

Solid State Drive Based Energy Efficient Cloud Storage

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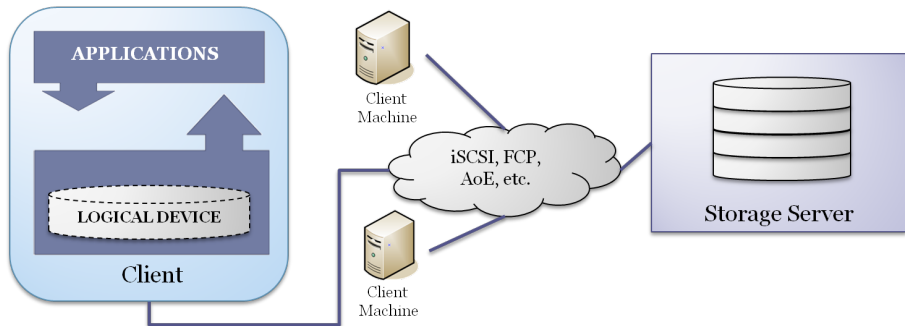
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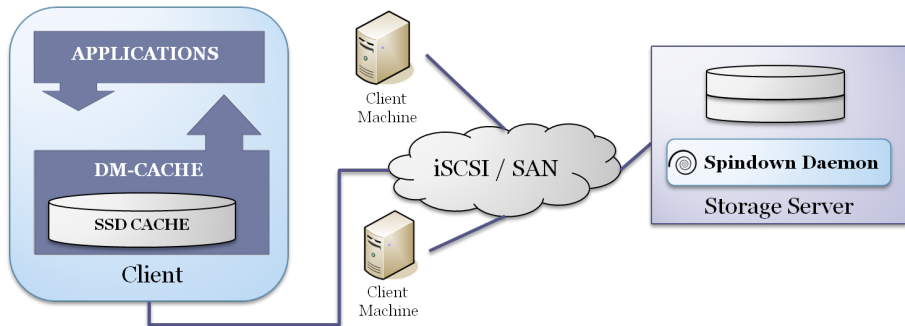
Outline

- Background
- Proposed Approach
- Implementation
- Web Interface
- Evaluation

Current System



Proposed Approach



Feasibility Study

Disk-State	Inc. from Inactive	Disk-State	Inc. from Inactive
HDD-Inactive:	+0	SSD-Inactive:	+0
HDD-Idle:	+4	SSD-Idle:	+0.7
HDD-Active (Read):	+7.2	SSD-Active (Read):	+3.5
HDD-Active (Write):	+7.6	SSD-Active (Write):	+5.1

Cache Management Policy

LRU (Least Recently Used)

Assumes that pages that aren't used for a long time will not be used in the near future

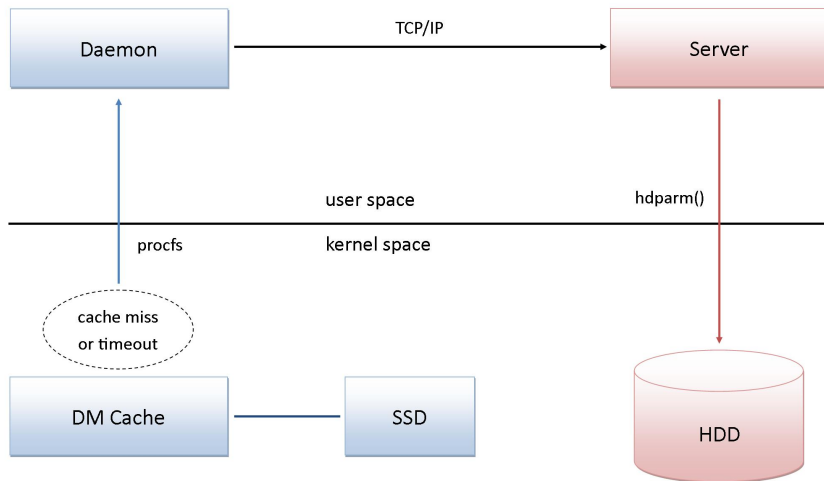
LFU (Least Frequently Used)

