NoSQL technologies for the CMS Conditions Database

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Overview

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  - Conditions Database and motivations
- Candidates
  - Options and choices
- Prototypes
  - Deployment aspects
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- Outro
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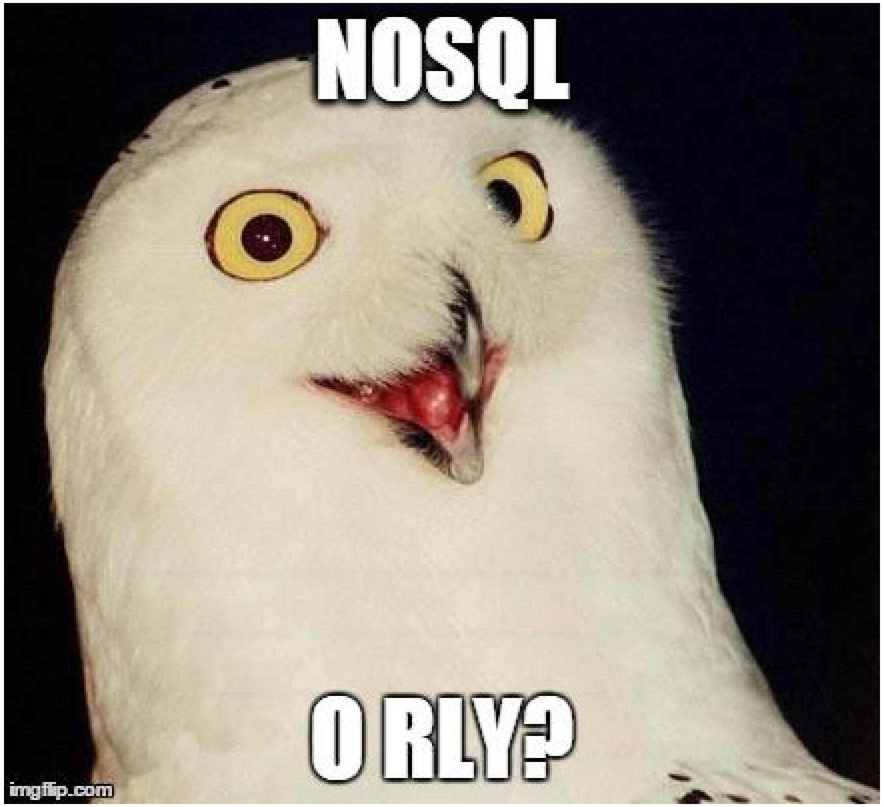
  - Outlook



Intro - CondDB and NoSQL

NoSQL - General

NoSQL in keywords.

- Only a buzzword
  - Meaning: “One size does not fit all!”
- CAP Theorem
- ACID vs BASE
- Different models
  - Doc. store, Key-Value, Column oriented, BigTable

NoSQL means: “we have options”!

Not against relational DBs,
but a complement to those!

Conditions Database

Alignment and Calibration constants, that records a given "state" of the CMS Detector.

Essential for the analysis and reconstruction of the recorded data.

Also critical for the dataflow and need to be properly re-synchronized during the data processing.

Poster: The CMS Condition Database system
(Contr.ID: 130)

CondDB - Details

Conditions are free from:

- Full table scans
  - Only “by key” access
- Joins
- Complex, nested queries
- Transactions
  - Data is written once, and never deleted, altered
- Absolute consistency
  - Only consistency criteria: newly appended data should be available for reads ASAP!
    (in less than few seconds)

CondDB - Motivations

Find alternative data storing technologies for the CMS Conditions data for:

