Orchestrator on Raft: internals, benefits and considerations

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About me

- **@github/database-infrastructure**
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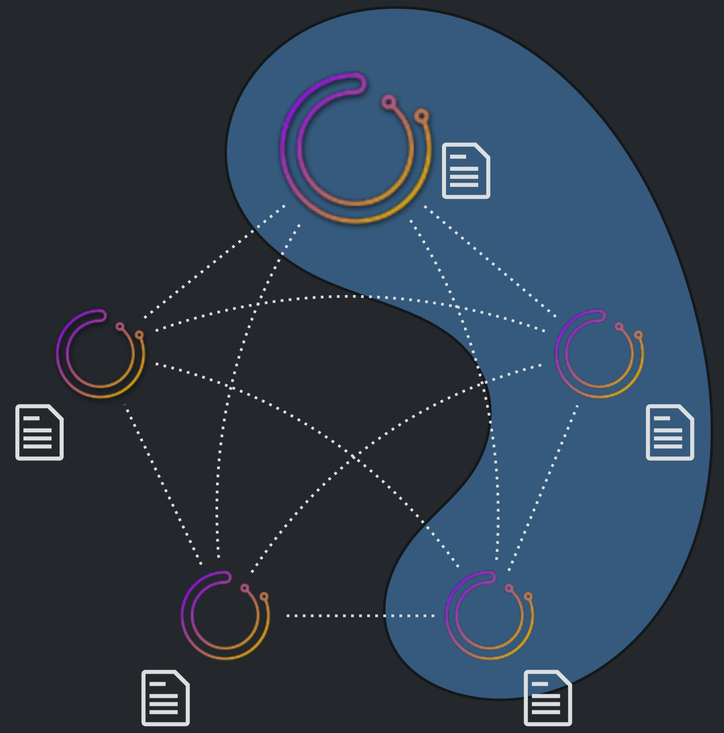
- Blog at http://openark.org
- @ShlomiNoach

Agenda

- Raft overview
- Why orchestrator/raft
- orchestrator/raft implementation and nuances
- HA, fencing
- Service discovery
- Considerations

Raft

- Consensus algorithm
- Quorum based
- In-order replication log
- Delivery, lag
- Snapshots

