An Out-of-band Approach to SAN-level Cache Management

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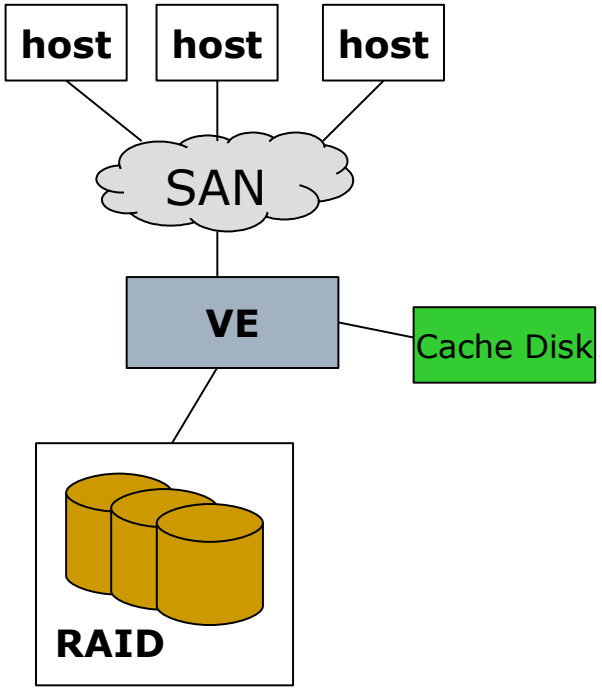
SAN-level cache

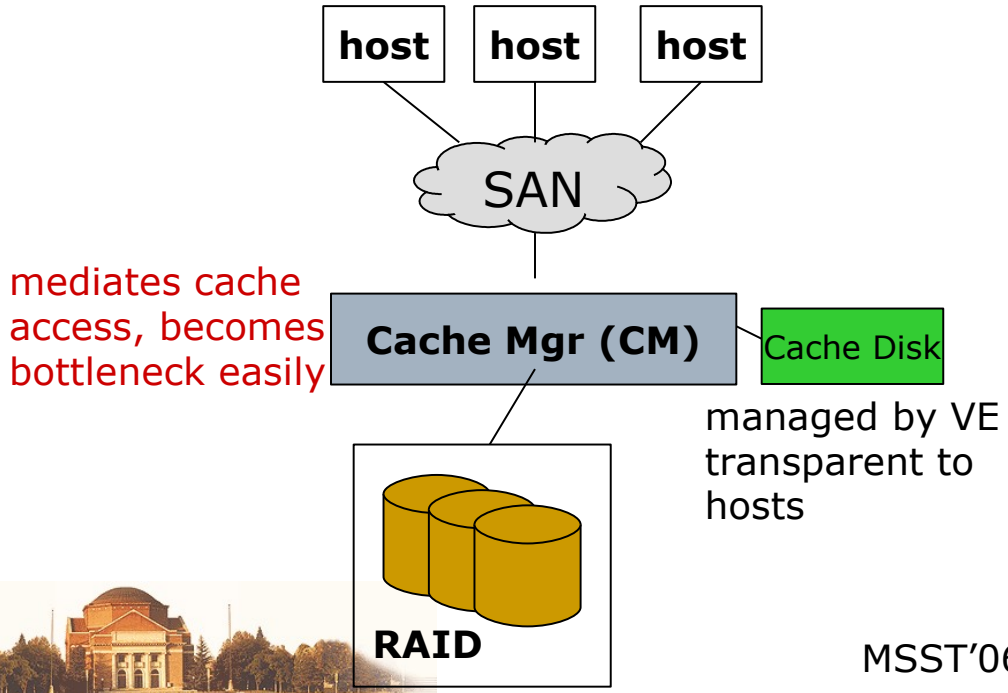
- Maintains "globally hot data blocks" in the cache disk to boost SAN performance