- Storing BLOBs
- And it’s meta data
- In a read-heavy environment

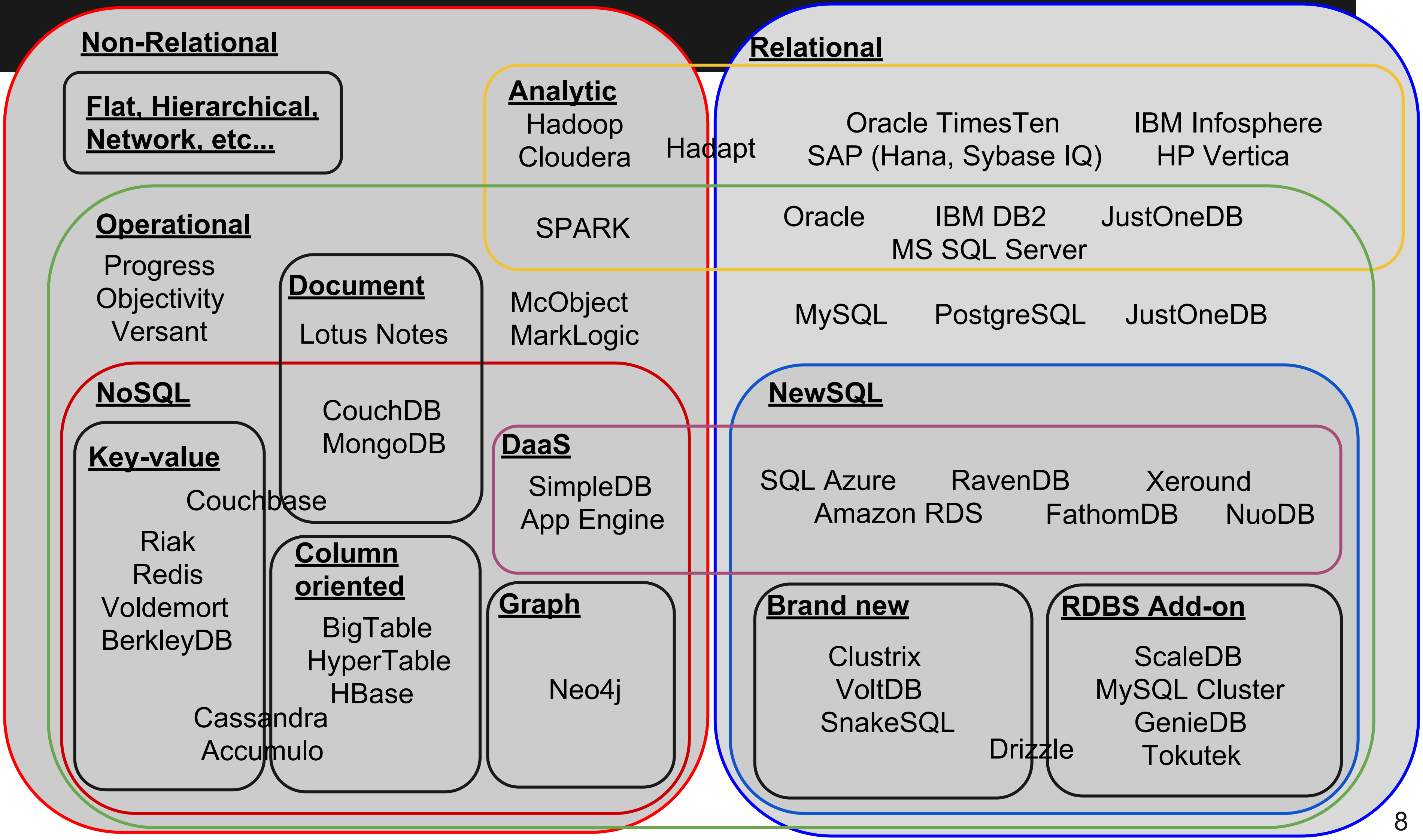
Further requirements:

- Durability
- High availability
- (Optional scalability)

Do we really need relational access for such use-case?

source: Tim Gasper - Big Data Right Now: Five trendy open source technologies

NoSQL - Options



Non-Relational

Flat, Hierarchical, Network, etc...

Analytic

Hadoop
Cloudera

Hadapt

SPARK

Relational

Oracle TimesTen
SAP (Hana, Sybase IQ)

