Fast, Reliable, Secure, Affordable MongoDB on AWS EC2

Paul Marcelin

OPEN SOURCE DATABASE CONFERENCE

PERCONA LIVE

Why are we here today?

- Among open-source databases,
  MongoDB is a **complete** production-ready solution

- Self-managing MongoDB is **worthwhile**,
  for the best AWS performance at the lowest cost

- A few simple but not widely-understood AWS tips ★
  prevent most AWS performance, cost, and security problems

Compute for MongoDB

- Choose between 3 major instance families...
  - Memory-optimized R5
  - Compute-optimized C5
  - General-purpose M5
- And one with a twist:
  - Burstable performance T3
- Use the latest generation
  - Better performance, lower unit price

Disk for MongoDB

- Network storage as a service: Elastic Block Store
  - Affordable: from 10¢ per gigabyte per month
  - Reliable: multiple copies; decoupled from compute
  - Convenient: snapshots; online volume enlarge

- Don’t use Provisioned IOPS SSD (io1 volumes) or local SSD (i3, i3en instances) before you:
  - Optimize for EBS general-purpose SSD (gp2) volumes
  - Study CloudWatch metrics data

Check with AWS for official prices.

Optimize for EBS General-Purpose SSD

- Use latest-generation instances
  - More EBS bandwidth
  - Less EBS overhead
- Use larger instances
  - Even more bandwidth!
- Enlarge your general-purpose (gp2) volumes
  - More operations per second at a much lower cost ★ than Provisioned IOPS (io1)

gp2 IOPS: *Base* = 3 × volume size in GB

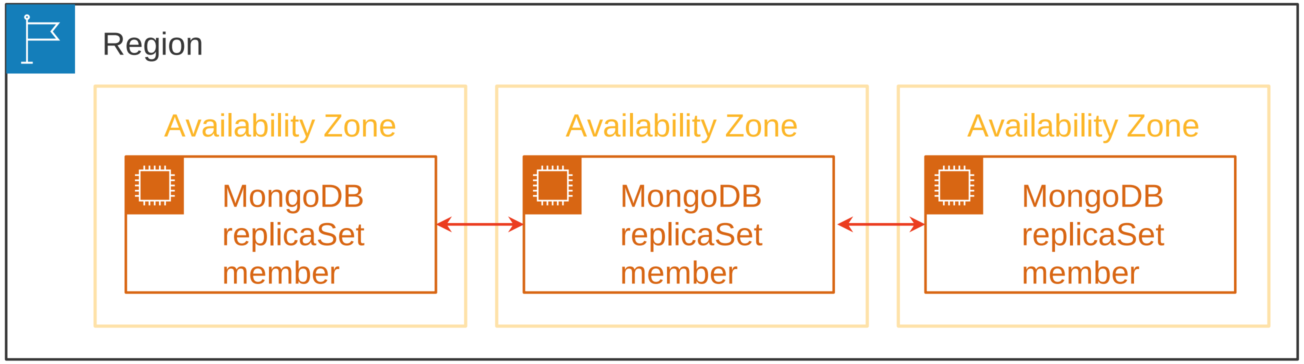
Max = 16,000 IOPS (5.3 to 16 TB volume size)

Back Up MongoDB with EBS Snapshots

- Create at least two separate EBS volumes
    1. Operating system + software
    2. Data + journal
- Enable journaling
- Keep journal on same volume as data
- Take frequent snapshots
    - You pay only for changed disk blocks ★
    - AWS Backups: every 12 or 24 hours
    - github.com/sqlxpert/aws-tag-sched-ops: up to every 10 minutes

