NoSQL

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Outline

- Motivation
- What is NoSQL
- Key-Value stores
- Wide-Column stores
- Document stores
- Summary

THE WORLD OF DATA

NUMBER OF EMAILS SENT EVERY SECOND

2.9 MILLION

DATA CONSUMED BY HOUSEHOLDS EACH DAY

375 MEGABYTES

VIDEO UPLOADED TO YOUTUBE EVERY MINUTE

20 HOURS

DATA PER DAY PROCESSED BY GOOGLE

24 PETABYTES

TWEETS PER DAY

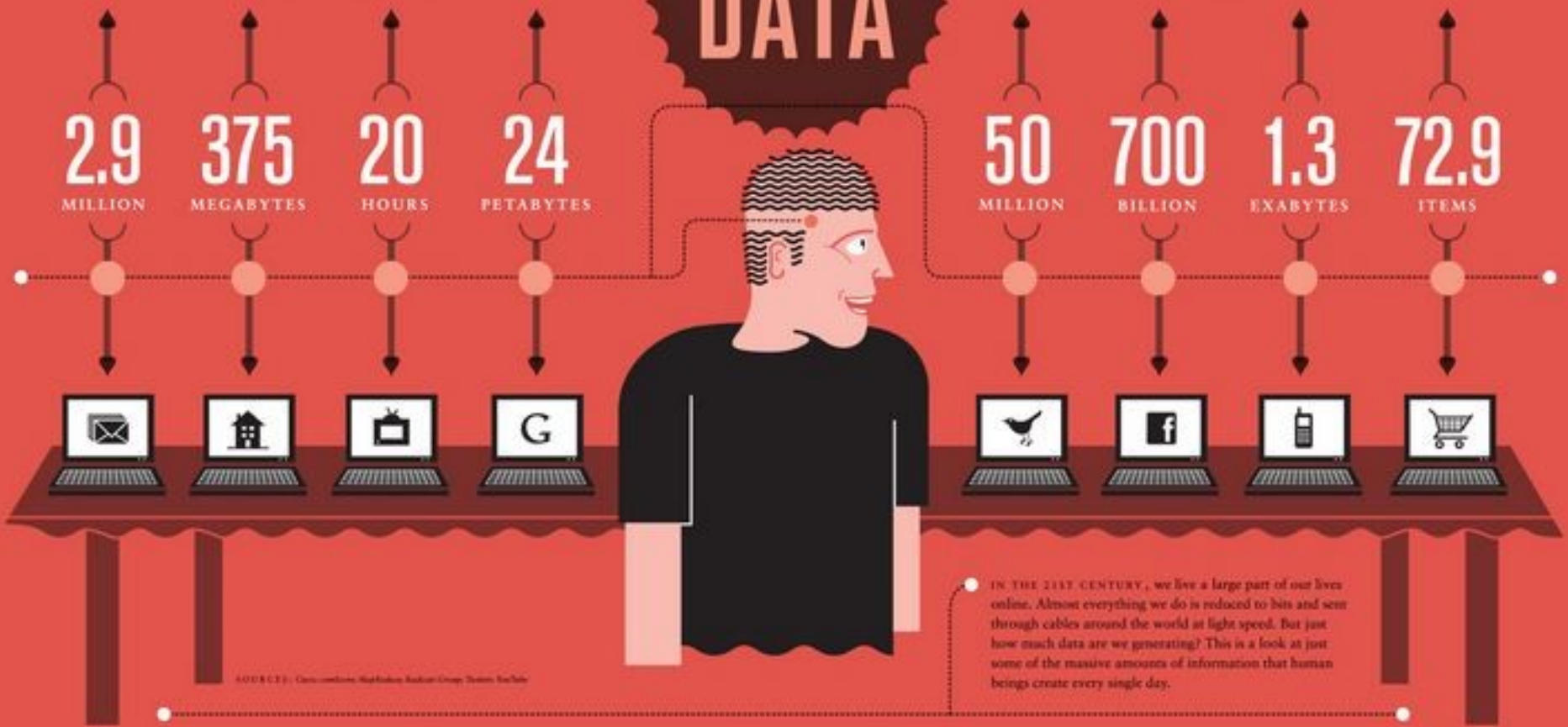**50 MILLION**

TOTAL MINUTES SPENT ON FACEBOOK EACH MONTH

700 BILLION

DATA SENT AND RECEIVED BY MOBILE INTERNET USERS

1.3 EXABYTES

PRODUCTS ORDERED ON AMAZON PER SECOND

72.9 ITEMS

IN THE 21ST CENTURY, we live a large part of our lives online. Almost everything we do is reduced to bits and sent through cables around the world at light speed. But just how much data are we generating? This is a look at just some of the massive amounts of information that human beings create every single day.