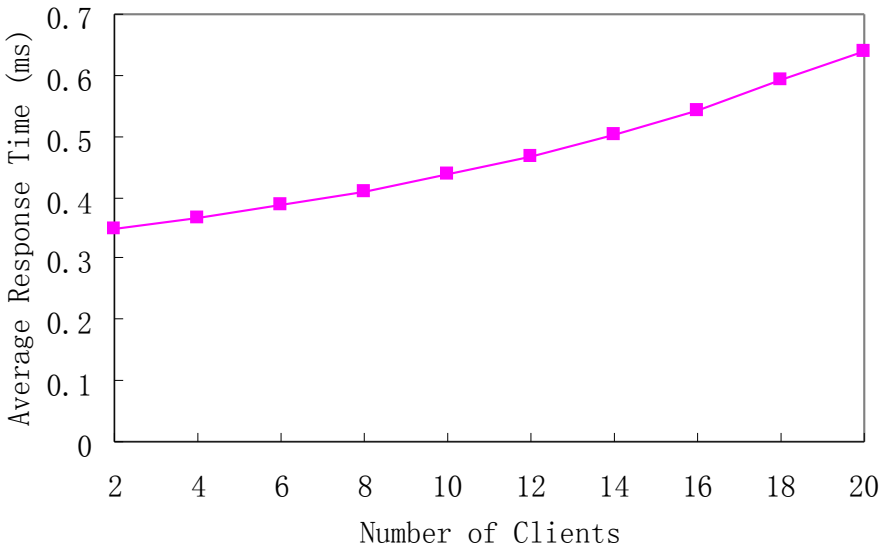
- SAN-level vs. localized cache
  - Exploits global storage access information to cache more valuable blocks
  - Scales the size easily



Motivation

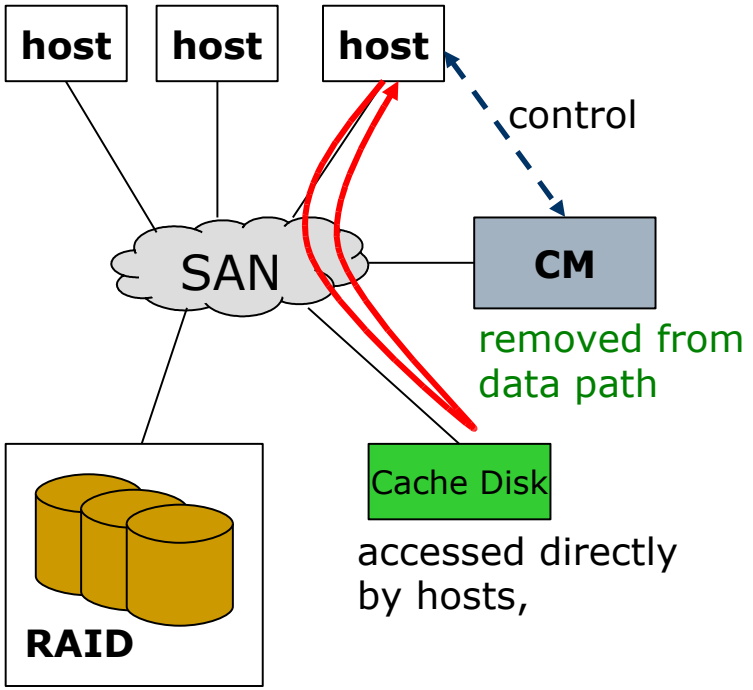
- In-band SAN Level Cache
  - Gets global access information easily
  - Poor scalability. The performance improved by cache will suffer with the increase of hosts





