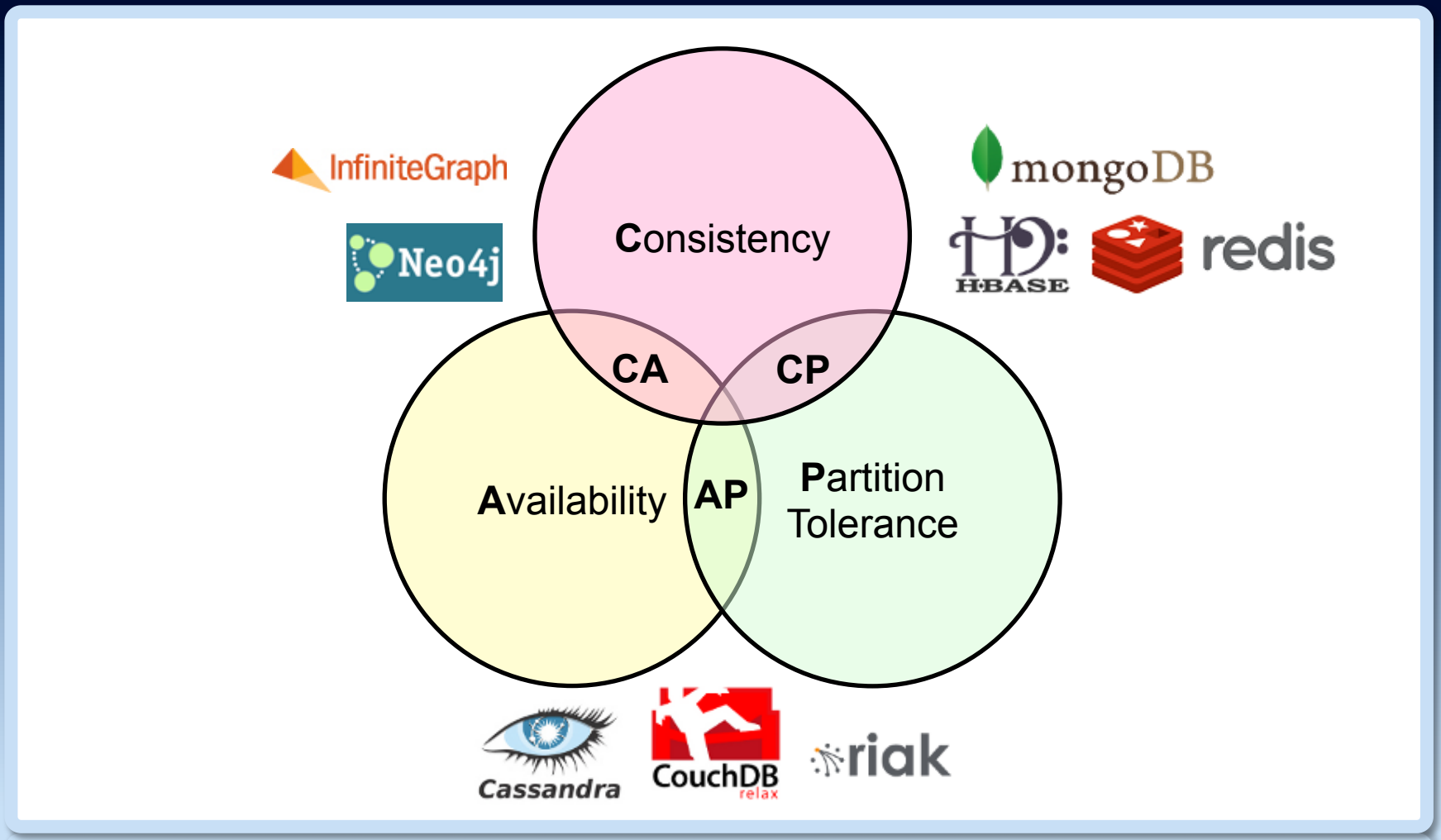


Source: Couchbase NoSQL Survey (December 2011)

Brewer's CAP Theorem ...



Brewer's CAP Theorem



ACID vs. BASE ...

- Atomicity
- Consistency
- Isolation
- Durability

- Basically Available
- Soft state
- Eventual consistency

ACID vs. BASE

ACID	BASE
• Strong consistency • Isolation • Focus on “commit” • Nested transactions • Conservative (pessimistic) • Availability • Difficult evolution	• Weak consistency • Availability first • Best effort • Approximate answers OK • Aggressive (optimistic) • Simpler, faster • Easier evolution

Source: After “Towards Robust Distributed Systems” Eric Brewer (2000)

But ...

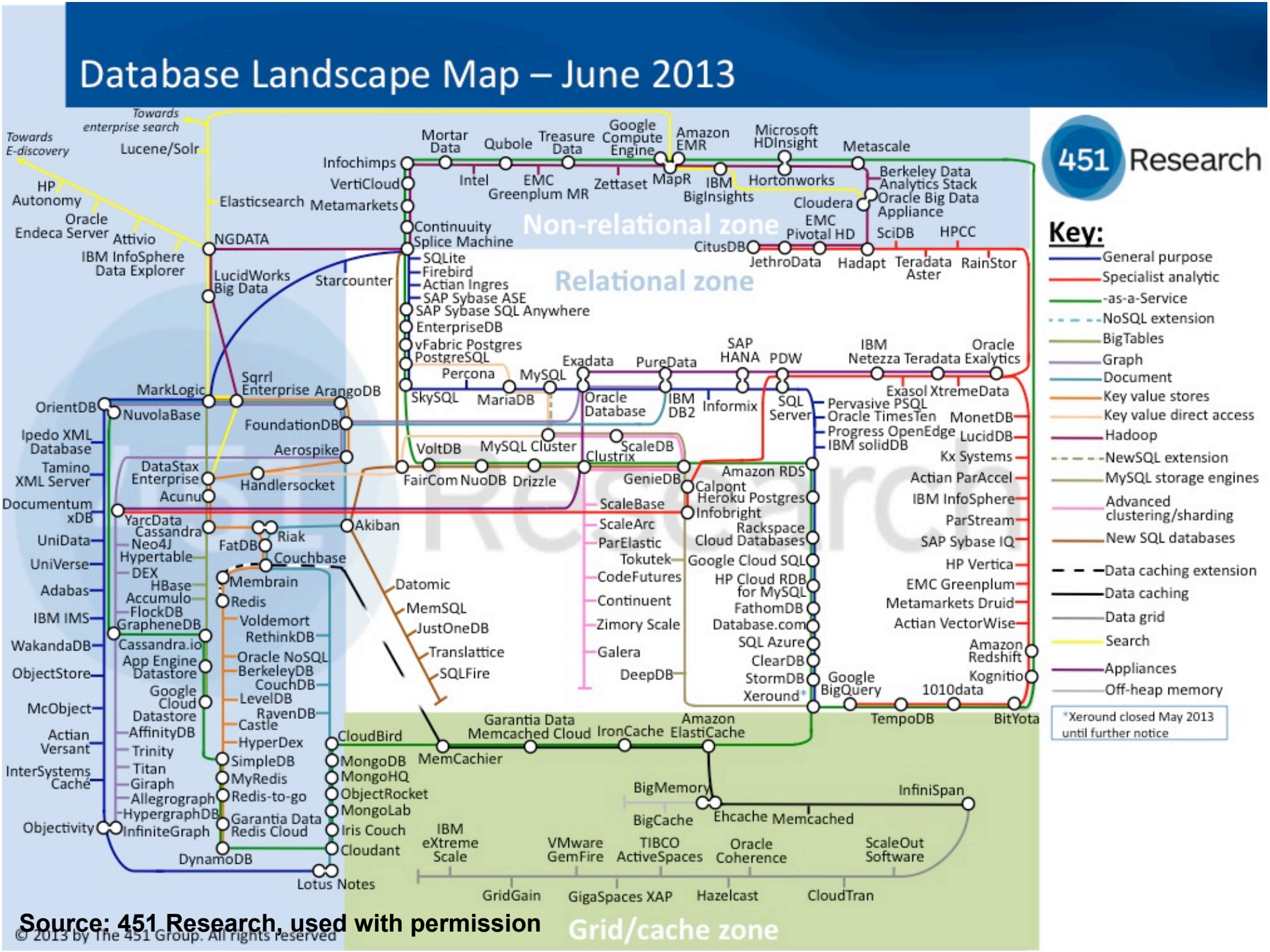
... we find developers spend a significant fraction of their time building extremely complex and error-prone mechanisms to cope with eventual consistency and handle data that may be out of date. We think this is an unacceptable burden to place on developers and that consistency problems should be solved at the database level.

Source: http://research.google.com/pubs/pub41344.html

Tuneable CAP

- Examples
  - Cassandra
  - Riak

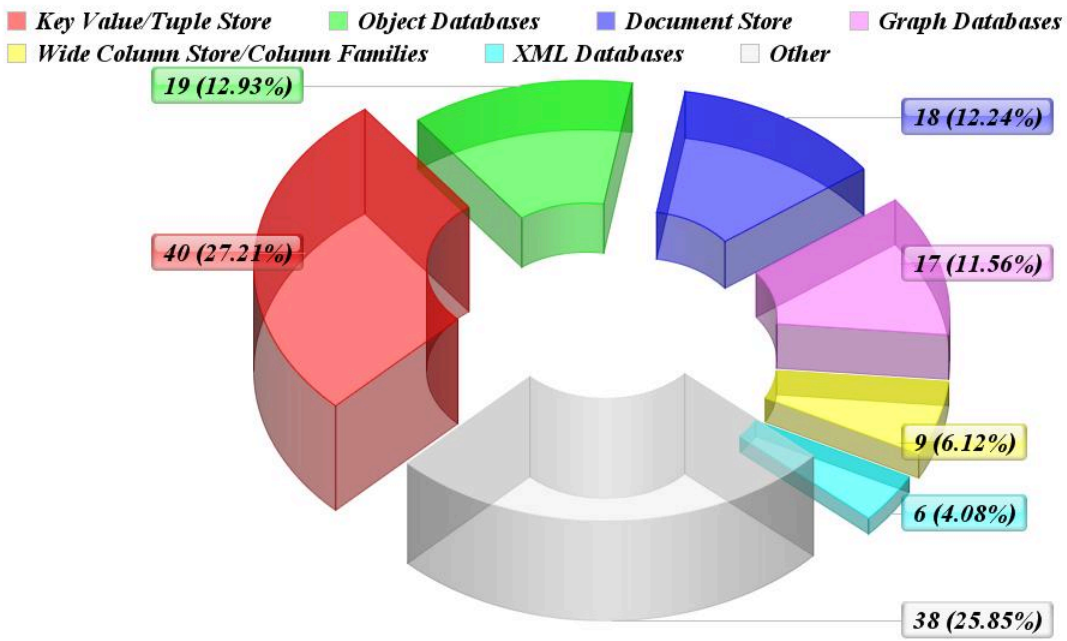
Database Landscape Map – June 2013



Source: 451 Research, used with permission

© 2013 by The 451 Group. All rights reserved

How many systems?



Source: http://nosql-database.org/ (October 2013)

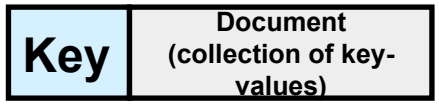
Choices, choices

Major categories of NoSQL ...

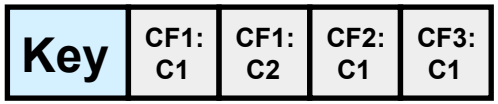
Type	Examples
Document store	
Column store	
Key-value store	
Graph store	

