

MongoDB I/O Access Patterns are under the Microscope

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MongoDB I/O access patterns are under the microscope





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I. Context

Université de Lorraine

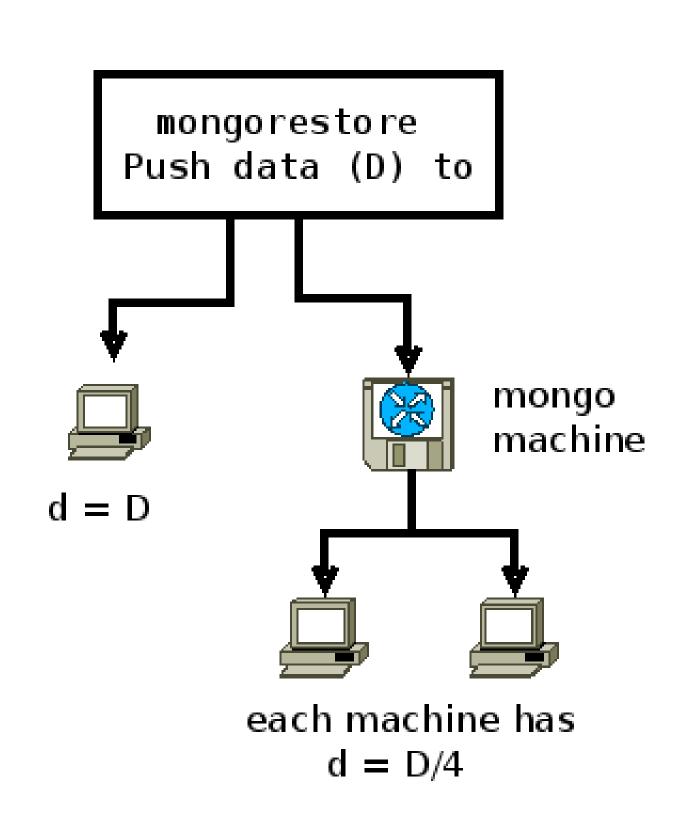
- ► MongoDB is a **document-based** NoSQL database
- ► NoSQL databases store semi-structured and/or unstructured data
- ► We need to **create indexes** to optimize querying data
- ► Based on certain industry reports, *MongoDB* takes unjustified time to create indexes over a pre-stored data
- ▶ Benchmarks report **high-level results** in general, they also use synthetic data (\neq in-production data)

II. Objectives

- ► Investigation on creating indexes by MongoDB
- ▶ Introducing new experimental methods that could go beyond benchmarking high-level results

