

Hybrid SkipNet – Reducing Maintenance Overhead in a SkipNet-like Routing Structure

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Abstract

The peer-to-peer communication is today an intensively studied field of the computer science. There are a variety of structured, scalable solutions, designed to be robust against failures and attacks when working in a dynamic environment. But the most of them suffer from high maintenance costs. We propose a scalable P2P overlay based on the deterministic version of a structured overlay called Deterministic SkipNet (DS, proposed by N. Harvey and J. Munro). The Hybrid SkipNet has similar properties to DS, and provides a guaranteed bound on the routing time complexity. It has also lower maintenance costs and provides a better balanced routing structure by utilizing the same amount of routing state by creating configurable-sized local groups of nodes for the rebalance operation.

1. Introduction

Scalability, robustness against failures and attacks, communication complexity of node joins, leaves and lookups, security and availability, self-organization in heterogeneous environments are today extensively studied issues concerning P2P overlay networks and grids. Let us take a little insight on the evolution of the P2P networking.

1.1 Evolution of the P2P networking

The wide spread of peer-to-peer networks began with the appearance of Napster [11], the first representative of centralized P2P networks. The main characteristic of centralized P2P architectures is the presence of a central server, used as a directory of files for the lookup process. After the search is done, the transfer of files in centralized P2P networks is performed in a distributed manner.

The problems, caused by the presence of a single central element in a distributed system, were solved by the introduction of unstructured P2P networks of the Gnutella

type [12]. These networks employ a type of flood-searching algorithm. That makes them very robust, on the other hand, the algorithm is very weakly scalable. These networks also suffer from other problems, e.g., limited nature of search and overloading the network by messages. One approach to overcome this problem is by the use of supernodes – an example could be the Kazaa network [6].

Recently emerged structured P2P networks, based on distributed hash tables (DHT), have excellent scalability properties. The DHT networks also show good robustness and resistance against errors. On the other hand, they destroy locality of the data. There are some of their representatives: CAN [1], Chord [2], Pastry [3], and Viceroy [4]. The disadvantage of destroying locality of the data has been recently removed by the appearance of overlays, that preserve content and path locality, e.g. SkipNet [7].

The majority of today's implementations, including the SkipNet, do not deterministically guarantee upper bounds on communication costs. (One attempt to create a design with guaranteed upper bound has been proposed by N. Harvey and J. Munro