SOURCES: Cisco, comScore, MapReduce, Radicati Group, Twitter, YouTube

Motivation

- Massive data volumes
- Extreme query workload
- Schema evolution

Traditional RDBMS

- Transactions – ACID
- Integrity
- Complex queries

But…

- Modern web apps may have different needs
  - Low latency
  - Scalability & elasticity
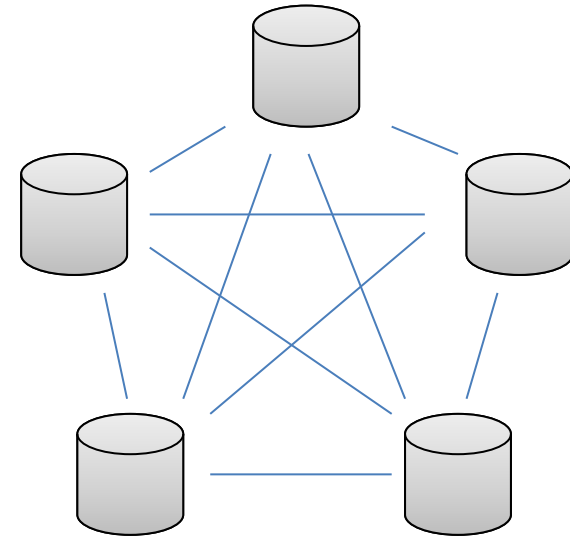 - High availability
  - Flexible schemas / ser
  - Distributed

What is NoSQL

- Term NoSQL
  - Not Only SQL
  - Non-relational database
- Databases different from traditional RDBMS

What is NoSQL

- Meet modern web apps requirement
- Scalable
  - huge volumes of data
- Distributed
  - multiple nodes
  - multiple datacenters
- Flexible
  - no strict schema

What is NoSQL

- Umbrella term for different types of datastores
  - Key-Value stores
  - Wide column stores / column families
  - Document stores
  - Graph databases
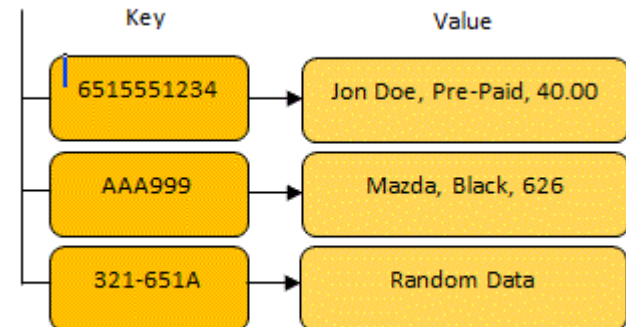 - Other…

What is NoSQL

- http://nosql-database.org/
  - 150 NoSQL databases
- Almost every big company has own solution

Key-Value Stores

- Simplest
- Largest group
- Something like distributed hash tables
- Examples
  - Amazon Dynamo
  - Amazon DynamoDB
  - Voldemort
  - Redis
  - Oracle NoSQL Database
  - SimpleDB

Key	Value
6515551234	Jon Doe, Pre-Paid, 40.00
AAA999	Mazda, Black, 626
321-651A	Random Data

Dynamo

- Key-Value distributed storage system
- Pioneer in the area
- Many features incorporated by others
- Peer-to-Peer
- Simple data model – unique keys, no schema

Dynamo

- Consistent hashing
  - "Ring" of nodes
  - Virtual nodes – node has several positions in the ring
- Replication
  - Successors in the ring