Major categories of NoSQL

Document store

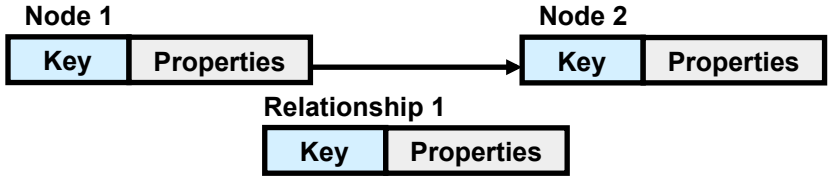


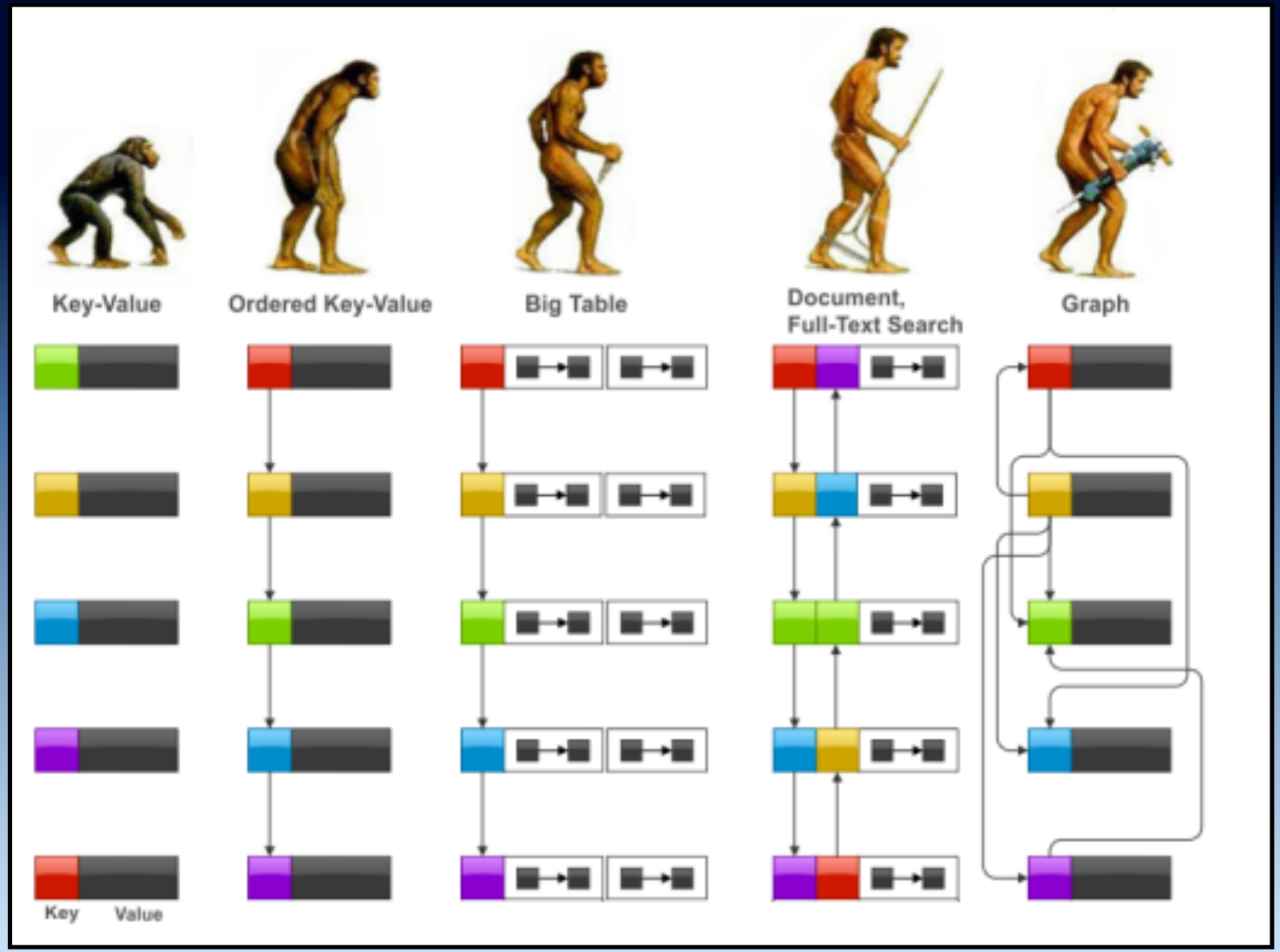
Column store



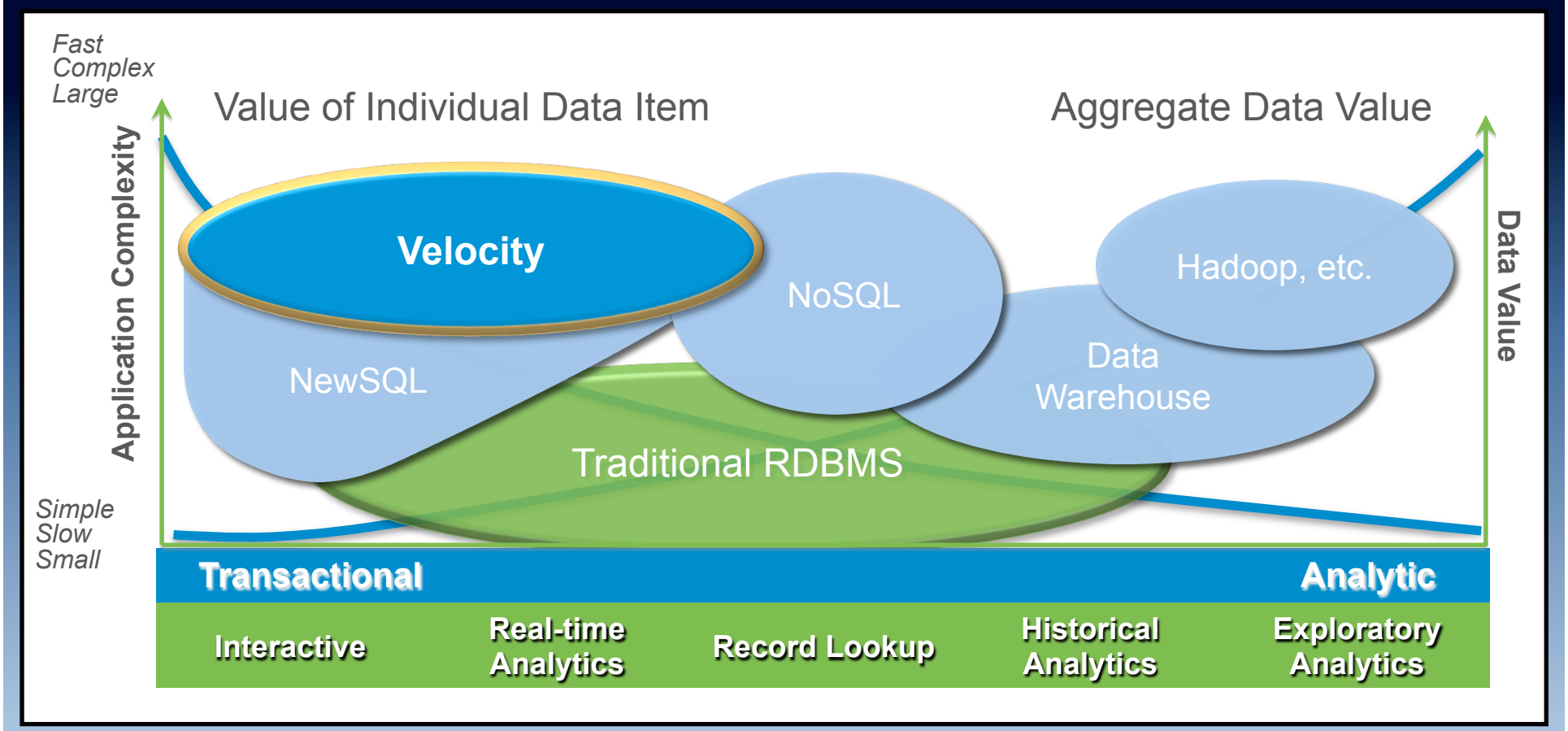
Key-value store

Graph store





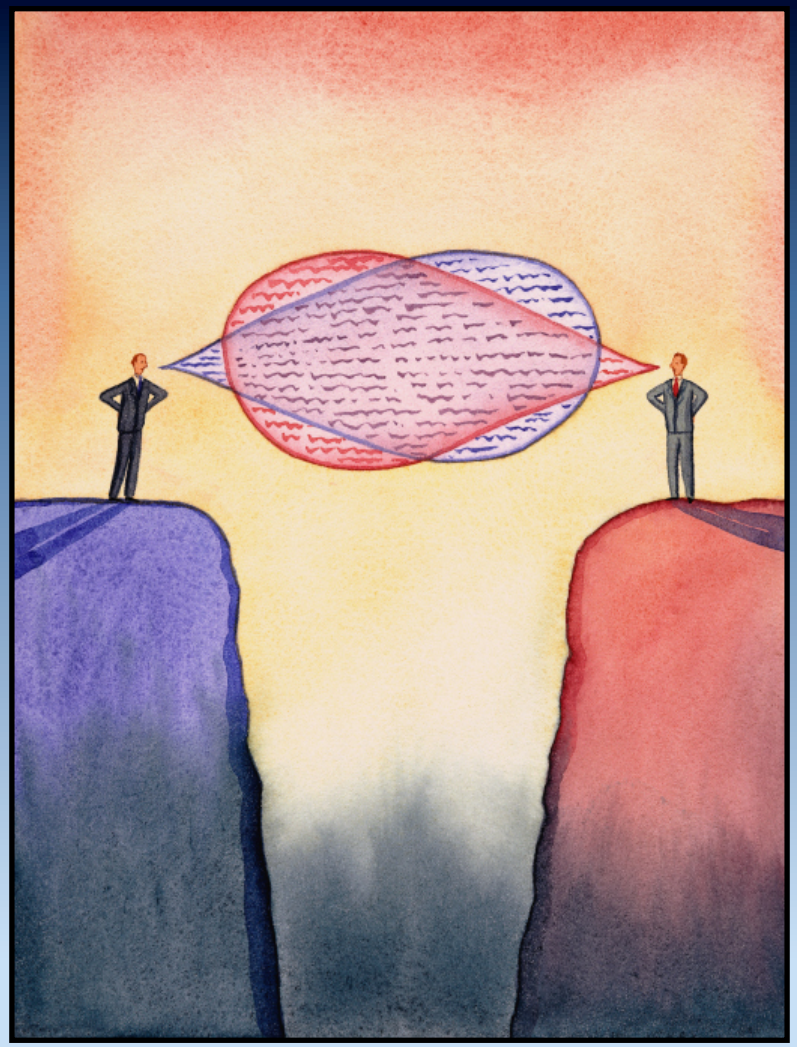
Source: Ilya Katsov, used with permission



Source: VoltDB, used with permission

History repeats itself

The great debate ...



The great debate ...

About every ten years or so, there is a "great debate" between, on the one hand, those who see the problem of data modelling through a more or less relational lens, and on the other, a noisier set of "refuseniks" who have a hot new thing to promote. The debate usually goes like this:

The great debate ...

Refuseniks: *Hah! You relational people with your flat tables and silly query languages! You are so unhip! You simply cannot deal with the problem of [INSERT NEW THING HERE]. With an [INSERT NEW THING HERE]-DBMS we will finish you, and grind your bones into dust!*

The great debate

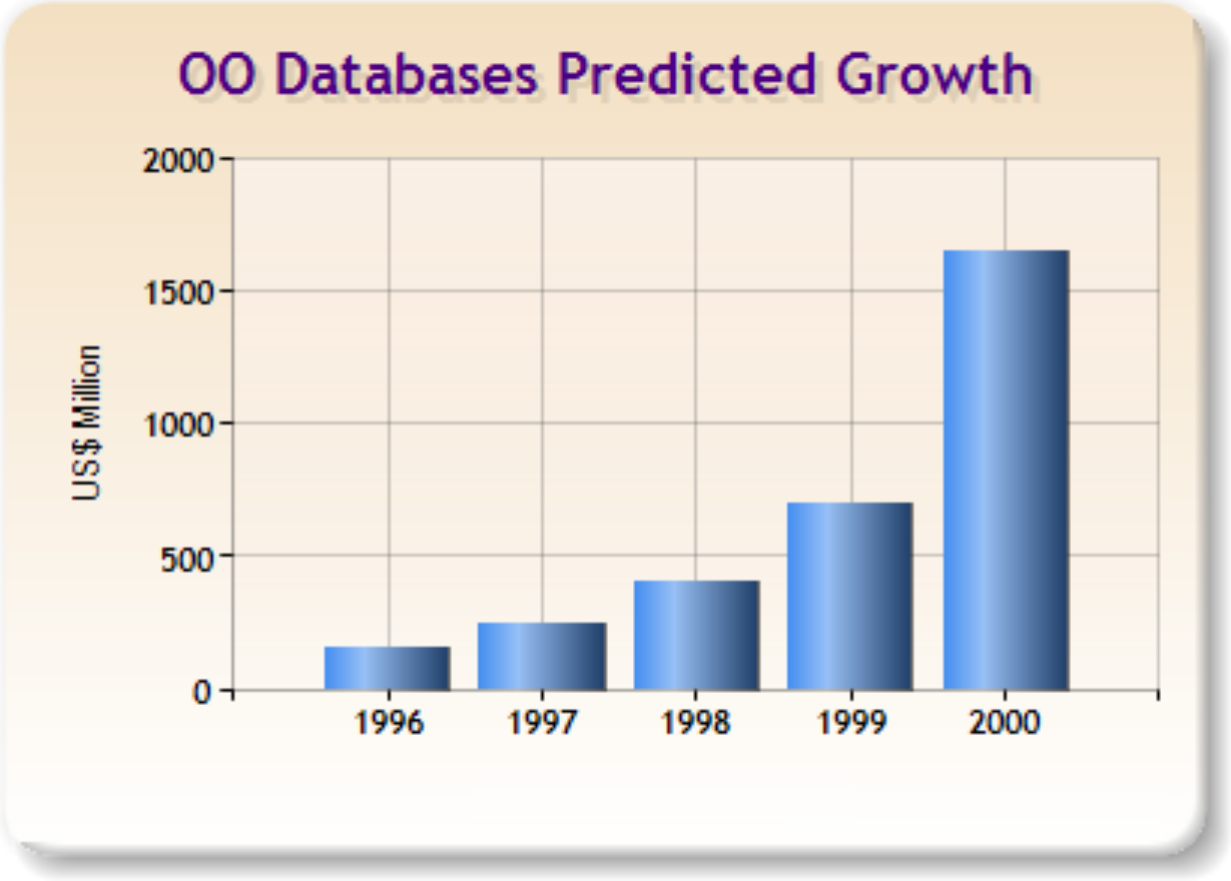
R-people: *You make some good points. But unfortunately a) there is an enormous amount of money invested in building scalable, efficient and reliable database management products and no one is going to drop all of that on the floor and b) you are confusing DBMS engineering decisions with theoretical questions. We plan to incorporate the best of these ideas into our products.*

Source: Paul Brown

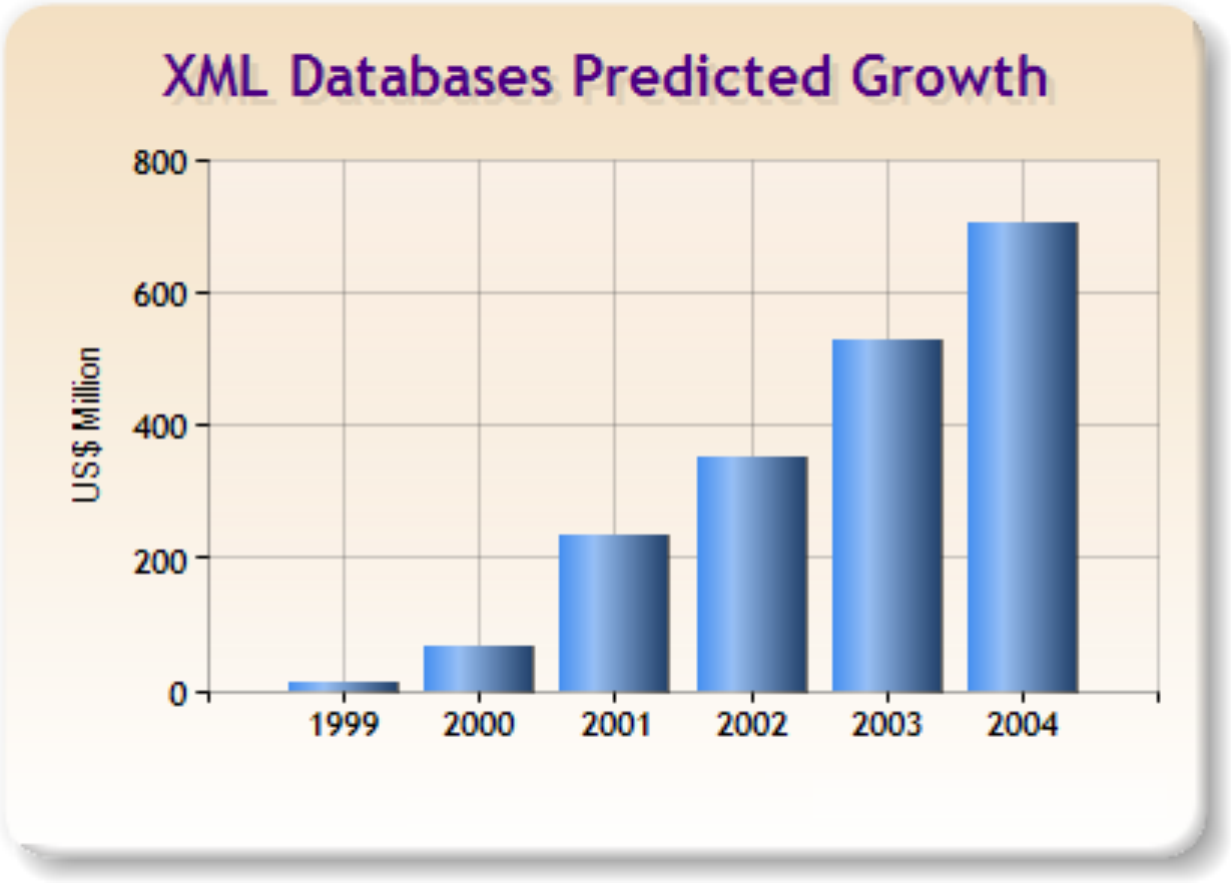
Past proclamations of the imminent demise of relational technology

- Object databases vs. relational
  - GemStone, ObjectStore, Objectivity, etc.
- In-memory databases vs. relational
  - TimesTen, SolidDB, etc.
- Persistence frameworks vs. relational
  - Hibernate, OpenJPA, etc.
- XML databases vs. relational
  - Tamino, BaseX, etc.
- Column-store databases vs. relational
  - Sybase IQ, Vertica, etc.

