SpringFS: Bridging Agility and Performance in Elastic Distributed Storage

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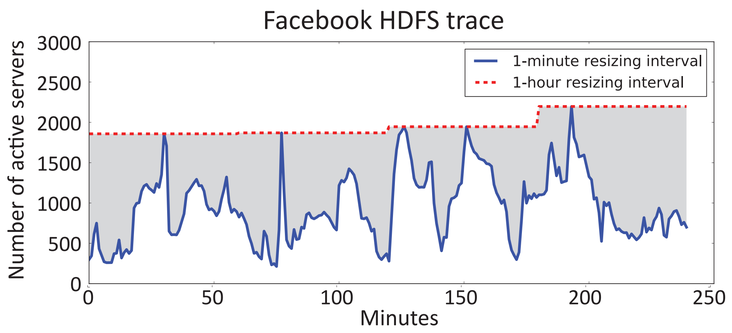
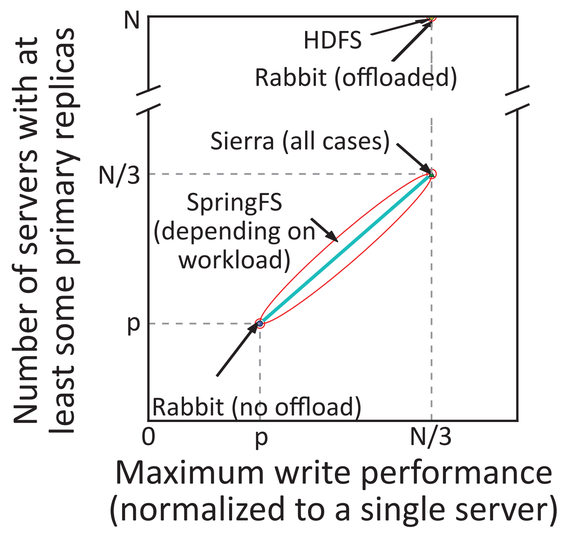
MOTIVATION

- Cloud storage can and should be elastic
  - Ability to extract/re-integrate servers on demand
- Elasticity is most useful when it is "agile"
  - Agility: quickness of elastic resizing
  - Value: machine-hour (money) savings
  - Challenge: Data migration is expensive



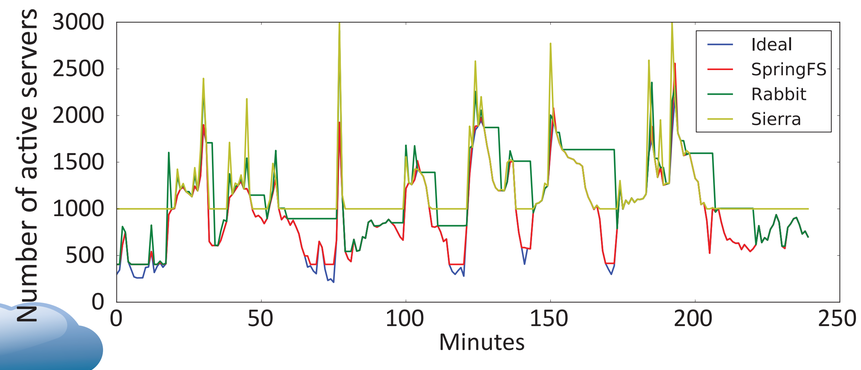
- Agile resizing → 50% less machine hour usage
- State-of-the-art elastic storage designs
  - Sierra and Rabbit force painful tradeoff between elasticity, performance and agility
- Need a new elastic storage design that
  - Fills the gap in the tradeoff space
  - Achieves great agility
  - Maintains performance and elasticity goals

BRIDGING AGILITY & PERFORMANCE



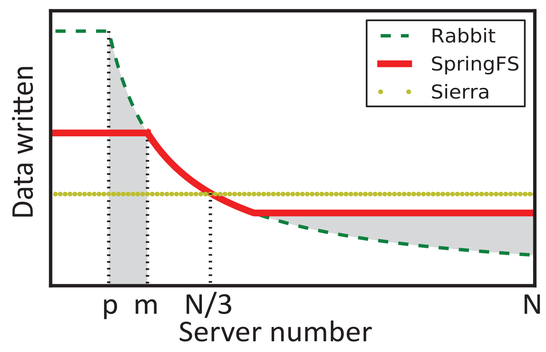
RESULTS WITH INDUSTRIAL TRACES

- SpringFS achieves "close-to-ideal" machine hour usage
- Better than Rabbit when extracting servers
- Better than Sierra when re-integrating servers