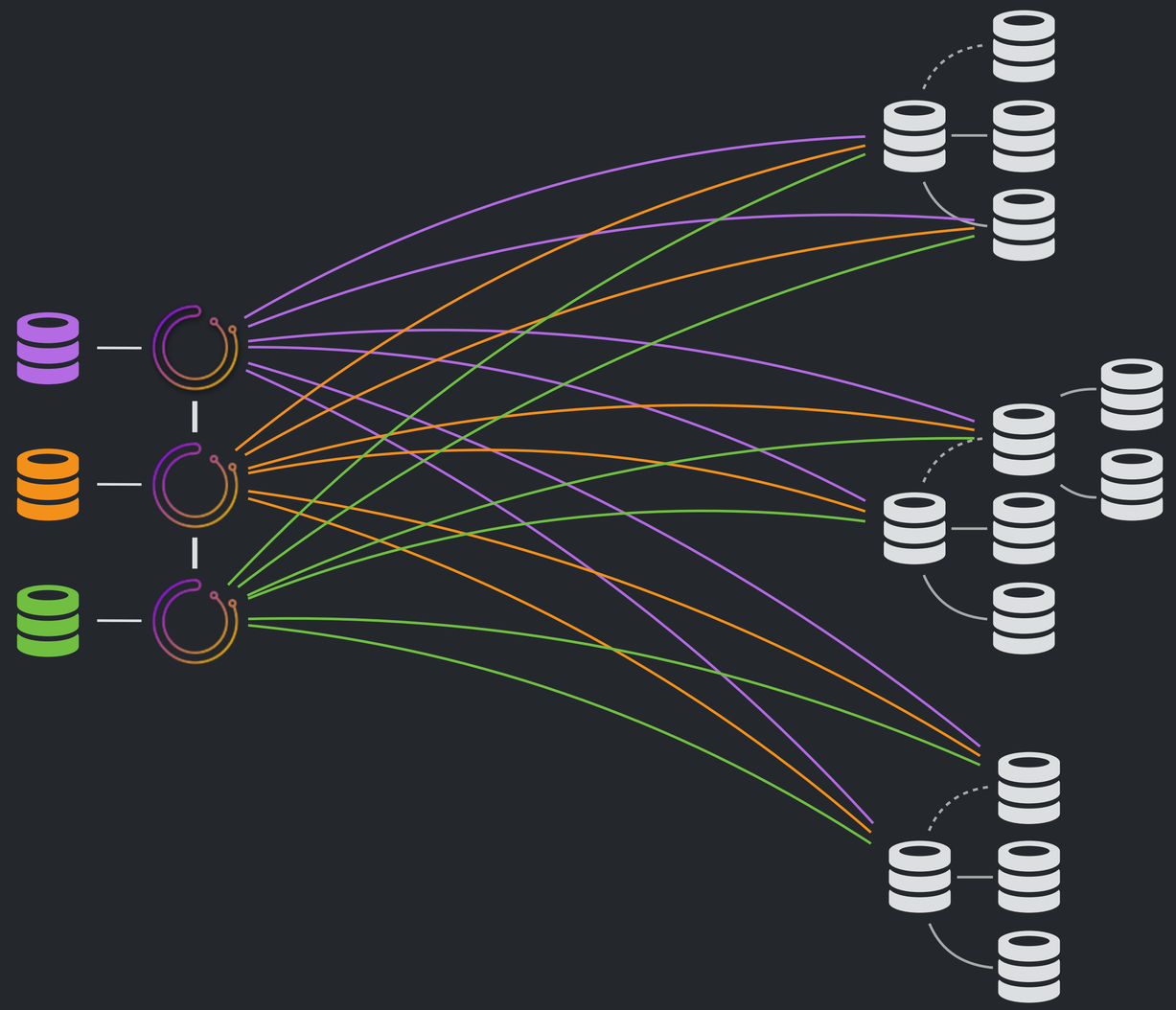


HashiCorp raft

- **golang** raft implementation
- Used by **Consul**
- Recently hit 1.0.0
- github.com/hashicorp/raft

orchestrator

- MySQL high availability solution and replication topology manager
- Developed at GitHub
- Apache 2 license
- github.com/github/orchestrator



Why orchestrator/raft

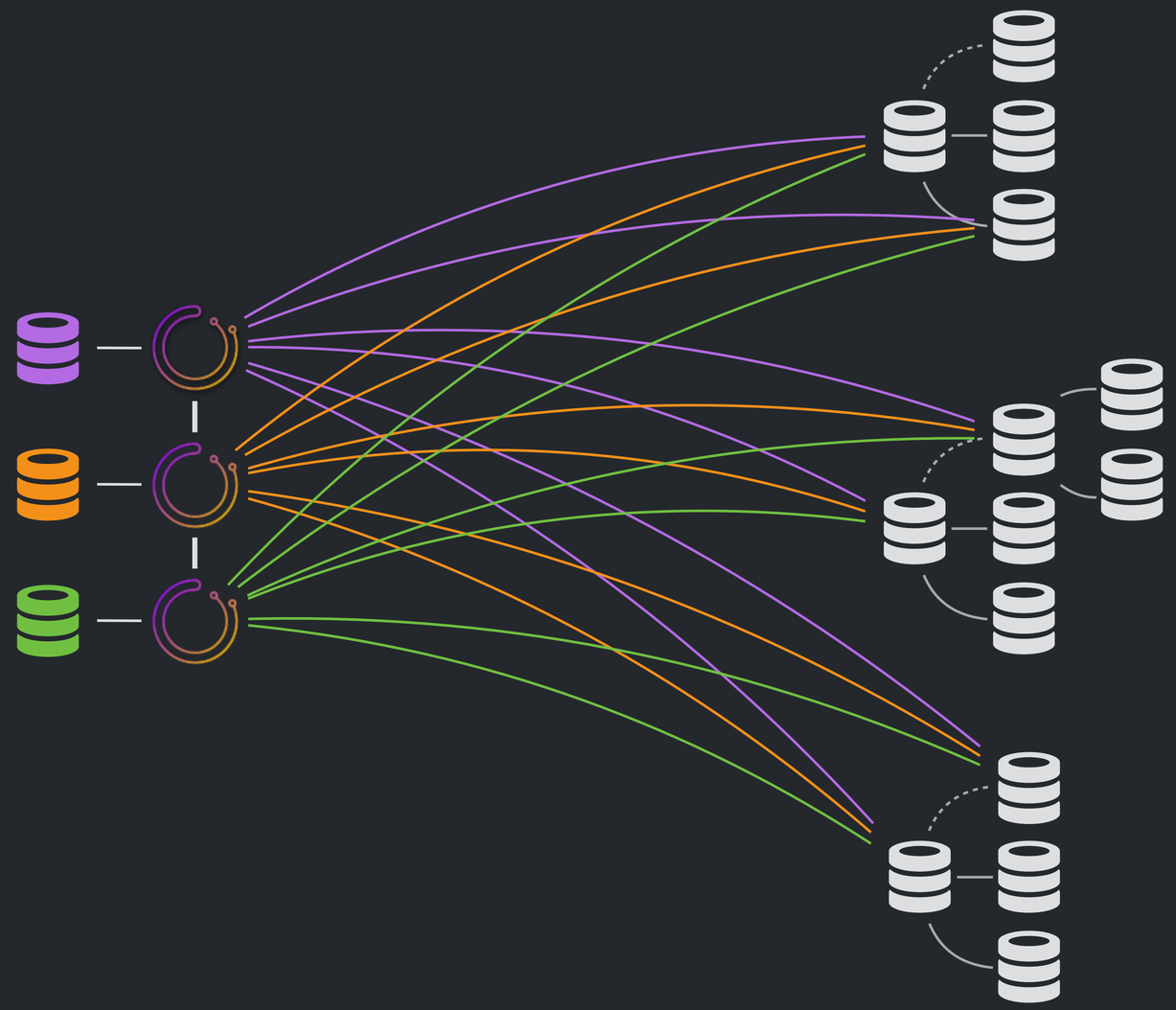
- Remove MySQL backend dependency
- DC fencing