Basic Fault Tolerance

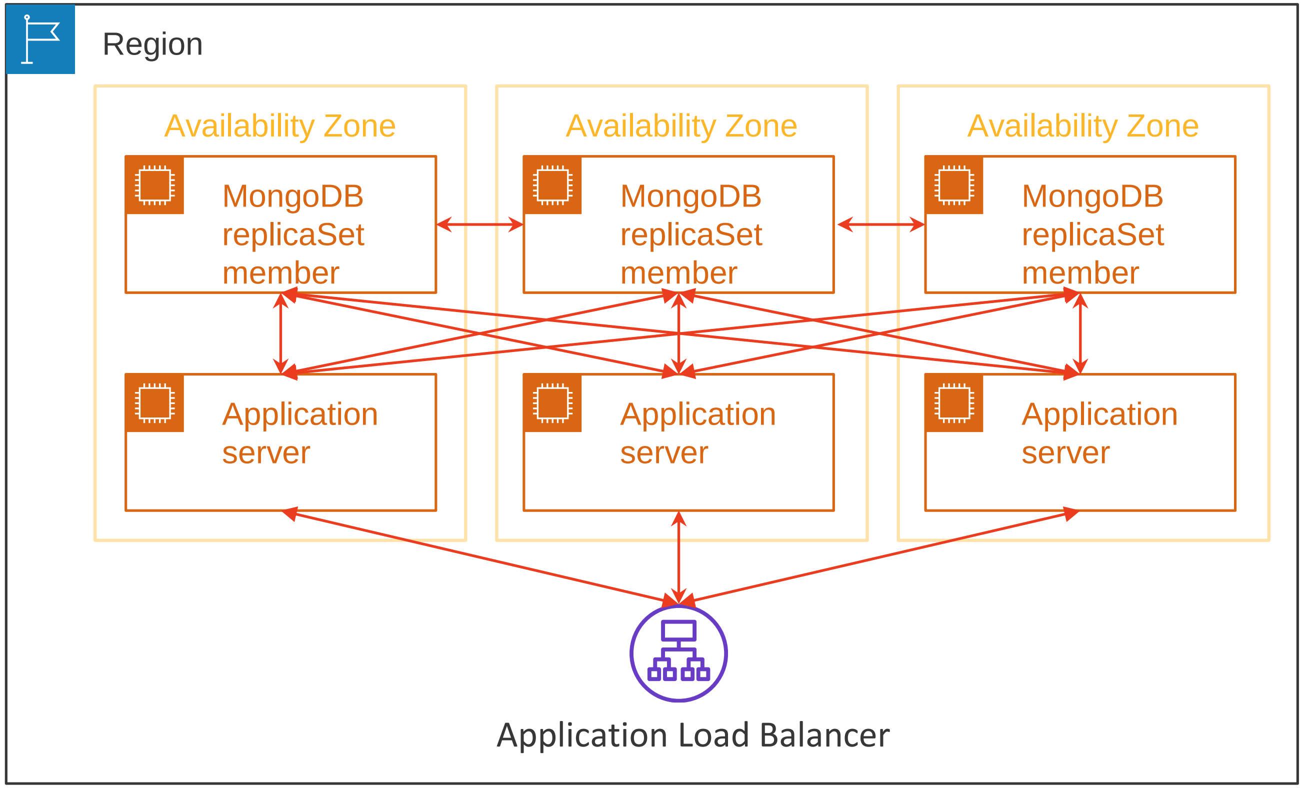
- Each AWS region has multiple availability zones, in separate locations
- Distribute your MongoDB replicaSet across availability zones


Region
Availability Zone
MongoDB replicaSet member
Availability Zone
MongoDB replicaSet member
Availability Zone
MongoDB replicaSet member

- Plan for a 2-zone minimum in some regions
- Multi-region replicaSets are possible (but consider network latency)

More Fault Tolerance

- Distribute your application layer, not just your database!
- Always use replicaSet connection strings for application traffic



Yet More Fault Tolerance

- Detect and replace failed replicaSet members
- Make this automatic, or at least quick and convenient
- Potential components:
  - An EC2 Fleet automatically replaces failed instances
  - A configuration management system (AWS OpsWorks, Chef, Ansible, SaltCloud, etc.) configures each new instance upon first boot
  - A pipeline updates a base Amazon Machine Image (AMI)