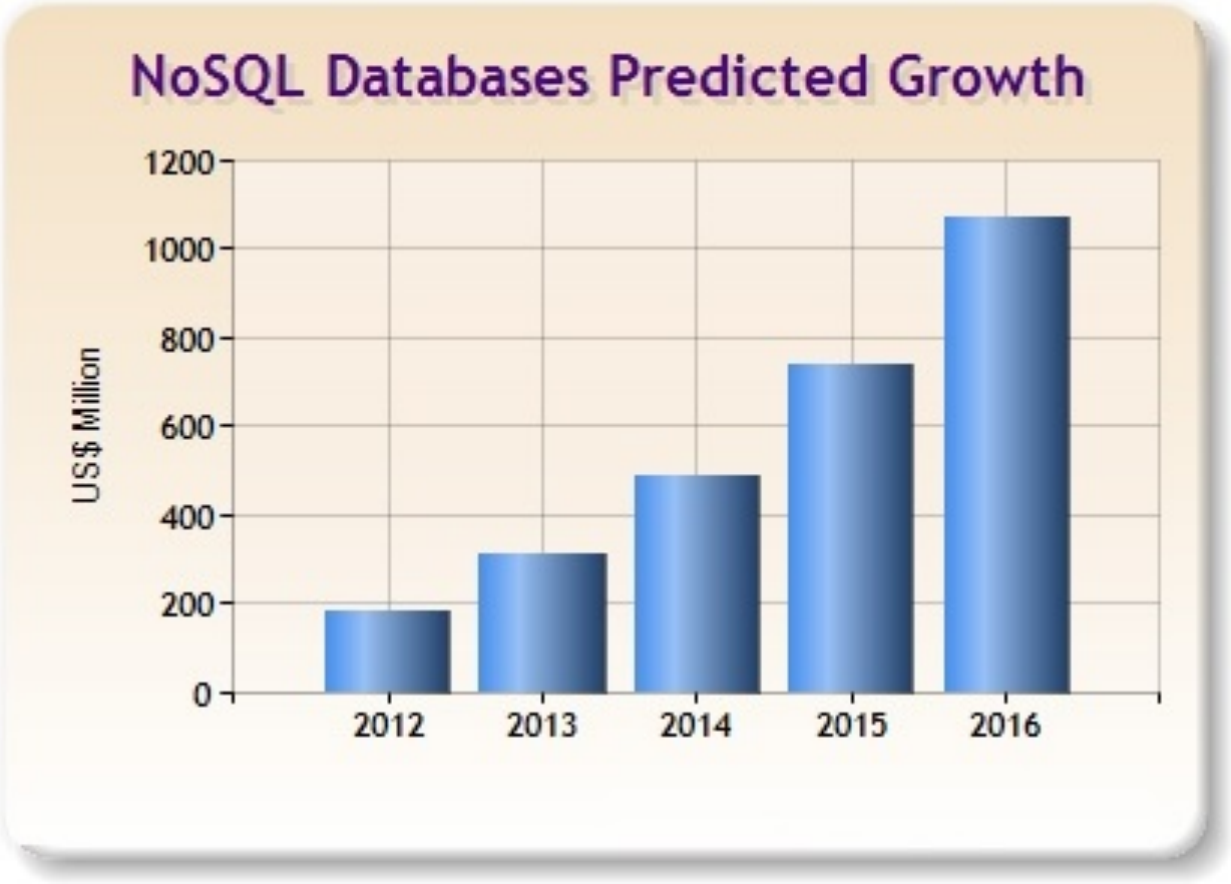
20 years ago


OO Databases Predicted Growth
US$ Million
2000
1500
1000
500
0
1996
1997
1998
1999
2000

10 years ago


XML Databases Predicted Growth
US$ Million
800
600
400
200
0
1999
2000
2001
2002
2003
2004

Today


NoSQL Databases Predicted Growth
US$ Million
1200
1000
800
600
400
200
0
2012
2013
2014
2015
2016

Object vs. Relational

Source: Inspired by comments from Esther Dyson during the 1990s

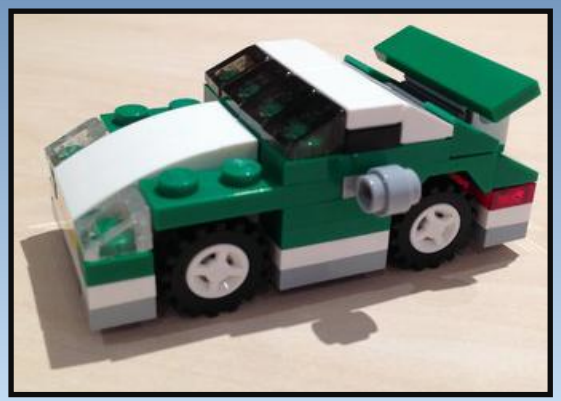
XML vs. Relational

Source: Inspired by https://webspace.utexas.edu/curtispe/NatConf/tam2005.html

NoSQL vs. Relational

Source: Inspired by http://www.slideshare.net/mongodb/webinar-the-opex-business-plan-for-nosql/ and http://www.slideshare.net/lj101197/couchbase-overview033113long/

But ...



The way developers really think

TNBT* is developer-friendly

*The Next Big Thing

But ...

Riak ... We're talking about nearly a year of learning.[1]

Things I wish I knew about MongoDB a year ago[2]

I am learning Cassandra. It is not easy.[3]

[1] http://productionscale.com/blog/2011/11/20/building-an-application-upon-riak-part-1.html
[2] http://snmaynard.com/2012/10/17/things-i-wish-i-knew-about-mongodb-a-year-ago/
[3] http://planetcassandra.org/blog/post/datastax-java-driver-for-apache-cassandra

Reasons for OODB failure ...

- Relational “dies hard”
  - Tremendous investment in SQL skills and tools
  - Comfort factor
  - Nobody got fired for buying Relational
- Relational customers waited for OO support
  - … or OO support simply not required
  - Growth in Object-Relational mapping and ORDBs
- Mismatch between OODBs and corporate data stores

Reasons for OODB failure ...

- Internal issues
  - Preferred database supplier
  - New developments postponed due to Y2K
- Proprietary query interfaces
- Poor standards support
- Lack of tools
- Lack of expertise
- Long-term risks

Reasons for OODB failure

Object-oriented database management could use a high-profile champion, but the realities are that revenue estimates for the ODBMS vendors are under $50 million even for the largest (ODI), and all of them together have less revenue than Oracle spends on advertising.

-- Nelson H. King

Source: "Object DBMSs: Now or Never" Nelson H. King (1997)

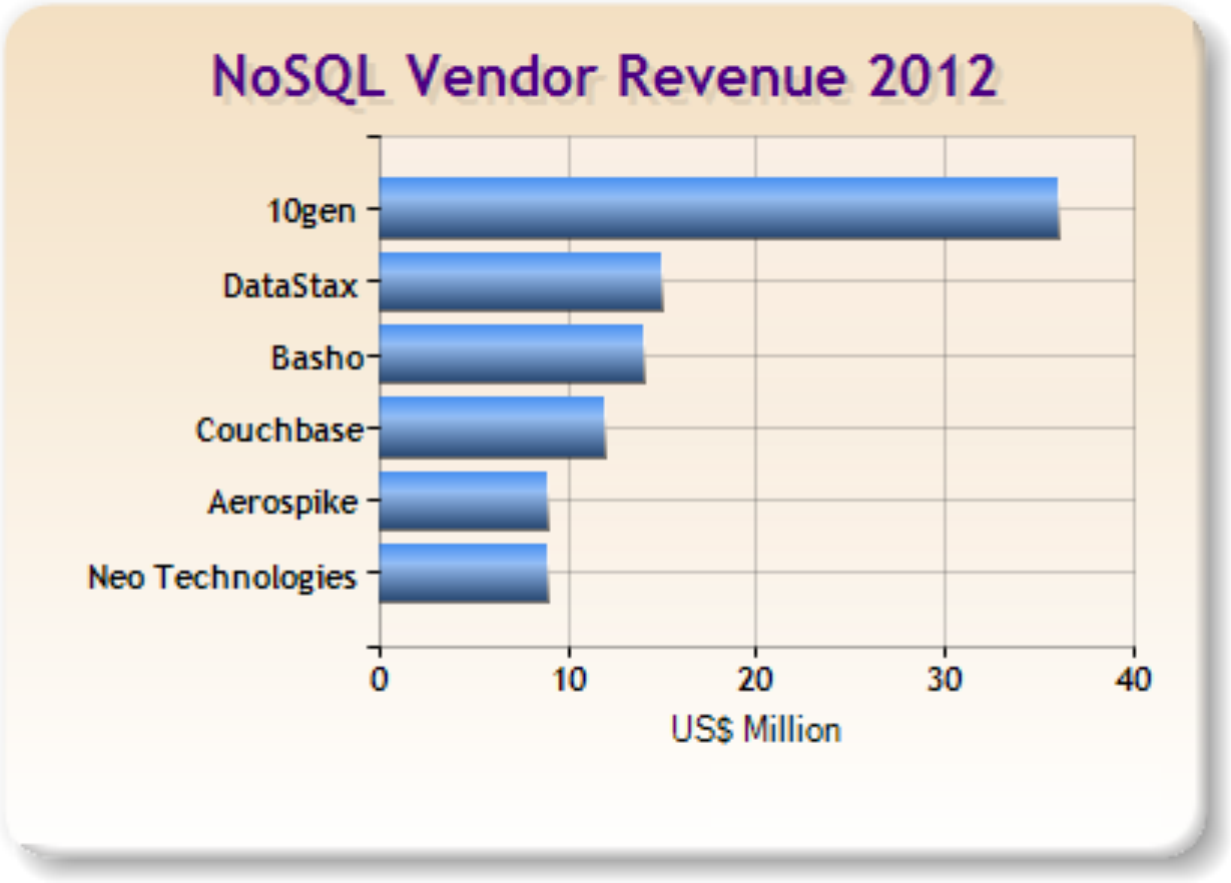
Market analysis

NoSQL market size ...

- Private companies do not publish results
- Venture Capital (VC) funding 10s/100s of millions of US $[1]
- NoSQL software revenue was US $20 million in 2011[2]

[1] http://blogs.the451group.com/information_management/2011/11/15/
[2] http://blogs.the451group.com/information_management/2012/05/

NoSQL market size

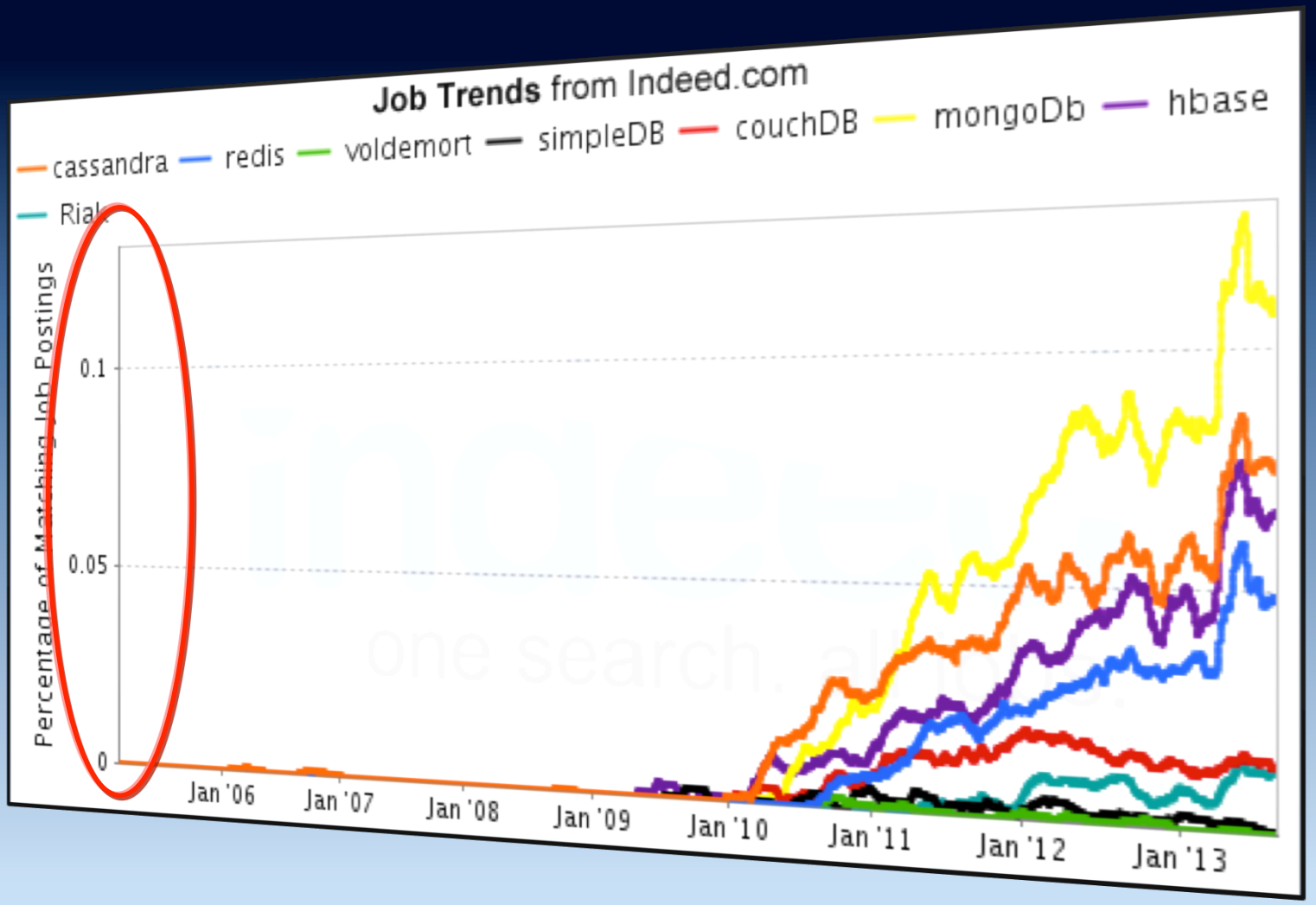


Source: http://wikibon.org/wiki/v/Big_Data_Vendor_Revenue_and_Market_Forecast_2012-2017

NoSQL job trends

Example:

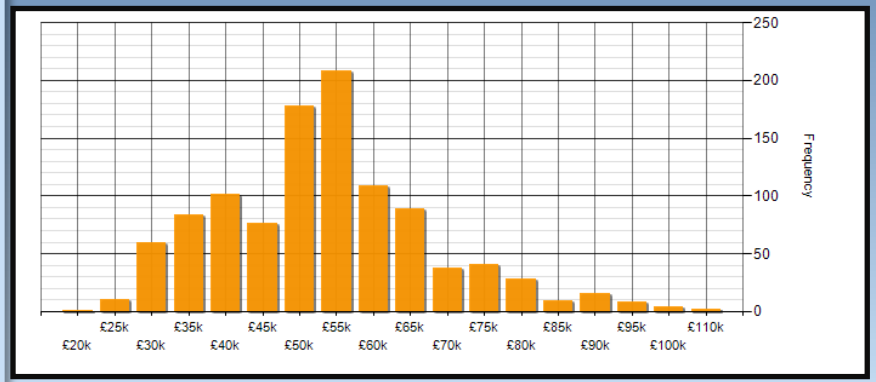
100,000
x 0.1 %
= 100 jobs!