And then good things happened that were not planned:

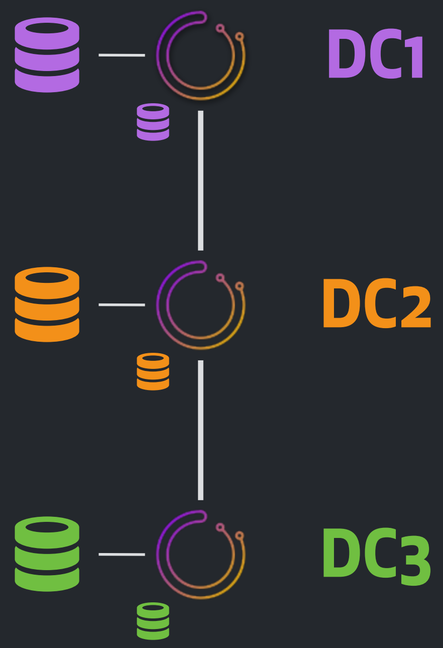
- Better cross-DC deployments
- DC-local KV control
- Kubernetes friendly

orchestrator/raft

- **n** orchestrator nodes form a raft cluster
- Each node has its own,dedicated backend database (MySQL or SQLite)
- All nodes probe the topologies
- All nodes run failure detection
- Only the leader runs failure recoveries

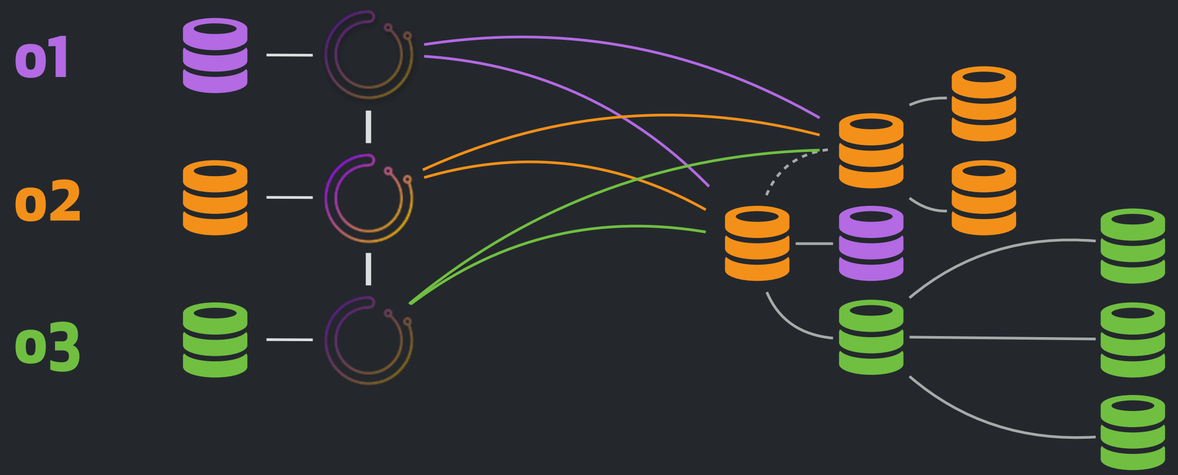


Implementation & deployment @ GitHub



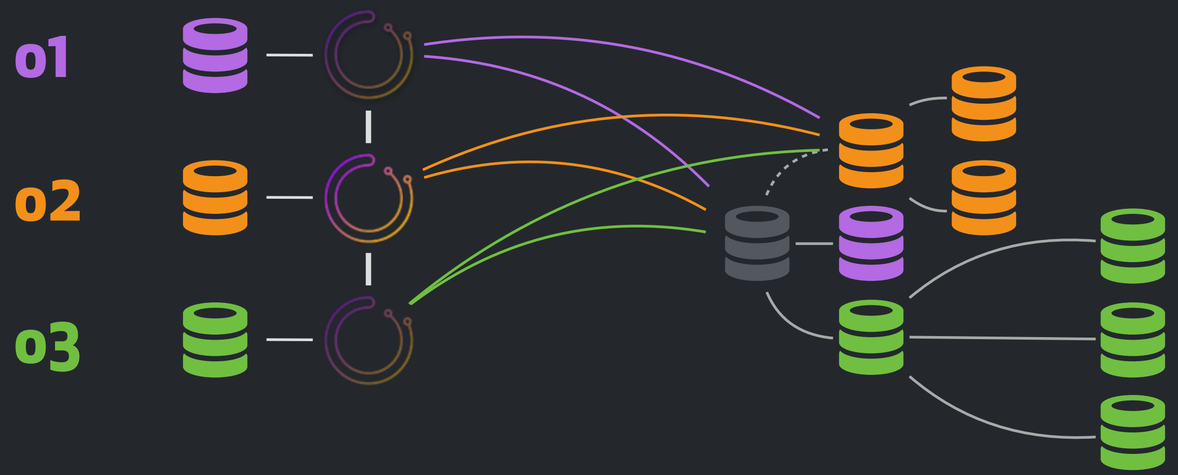
- One node per DC
- 1 second raft polling interval
- step-down
- raft-yield
- SQLite-backed log store
- MySQL backend (SQLite backend use case in the works)