Basic Security Elements

- AWS Key Management System (KMS) customer-managed key
  - Encrypts disks and snapshots
- TLS certificates (not from AWS)
  - Encrypt application and replication traffic
  - Validate server identity
- AWS security groups
  - Enforce network firewall rules
  - Also validate server identity (within the same AWS region)

Understand Disk Encryption (EBS + KMS)

- Use customer-managed keys, not your default EBS service key!
- Create a separate key for every MongoDB replicaSet
- Encrypt both your data volume and your OS volume
- Snapshots of encrypted volumes are necessarily encrypted
- Edit the key policy to limit the people who can:
  - Attach encrypted volumes to instances
  - Create volumes from snapshots
  - Copy snapshots

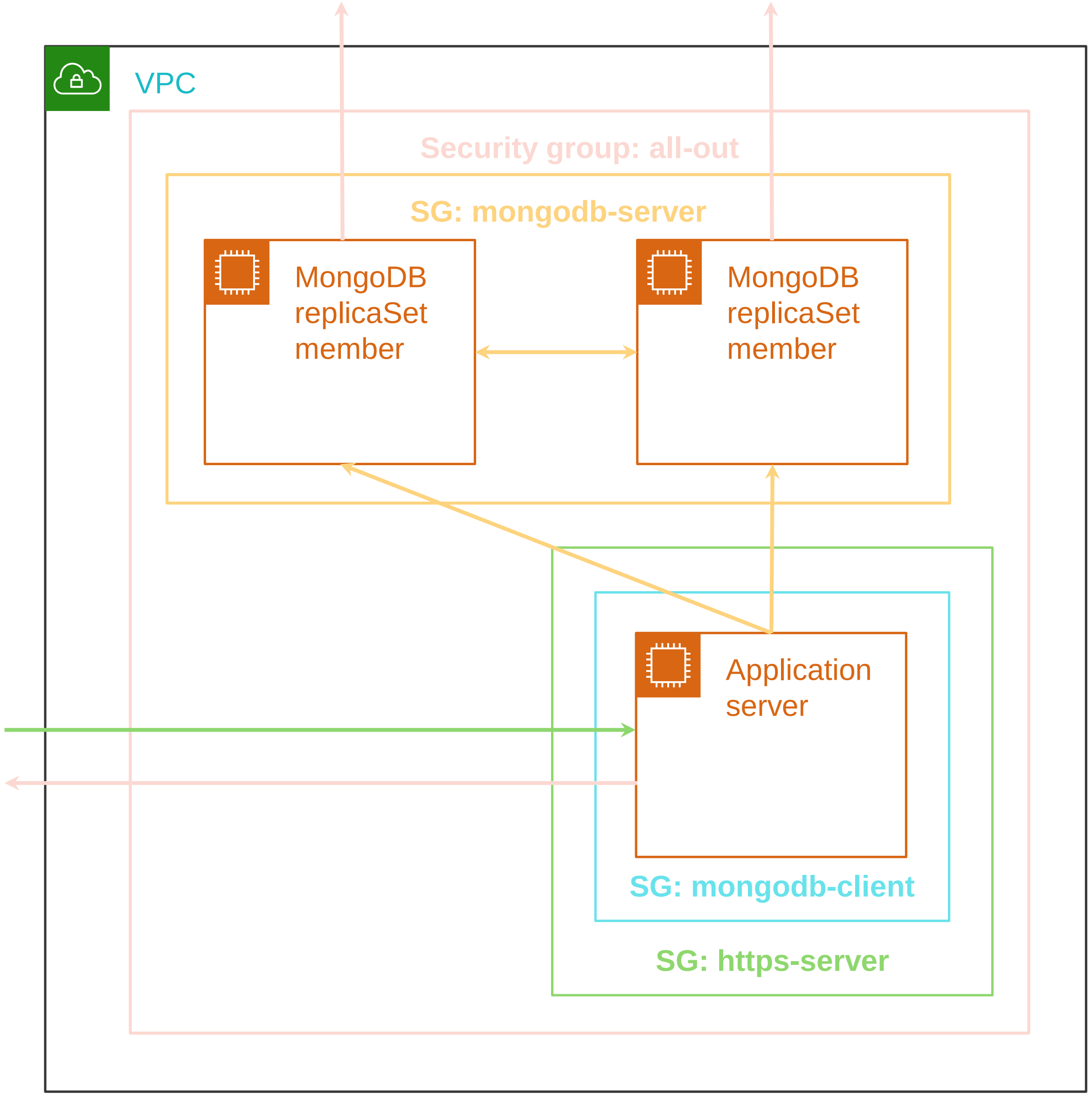
Take Full Advantage of TLS Certificates

- Every replicaSet member needs its own TLS certificate (and DNS record)
- Underlaying an AWS Route 53 DNS private hosted zone may help!
- The private key should live only as long as the replicaSet member
- Obtain certificates from a third party; don’t self-sign
- My personal favorites:
  - Let’s Encrypt (free)
  - DigiCert’s duplicate certificate feature + a wildcard certificate (worth the cost)

Understand AWS Security Groups

- A security group is a set of network firewall rules
- These rules can only allow, not block
- Traffic that’s not allowed is blocked, but...
- If you send out a request, the response is always allowed in (“stateful”)
- Never use a default security group!
- An instance can be a member of multiple security groups
- Never reference same-region instances by IP address; instead, identify source and destination instances by their security groups ★
- If you only police inbound traffic, put all instances in an all-outbound group and delete the default all-outbound rule from all other groups

Define Security Groups by *Membership*



<u>all-out</u>

- All traffic *out* to 0.0.0.0/0

<u>mongodb-server</u>

TCP 27017 *in* from:

- mongodb-server (replication)
- mongodb-client (application data)

<u>mongodb-client</u>

No rules; just identifies clients

<u>https-server</u>

- TCP 443 *in* from 0.0.0.0/0

Advanced Security Elements

- AWS Identity and Access Management EC2 instance role
  - Authorizes AWS API calls from an instance (including calls made by the Systems Manager agent)
  - No AWS API keys to rotate, distribute, and hold on disk ★
- Task-specific IAM roles ⛑ ⛑ ⛑
  - Grant specific people shell access to specific instances
- AWS Systems Manager – Session Manager
  - Provides shell access, with no SSH key pairs to manage ★