Pages that are used less frequently should be evicted first

Changes to accommodate policies:

- Replace hash table with a radix tree ordered by sectors
- Use linked list to manage LRU and LFU schemes

Dynamic Spin-down Daemon



Measuring Power



Watts Up? Pro

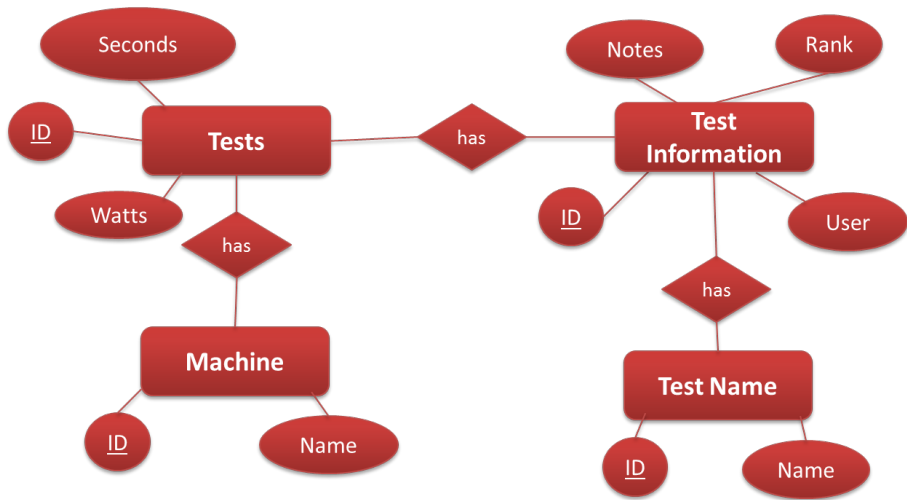
Web Application

Purpose: display data from measurements

Important Features:

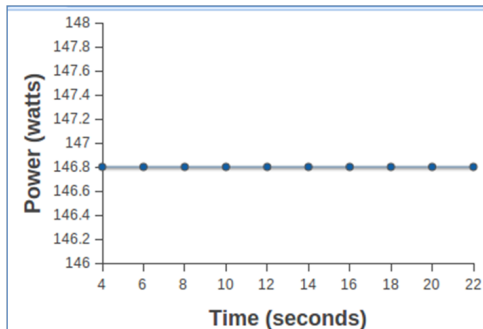
- View current power
- View past power tests