A high availability scenario



o2 is leader of a 3-node orchestrator/raft setup

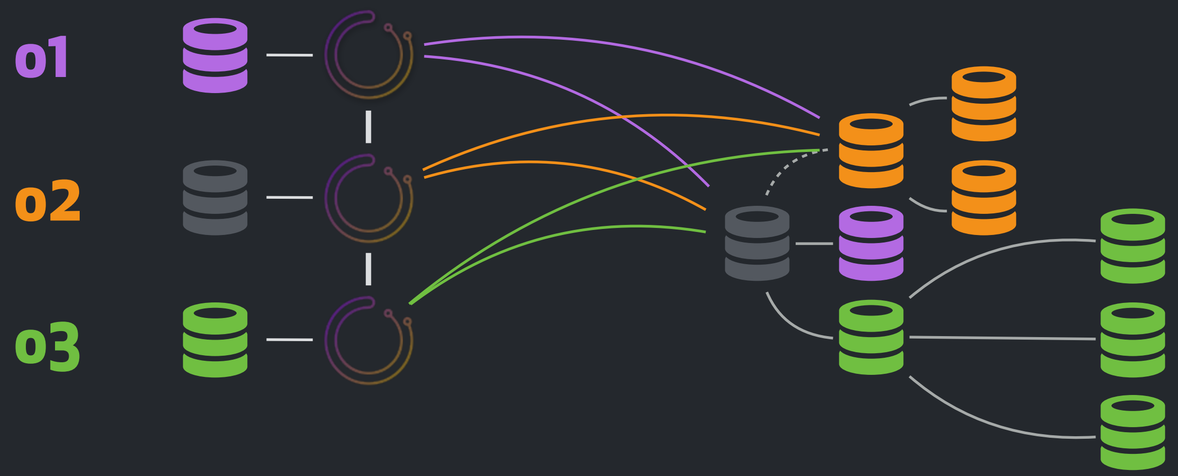
Injecting failure



master: **killall -9 mysqld**

o2 detects failure. About to recover, but…

Injecting 2nd failure

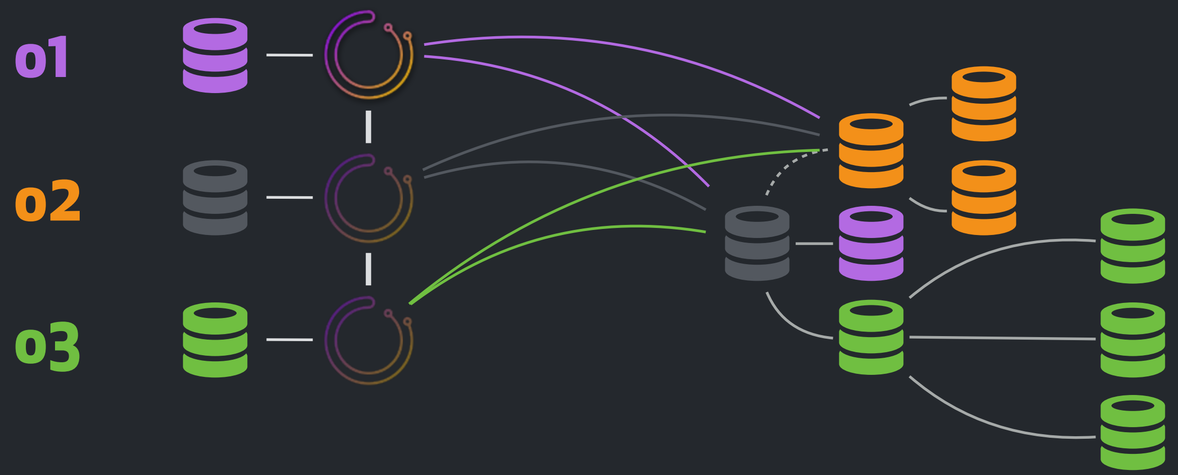


o2: **DROP DATABASE orchestrator;**

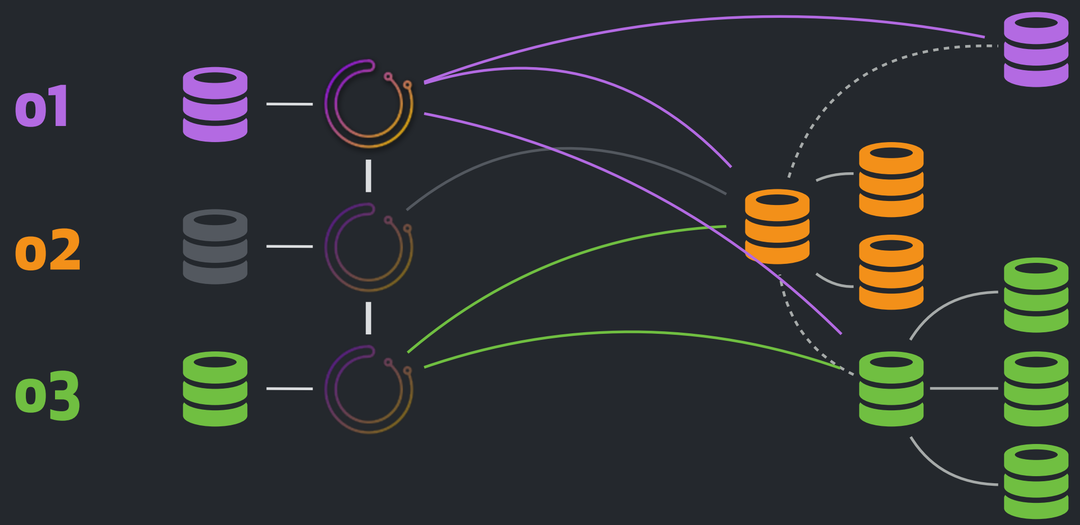
o2 freaks out. 5 seconds later it steps down