SPRINGFS DATA LAYOUT

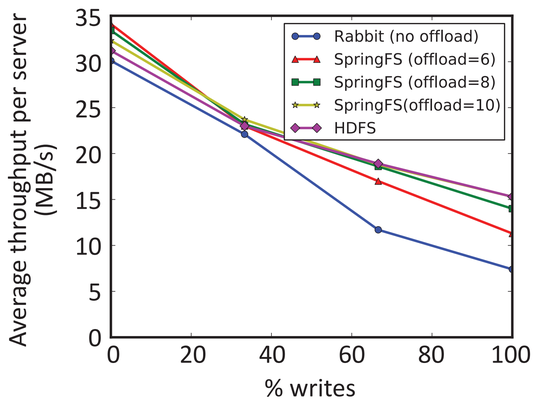
- Continuum between "Rabbit" and "Sierra"
  - Elasticity of Rabbit
  - Peak write performance of Sierra
  - Maximized agility along continuum between best cases



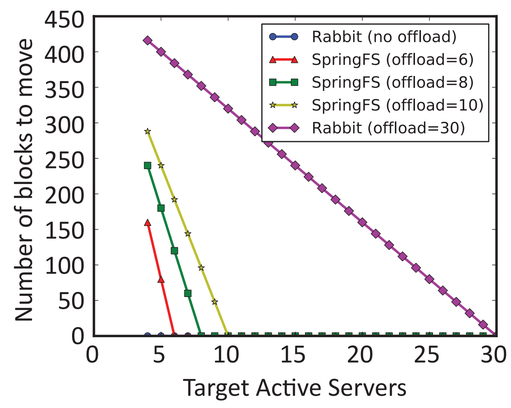
- N: Total size of the cluster
- p: Number of primaries of Rabbit
  - $p=N/e^2$ (e is Euler Constant)
- m: "Offload set" in SpringFS
  - Bounds the offloading of primary replicas
  - Adjustable tradeoff between write perf & cleanup work
  - Adapted to workload changes

SPRINGFS PERFORMANCE & CLEANUP WORK

30 nodes, each with a 2GB file, 128MB block size

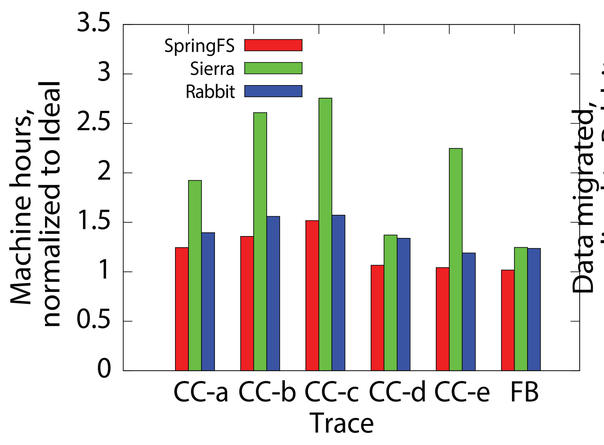


Write throughput scales with offload set

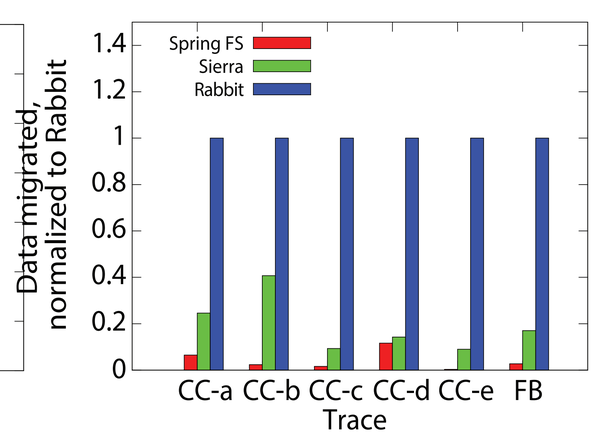


Minimize cleanup work with varied offload set

Machine hour usage: 6-120% improvement



Data migration: 9-208X improvement



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