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Assignment 2 - Problem 1

Summary on "An Efficient Ring-Based Metadata Management Policy for Large-Scale Distributed File Systems" conducted by Y. Gao, X. Gao, X. Yang, J. Liu and G. Chen.

Central Idea:

This research paper emphasizes on the metadata service management and how it can be made more efficient and scalable. It discusses the current limitations and further elaborates on the need of a better metadata management system for large scale distributed file systems. It is expected that the size of file systems will be reaching EB-scale in the future and thus the need for an optimal management policy was proposed in this research paper.

It is noticed that the distributed metadata management systems currently use multiple metadata servers to store metadata. This research paper notices that it is difficult to maintain metadata locality and load balancing among metadata servers consecutively. Metadata processing is the most crucial issue to optimize the system performance. To solve this issue, the publishers propose a new scheme in this paper called AngleCut to bifurcate metadata namespace tree to serve huge distributed storage systems [1].

The proposed scheme AngleCut uses locality-preserving hashing function to project the namespace tree into a linear keyspace [1]. Having used the hashing function, AngleCut designs an allocation strategy based on the history and thus manages the workload of metadata servers dynamically. Additionally, AngleCut provides a double layer metadata cache mechanism. This includes both server side and client side caching to provide dual access acceleration. This new scheme also introduces a distributed metadata processing 2PC Protocol Based on Message Queue (2PC-MQ). This ensures that the data is consistent in the system as a whole.

To summarize, the paper first discusses the two factors on which AngleCut will optimize on - locality and load balancing degree to transcribe the measurement of the system. Secondly, it uses a novel locality preserving hashing (LPH) function to maintain rings (layers) to provide a multi-layer mechanism. It also implements a novel history based allocation strategy to bifurcate metadata evenly to meta data servers which would adjust the workload more dynamically. This paper finally elaborates on this system by comparing

the system with the already existing Amazon EC2. The researchers of this paper conducted various experiments on Amazon EC2 to validate its efficacy. These experiments resulted to exhibit superiority of AngleCut over the previous known system [1].

***Topic of interest*:**

The overall idea of efficiently optimizing and scaling the metadata management system is quite compelling, especially the part where the paper emphasizes on maintaining consistency in metadata in such a huge distributed file system of EB-scale.

I believe that the researchers could have analyzed more on maintaining the consistency of the metadata in the file system. While a traditional two-phase commit (2PC) algorithm can be used, it is too costly for a huge distributed file system [2]. It would have been more optimal if AngleCut combined the two-phase commit (2PC) algorithm with metadata processing to reduce overheads. This would not only be a cheaper option but would also ensure fast recovery and would greatly reduce fail free execution overheads [2].

References:

[1] Y. Gao, X. Gao, X. Yang, J. Liu and G. Chen, "An Efficient Ring-Based Metadata Management Policy for Large-Scale Distributed File Systems," in IEEE Transactions on Parallel and Distributed Systems, vol. 30, no. 9, pp. 1962-1974, 1 Sept. 2019, doi: 10.1109/TPDS.2019.2901883.

[2] Xiong, J., Hu, Y., Li, G., Tang, R. and Fan, Z., 2011. Metadata Distribution and Consistency Techniques for Large-Scale Cluster File Systems. *IEEE Transactions on Parallel and Distributed Systems*, 22(5), pp.803-816.