orchestrator recovery

o1 grabs leadership



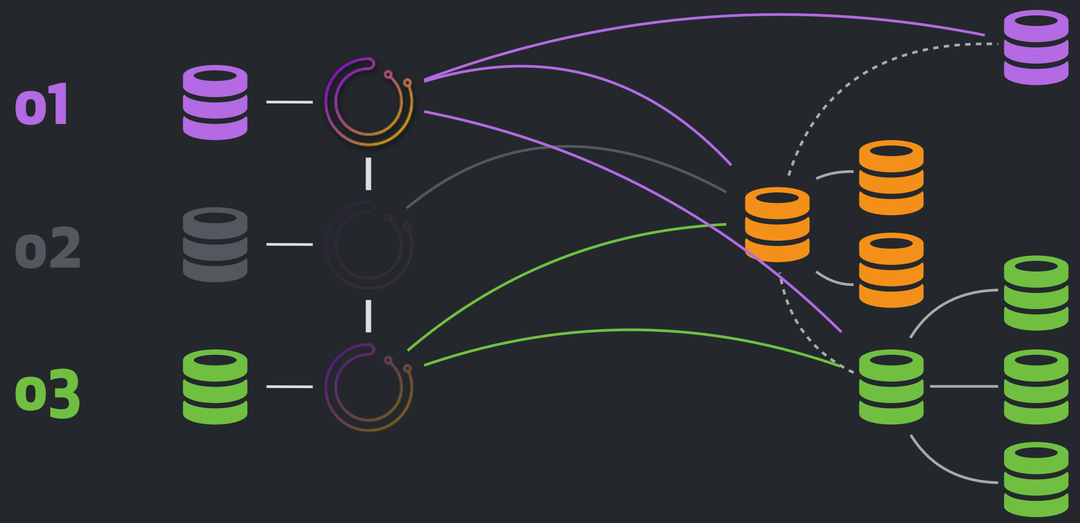
MySQL recovery



o1 detected failure even before stepping up as leader.

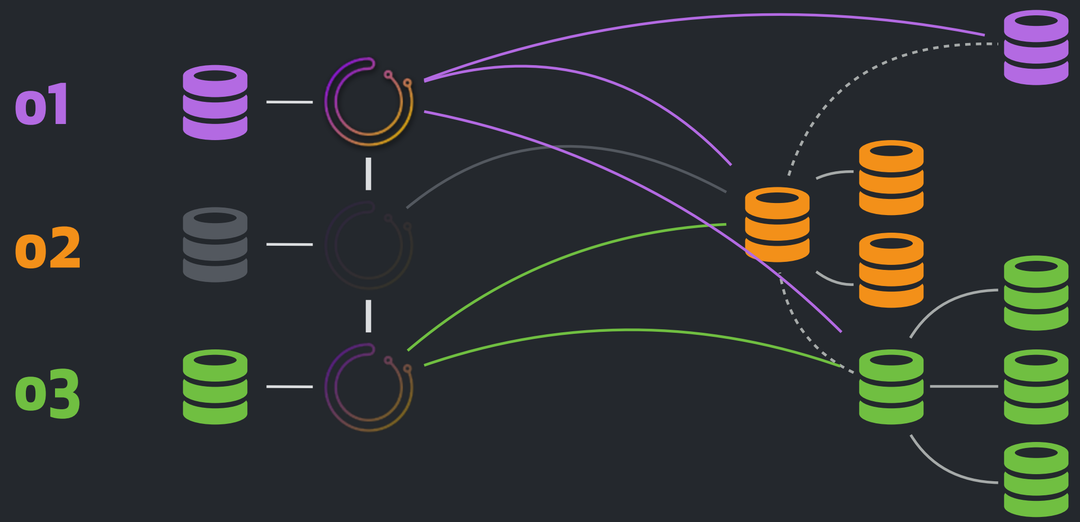
o1, now leader, kicks recovery, fails over MySQL master