IBM Infosphere
HP Vertica

Oracle
IBM DB2
JustOneDB
MS SQL Server

Operational

Progress
Objectivity
Versant

Document

Lotus Notes

CouchDB
MongoDB

McObject
MarkLogic

MySQL
PostgreSQL
JustOneDB

NoSQL

Key-value

Couchbase

Riak
Redis
Voldemort
BerkleyDB

Cassandra
Accumulo

Column oriented

BigTable
HyperTable
HBase

DaaS

SimpleDB
App Engine

SQL Azure
RavenDB
Xeround
Amazon RDS
FathomDB
NuoDB

Graph

Neo4j

NewSQL

Brand new

Clustrix
VoltDB
SnakeSQL

Drizzle

RDBS Add-on

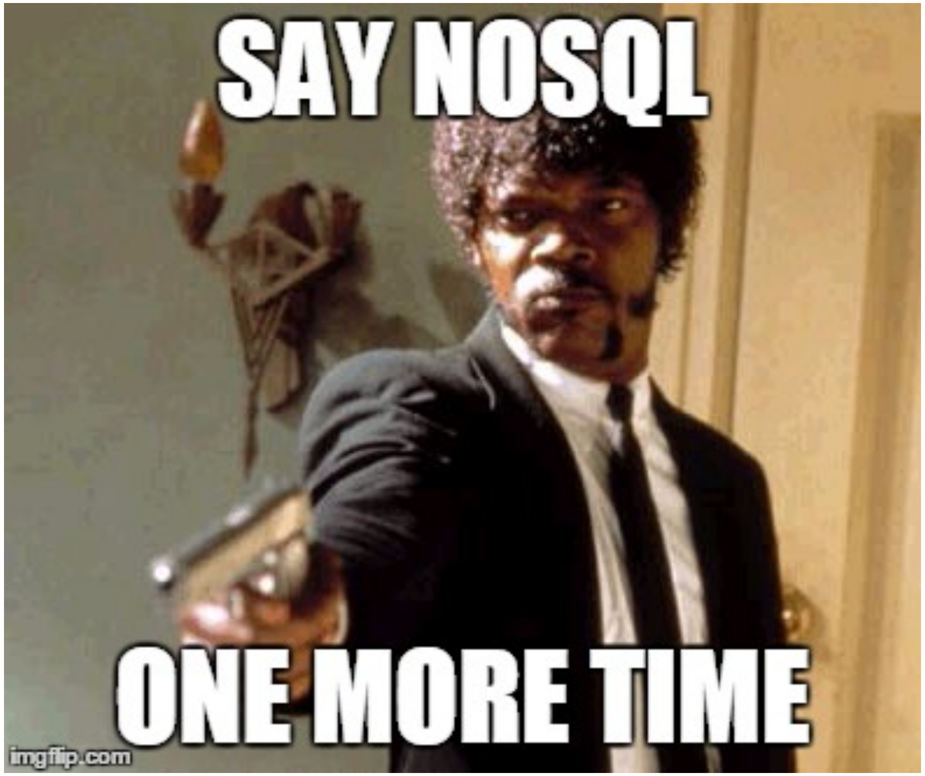
ScaleDB
MySQL Cluster
GenieDB
Tokutek

NoSQL - Candidates

How to chose?

Empirical evaluation: Check if a given prototype meets the usability and performance criterias from the original solution.

If more of them passes the criteria, choose the best, based on essential features and performance characteristics.



Prototypes - The candidates

Selection

In multiple phases...

Find:

- Showstopper problems (no-go)
- Barely usable (some issues)
- Promising candidates

Preliminary testing.

Candidates

No-go

- HBase (/w HDFS)
  - BLOB size problem.
- CouchDB
  - Drivers
- Hypertable
  - In development
- etc.: app layer needs, CAP characteristics, durability problems.

Promising

- **MongoDB**
- **Cassandra**

So-so

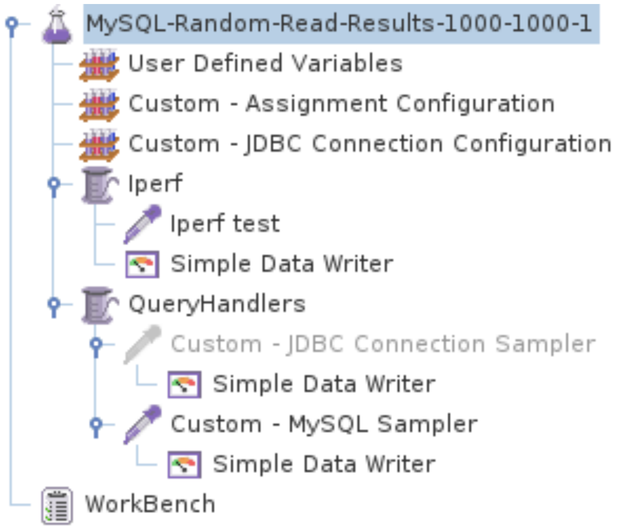
- **RIAK**
  - Query routing!
- (Couchbase)

CustomSamplers

An extension for JMeter, with CMS specific needs, in order to measure the performance of the different databases.