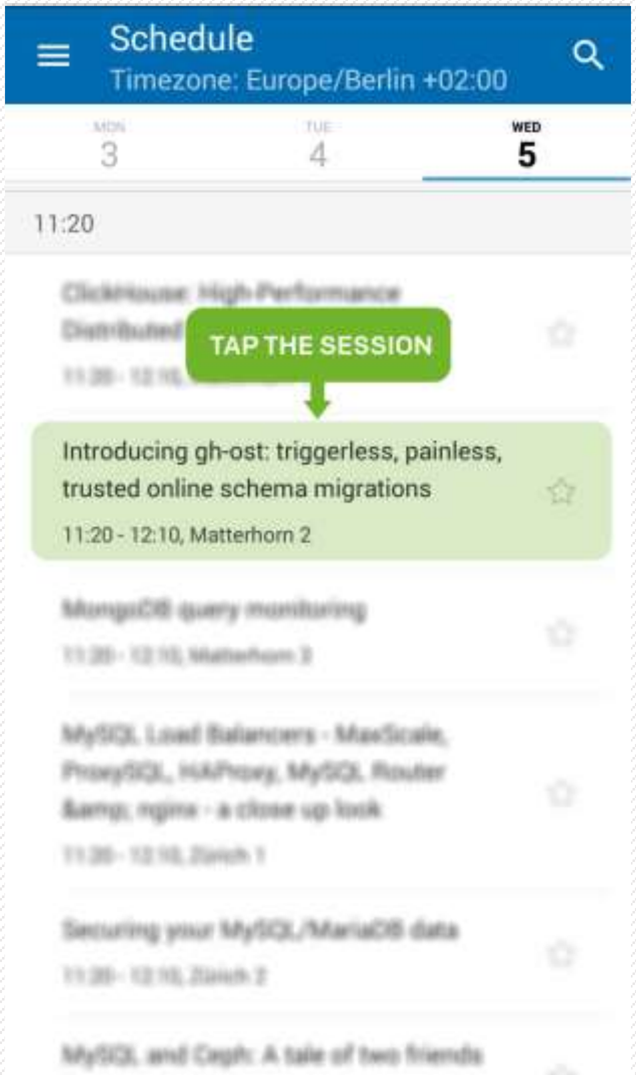
Summary: MongoDB on AWS EC2

- Three t3 instances, in multiple availability zones
- Instance role with **`AmazonEC2RoleforSSM`** policy
- AWS Systems Manager – Session Manager for shell access
- Security groups: all-out, mongodb-server, mongodb-client
- KMS key to encrypt only this replicaSet’s disks
- For each instance:
  - Large additional EBS gp2 volume for data + journal
  - Public + private DNS records and a TLS certificate

We’re Almost Done

- Thanks for coming!
- Keep in touch at marcelin@alumni.cmu.edu
- Try my template, **github.com/sqlxpert**/mongodb-percona-live
- Or try Amazon’s, **aws.amazon.com/quickstart**/architecture/mongodb/
- Don’t forget to rate this session...

Rate This Session



Schedule
Timezone: Europe/Berlin +02:00

MON 3 | TUE 4 | WED 5

11:20

ClickHouse: High-Performance Distributed ...
11:20 - 12:10, ...

TAP THE SESSION

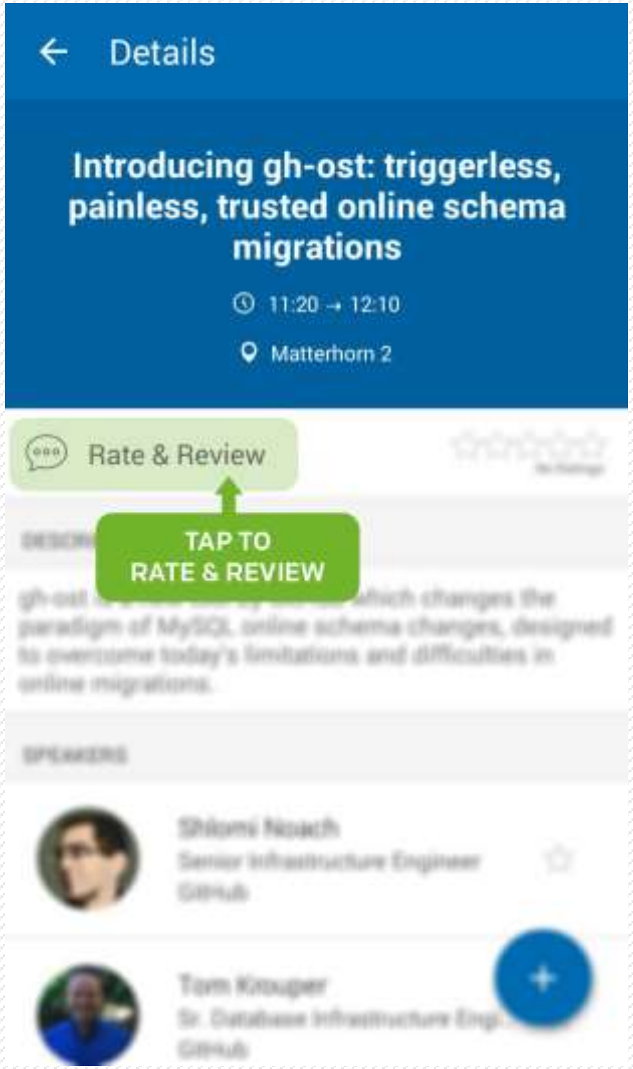
Introducing gh-ost: triggerless, painless, trusted online schema migrations
11:20 - 12:10, Matterhorn 2