orchestrator self health tests



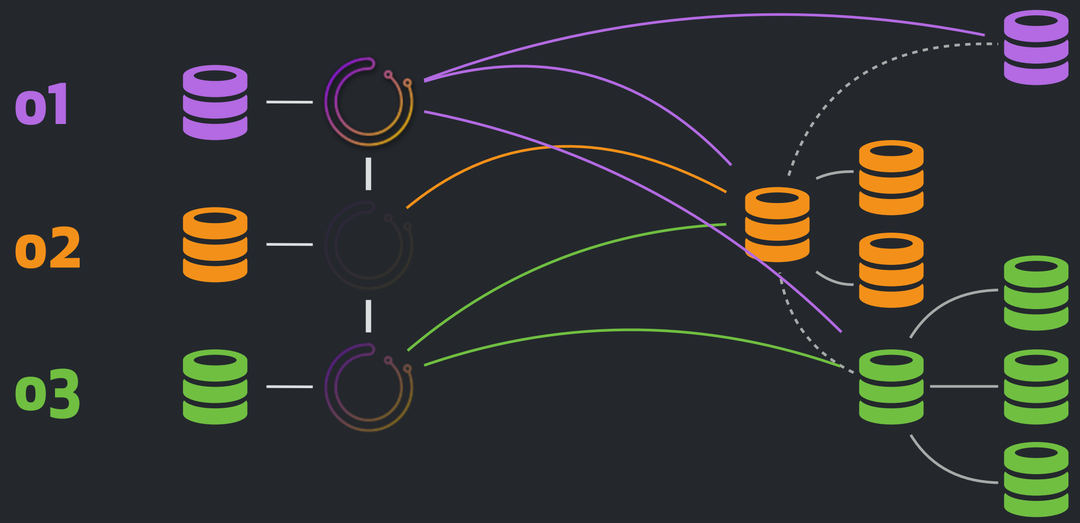
Meanwhile, **o2** panics and bails out.

puppet



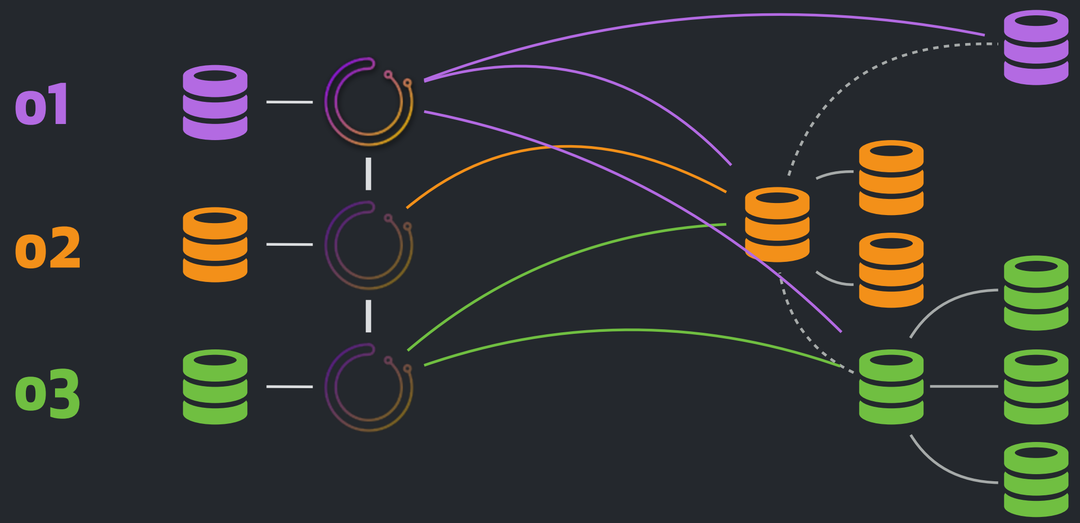
Some time later, puppet kicks **orchestrator** service back on **o2**.

orchestrator startup



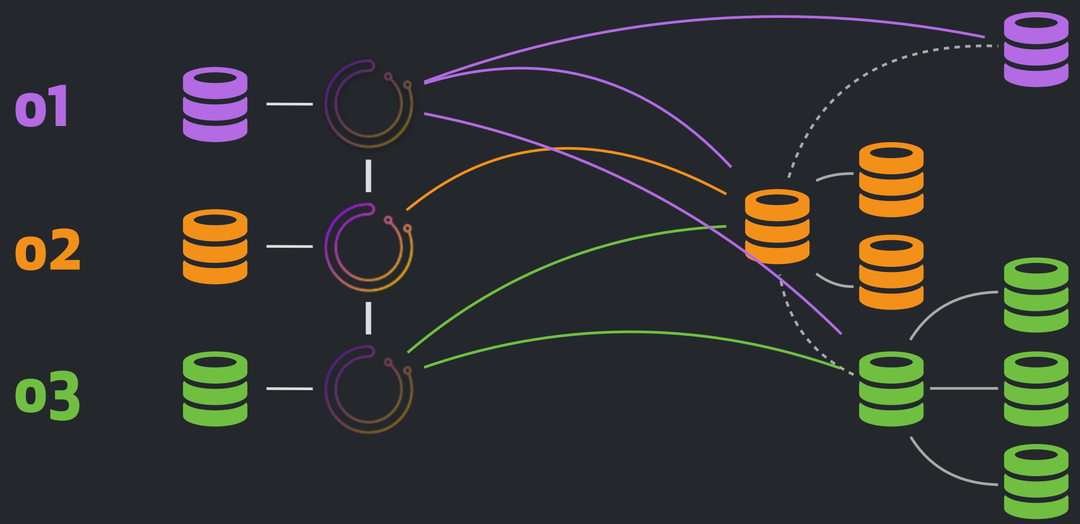
orchestrator service on **o2** bootstraps, creates `orchestrator` schema and tables.

