A Prediction-Based Fair Replication Algorithm in Structured P2P Systems

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Abstract. Highly skewed query distribution in structured Peer-to-Peer system may cause huge amount of dropped queries and consequently lead to poor system performance. This paper describes a Prediction-based Fair Replication Algorithm (PFR), which aims to maintain excellent system performance when the query is highly skewed. For the purpose of fairly distributing load onto each node, nodes that host hot items always shed load onto light-loaded nodes by creating replicas along the query path. Through the use of a simple prediction method, we can foresee traffic surge and replicate beforehand. Consequently, the number of dropped queries will decrease. Further more, each node can fairly decide the load redistribution speed for itself merely based on local information. The experimental evaluation demonstrates the effectiveness of our approach, which can simultaneously reduce the number of dropped queries as well as the number of created replicas without introducing unaffordable overhead.

1 Introduction

P2P networks, such as Gnutella [1], Freenet [2], Chord [3], CAN [4], and Pastry [5], have been widely used in recent years. The implementation of structured P2P network assumes that all data items are of the same popularity. However, the distribution of queries for real data items has shown to be highly skewed, with several popular objects being requested most of the time. This type of traffic may overwhelm not only the source nodes that host the frequently-accessed data items but also the nodes along the busy query path. When flash crowd [11] happens, the amount of requests for the popular objects can increase dramatically to tens or hundreds of times as compared with the original amount, which is far beyond the node capacity. Such nodes may suffer from severe performance failures, and almost all the services they provide will be unavailable. Therefore, a poor system performance can be expected if the solution can't be found.

The common method of balancing load is to distribute replicas of the popular data items to various nodes, by which we can help the overloaded source nodes shed load. And thus the system performance is enhanced. In this paper, we propose a Prediction-based Fair Replication Algorithm (PFR), which can mitigate flash crowd symptoms