SSD-based Energy Efficient Cloud Storage

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Motivation

Solid State Technology

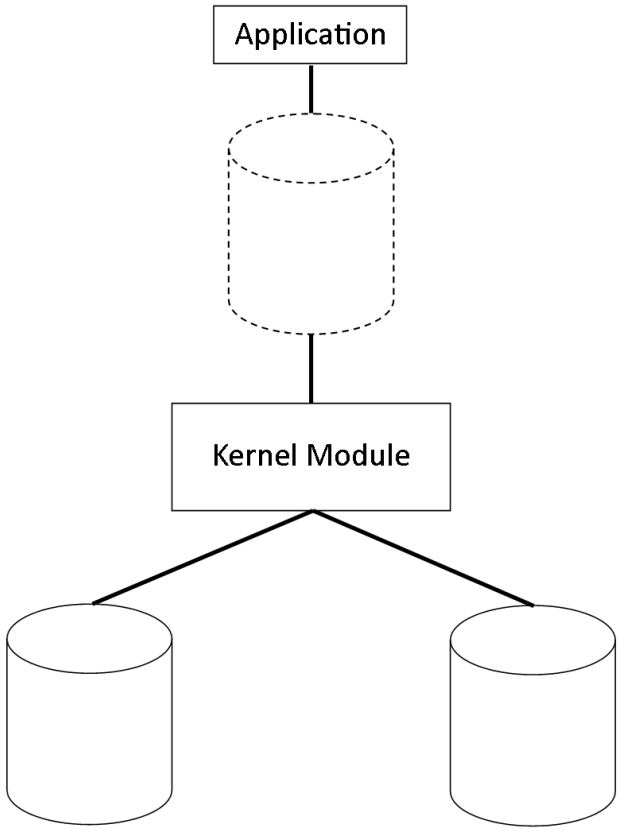
High capacity EEPROM devices reduces energy consumption on storage server by moving data on disk to the more energy-efficient flash memory.

Distributed SSD Caching

We want to reduce energy consumption on distributed systems by exploring the properties of dynamic spin control of storage server disks and replication of cold pages.

Linux Device Mapper

- pseudo device is the only device visible to applications
- device mapper facilitates mapping between two block devices
- kernel module uses device mapper to map bios from pseudo device



Device Mapper Cache

Disk Spin: Implementation

Algorithm 1 Spinning the disk up or down dynamically

```
1: procedure SPIN UP OR DOWN
2:     while true do
3:         if disk is spinning then
4:             k ← current time in seconds
5:             c ← time since last cache miss
6:             if c + 20 ≤ k then
7:                 spin down the disk and change state to not spinning
8:         else                                          ▷ disk is not spinning
9:             if DM Cache is blocking on a cache miss then
10:                spin up the disk and change state to spinning
11:                unblock DM Cache
```

Consistent Hashing

Idea: replicate data evenly with as little disruption as possible when nodes join and exit a network.

Theorem

For any set of N nodes and K keys, with high probability:

1. *Each node is responsible for at most $(1 + \epsilon)K/N$ keys*

2. *When an $(N + 1)$st node joins or leaves the network, responsibility for $O(K/N)$ keys changes hands (to or from the joining or leaving node)*

Here ϵ may vary but has an upper bound of $O(\log N)$.

References

Author's name (1987)

Title of the paper.

Journal Name 55(4), 765 – 799.