Joining raft cluster



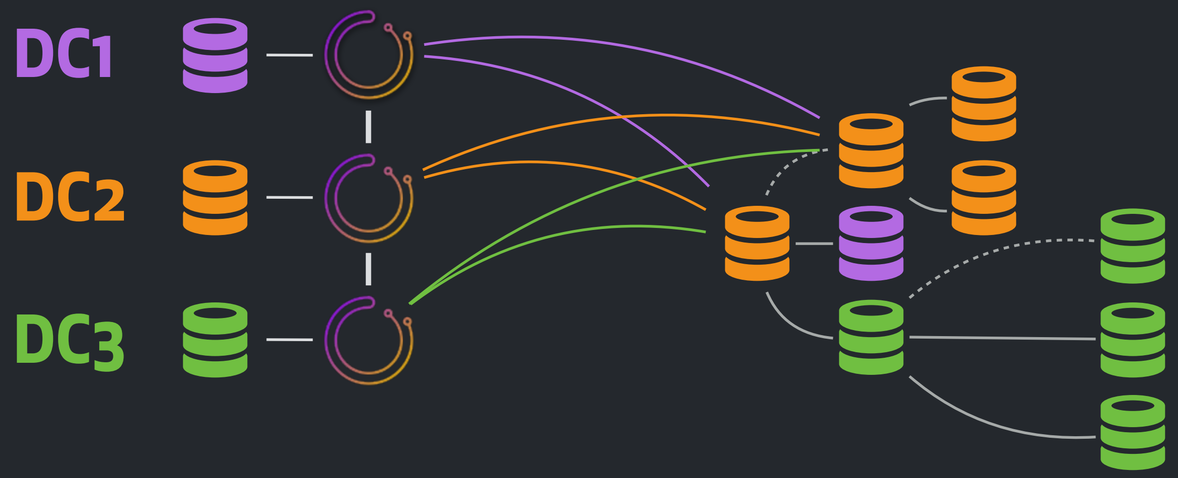
o2 recovers from raft snapshot, acquires raft log from an active node, rejoins the group

Grabbing leadership



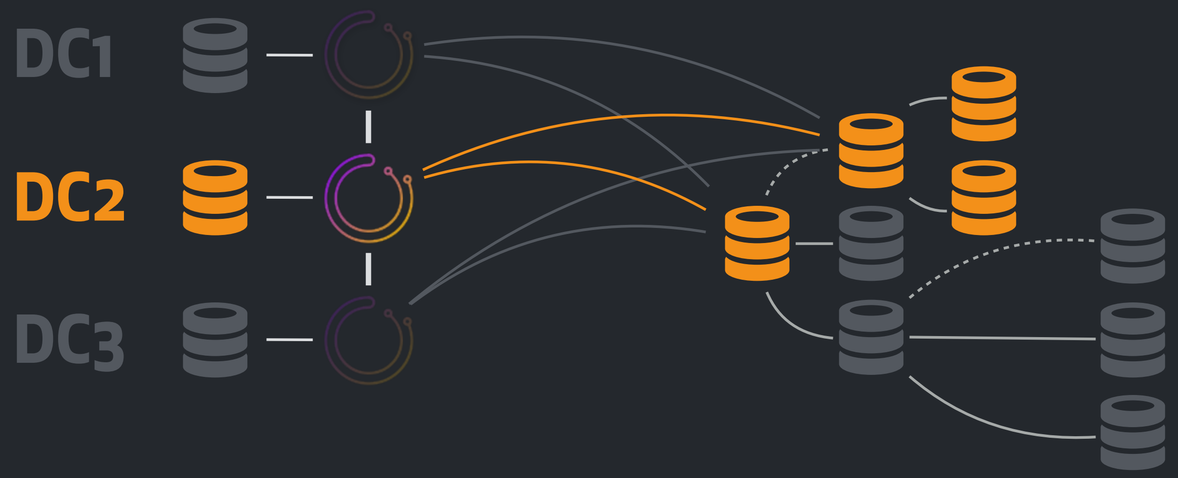
Some time later, **o2** grabs leadership

DC fencing



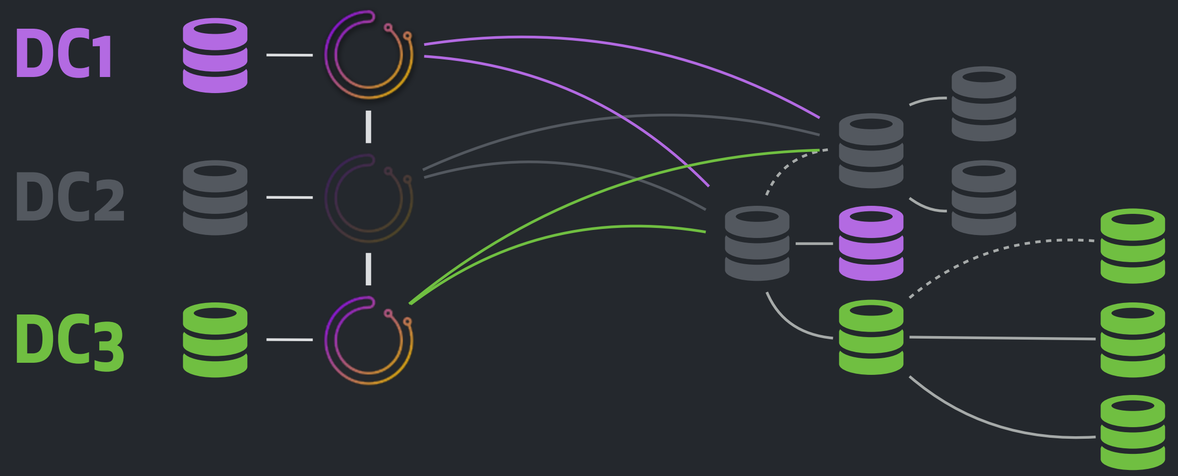
- Assume this 3 DC setup
- One orchestrator node in each DC
- Master and a few replicas in **DC2**
- What happens if **DC2** gets network partitioned?
  - i.e. no network in or out **DC2**

