Humongous MongoDB

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Agenda

- Scaling MongoDB - Concepts
- Replica Sets & Sharding
- Read Preference, Write Concern, Etc
- Map/Reduce
- Aggregation

You Might Prefer...

- Queries and Looping and Grouping
- Enterprise JavaScript Workflows
- Using PhoneGap to Build Mobile Apps
  - Deep Dive - two hours, halfway thru!
- Caching in ColdFusion 10

Me

- Functional Programming in the 80's
- Object-Oriented Programming in the 90's
- Web / Dynamic Programming in the 00's
- Mostly Clojure today

Me & MongoDB

- Using MongoDB in production (2 years)
- Took 10gen "MongoDB for Developers" course (Python + MongoDB)
- Lead maintainer for Clojure's MongoDB wrapper "CongoMongo"

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- **Scaling MongoDB - Concepts**
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Scaling Concepts

- Master / slave for traditional DBs
  - One master
  - One or more slaves
- Usually scale "up" not "out"

Scaling Concepts

- MongoDB replaces "master / slave" with "replica set" for failover & load distribution
- MongoDB adds sharded clusters to support very large data sets - horizontal scale out

Replica Set Concepts

- A replica set contains any number of (mostly) identical nodes
- A subset of these vote to elect a primary
- All remaining nodes are then secondaries
- Writes go to the primary node and replicate to the secondary nodes

Replica Set Concepts

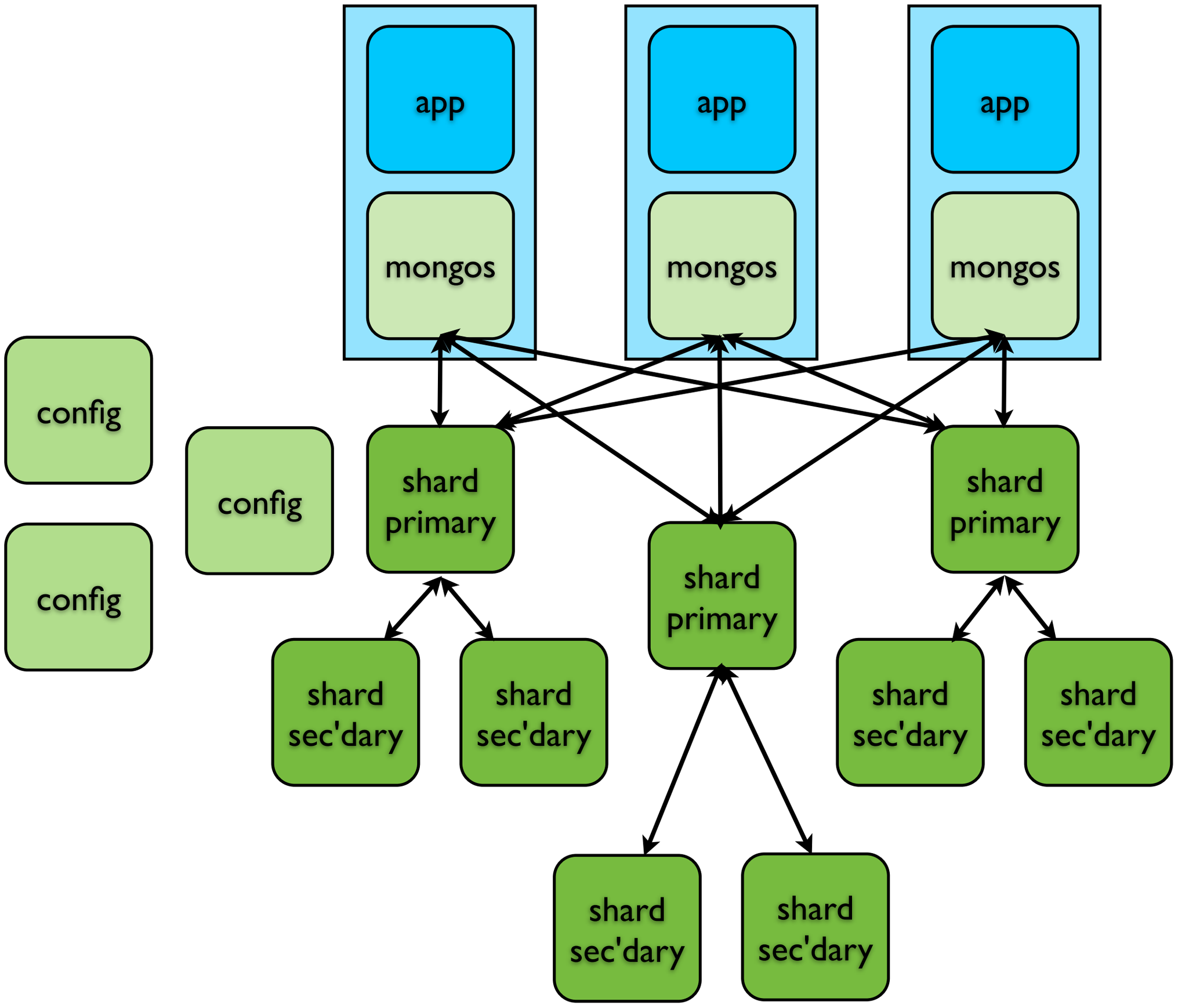
- Reads generally go to the primary node but can be performed against secondaries
  - Per connection or per operation
  - Can also be targeted to specific nodes
    - Tagged of nodes and reads

Replica Set Concepts

- Nodes may also be
  - Secondary only
  - Hidden
  - Arbiter
  - Non-voting
  - Delayed

Sharding Concepts

- Multiple "shards"
  - Servers or clusters (replica sets)
- Configuration server (or a cluster)
- Shard server proxy (mongos process)
  - Lightweight, can have one per app server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Sharding Concepts

- A collection is split across the shards
  - Automatic, based on a key column
  - Automatically balanced across shards
  - Reads directed to appropriate shards
    - May run on all shards, then aggregate

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Replica Set Setup

- Start MongoDB servers as replica nodes
  - add --replSet {rsName}
  - specify unique ports and --dbpath folders!