Dynamo

- Quorum
  - Coordinator
  - R+W > N
- Gossip
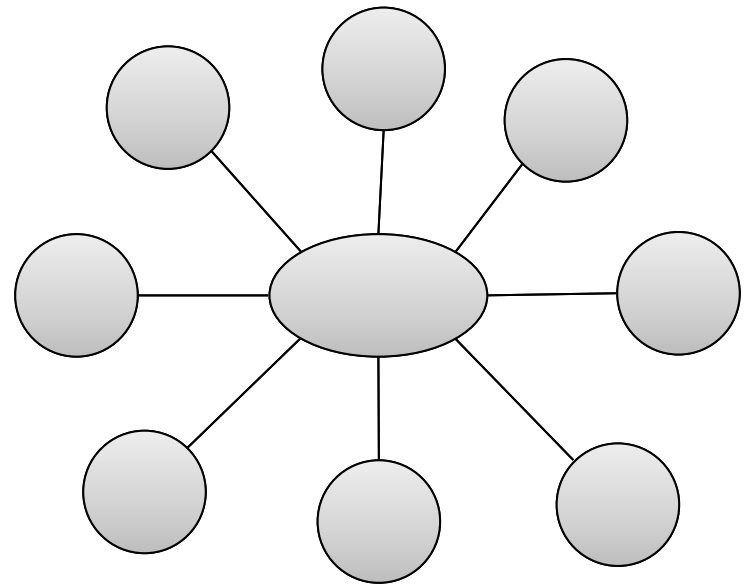 - Failure detection
- Object versioning

Voldemort

- LinkedIn, now open-source
- Based on Dynamo
- Written in Java

Wide-Column Stores

- Key is associated with multiple attributes
- Inspired by Google BigTable
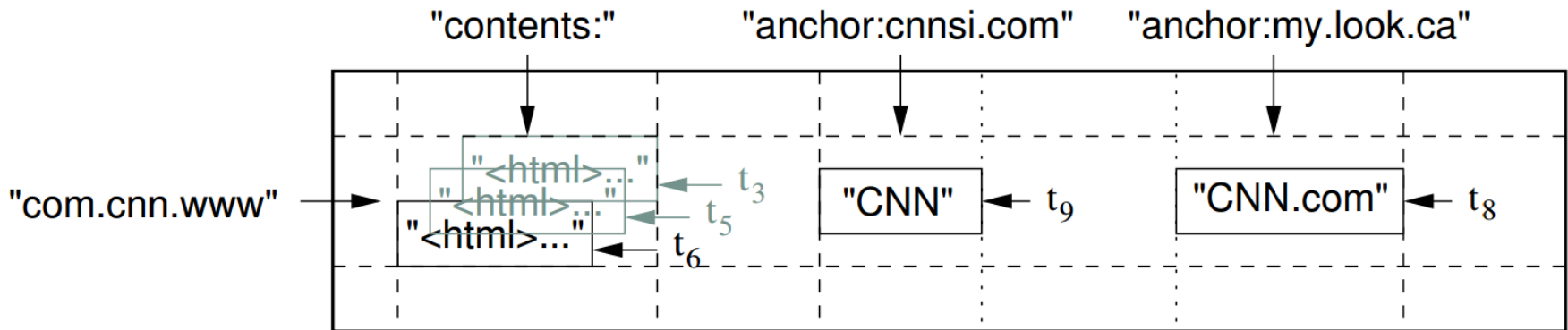- Examples
  - Google BigTable
  - HBase
  - Cassandra

BigTable

- Proprietary
  - Only short info paper released
- Sparse, distributed multi-dimensional sorted map
- `<row_key,column_key,timestamp> → <value>`

BigTable

- Rows
  - Data sorted by row key
- Tablets
  - Sequence of rows
  - Distributed
- Columns, Column families
  - Unlimited numbers of columns

BigTable

- Versioning
  - Timestamps
  - Garbage collection
- Stores data on Google File System

HBase

- Inspired by BigTable
- Open-source – Apache
- Uses Hadoop Distributed File System

Cassandra

- Facebook
  - Fast inbox search
- Now open-source Apache project
- Data model of BigTable
- Infrastructure of Dynamo

Document Stores

- Value is more than a string
  - JSON
  - BSON
- Inspired by IBM Lotus Notes
- Very flexible schema
- Examples
  - MongoDB
  - CouchDB

CouchDB

- Open-source Apache project
- Schema free
- JSON format
- B-Tree storage
- MVCC, no locking
- No joins, no primary or foreign keys
- Written in Erlang
- REST API