Motivation

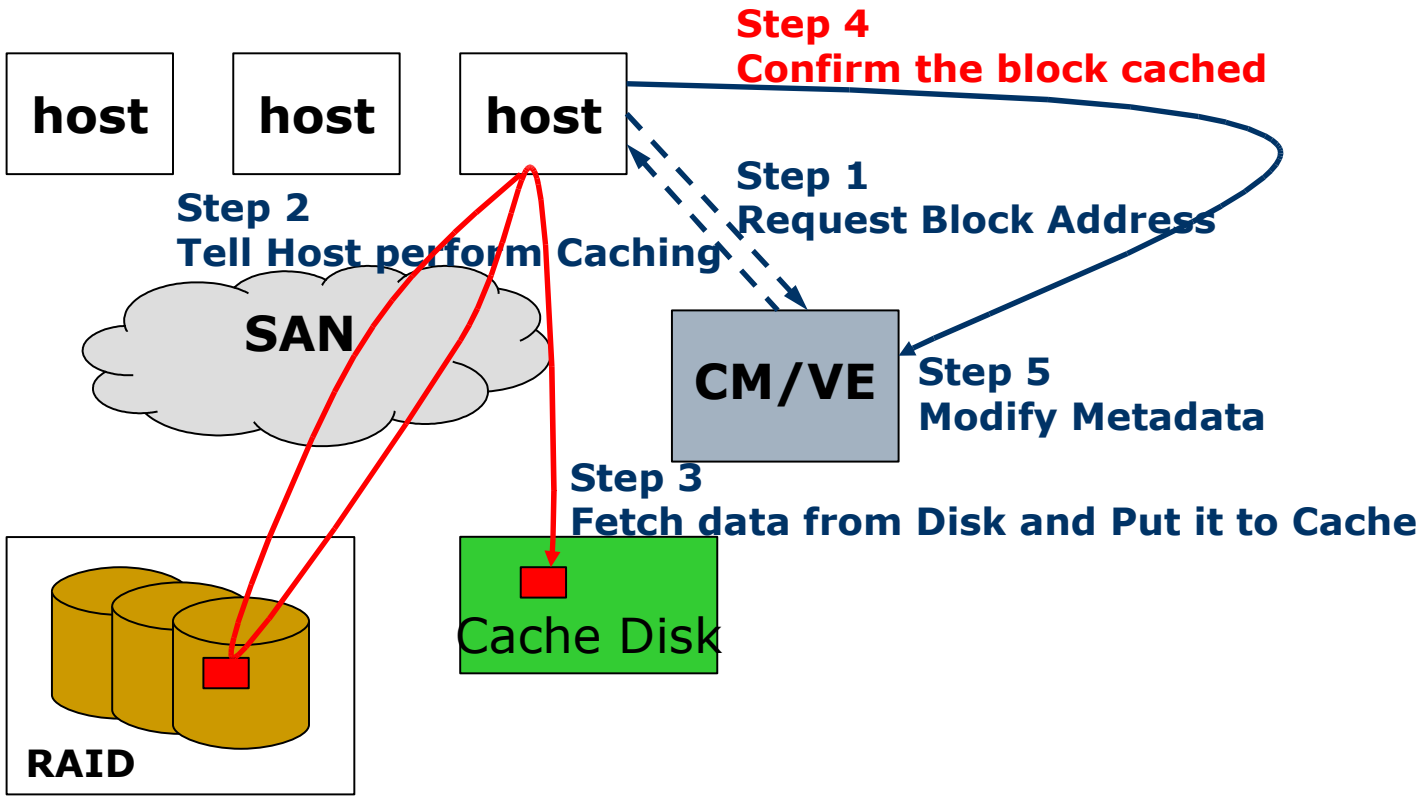
- Out-of-band SAN Level Cache



- Out-of-Band Architecture is more Scalable
- SAN Level Cache based on Out-of-Band Architecture
  - How to implement
  - **How to perform the place/replace cache?**

Out-of-Band SAN level Cache

- Example: Cache Miss and Placement/Replacement



Cache Placement and Replacement

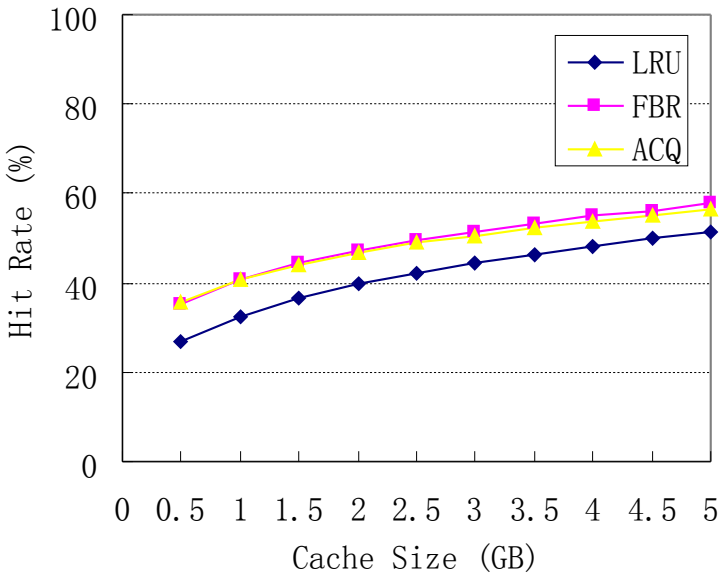
- Release the overhead introduced by replacement of out-of-band SAN cache

