Notes on power proportionality and storage

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Part I

Turn off servers

![Graph showing load over time of day](image-url)
One goal: power proportionality
Migrate state and turn off?

Storage: 1 PetaByte
Cannot migrate!!!

Migrate VMs
Our solution: Everest
[FAST’08,OSDI08]

- Writes: offload writes temporarily
- Reads: exploit redundancy (or turn on server)
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• Writes: offload writes temporarily
• Reads: exploit redundancy (or turn on server)
What was so hard about that?

- Metadata management
- Reads must always return latest version
- State must be consistent, recoverable
- Maintain original redundancy level
- Recover state eventually

- Must happen automatically
  - Continuous monitoring of load
Part II

Do NOT turn off servers

(discussions with James Hamilton @ MSR -> Amazon)
Server bill > power bill

- Turning off servers is a waste of $$$
- But, they have plenty of idle time
  - Workloads tend to be periodic
Fill in troughs

• Many options:
  – Less over-provisioning (buy fewer servers)
  – Schedule lots of analytical jobs
  – Place together uncorrelated workloads

• Hard problems, not all about IT
  – Administrator trust is important
Summary

- Turn off when all other options exhausted
- Storage was missing piece in migration

- Ongoing work:
  - Low-power disks and/or SSDs in the data center [Eurosys’09]