Replica Set Setup

- Connect via mongo shell to one server
- initiate the replica set
- add the other servers to that

Replica Sets

- Either:

```
conf = { _id: "rsName",
    members: [ { _id: 0,
                 host: "server-x:27017" } ] }
rs.initiate( conf )
```

Replica Set Setup

- Or:
  rs.initiate()
- Creates default rs.conf()
- Now add the others:
  rs.add("server-y:27017")
  rs.add("server-z:27017")

Replica Set Demo

- Let's see a real replica set running locally!
  - Must use local machine name
  - Must use different ports for each instance

Sharding Setup

- Start config server(s)
  - mongod --configsvr --dbpath /data/cfg
- Start mongos process(es)
  - mongos --configdb server-c:27019
- Start server (or replica set) for each shard
  - mongod --dbpath /data/sh1

Sharding Setup

- Add each shard to configuration
  - sh.addShard("server-s:27100")
- Enable sharding for the database
  - sh.enableSharding("mydb")
- Enable sharding for a collection
  - sh.shardCollection("mydb.coll",{thekey:1})

Sharding In Use

- Connect to the mongos server (or cluster)
- Interact with the database as usual
- Data automatically moved between shards
- Reads automatically routed based on key

Sharding In Use

- If a query includes the shard key, it will be routed directly to the appropriate server
- If a query does not include the shard key (or uses a range), the query will be sent to multiple servers and the results merged in the mongos process

Sharding Demo

- Let's see it running!

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Read Preference

- Normally all reads go to the primary
  - Just like writes
- As we saw, you cannot normally read from a secondary unless you explicitly allow it
- Sometimes you want to spread the read load or read from nearby servers (in a geographically distributed cluster)

Read Preference

- Available options:
  - primary - default
  - primaryPreferred
  - secondary
  - secondaryPreferred
  - nearest

Read Preference

- Secondaries can return stale data!
- Can specify preference
  - Per connection
  - Per collection
  - Per operation
- Not currently supported by cfmongodb

Write Concern

- By default, receipt of a write command is acknowledged by the server (but may not yet have been written to disk)
- You can control what operations you wait for before a write command returns

Write Concern

- Errors Ignored - do not use!
- Unacknowledged
- Fire and forget
- Network errors are detected
- Used to be the default

Write Concern

- Acknowledged
  - Current default (as of late 2012)
  - Network errors, duplicate keys etc
- Journaled
  - The update is written to local journal
  - Durable - will survive shutdown / crash

Write Concern

- Replica Acknowledged
  - The update is written to one or more secondaries in a replica set
  - Can specify number or "majority"
  - Specifying number will block until that many secondaries have the write (and therefore it can block "forever"!)

Write Concern

- cfmongodb supports per-connection only
  - Not per-operation
- mongoClientOptions arg to MongoConfig
  - writeConcern field of that struct

WriteConcern

- Retrieve from a Java class
  - mongoFactory.getObject(
    "com.mongodb.WriteConcern"
).UNACKNOWLEDGED
- http://api.mongodb.org/java/2.10.1/com/mongodb/WriteConcern.html

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Map/Reduce

- Intended for complex data processing
- Batch operation, not real time!
- You provide map, reduce, finalize functions written in JavaScript (as strings!)

Map/Reduce

- people = mongo.getDBCollection("people");
  people.mapReduce(
  map = "function(){ ...}",
  reduce = "function(key,values){ ... }",
  outputTarget = ...);
- For finalize you must use a DB command
- Examples in cfmongodb aggregation folder

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Aggregation Framework

- Added in MongoDB 2.2
- Native, pipeline-based functions
  - project (SELECT), match (WHERE), group (GROUP BY), sort (ORDER BY), unwind, skip, limit, geoNear (new in 2.4)
- Simple aggregate() function takes each operation as an argument in order

Aggregation Framework

- result = musicians.aggregate(
  { "$group" : { "_id" : "$status",
                 "total" : { "$sum" = 1 } } },
  { "$project" : { "status" : "$_id",
   "numberOfMusicians" : "$total",
                         "_id" : 0 } }
);

Aggregation Framework

- Equivalent to
  - SELECT COUNT(*) AS total, status
    FROM musicians
    GROUP BY status
- More examples in cfmongodb aggregation folder

Summary

- MongoDB
  - Supports simple, robust clustering with automatic failover
  - Supports data sharding to provide automatic horizontal scalability
  - Provides plenty of control over reading and writing in a clustered environment

Summary

- cfmongodb supports
  - Robust, scalable clustering
  - Big Data manipulation through map/reduce and the aggregation framework
  - Write Concern (partially)
- It's open source - contribute!

Resources

- http://cfmongodb.riaforge.org
- http://mongodb.org
- http://docs.mongodb.org
- http://www.10gen.com

Q & A?

- @seancorfield
- http://corfield.org
- sean@corfield.org