DC fencing



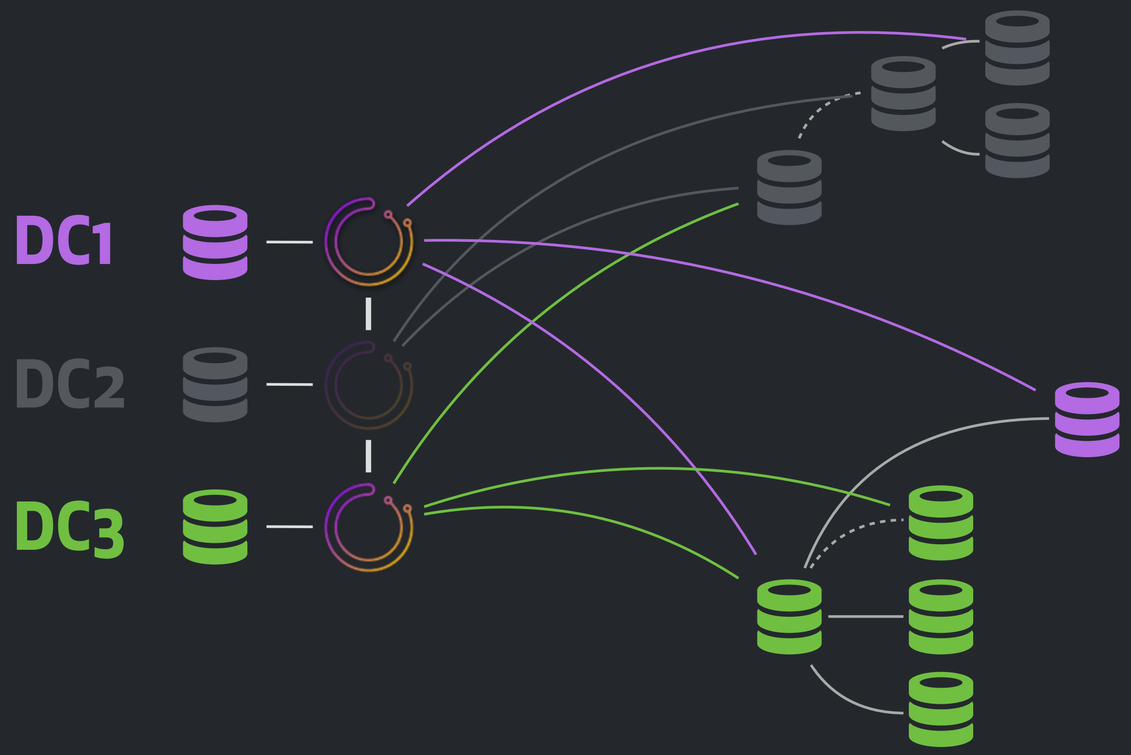
- From the point of view of **DC2** servers, and in particular in the point of view of **DC2**'s orchestrator node:
  - Master and replicas are fine.
  - **DC1** and **DC3** servers are all dead.
  - No need for fail over.
- However, **DC2**'s orchestrator is not part of a quorum, hence not the leader. It doesn't call the shots.

DC fencing



- In the eyes of either **DC1**'s or **DC3**'s orchestrator:
- All **DC2** servers, including the master, are dead.
- There is need for failover.
- **DC1**'s and **DC3**'s orchestrator nodes form a quorum. One of them will become the leader.
- The leader will initiate failover.

DC fencing



- Depicted potential failover result. New master is from **DC3**.

orchestrator/raft & consul

- **orchestrator** is Consul-aware
- Upon failover **orchestrator** updates Consul KV with identity of promoted master
- Consul @ GitHub is DC-local, no replication between Consul setups
- **orchestrator** nodes, update Consul locally on each DC

Considerations, watch out for

- Eventual consistency is not always your best friend
  - What happens if, upon replay of raft log, you hit two failovers for the same cluster?
- **NOW()** and otherwise time-based assumptions
- Reapplying snapshot/log upon startup

orchestrator/raft roadmap

- Kubernetes
  - ClusterIP-based configuration in progress
  - Already container-friendly via auto-reprovisioning of nodes via Raft

Thank you!

Questions?

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