View Past Power

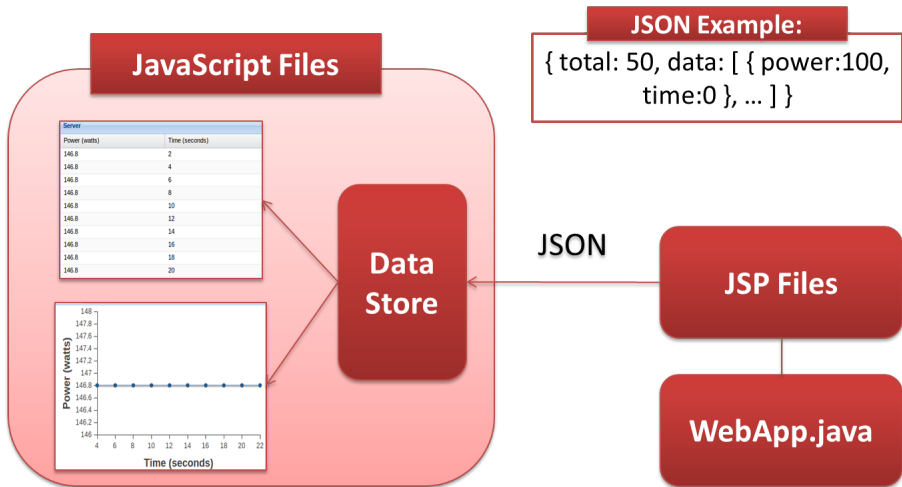


View Past Power

Load Test				
Test Name	Start Time	End Time	Notes	Rank
dmc-pagecache-8g-warm-read	2012-10-26 12:57:29.0	2012-10-26 12:58:38.0	BW: 165833 IOPS: 41458.25	1
iscsi-pagecache-8gb-read	2012-10-26 18:04:59.0	2012-10-26 18:06:39.0	BW: 104040 IOPS: 26010	1



View Current Power

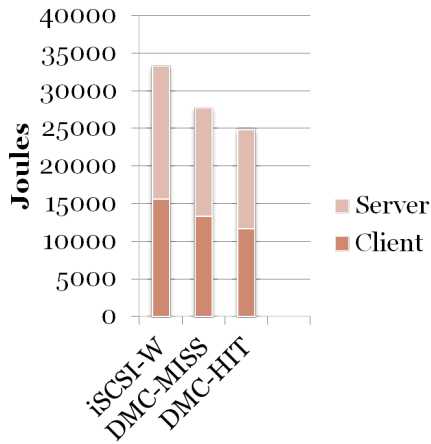


Evaluation Setup

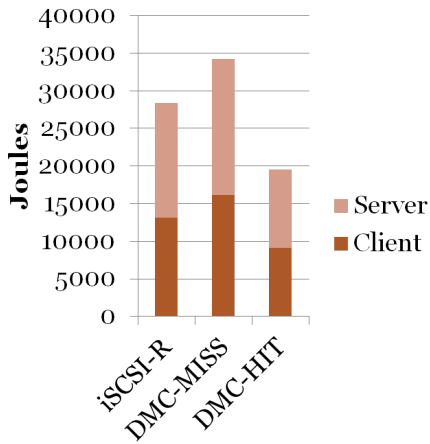
- Collected power consumption measurements from a client and server node
- Three configurations:
 - Baseline
 - DM-Cache
 - DM-Cache with daemon modifications
- Two types of benchmarks
 - Simple file operations
 - Workload emulation

IOZone: Micro Benchmarks

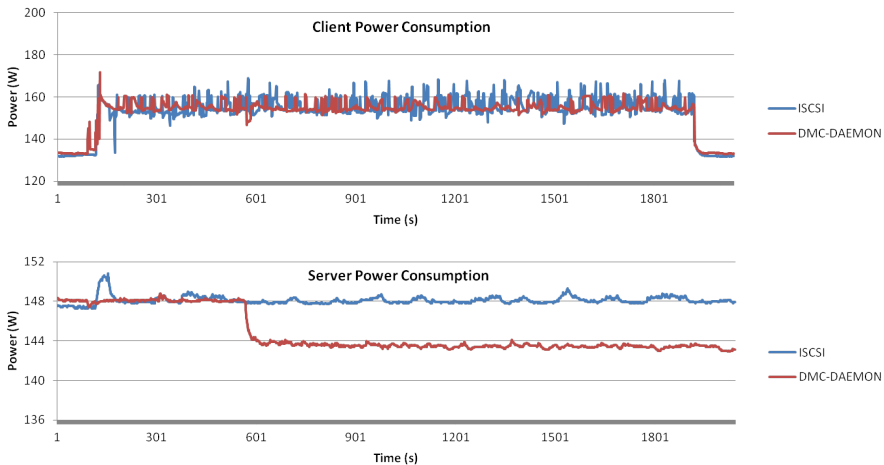
Energy - Writes



Energy - Reads



Filebench: Synthetic Workload



Conclusion

- Leveraged existing client-side caching and added new cache eviction policies
- Implemented disk spin-down daemon to exploit idle disk periods
- Developed a web application to display power consumption graphs
- Presented experiments showing the benefits of client-side SSD caching