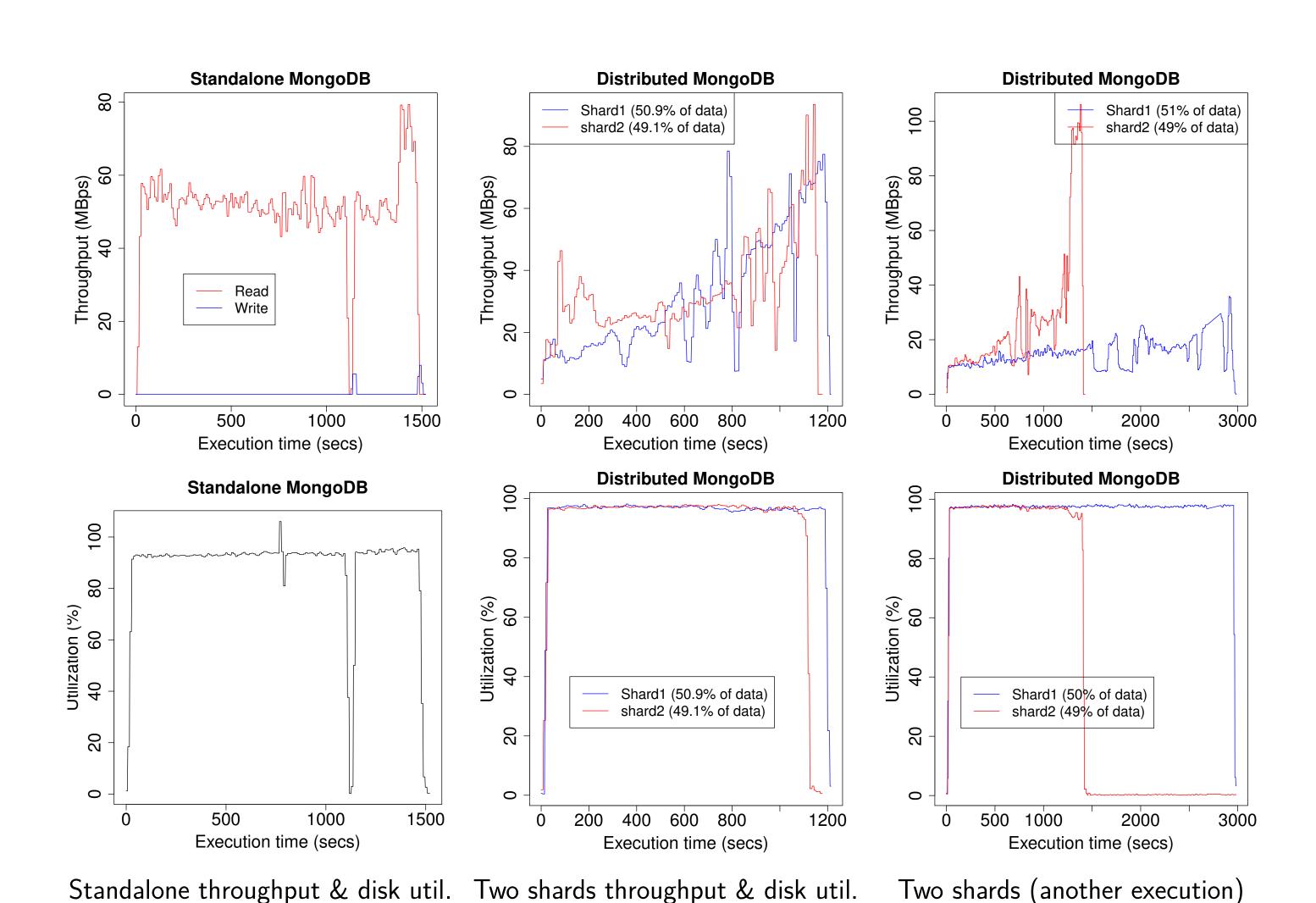
III. Experimental settings

- \blacktriangleright A data set of **20 million doc.** is created; about 71 GB
- ► Experiments are performed on Grid'5000 testbed
- ➤ Ubuntu 14.04, Linux 4.9.13
- ► Tests are performed on **one** HDD per machine
- ► MongoDB V3.4, replicas are disabled, hash sharding, sharding on $_id_s$
- ► MongoDB storage engine (WT) stores each collection on a **separate file**



Worklaod: try to index a simple field (int) Experimental scenarios

IV. Performance results



► Data distribution is poorly done by MongoDB

► Every Shard uses a **different plan** for accessing data

How to get the main raison behind these results?

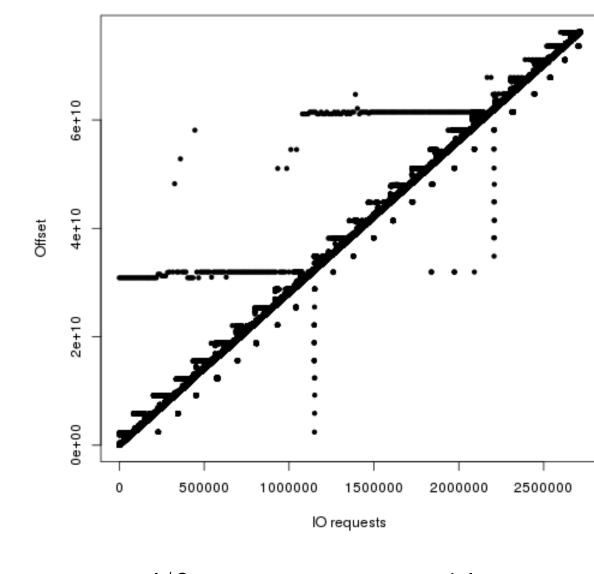
V. extended Berkeley Packet Filter (eBPF)

- ► It is a recent **dynamic tracing technique** in *Linux*
- ► It could connect to all *Linux* data sources
- ➤ Very negligible overhead (4 ns per syscall)
- ► Fits with systems in production

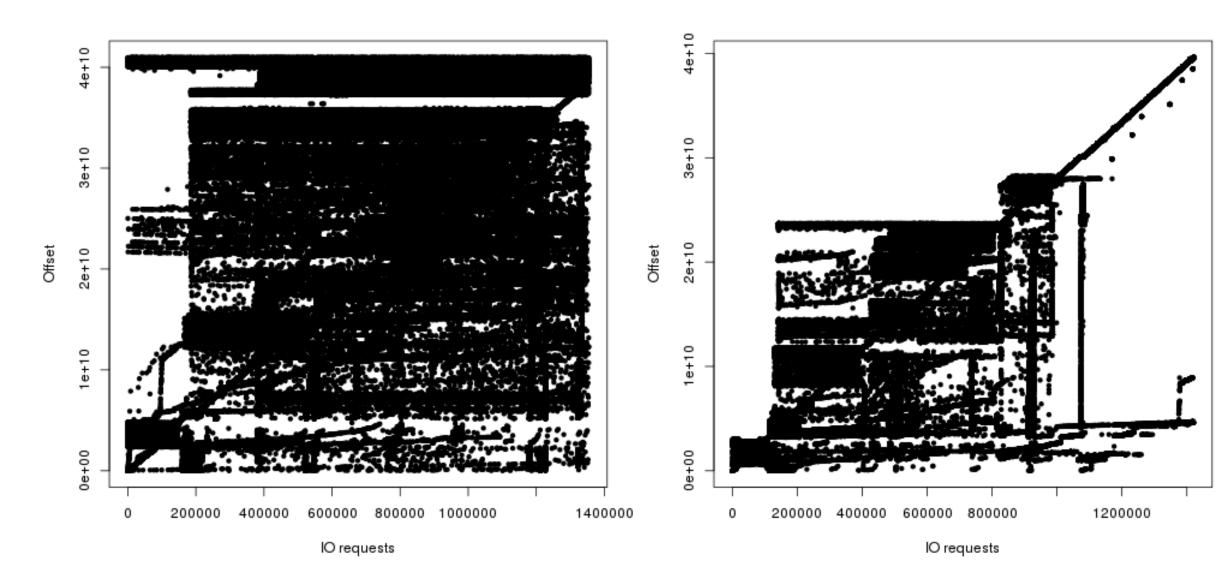
An eBPF tool is built to evaluate the I/O access patterns:

- ► A generic tool, could be used by other systems
- ► It traces all I/O requests
- ▶ It reports offsets, request latencies & data size
- ► Its results could be filtered by **accessed files**

VI. I/O access patterns using eBPF



I/O access pattern on standalone



Tow shards I/O access patterns (Every shard has 50% of data

VII. Conclusion

- ► A performance study on *MongoDB* I/O access pattern is done
- \blacktriangleright A generic eBPF tool for testing I/O access patterns is developed
- ► A new experimental method to go beyond benchmarking results is introduced

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