Source: http://regulargeek.com/2012/08/30/nosql-job-trends-august-2012/ (October 2013)

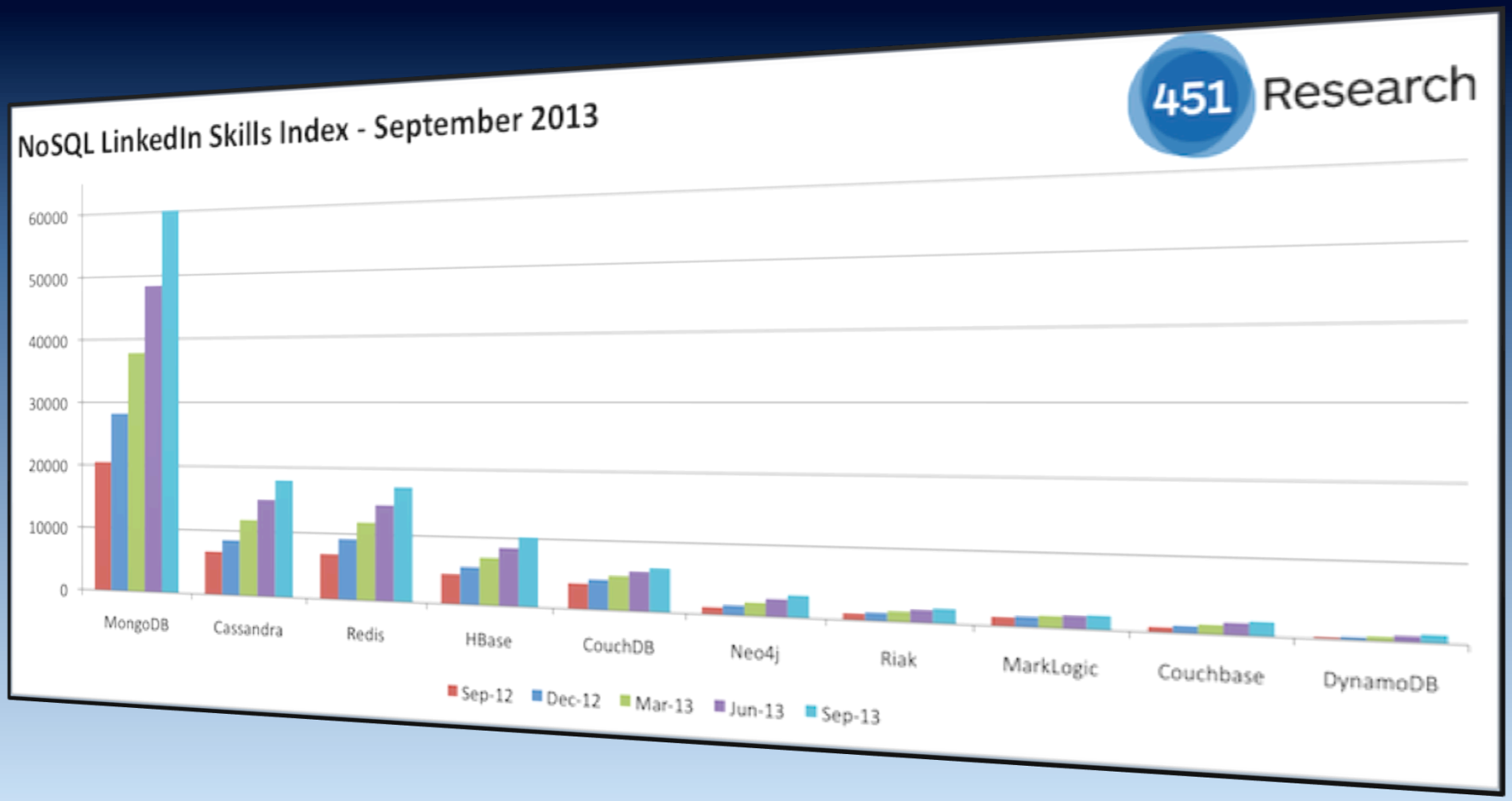
NoSQL jobs in the UK

- Database and Business Intelligence
  - MongoDB (901)
  - Cassandra (363)
  - Redis (292)
  - HBase (146)
  - CouchDB (141)
  - Hive (130)
  - Couchbase (120)



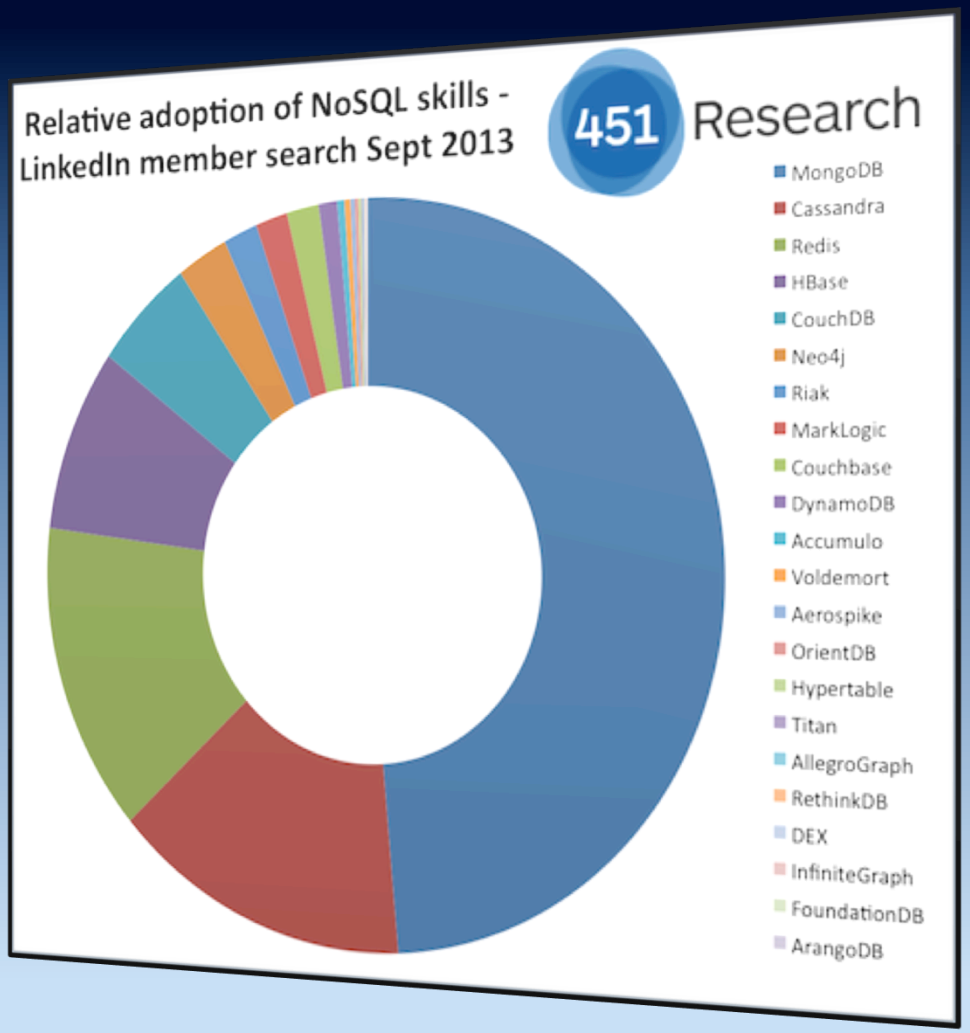
Source: http://www.itjobswatch.co.uk/jobs/uk/nosql.do (October 2013)

NoSQL LinkedIn skills index ...



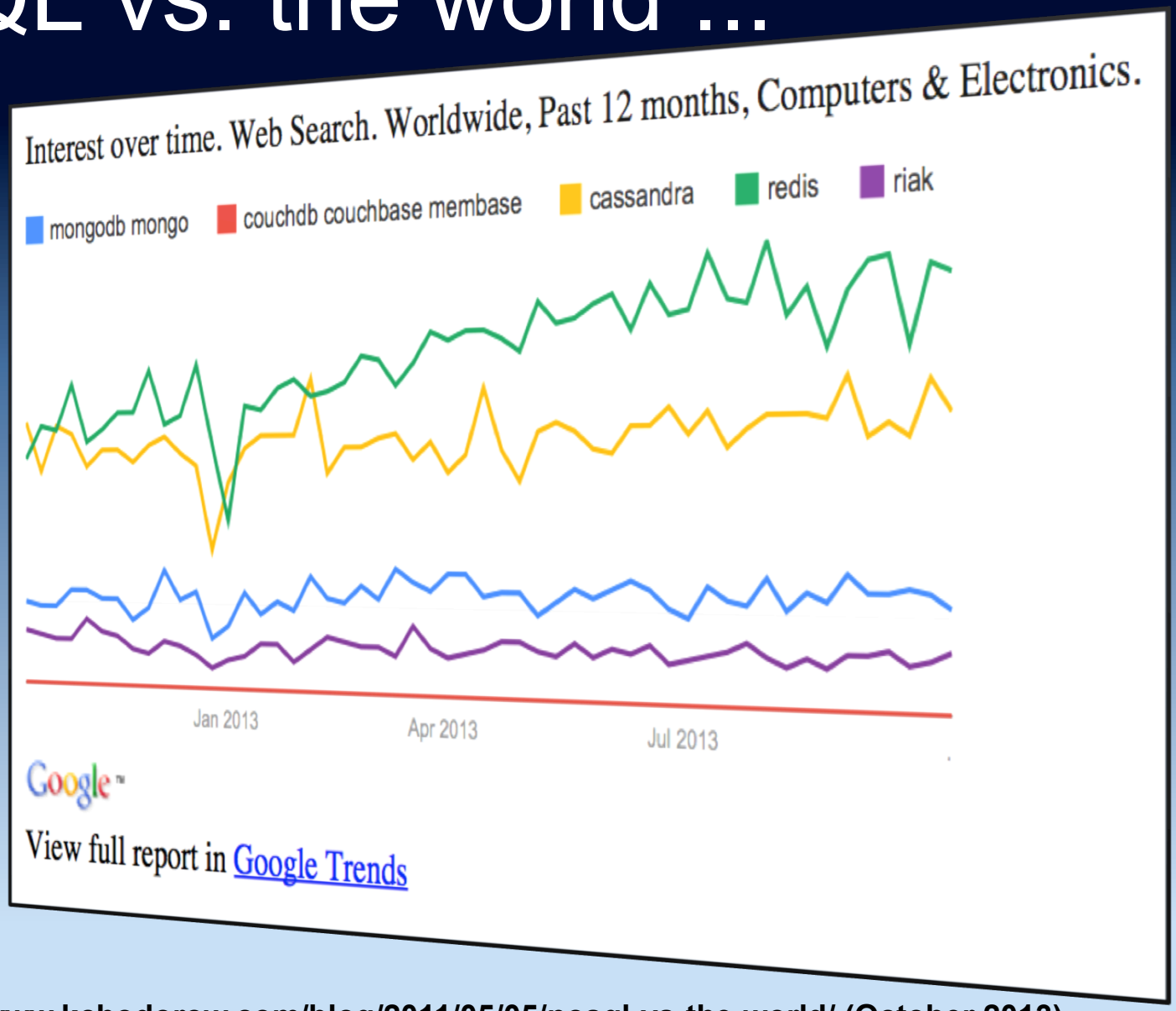
Source: 451 Research

NoSQL LinkedIn skills index



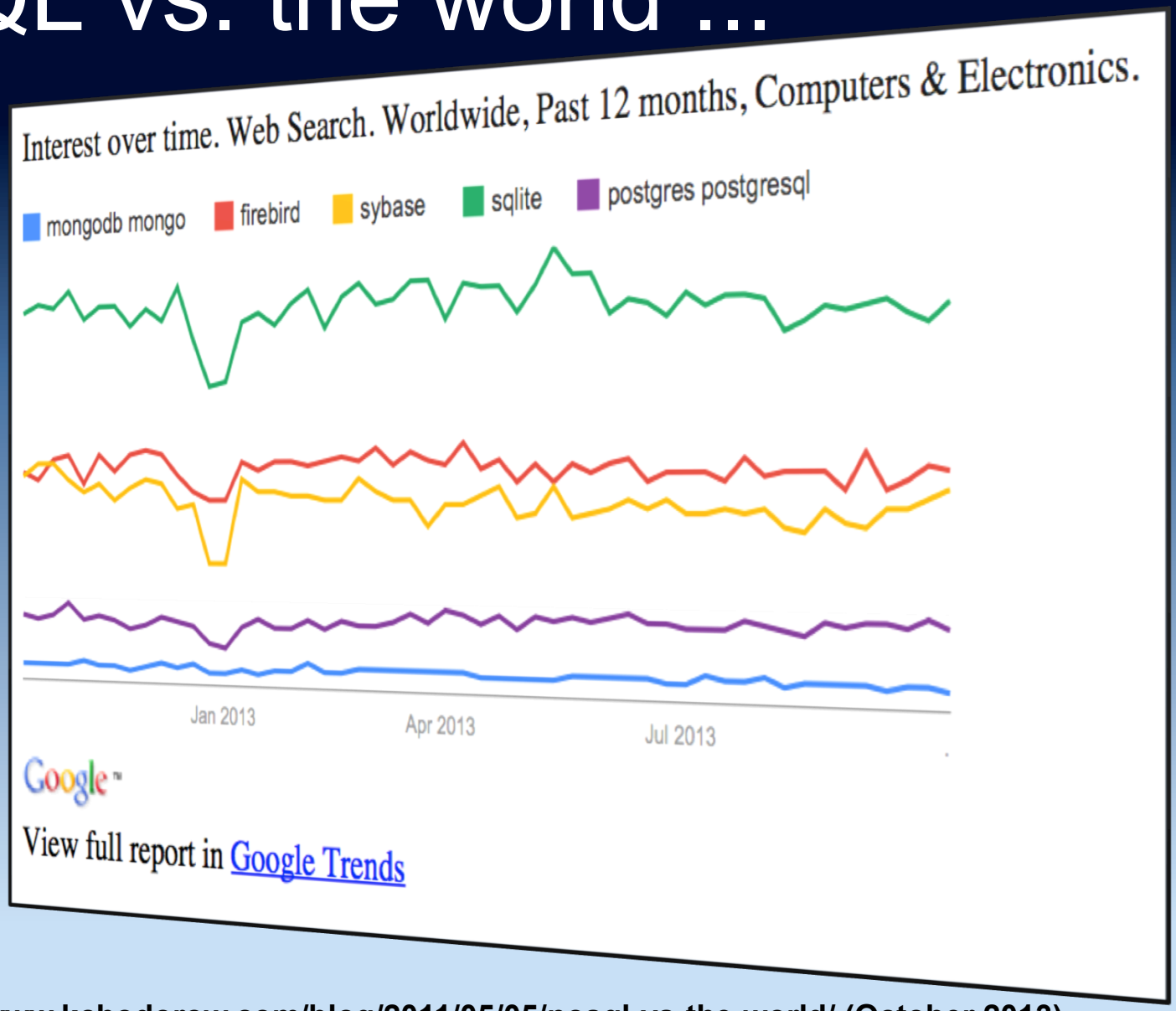
Source: 451 Research

NoSQL vs. the world ...



