Polyglot Persistence in the Cloud

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Topics for this talk

- The new database landscape
- Impact of Cloud
Polyglot Persistence

Using multiple specialized persistent stores rather than one single general-purpose database
Infrastructure Evolution

# users

50 bn+

1-2 bn

10-20 m

Client/Server

Web/LAMP

MySQL

Oracle

Cloud

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The database landscape...

Source: 451 Research, NoSQL and NewSQL report
RDBMS used to be the default choice

- Development speed
  - Rigid relational schema
  - SQL vs something simpler

- Performance
  - Real-time
  - Prioritise availability over ACID

- Scale
  - Service lots of users

- Big Data
  - Variety of formats
  - Structure not as important
Do more with less
## Popularity

193 systems in ranking, September 2013

<table>
<thead>
<tr>
<th>Rank</th>
<th>Last Month</th>
<th>DBMS</th>
<th>Database Model</th>
<th>Score</th>
<th>Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>1.</td>
<td>Oracle</td>
<td>Relational DBMS</td>
<td>1529.61</td>
<td>-14.83</td>
</tr>
<tr>
<td>2.</td>
<td>3.</td>
<td>Microsoft SQL Server</td>
<td>Relational DBMS</td>
<td>1313.78</td>
<td>+8.82</td>
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<tr>
<td>3.</td>
<td>2.</td>
<td>MySQL</td>
<td>Relational DBMS</td>
<td>1305.76</td>
<td>-19.07</td>
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<tr>
<td>4.</td>
<td>4.</td>
<td>PostgreSQL</td>
<td>Relational DBMS</td>
<td>182.23</td>
<td>+0.01</td>
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<tr>
<td>5.</td>
<td>5.</td>
<td>DB2</td>
<td>Relational DBMS</td>
<td>172.25</td>
<td>+9.31</td>
</tr>
<tr>
<td>7.</td>
<td>7.</td>
<td>Microsoft Access</td>
<td>Relational DBMS</td>
<td>146.71</td>
<td>-4.18</td>
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<tr>
<td>8.</td>
<td>9.</td>
<td>SQLite</td>
<td>Relational DBMS</td>
<td>82.78</td>
<td>+3.33</td>
</tr>
<tr>
<td>9.</td>
<td>8.</td>
<td>Sybase</td>
<td>Relational DBMS</td>
<td>75.35</td>
<td>-6.24</td>
</tr>
<tr>
<td>10.</td>
<td>11.</td>
<td>Cassandra</td>
<td>Wide column store</td>
<td>51.69</td>
<td>+4.98</td>
</tr>
</tbody>
</table>

## RDBMS vs NoSQL

<table>
<thead>
<tr>
<th>RDBMS</th>
<th>NoSQL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structure and relations are important</td>
<td>Structure and relations not as important</td>
</tr>
<tr>
<td>Relational schema</td>
<td>Focus on storing/retrieving</td>
</tr>
<tr>
<td>Complex Queries</td>
<td>Simple access</td>
</tr>
<tr>
<td>JOINs</td>
<td>E.g. Key Value: get(), set()</td>
</tr>
<tr>
<td>ACID</td>
<td>Eventual Consistency</td>
</tr>
<tr>
<td>Scalability <em>usually</em> not built-in</td>
<td>Scalability built-in</td>
</tr>
<tr>
<td>Durability of data on one node</td>
<td>Durability of data guaranteed by having data on multiple nodes</td>
</tr>
</tbody>
</table>

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Why NoSQL?

- Flexibility
- Horizontal scalability
- Performance
Developer’s view of the world

App

DB
DBA’s view of the world
Upfront structure vs Speed
Variety of data

- People to People
  - Virtual communities, social networks, web logs, tweets
- People to Machine
  - Archives, medical devices, digital TV, e-commerce, smart cards, bank cards, computers, mobiles
- Machine to Machine
  - Sensors, GPS devices, bar code scanners, surveillance, scientific research

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Vertical vs Horizontal scaling
Performance
Less constraints

- Durability not IO bound
- Limited transactions and overhead
- In-memory database technology
Structure on disk
“how is my data queried?”