For each candidate the extension has:

- Deployers
  - To build up the data model
- QueryHandlers
  - Simulate the CMS workflow
- ConfigElements
  - Configure persistency objects
- Samplers
  - Report to the testplan listeners



MySQL-Random-Read-Results-1000-1000-1
User Defined Variables
Custom - Assignment Configuration
Custom - JDBC Connection Configuration
Iperf
Iperf test
Simple Data Writer
QueryHandlers
Custom - JDBC Connection Sampler
Simple Data Writer
Custom - MySQL Sampler
Simple Data Writer
WorkBench

Deployment

Automated virtual environments on OpenStack.

- Personal tenant - biased by user interactions
- Thanks to the collaboration with CERN IT, the evaluation was made on dedicated resources
- Also SSD cached vs. disk comparisons were made

Details:

- No overcommit
- Instances are “equally” distributed on the hypervisors. (for 5 node: 2-2-1 on 3 hypervisors)
- 1 GBit NICs (shared between co-hosted VMs)

Results

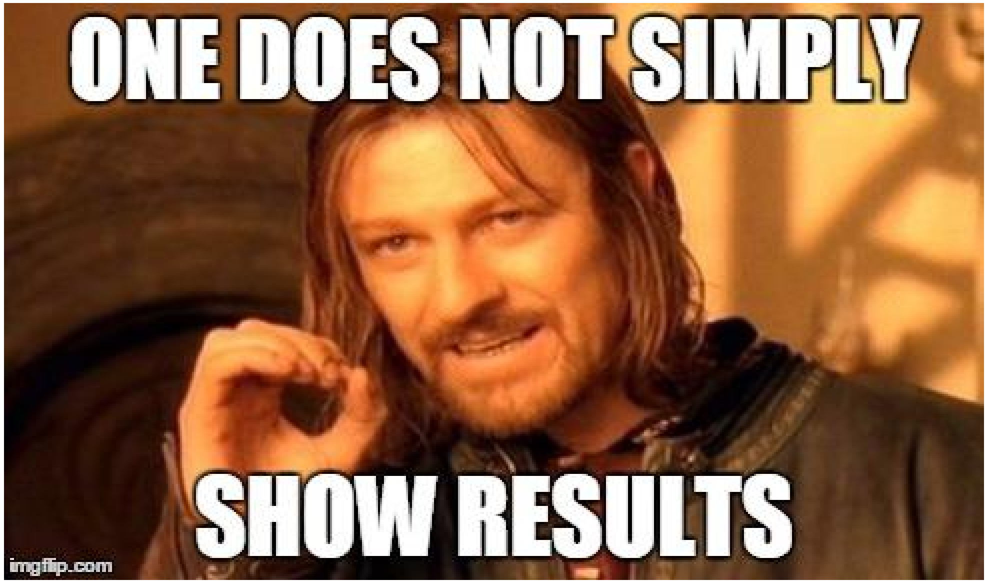
Increasing request numbers: 1-9 TPS
(For both remote and single testplans)

- Exploring limits for saturating factors like:
  - Network bandwidth
  - Access of persistency objects
  - Storage elements (Ephemeral disk/SSD, Ceph)
- Scaling out (different cluster setups):
  - Node numbers (5 x m1.large, 4 x m1.medium)
  - Routing techniques (Round robin, Token-aware)
  - Distributed testing (4 JMeter engine)

Plots

Loadosophia - Roland.Sipos@cern.ch

Composite timeline analysis (request time vs. monitoring)



Remarks

- MongoDB - 10Gen
  - ○ Scaling ✓
  - ○ BLOBs ✓
  - ○ API ✓ (however… mongos.)
- Cassandra - Datastax
  - ○ Scaling ✓
  - ○ BLOBs ! (splitting of large binaries?)
  - ○ API ✓
- RIAK - Basho
  - ○ Scaling ✓
  - ○ BLOBs ✓
  - ○ API ! (token aware routing? C++ driver?)