MongoDB

- Open-source
- BSON format – similar to JSON
- Queries can be objects
- Multiple types of indexing
- Master/slave replication
- Written in C++
- Drivers in many languages
- Most popular
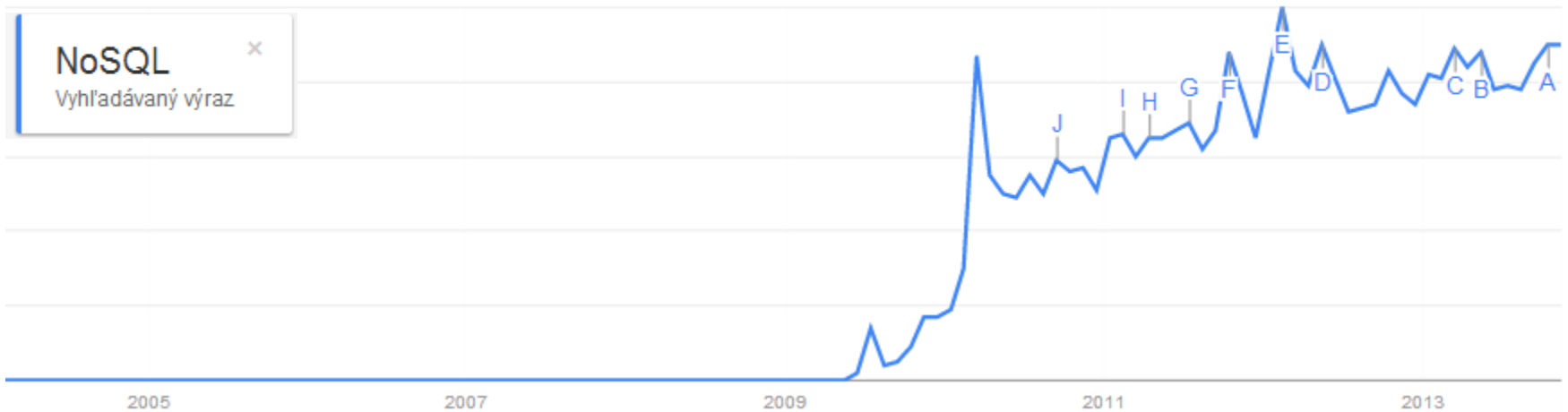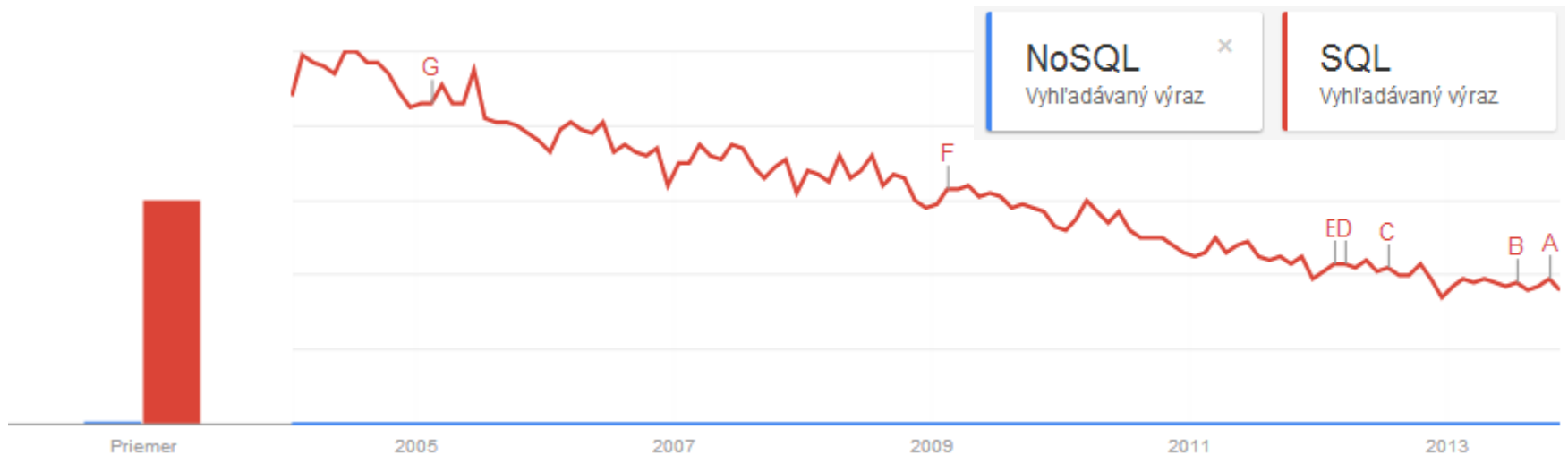 - 23 000 questions on stackoverflow

Trends

Trends

- Gaining in popularity…

Trends

- …but still got a long way to go

Summary

- NoSQL is suitable for modern web apps
  - Scalable
  - Distributed
  - Flexible
- 4 main types
  - Key-Value stores
    - Key to value mapping
  - Wide column stores / column families
    - More attributes associated with key
  - Document stores
    - Key to document mapping, not only to string
  - Graph databases
    - Connection between objects

References

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