# Hierarchical DHT to Efficiently Load Balancing in Dynamic Peer-to-Peer Environment

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**Abstract.** There has been tremendous interest in emerging Peer-to-Peer (P2P) network overlays because they provide a good substrate for creating large-scale data sharing, content distribution and application-level multicast applications. P2P networks offer an efficient routing architecture that is massively scalable, self-organizing, and robust. It also provides fault tolerance. Structured peer-to-peer (P2P) such as Chord organizes peers into a flat overlay network and offer distributed hash table (DHT) functionality. Basically in this system, data is associated with keys and each peer is responsible for a subset of the keys. In Hierarchical DHTs peers are arranged into groups, and each group has its autonomous intra-group overlay network and lookup service. Compare to flat DHT systems, hierarchical systems can efficiently distribute the load among different peers. It is also observed that peers join and leave the P2P network frequently, which affect the structured network. In this paper, we are proposing the architecture which can efficiently balance the load among peers, also it can handle the frequent joining and leaving of peers in P2P system.

**Keywords:** Chord, Hierarchical DHT, Load Balancing, P2P System, Superpeer.

## 1 Introduction

Peer-to-Peer (P2P) applications are gaining increased popularity and deployment for their conspicuous advantages. As P2P network do not rely on dedicated servers, it is free from single point of failure and bandwidth bottleneck. P2P network has advantages of scalability, reliability, self-organizing and resistance to attack like DOS to some extent. P2P networks can be categorized as structured and unstructured overlays based on topology. In un-structured P2P network the overlay topology is completely unrelated to the placement of content while in structured networks the overlay topology is tightly controlled and files are placed at precisely specified locations based on the key generated by hash. In unstructured P2P overlays, such as Gnutella, Kazza, peers use flooding or random walks to resolve queries. These routing techniques can be used for complex searches since they are not limited to indexed data in the network. The main problem of these systems is that search cost does not scale well, as it grows linearly with the

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size of the network. In structured P2P system, node is responsible for a certain set of items and the system has an appropriate protocol for efficient routing of queries for items. The design objective of these overlays is to have every node store pointers to certain other nodes in the system such that a query for an item reaches the destination node in as few hops as possible.

Hierarchical P2P systems, offer a range of benefits in comparison with their flat structured system. They fit better the underlying physical network and are more appropriate for heterogeneous environments. The hierarchical distributed hash table (DHT) systems are generally organised into two layers, a superlayer built by superpeers and a leaf-peer layer built by rest of peers. The superlayer is implemented using a DHT algorithm such as chord. Each superpeer responsible for managing a group of leaf peers. Superpeer also responsible for delivering queries on behalf of the leaf peers in its group.

Chord is structured DHT protocol that organizes peers into a flat overlay network and offers DHT functionality. In the chord protocol each peer has to maintain finger table (routing information) to efficiently route the query, also it has to maintain successor info for repairing chord ring. As a node joins or leaves the system, the finger table must be created on this node; the affected finger table entry on several other nodes must be modified accordingly. To make the system work properly, each node periodically send message to its neighbours to check their availability.

In large system this communication overhead can be very high. In the environment where node joins and leaves very frequently, system generates considerable routing information traffic. Besides this, in conventional chord protocol it is assumed that all the nodes (peers) have equal capability, but in real scenario thats not the case. In reality each node has different bandwidth, CPU power, storage capacity, uptime in P2P overlay and so on.

In this paper we attempt to present an improved chord algorithm using hierarchical architecture. Propose architecture can efficiently balance load among different peers. It also considers the frequent joining and leaving of the node, so that there will be minimum affect on existing routing information which in terns reduces the network traffic.

The rest of this paper is structured as follows. Section 2 describes related work in hierarchical architecture. Section 3 discusses the proposed architecture. Section 4 shows the simulation and evaluation results of proposed architecture. In section 5 conclusion is presented.

## 2 Related Work

There is the growing interest in hierarchical DHTs. Although many hierarchical DHTs have been proposed in the literature, most of the works addressing the problem of building and configuring hierarchical P2P networks deal with un-structured networks and generally it do not consider frequent joining and leaving of nodes in network. In our work, we basically concentrate on the load balancing and peers behaviour of frequent joining and leaving the P2P network.