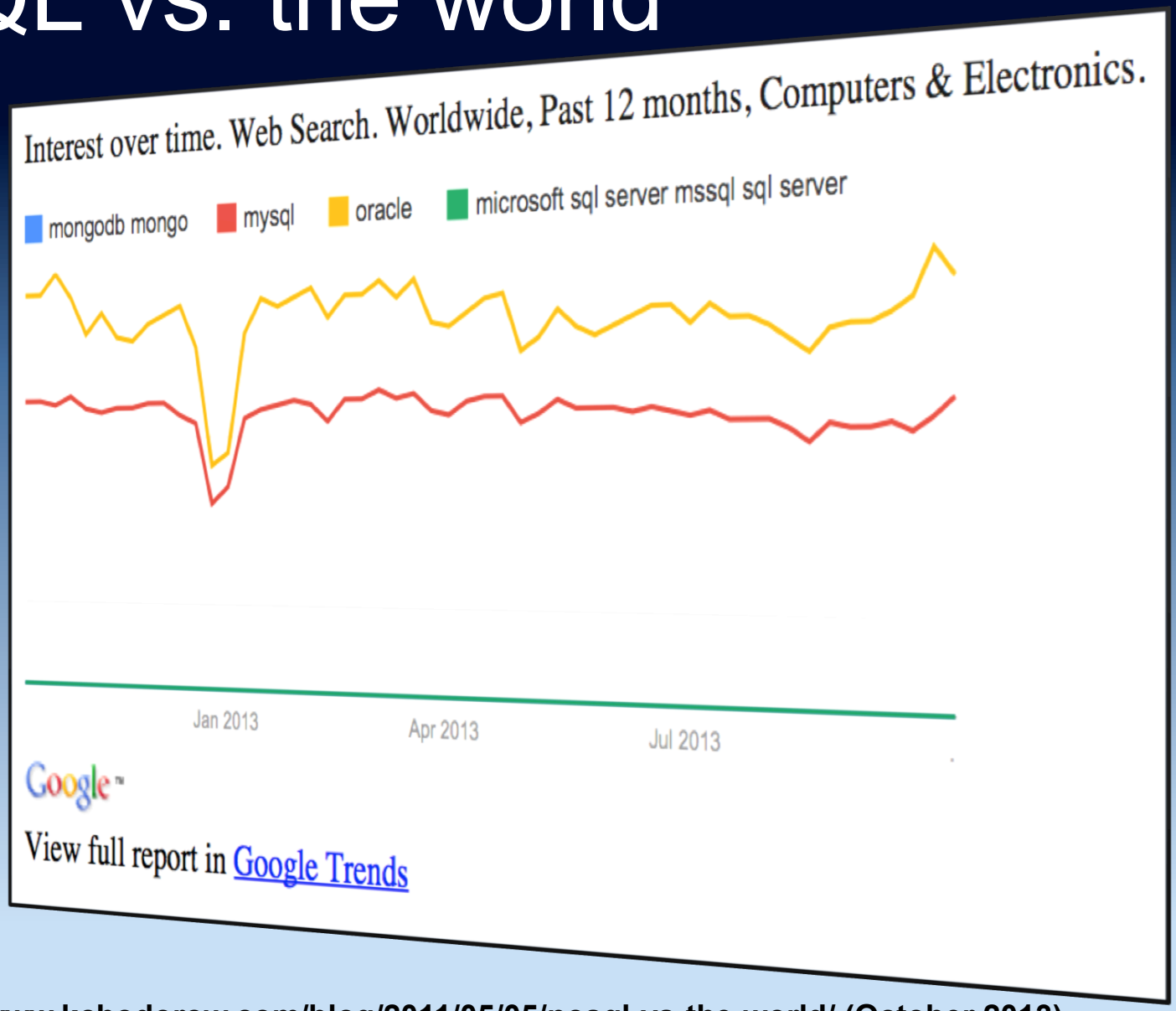
Source: After http://www.kchodorow.com/blog/2011/05/05/nosql-vs-the-world/ (October 2013)

NoSQL vs. the world ...



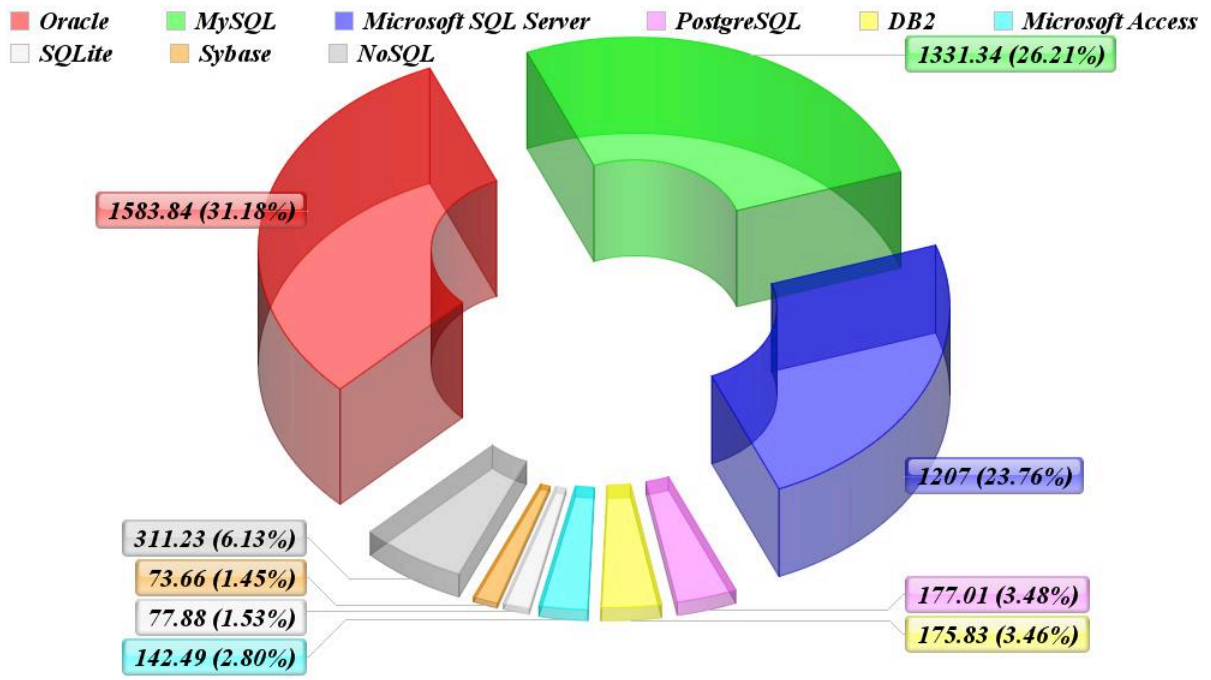
Source: After http://www.kchodorow.com/blog/2011/05/05/nosql-vs-the-world/ (October 2013)

NoSQL vs. the world



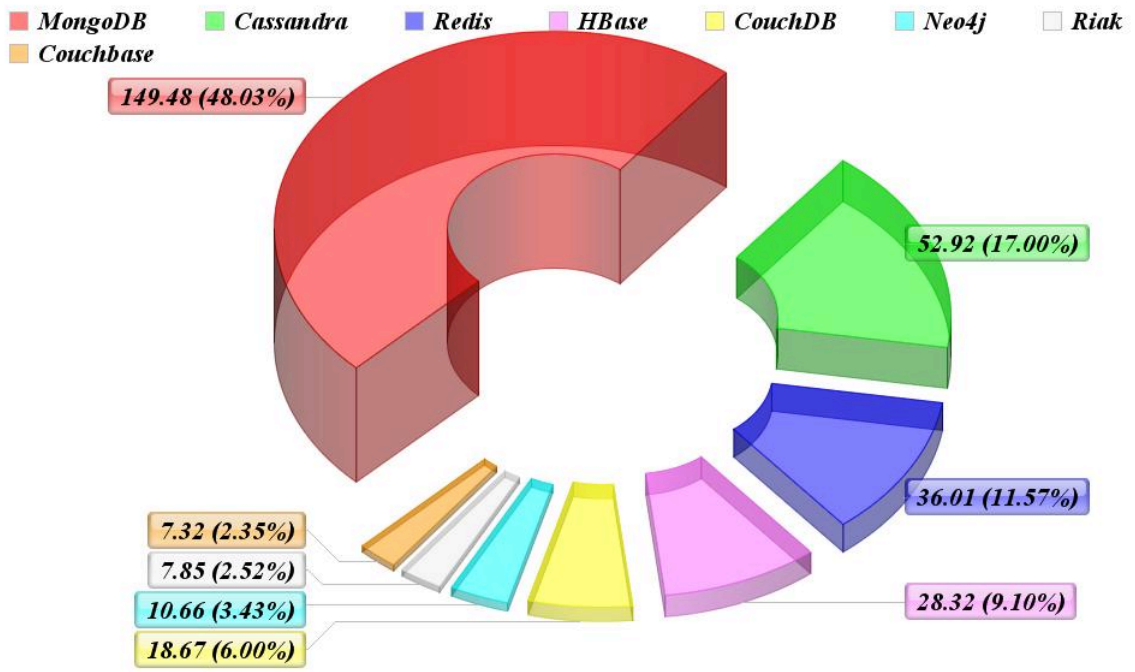
Source: After http://www.kchodorow.com/blog/2011/05/05/nosql-vs-the-world/ (October 2013)

DB-Engines ranking ...



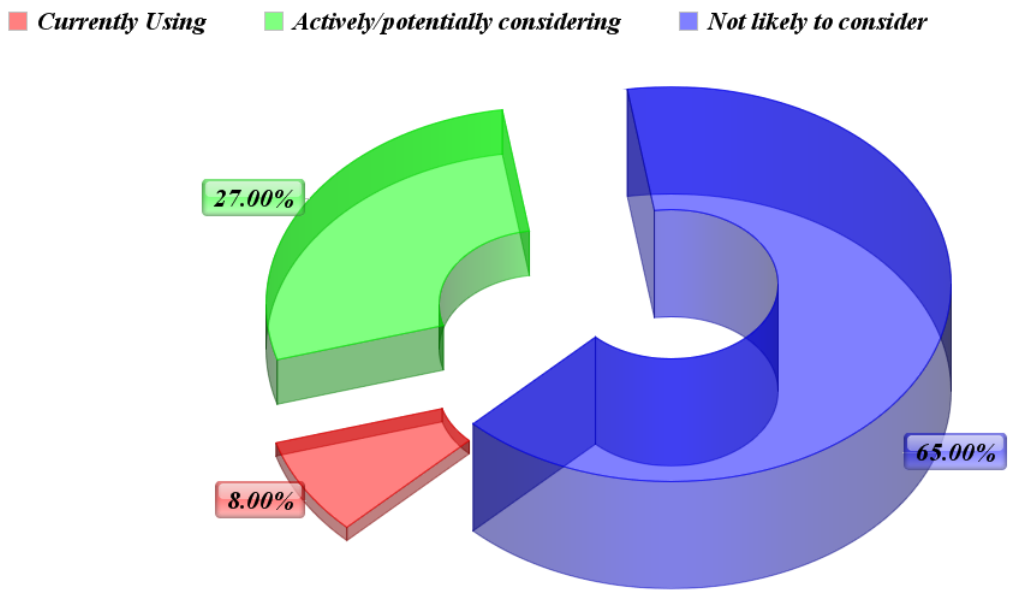
Source: http://db-engines.com/en/ranking/ (October 2013)

DB-Engines ranking



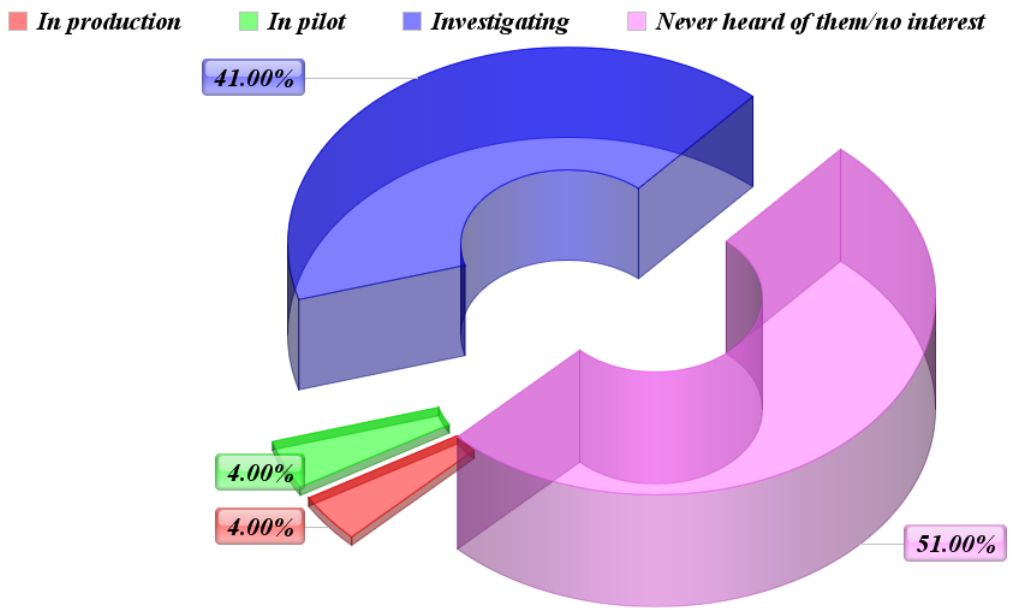
Source: http://db-engines.com/en/ranking/ (October 2013)

