Inside ArangoDB’s new Sharding

Max Neunhöffer

NoSQL matters 2014

Cologne, 30 April 2014
What is sharding?

- Use **multiple servers** and **distribute the data**.
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- Let the whole **cluster** appear as **one big database**.
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- Heterogeneous and decentralised infrastructure possible.
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Horizontal Scaling — scale out
Do you need sharding???

---

Probably not! — at this stage

If at all possible, you probably want to buy one or two big enough machines, providing a reserve of about a factor of 3 – 10. Possibly use replication for reliability.

However: Everybody wants to be the next WhatsApp... ⇒ You want to use a database that can do sharding.
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If at all possible, you probably want

- to buy **one or two big enough machines**,  
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⇒ You want to use a database that can do sharding.
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. . . recently added sharding in Version 2.0.
Overview over ArangoDB's sharding

Cluster components

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30 April 2014
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Cluster components

DBserver DBserver DBserver
1 4 2 5 3 1

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Requests

Coordinator

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A sharded collection **consists** of local collections (the **shards**) *distributed over the DBservers.*
A sharded collection consists of local collections (the shards) distributed over the DBservers.

Each document in the collection is stored in exactly one shard.
Sharded collections

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- The shard is chosen by shard keys, which are one or more attributes in the documents (default: `_key` only).
Sharded collections

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- Each document in the collection is stored in exactly one shard.
- The shard is chosen by shard keys, which are one or more attributes in the documents (default: \_key only).
- The coordinators redirect incoming queries to the right DBserver(s).
Reading a document in a sharded collection

Assume that we use \texttt{\_key} as only shard key.
Reading a document in a sharded collection

Assume that we use `_key` as only shard key.

The **coordinator**

1. receives a GET request via HTTP with a `_key`,
Reading a document in a sharded collection

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Reading a document in a sharded collection

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More difficult case

If we use other shard keys than \_key, it needs to ask every shard!
Updating a document in a sharded collection

Assume we use some shard keys other than _key. The coordinator receives a PUT or PATCH request with a changed document.
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Details of sharding  CRUD operations

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Easier case

If we use \_key as only shard key, it only needs to ask one shard!
Querying **byExample**

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6. subsequently serves the meta-cursor **using all internal cursors** one after another.
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AQL queries are much more complicated, but handled similarly.
Consistency

Question

Which state does the client see?
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Answer (currently!)
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Eventually, we will use Multi Version Concurrency Control (MVCC) to provide a consistent snapshot across the whole database.
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Eventually, we will use Multi Version Concurrency Control (MVCC) to provide a consistent snapshot across the whole database. This brings us to TRANSACTIONS . . .
Transactions ...
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... are **hard** in a distributed database.
Transactions ...  
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Questions

- **What state** does a transaction see?
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Details of sharding  Consistency and transactions

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⇒ Need **global transaction management**:
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- may change all docs that have not been changed since then.
- every document revision has an associated transaction, and
- the transaction manager must be able to order transactions by their start time.
- It is only asked, when two transactions try to modify the same doc.
Our approach to transactions in a cluster
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- **Later**, we will temporarily **relax isolation**: “eventual atomicity”.
Our approach to transactions in a cluster

- **In Version 2.0**, transactions in a cluster are just **fake**.

- **Later**, we will temporarily **relax isolation**: “eventual atomicity”.

- **Eventually**, we will **implement full transaction semantics** in the MVCC sense.
Fault tolerance and automatic failover

Synchronisation and failover organisation is done via the agency.

Coordinator

Primary DB
1 2
3 5

Secondary DB
1 2
3 5

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Fault tolerance and automatic failover

Coordinator

Primary DB

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Distributed failover

**Green:** primary shard instances  
**Pink:** secondary shard instances

If any one server fails, all shards are still there, and the load is still relatively evenly distributed.

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State of our implementation

Done and Todo

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- Graphical user interface to cluster planning/launching/shutdown
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- Graphical dash board for cluster state monitoring
- Authentication with and in cluster, including SSL
Done and Todo

Todo (see roadmap for later this year)

- Dump and restore for clusters
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- Secondary DBservers, synchronous replication, automatic failover

Stay tuned for new releases later this year!
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