- Example: Read and update Customer Profile
  - 20 table join vs reading one document

Document Model
Collection ("Things")

```json
{"id": "13434",
"value1": "sfsd",
"value2": "sfsd",
"items": [{"id": "3fes2",
"t2value": "abcd", ...}]
```
Specialized datastores
Key-Value

- Hash map
  - Simple
  - Fast to read/write
- No relations between data
- Memcached, DynamoDB, Redis, Riak
Column Oriented

- Data in same column stored together
  - Fast column operations

- Storage efficiency
  - Sparse tables, null values

- Hbase, Cassandra
Document

- Nice fit for e.g. web apps using JSON
  - No “flattening” of data into tables
- Schemaless
- MongoDB, CouchDB
Graph

- Highly interconnected data
  - Graph traversal

- Recommendations engine, social graph

- Neo4j
Cloud Impact
Cloud Impact

- Limited scale up
- Disk IO
- Availability
Pets vs Cattle

Service Model

- Pets are given names like pussinboots.cern.ch
- They are unique, lovingly hand raised and cared for
- When they get ill, you nurse them back to health

- Cattle are given numbers like vm0042.cern.ch
- They are almost identical to other cattle
- When they get ill, you get another one

- Future application architectures should use Cattle but Pets with strong configuration management are viable and still needed
Cloud Impact

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Cloud Impact

- Limited scale up
- Disk IO
- Availability
Uptime stats

Global Provider View

Compare the end-user experience of PaaS and IaaS providers from around the world.

Metric:  

Response Time  Availability

Time Frame:  

30 day

Locations:

World

Cloud Providers

Provider  Availability

Google App Engine  97.57 %
Windows Azure  99.70 %
GoGrid (East)  99.88 %
OpSource  99.32 %
Rackspace  99.70 %
Amazon EC2 (US)  99.88 %
TokLinks  99.94 %
Bit Refinery  99.85 %
Amazon EC2 (US)  99.99 %
Terremark  99.81 %
GoGrid (West)  99.97 %
CloudSigma  99.93 %
Amazon EC2 (EU)  99.82 %
Amazon EC2 (AP)  99.81 %
IU IOS  99.94 %
Windows Azure (AP)  99.85 %
IT Clouds  99.85 %
Amazon EC2 (AP)  99.94 %

22 Mar 2011 16:59 To 21 Apr 2011 16:59 (GMT+0100)

Backbone Network

> 99 (%)  99~95 (%)  < 95 (%)
Cloud availability

99.68% 97.57% 99.76%
Amazon EC2 goes down, taking with it Reddit, Foursquare and Quora

by Mike Butcher on April 21, 2011

Cloud computing is all very well until someone trips over a wire and the whole thing goes dark.

Reddit, Foursquare and Quora were among the sites affected by Amazon Web Services suffering network latency and connectivity errors this morning, according to the company's own status dashboard.

Amazon says performance issues affected instances of its Elastic Compute Cloud (EC2) service and its Relational Database Service, and it's "continuing to work towards full resolution". These are hosted in its North Virginia data centre.

1:48 AM PDT We are currently investigating connectivity and latency issues with RDS database instances in the US–East–1 region.
2:16 AM PDT We can confirm connectivity issues impacting RDS database instances across multiple availability zones in the US–East–1 region.
3:05 AM PDT We are continuing to see connectivity issues impacting some RDS database instances in multiple availability zones in the US–East–1 region. Some Multi AZ failovers are taking longer than expected. We continue to work towards resolution.
4:03 AM PDT We are making progress on failovers for Multi AZ instances and restore access to them. This event is also impacting RDS instance creation times in a single Availability Zone. We continue to work towards the resolution.

European–based startups affected include Paper.li and Mobypicture.
Managing polyglot persistence
Demo: Multi-Datacenter Deployment

POINT OF CONTROL