NoSQL in enterprise apps



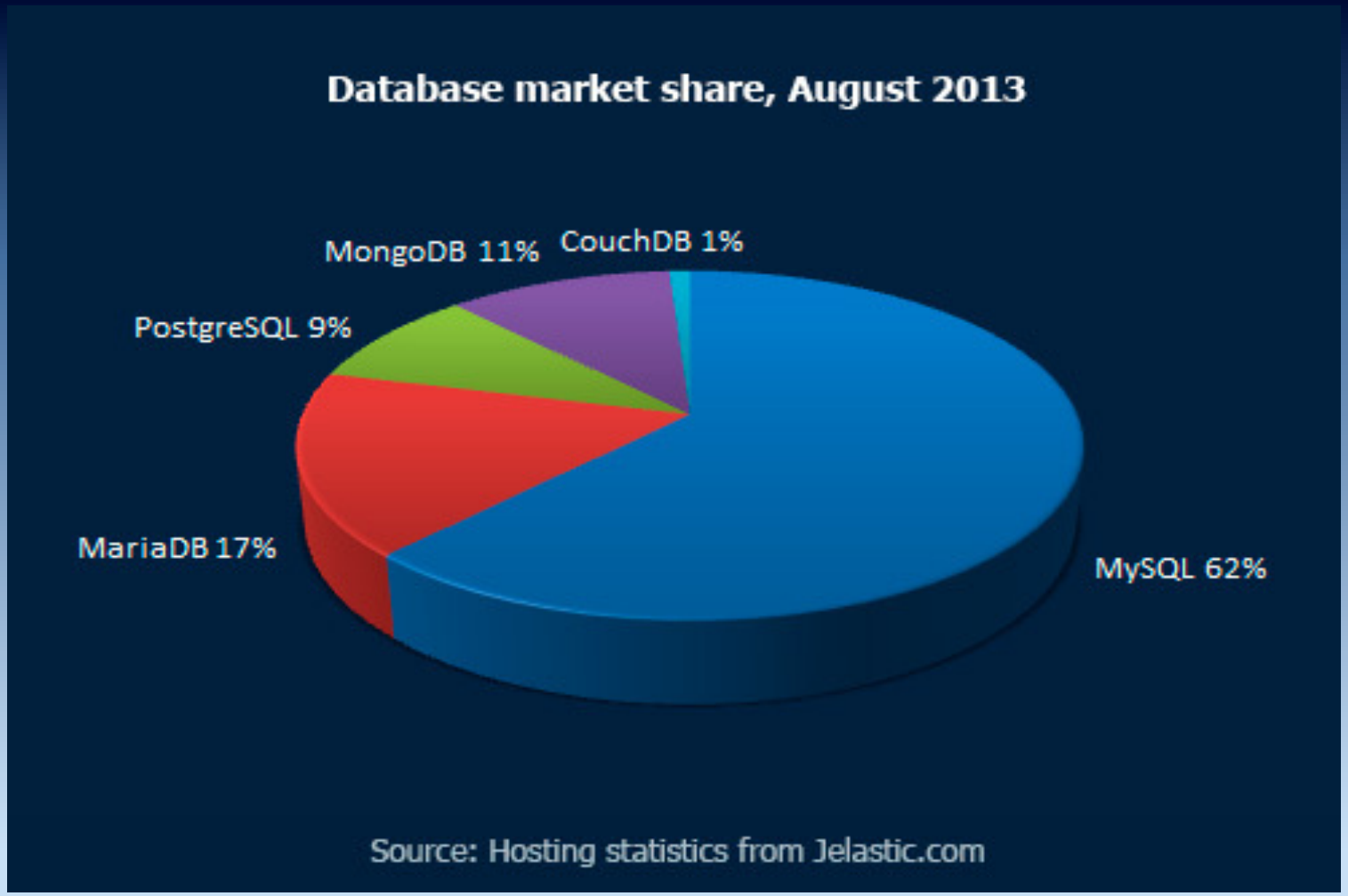
Source: “Cloud Software: Where Next?” InformationWeek August 2013

Use of NoSQL products



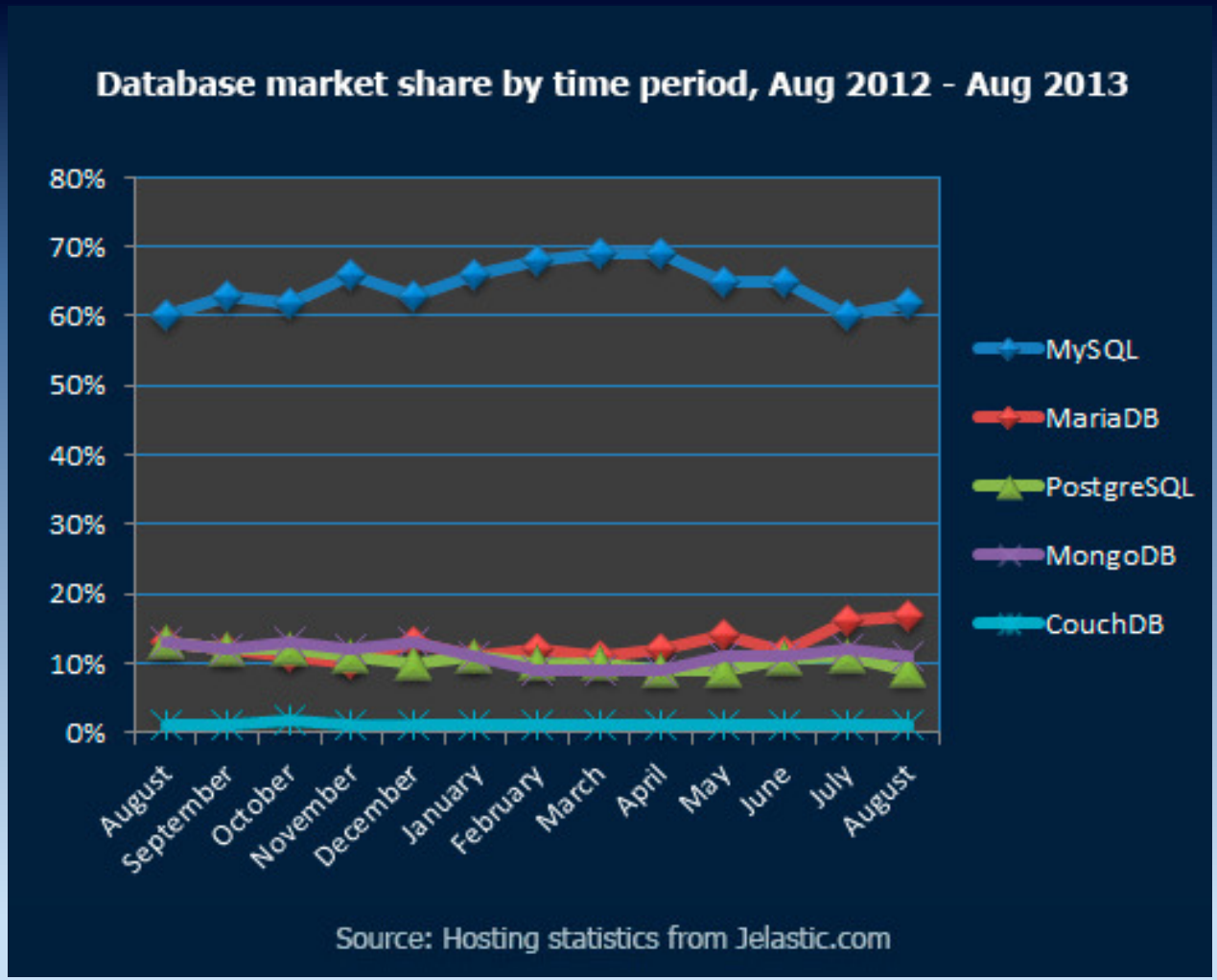
Source: “State of Database Technology 2013” InformationWeek April 2013

Hosting example ...



Source: Jelastic, used with permission

Hosting example



Source: Jelastic, used with permission

Polyglot persistence

Source: Heroku, used with permission

Polyglot persistence

User Sessions	Financial Data	Shopping Cart	Recommendations
redis	DB2	riak	Neo4j
Product Catalog	**Reporting**	**Analytics**	**User Activity Logs**
mongoDB	DB2	Cassandra	Cassandra

Source: Adapted from http://martinfowler.com/bliki/PolyglotPersistence.html

Polyglot persistence examples

- Disney
  - Cassandra, Hadoop, MongoDB
- Interactive Mediums
  - CouchDB, MySQL
- Mendeley
  - HBase, MongoDB, Solr, Voldemort
- Netflix
  - Cassandra, Hadoop/HBase, RDBMS, SimpleDB
- Twitter
  - Cassandra, FlockDB, Hadoop/HBase, MySQL

Polyglot persistence

- NoSQL product specialization requires developer knowledge and skills for each platform
- Different APIs
  - Develop public API for each NoSQL store (Disney)

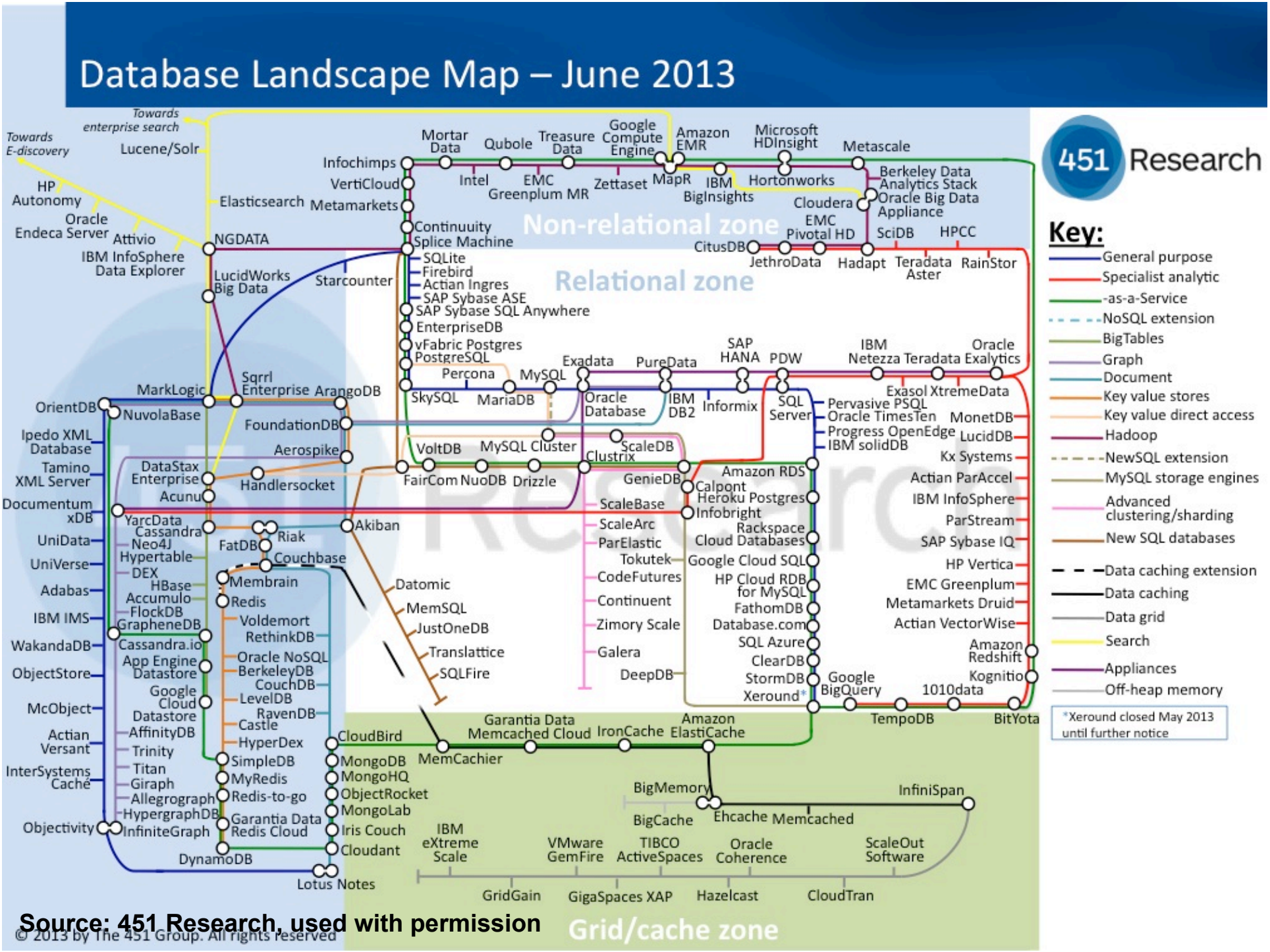
Public API for NoSQL store

In some cases, the team decided to hide the platform's complexity from users; not to facilitate its use, but to keep loose-cannon developers from doing something crazy that could take down the whole cluster. It could show them all the controls and knobs in a NoSQL database, but "they tend to shoot each other," Jacob said. "First they shoot themselves, then they shoot each other."

Source: "How Disney built a big data platform on a startup budget" Derrick Harris (2012)

NoSQL alternatives

Database Landscape Map – June 2013



Source: 451 Research, used with permission

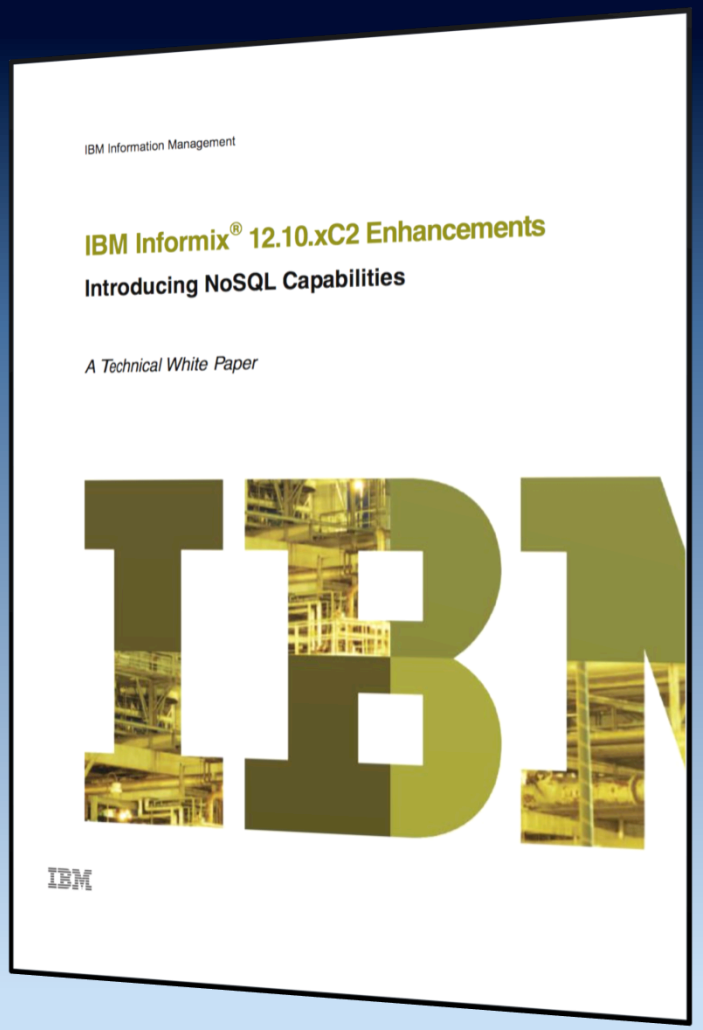
© 2013 by The 451 Group. All rights reserved

