Reducing Network Overhead with Common Junction Methodology

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ABSTRACT

In structured and unstructured Peer-to-Peer (P2P) systems, frequent joining and leaving of peer nodes causes topology mismatch between the P2P logical overlay network and the physical underlay network. This topology mismatch problem generates high volumes of redundant traffic in the network. This paper presents Common Junction Methodology (CJM) to reduce network overhead by optimize the overlay traffic at underlay level. CJM finds common junction between available paths, and traffic is only routed through the common junction and not through the conventional identified paths. CJM does not alter overlay topology and performs without affecting the search scope of the network. Simulation results show that CJM resolves the mismatch problem and significantly reduces redundant P2P traffic up to 87% in the best case for the simulated network. CJM can be implemented over structured or unstructured P2P networks, and also reduces the response time by 53% approximately for the network.

Keywords: Common Junction Methodology, Mismatch Problem, Overlay Networks, Peer-to-Peer Networks, Redundant Traffic

1. INTRODUCTION

A peer-to-peer (P2P) network is an abstract, logical network called an overlay network, deployed on the peers already connected with the internet. Instead of strictly decomposing the system into clients (which consume services) and servers (which provides them), peers in the system can elect to provide services as well as consume them. All participating peers form a P2P network over a physical network. The network overlay abstraction provides flexible and extensible application-level management techniques that can be easily and incrementally deployed despite the underlay network. When a new peer wants to join a P2P network, a bootstrapping node provides the IP address list of existing peers in the P2P network. The new peer then tries to connect with these peers. If some attempts succeed then the connected peers will be the new peer’s neighbors. Once this peer connects into a P2P network, the new peer will
periodically ping the network connections and obtain the IP addresses of some other peers in the network. These IP addresses are cached by this new peer. When a peer leaves the P2P network and later wants to join the P2P network again, the peer will try to connect to those peers whose IP addresses are present in the cache.

In unstructured P2P systems, the mechanism of a peer randomly joining and leaving a P2P network causes topology mismatch between the P2P logical overlay network and the physical underlay network, causing a large volume of redundant traffic in the Internet (Sen et al., 2002; Saroiu et al., 2002). Studies by Ritter (2001) and Ripeanu et al. (2002) have shown that the flooding-based routing algorithm generates 330 TB/month in a Gnutella network with only 50,000 nodes considering the fact that Internet consists of nodes much more in number. A large portion of the heavy P2P traffic is due to topology mismatch problem between overlay topology and underlay topology, which makes the unstructured P2P systems being far from scalable (Ritter, 2001).

In P2P networks peer nodes rely on one another for service rather than solely relying on dedicated and often centralized infrastructure. Decentralized data-sharing and discovery algorithms/mechanisms will be the boosting option for the deployment of P2P networks (Andersen et al., 2001; Huebsch et al., 2003 & Rowstron et al., 2001). The challenges for the researchers are to chase the topology mismatch problem for avoiding unnecessary redundant traffic from the network.

In this paper we have proposed a Common Junction Methodology (CJM) that resolves the topology mismatch problem and also reduces the large amount of redundant traffic over the network. CJM finds the optimal physical links for routing the messages/queries. It works for both the structured and unstructured P2P networks. For implementing our methodology an overlay network model is also identified. The identified model makes information placement and dissemination easy on the P2P networks. It supports the scalability and optimizes the communication cost of the system. CJM also minimizes redundant network traffic in the P2P networks.

Rest of the paper is organized as follows. Section 2 gives the related work. Section 3 presents a case of topology mismatch problem and Section 4 explores System Model. Section 5 introduces CJM, System Analysis is given in Section 6. Section 7 explores on implementation and performance study of CJM and finally paper is concluded in Section 8.

2. RELATED WORKS

There are several traditional topology optimization approaches. The end system multicast is used in NARADA (Chu et al., 2000). NARADA first constructs a rich connected graph on which it further constructs shortest path spanning trees. Each tree rooted at the corresponding source uses well-known routing algorithms (Chu et al., 2000). This approach introduces large overhead of forming the graph and trees in a large scope, and does not consider the dynamic joining and leaving characteristics of peers. The overhead of NARADA is proportional to the multicast group size. Further this approach is impractical in large-scale P2P systems.

Researchers have also considered clustering of closely located peers based on their IP addresses (Krishnamurthy et al., 2001; Padmanabhan et al., 2001). In this approach there are two limitations- (a) mapping accuracy is not guaranteed and (b) searching scope is affected with increase in volume of traffic in P2P networks.

In Xu et al. (2003) authors measure the latency between peers using multiple stable Internet servers called “landmarks”. The measured latency is used to determine the distance between peers. This measurement is conducted in a global P2P domain and needs the support of additional landmarks. Similarly, this approach also affects the search scope in P2P systems.

In GIA, Chawathe et al. (2003) introduces a topology adaptation algorithm to ensure that high capacity nodes are the ones with high degree and low capacity nodes are within short...
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