MongoDB query monitoring
11:20 - 12:10, Matterhorn 3

MySQL Load Balancers - MaxScale, ProxySQL, HAProxy, MySQL Router &amp; nginx - a close up look
11:20 - 12:10, Zürich 1

Securing your MySQL/MariaDB data
11:20 - 12:10, Zürich 2

MySQL and Ceph: A tale of two friends



Details

Introducing gh-ost: triggerless, painless, trusted online schema migrations

11:20 → 12:10

Matterhorn 2

Rate & Review

No Ratings

TAP TO RATE & REVIEW

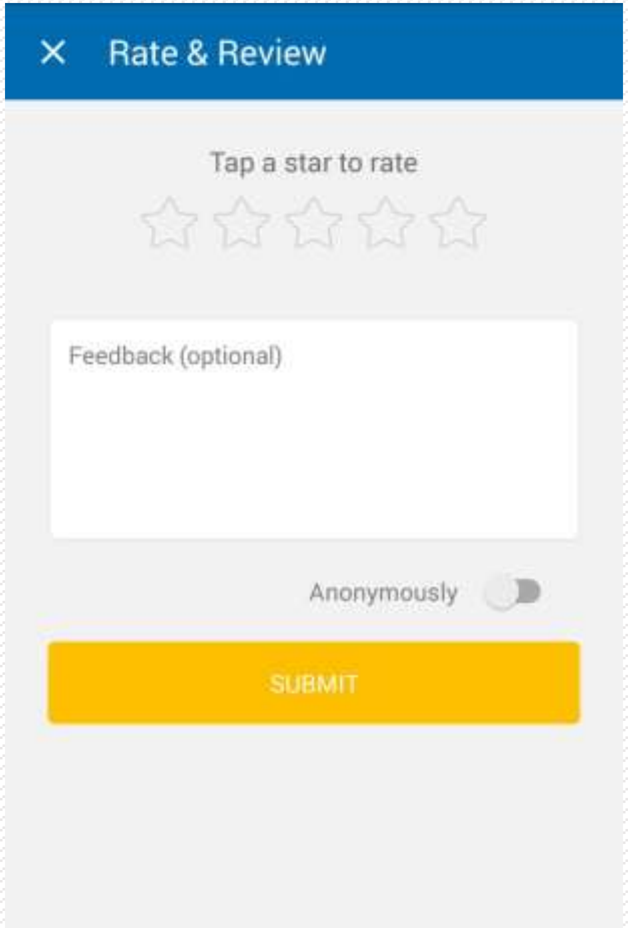
DESCRIPTION

gh-ost is a new tool by GitHub which changes the paradigm of MySQL online schema changes, designed to overcome today's limitations and difficulties in online migrations.

SPEAKERS

Shlomi Noach
Senior Infrastructure Engineer
GitHub

Tom Krouper
Sr. Database Infrastructure Eng...
GitHub



Rate & Review

Tap a star to rate

☆ ☆ ☆ ☆ ☆

Feedback (optional)

Anonymously

SUBMIT

MongoDB + AWS Loose Ends

- Swap
  - MongoDB documentation recommends it!
  - Put it on a third EBS volume
  - Encrypt that volume (of course)
  - Extra work is required to put swap on local (instance store) volumes, ★ for instance types (e.g., m5d) that offer local storage
- Customary configuration changes for MongoDB
  - Transparent Huge Pages: disable
  - File descriptor and process limits (**`ulimit`**): increase
  - Data volume mount options: add **`noatime`**