NewSQL

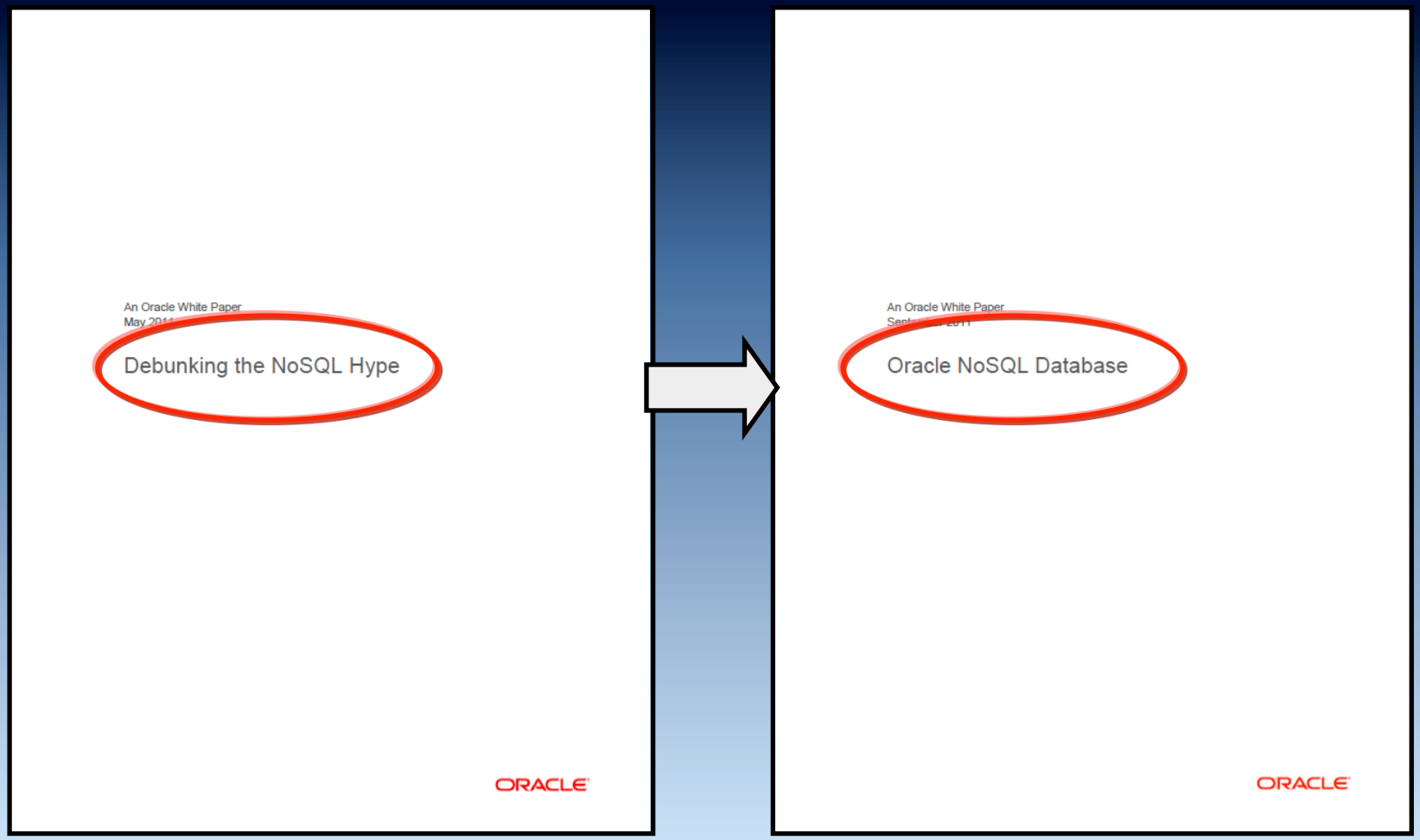
- Today, new challenges and requirements
  - “Web changes everything”
- Need more OLTP throughput
- Need real-time analytics
- ACID support
- Preserve SQL
  - Automatic query optimization
- Preserve investment
  - Existing skills and tools

Relational

- Vendors adding NoSQL capabilities
  - Documents (JSON)
  - Linked data (RDF)



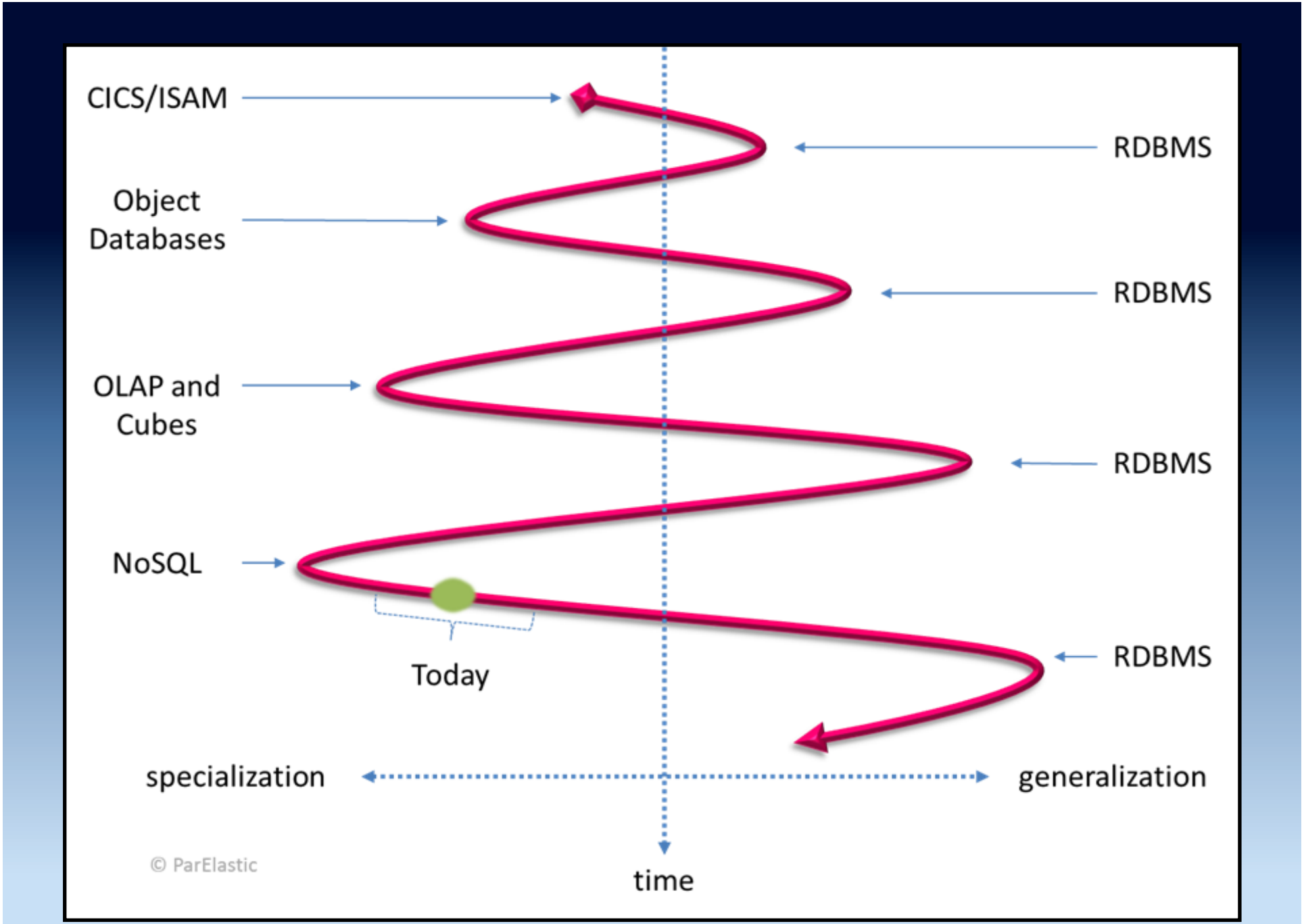
What about Oracle?



Future directions

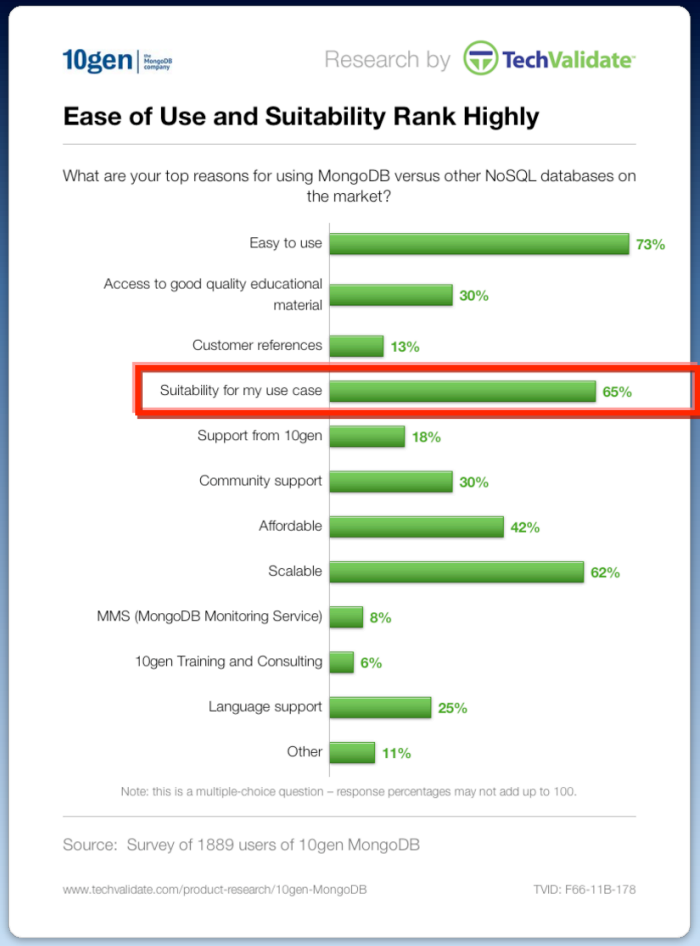
- Internal polyglot support
- Multi-model systems
- Google F1-inspired systems
  - “Can you have a scalable database without going NoSQL? Yes.”
- Further support for NoSQL in Relational
- DBaaS
- Orchestrate.io
  - “The Next Big Thing”?

Summary



Source: ParElastic, used with permission

Understand your use case



Source: http://www.techvalidate.com/tvid/F66-11B-178/

Understand vendor-speak

What vendor says	What vendor means
The biggest in the world	The biggest one we've got
The biggest in the universe	The biggest one we've got
There is no limit to ...	It's untested, but we don't mind if you try it
A new and unique feature	Something the competition has had for ages
Currently available feature	We are about to start Beta testing
Planned feature	Something the competition has, that we wish we had too, that we might have one day
Highly distributed	International offices
Engineered for robustness	Comes in a tough box

Source: "Object Databases: An Evaluation and Comparison" Bloor Research (1994)

Contact details

Find me on ...

http://www.linkedin.com/in/akmalchaudhri

http://twitter.com/akmalchaudhri

http://www.quora.com/Akmal-Chaudhri

http://www.facebook.com/akmal.chaudhri

http://plus.google.com/
105126255575427189842/

http://www.slideshare.net/VeryFatBoy/

http://www.youtube.com/VeryFatBoyVideos/

Akmal B. Chaudhri
firstname.lastname@live.com

{"thank":"You"}

Resources

History

- First NoSQL meetup
  - http://nosql.eventbrite.com/
  - http://blog.oskarsson.nu/post/22996139456/nosql-meetup
- First NoSQL meetup debrief
  - http://blog.oskarsson.nu/post/22996140866/nosql-debrief
- First NoSQL meetup photographs
  - http://www.flickr.com/photos/russss/sets/72157619711038897/

NoSQL Search roadshow

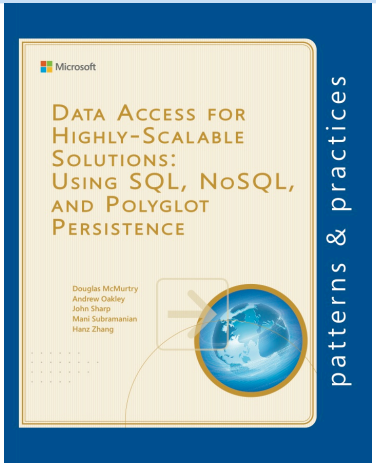
- Multi-city tour 2013
  - Munich
  - Berlin
  - San Francisco
  - Copenhagen
  - Zurich
  - Amsterdam
  - London

Source: http://nosqlroadshow.com/

Web sites

- NoSQL Databases and Polyglot Persistence: A Curated Guide
  - http://nosql.mypopescu.com/
- NoSQL: Your Ultimate Guide to the Non-Relational Universe!
  - http://nosql-database.org/

Free books …

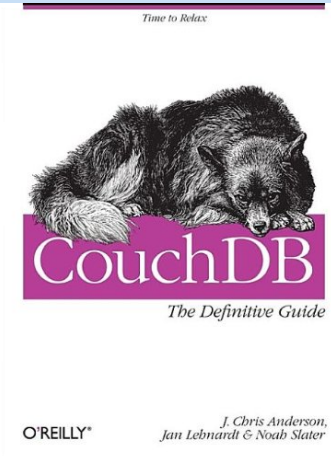


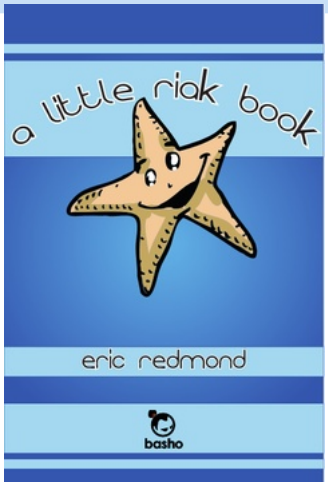
- Data Access for Highly-Scalable Solutions: Using SQL, NoSQL, and Polyglot Persistence
  - http://www.microsoft.com/en-us/download/details.aspx?id=40327

Free books ...

- The Little MongoDB Book
  - http://openmymind.net/2011/3/28/The-Little-MongoDB-Book/
- The Little Redis Book
  - http://openmymind.net/2012/1/23/The-Little-Redis-Book/

Free books ...





- CouchDB: The Definitive Guide
  - http://guide.couchdb.org/
- A Little Riak Book
  - http://littleriakbook.com

Free books

- Understanding The Top 5 Redis Performance Metrics
  - http://info.datadoghq.com/top-5-redis-performance-metrics-ebook

Free training

10gen | The MongoDB Company

CERTIFICATE
Dec. 24th, 2012

This is to certify that

Akmal Chaudhri

successfully completed

M101: MongoDB for Developers

a course of study offered by 10gen, The MongoDB Company

Dwight Merriman
Chief Executive Officer
10gen, Inc.

Andrew Erlichson
Vice President, Education
10gen, Inc.

10gen | The MongoDB Company

CERTIFICATE
Dec. 24th, 2012

This is to certify that

Akmal Chaudhri

successfully completed

M102: MongoDB for DBAs

a course of study offered by 10gen, The MongoDB Company

Dwight Merriman
Chief Executive Officer
10gen, Inc.

Andrew Erlichson
Vice President, Education
10gen, Inc.