Outro - Present and future

Application layer

The current implementation of the session layer is extendable with alternative storage backends.

Steps:

- Handling persistency objects
  - Extending the software framework with NoSQL support
- Implement the Session interfaces
  - Implementing the “equivalent” CondDB queries
- Testing

Integration

- Release validation
- Find differences between the current solution and the prototypes
    - Using real data
    - Real use-cases - using CMSSW

This will be the final performance comparison between different deployments.

Outlook

- Understand and eliminate issues during the release validation
- Fine-tuning critical performance factors
- Formal evaluation and comparison of the different solutions

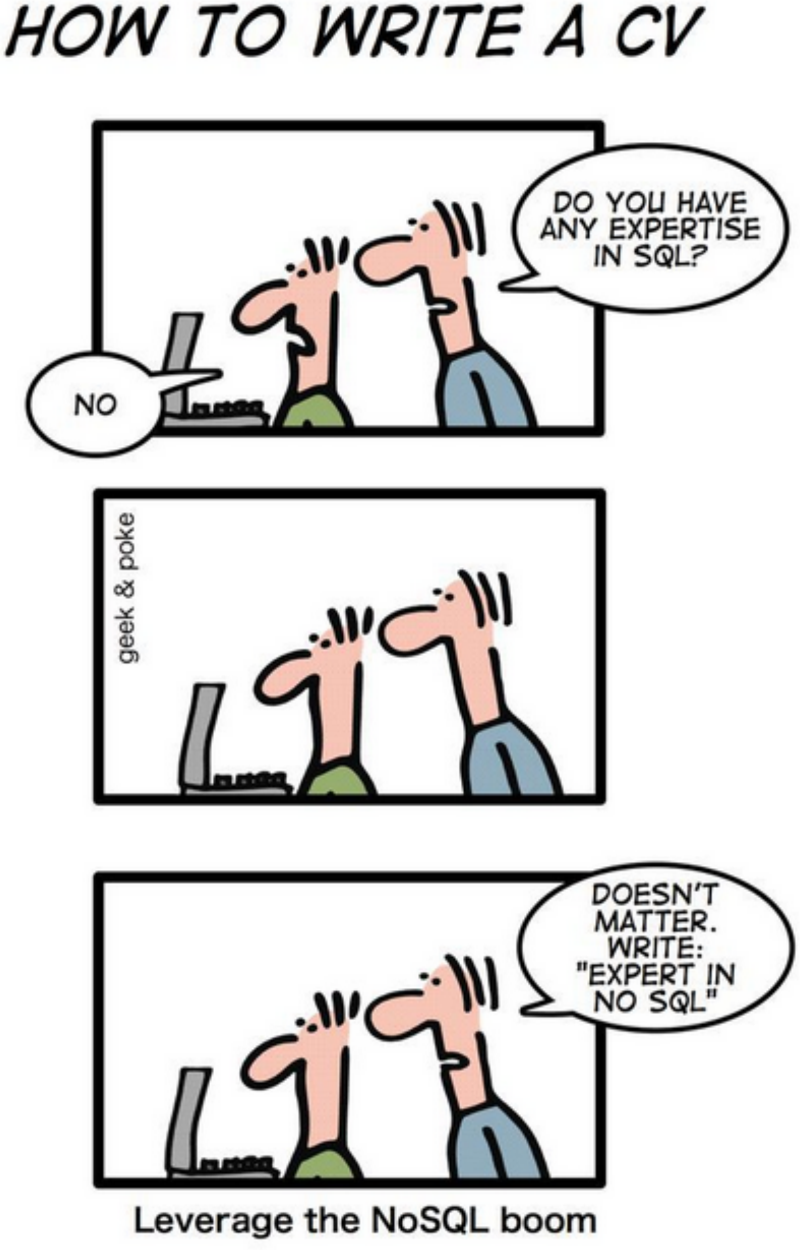
Long term project!

Not a “by tomorrow” change, but for LS2.

The end

Thank you for your attention!

Any questions are welcome!


HOW TO WRITE A CV
DO YOU HAVE ANY EXPERTISE IN SQL?
NO
geek & poke
DOESN'T MATTER. WRITE: "EXPERT IN NO SQL"
Leverage the NoSQL boom

From: http://geek-and-poke.com/