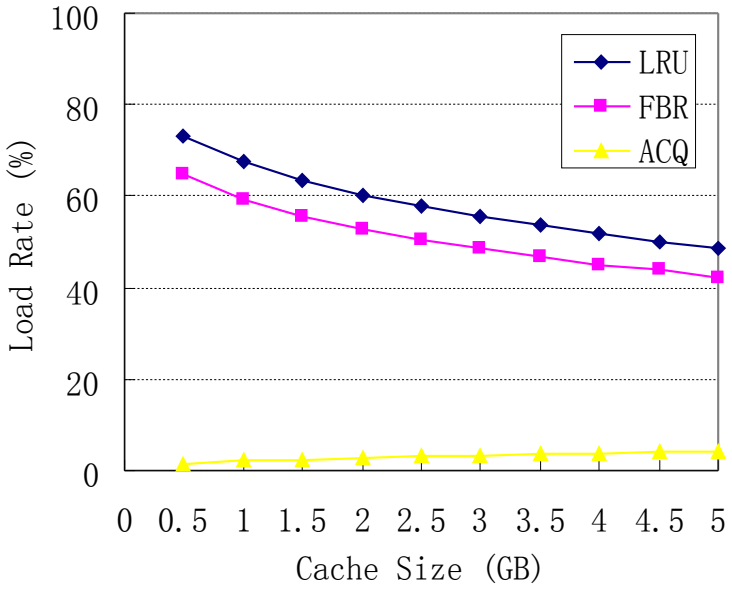
- Access and Cache Queue algorithm (ACQ)
  - Which is Cache Candidate
    - The request block is the candidate
    - Only the identifiers and reference counts of recent access blocks are recorded in Access Queue, replacing by LRU policy.
  - Which in cache will be replaced
    - Cache Queue keeps ids and reference counts of the cached blocks
    - The block with the least RC in CQ --- Threshold
  - When replace - take load rate into account
    - RC of request block in AQ > the least RC in CQ

Cache Placement and Replacement

- Comments
  - Well cache space usage is achieved in most cases
    - threshold changes according to the state of cache
  - Load rate is reduced compared with demanding caching, such as LRU
    - Only part of request blocks enter into cache
  - Fit well to the Second level cache access pattern
    - Algorithm based on access frequency

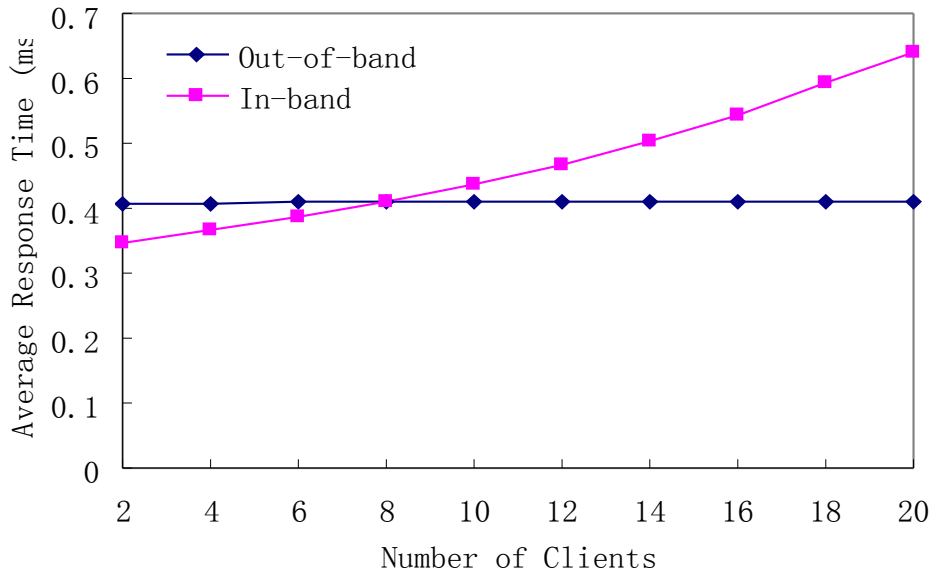
Simulation results – cache hit and load rate





- **ACQ is close to FBR (<1.5%)**
- **ACQ is more than 90% lower than FBR**

Simulation results – Performance and Scalability



Average Response Time using ACQ of out-of-band compared with FBR of in-band

- **less when host number > 10**
- **increase much slower**

Thank you!

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