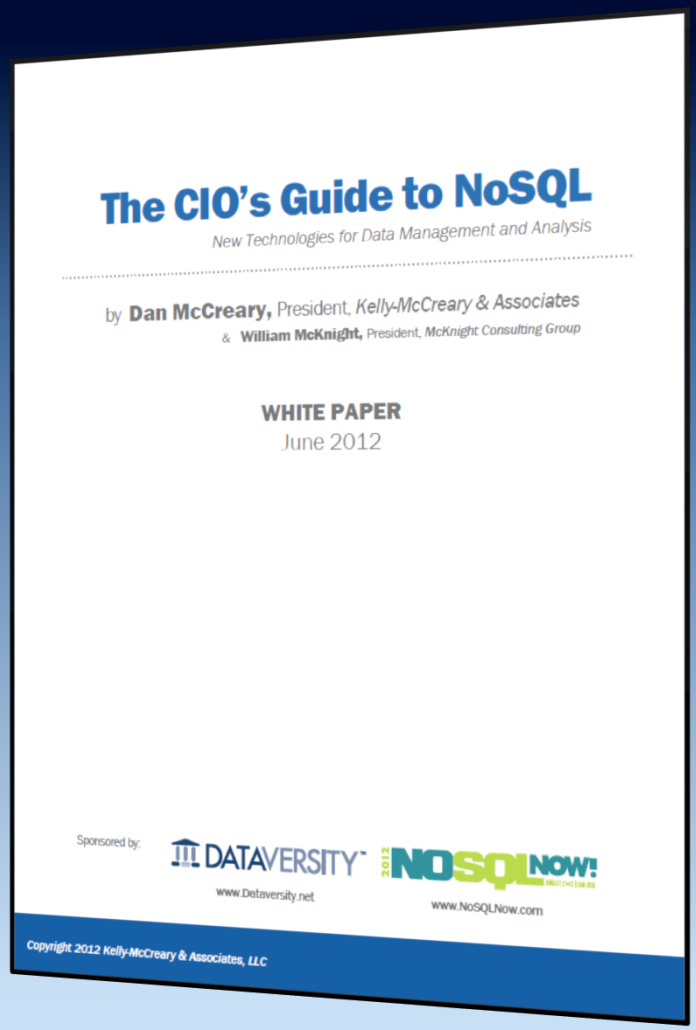
- Free courses on MongoDB
  - https://education.mongodb.com/

Articles and reports

- Saying Yes to NoSQL
  - http://www.nofluffjuststuff.com/s/magazine/NFJS_theMagazine_Vol3_Issue3_May2011.pdf
- The State of NoSQL
  - http://www.infoq.com/articles/State-of-NoSQL/
- D. Feinberg, M. Adrian and N. Heudecker (2013) Magic Quadrant for Operational Database Management Systems, *Gartner*, ID:G00251780, 21 October 2013
  - http://www.aerospike.com/only-visionary-in-gartner-mq-2013/

White papers

- The CIO's Guide to NoSQL
  - http://documents.dataversity.net/whitepapers/the-cios-guide-to-nosql.html



Product selection ...

- 101 Questions to Ask When Considering a NoSQL Database
  - http://highscalability.com/blog/2011/6/15/101-questions-to-ask-when-considering-a-nosql-database.html
- 35+ Use Cases for Choosing Your Next NoSQL Database
  - http://highscalability.com/blog/2011/6/20/35-use-cases-for-choosing-your-next-nosql-database.html

Product selection

- NoSQL Options Compared: Different Horses for Different Courses
  - http://www.slideshare.net/tazija/nosql-options-compared/
- NoSQL Data Modeling Techniques
  - http://highlyscalable.wordpress.com/2012/03/01/nosql-data-modeling-techniques/
- Choosing a NoSQL data store according to your data set
  - http://00f.net/2010/05/15/choosing-a-nosql-data-store-according-to-your-data-set/

Short product overviews ...

- Picking the Right NoSQL Database Tool
  - http://blog.monitis.com/index.php/2011/05/22/picking-the-right-nosql-database-tool/
- NoSQL Databases -- A Look at Apache Cassandra
  - http://blog.monitis.com/index.php/2011/05/24/nosql-databases-a-look-at-apache-cassandra/
- The NoSQL Databases -- A Look at HBase
  - http://blog.monitis.com/index.php/2011/05/31/the-nosql-databases-a-look-at-hbase/

Short product overviews ...

- A Look at Some NoSQL Databases -- MongoDB, Redis and Basho Riak
  - http://blog.monitis.com/index.php/2011/06/06/a-look-at-some-nosql-databases-mongodb-redis-and-basho-riak/
- Picking the Right NoSQL Database, Part 4 -- CouchDB and Membase
  - http://blog.monitis.com/index.php/2011/06/17/picking-the-right-nosql-database-part-4-couchdb-and-membase/

Short product overviews

- Cassandra vs MongoDB vs CouchDB vs Redis vs Riak vs HBase vs Couchbase vs Neo4j vs Hypertable vs ElasticSearch vs Accumulo vs VoltDB vs Scalaris comparison
  - http://kkovacs.eu/cassandra-vs-mongodb-vs-couchdb-vs-redis/
- vsChart.com
  - http://vschart.com/list/database/

Case studies ...

- Real World NoSQL: HBase at Trend Micro
  - http://gigaom.com/cloud/real-world-nosql-hbase-at-trend-micro/
- Real World NoSQL: MongoDB at Shutterfly
  - http://gigaom.com/cloud/real-world-nosql-mongodb-at-shutterfly/
- Real World NoSQL: Cassandra at Openwave
  - http://gigaom.com/cloud/realworld-nosql-cassandra-at-openwave/

Case studies

- Real World NoSQL: Amazon SimpleDB at Netflix
  - http://gigaom.com/cloud/real-world-nosql-amazon-simpledb-at-netflix/
- Real World NoSQL: Membase at Tribal Crossing
  - http://gigaom.com/cloud/real-world-nosql-membase-at-tribal-crossing/
- How Disney built a big data platform on a startup budget
  - http://gigaom.com/data/how-disney-built-a-big-data-platform-on-a-startup-budget/

Negative NoSQL comments …

- Scaling with MongoDB
  - http://opensourcebridge.org/wiki/2011/Scaling_with_MongoDB
  - https://speakerdeck.com/robotadam/postgres-at-urban-airship/
- A Year with MongoDB
  - http://blog.engineering.kiip.me/post/20988881092/a-year-with-mongodb/
  - https://speakerdeck.com/mitsuhiko/a-year-of-mongodb/

Negative NoSQL comments …

- Why MongoDB Never Worked Out at Etsy
  - http://mcfunley.com/why-mongodb-never-worked-out-at-etsy/
- Goodbye, CouchDB
  - http://sauceio.com/index.php/2012/05/goodbye-couchdb/
- Don't use NoSQL
  - https://speakerdeck.com/roidrage/dont-use-nosql/
  - http://vimeo.com/49713827/

Negative NoSQL comments …

- MongoDB is to NoSQL like MySQL to SQL -- in the most harmful way
  - http://use-the-index-luke.com/blog/2013-10/mysql-is-to-sql-like-mongodb-to-nosql
- The Genius and Folly of MongoDB
  - http://nyeggen.com/blog/2013/10/18/the-genius-and-folly-of-mongodb/

Negative NoSQL comments …

- Do Developers Use NoSQL Because They're Too Lazy to Use RDBMS Correctly?
  - http://architects.dzone.com/articles/do-developers-use-nosql/
  - http://gaiustech.wordpress.com/2013/04/13/mongodb-days/
- The parallels between NoSQL and self-inflicted torture
  - http://www.parelastic.com/blog/parallels-between-nosql-and-self-inflicted-torture/

Negative NoSQL comments

- 7 hard truths about the NoSQL revolution
  - http://www.infoworld.com/d/data-management/7-hard-truths-about-the-nosql-revolution-197493
- Google goes back to the future with SQL F1 database
  - http://www.theregister.co.uk/2013/08/30/google_f1_deepdive/

Security ...

- NoSQL, no security?
  - http://www.slideshare.net/wurbanski/nosql-no-security/
- NoSQL, No Injection!?
  - http://www.slideshare.net/wayne_armorize/nosql-no-sql-injections-4880169/
- Attacking MongoDB
  - http://www.slideshare.net/cyber-punk/mongo-db-eng/
- NoSQL, But Even Less Security
  - http://blogs.adobe.com/asset/files/2011/04/NoSQL-But-Even-Less-Security.pdf

Security

- NoSQL Database Security
  - http://conference.auscert.org.au/conf2011/presentations/Louis Nyffenegger V1.pdf
- Does NoSQL Mean No Security?
  - http://www.darkreading.com/database-security/167901020/security/news/232400214/does-nosql-mean-no-security.html
- A Response To NoSQL Security Concerns
  - http://www.darkreading.com/blog/232600288/a-response-to-nosql-security-concerns.html

Polyglot persistence ...

- Polyglot Persistence
  - http://www.slideshare.net/jwoodslideshare/polyglot-persistence-two-great-tastes-that-taste-great-together-4625004/
- HBase at Mendeley
  - http://www.slideshare.net/danharvey/hbase-at-mendeley/
- Polyglot Persistence Patterns
  - http://abhishek-tiwari.com/post/polyglot-persistence-patterns/

Polyglot persistence

- Polyglot Persistence: EclipseLink with MongoDB and Derby
  - http://java.dzone.com/articles/polyglot-persistence-0/
- D. Ghosh (2010) Multiparadigm data storage for enterprise applications. *IEEE Software*. Vol. 27, No. 5, pp. 57-60

Performance benchmarks ...

- Yahoo Cloud Serving Benchmark
  - http://research.yahoo.com/node/3202/
  - http://altoros.com/nosql-research
  - http://www.slideshare.net/tazija/evaluating-nosql-performance-time-for-benchmarking/
- Benchmarking Couchbase Server
  - http://www.slideshare.net/Couchbase/t1-s4-couchbase-performancebenchmarkingv34/

Performance benchmarks ...

- Ultra-High Performance NoSQL Benchmarking
  - http://thumbtack.net/solutions/ThumbtackWhitePaper.html
- Benchmarking Top NoSQL Databases
  - http://www.datastax.com/resources/whitepapers/benchmarking-top-nosql-databases

Performance benchmarks ...

- MongoDB Performance Pitfalls -- Behind The Scenes
  - http://blog.trackerbird.com/content/mongodb-performance-pitfalls-behind-the-scenes/
- MySQL vs. MongoDB Disk Space Usage
  - http://blog.trackerbird.com/content/mysql-vs-mongodb-disk-space-usage/
- MongoDB: Scaling write performance
  - http://www.slideshare.net/daumdna/mongodb-scaling-write-performance/

Performance benchmarks ...

- Can the Elephants Handle the NoSQL Onslaught?
  - http://vldb.org/pvldb/vol5/p1712_avriliafloratou_vldb2012.pdf
- Solving Big Data Challenges for Enterprise Application Performance Management
  - http://vldb.org/pvldb/vol5/p1724_tilmannrabl_vldb2012.pdf
- NoSQL RDF
  - http://ribs.csres.utexas.edu/nosqlrdf/index.php

Performance benchmarks

- Benchmarking Graph Databases
  - http://istc-bigdata.org/index.php/benchmarking-graph-databases/
- Benchmarking Graph Databases -- Updates
  - http://istc-bigdata.org/index.php/benchmarking-graph-databases-updates/
- Linked Data Benchmark Council
  - http://ldbc.eu/

Stress testing

- Jepsen
  - http://www.aphyr.com/tags/jepsen
- Jepsen: Testing the Partition Tolerance of PostgreSQL, Redis, MongoDB and Riak
  - http://www.infoq.com/articles/jepsen/
- The Man Who Tortures Databases
  - http://www.informationweek.com/software/information-management/the-man-who-tortures-databases/240160850/

BI/Analytics

- BI/Analytics on NoSQL: Review of Architectures Part 1
  - http://www.dataversity.net/bianalytics-on-nosql-review-of-architectures-part-1/
- BI/Analytics on NoSQL: Review of Architectures Part 2
  - http://www.dataversity.net/bianalytics-on-nosql-review-of-architectures-part-2/

Various graphics ...

- NoSQL LinkedIn Skills Index -- September 2013
  - http://blogs.the451group.com/information_management/2013/10/01/nosql-linkedin-skills-index-september-2013/
- Updated Database Landscape map -- June 2013
  - http://blogs.the451group.com/information_management/2013/06/10/updated-database-landscape-map-june-2013/

Various graphics ...

- Necessity is the mother of NoSQL
  - http://blogs.the451group.com/information_management/2011/04/20/necessity-is-the-mother-of-nosql/
- NoSQL, Heroku, and You
  - https://blog.heroku.com/archives/2010/7/20/nosql/

Various graphics

- The NoSQL vs. SQL hoopla, another turn of the screw!
  - http://www.parelastic.com/blog/nosql-vs-sql-hoopla-another-turn-screw/
- Navigating the Database Universe
  - http://www.slideshare.net/lisapaglia/navigating-the-database-universe/

Discussion fora

- LinkedIn NoSQL
  - http://www.linkedin.com/groups?gid=2085042
- LinkedIn NewSQL
  - http://www.linkedin.com/groups/NewSQL-4135938
- Google groups
  - http://groups.google.com/group/nosql-discussion
- Quora
  - https://www.quora.com/NoSQL/

NoSQL jokes/humour ...

- LinkedIn discussion thread
  - http://www.linkedin.com/groups/NoSQL-Jokes-Humour-2085042.S.177321213
- NoSQL Better Than MySQL?
  - http://www.youtube.com/watch?v=QU34ZVD2ylY
  - Shorter version of “Episode 1 - MongoDB is Web Scale”
- say No! No! and No! (=NoSQL Parody)
  - http://www.youtube.com/watch?v=fXc-QDJBXpw

NoSQL jokes/humour

- When someone brags about scaling MongoDB to a whopping 100GB
  - http://dbareactions.tumblr.com/post/62989609976/when-someone-brags-about-scaling-mongodb-to-a
- C.R.U.D.
  - http://crudcomic.tumblr.com/
- Twitter
  - @mongodbfacts
  - @BigDataBorat

Miscellaneous ...

- PowerPoint template
  - http://www.articulate.com/rapid-elearning/heres-a-free-powerpoint-template-how-i-made-it/
- Autostereogram
  - http://www.all-freeware.com/images/full/46590-free_stereogram_screensaver_audio___multimedia_other.jpeg
- Theatre Curtain Animations
  - http://www.slideshare.net/chinateacher1/theater-curtain-animations/

Miscellaneous ...

- Bar and Column charts
  - http://www.diychart.com/
- Newspaper headlines
  - http://www.imagechef.com/ic/make.jsp?tid=Newspaper+Headline
- Pie charts
  - http://www.onlinecharttool.com/

Miscellaneous

- Icons and images
  - http://www.geekpedia.com/icons.php
  - http://cemagraphics.deviantart.com/
  - http://www.freestockphotos.biz/
  - http://www.graphicsfuel.com/2011/09/comments-speech-bubble-icon-psd/
  - http://icondock.com/