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Traffic Balancing on Co-Operative Proxy Caching for Peer to Peer Networks

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Abstract: We propose a novel scheme, called Cooperative Semantic Caching Scheme (CSCS) for multi-level super-peer networks that support hierarchical P2P architecture. Peers share information according the semantic proximity between peers and between shared files to self-organism into clustered groups. In this paper we tackle the problem of exploiting the semantic locality of peer requests to improve the performance of a P2P network by the use of cooperative semantic caches. Such caches group together peers with similar interests as well as files with similar request patterns. Simulation experiments show that the CSCS mechanism achieves significant improvements in terms of access latency and global cache hit ratio.

Key words: Routing security · P2P network · Asymmetric nested encryption · Active detectio

INTRODUCTION

A major fraction of the total Internet traffic accounting for as much as 60-70 percent of the traffic in some Internet Service Providers (ISPs) is been generated by Peer to peer system. Increasing the traffic load on ISP networks escalates the costs incurred by ISPs to provision and run their networks [1]. In addition, since the Internet is a shared platform, higher chances of network congestion may indirectly degrade the performance of other Internet applications [2].

Several approaches have been proposed in the literature to reduce the impacts of P2P traffic. These include enhancing traffic locality and traffic caching. These may not always be feasible for some ISPs because many of their clients like to participate in P2P systems and might switch to other ISPs if they were blocked [3].

Here we propose two models for cooperative caching of P2P traffic. The first model enables cooperation among caches that belong to different autonomous systems (ASs), while the second considers cooperation among caches deployed within the same AS. We analyze the potential gain of cooperative caching in these two models.

Terminology: P2P traffic has been extensively studied for multiple reasons. First of all, P2P applications generate a tremendous quantity of traffic in the network. At first a lot of ISPs tried to rate-limit, or even block P2P applications are existing approaches it led to efforts by P2P applications developers to obfuscate their traffic so as to not be detected by network operators. Existing approaches using devices for traffic blocking and shaping have also been used in practice. These approaches are not feasible to the internet service providers because many of their clients wish to participate in P2P system and feel dissatisfied if it is blocked [4].

A cooperative proxy cache concept is used in the proposed system to reduce the P2P traffic. In particular, two models are proposed for caching of P2P traffic. The first model enables cooperation among caches that belong to different autonomous systems (ASs), while the second considers cooperation among caches deployed within the same AS. Caching is a promising approach because objects in P2P systems are mostly immutable and the traffic is highly repetitive. Caching does not require changing the P2P protocols and can be deployed transparently from clients. Therefore, ISPs can readily deploy caching systems to reduce their costs. Independent caches are handled in the proposed system [5].

MATERIALS AND METHODS

Analysis Services includes various algorithms - Decision trees, clustering algorithm, Naïve Bayes algorithm, time series analysis, sequence clustering algorithm, linear and logistic regression analysis and neural networks - for use in data mining [6, 7].

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Verification Experiment: We believe that multiple approaches will likely be required to mitigate the problems created by the enormous amount of P2P traffic. For example, caching can be used in conjunction with locality-aware neighbor selection algorithms to further reduce the amount of traffic downloaded from sources outside of the local network domain [8].

Network Generation of Peer to Peer: The network design task consists of implementations for upper layers of the protocol stack, namely presentation, session, transport and network layers. The presentation layer is responsible for data formatting [9].

It converts abstract data types in the application to blocks of ordered bytes as defined by the canonical byte layout requirements of the lower layers.

The session layer implements end-to-end synchronization to provide synchronous communication as required between system components in the application.

It is responsible for multiplexing messages of different channels into a number of end-to-end sequential message streams. The transport layer splits messages into smaller packets.

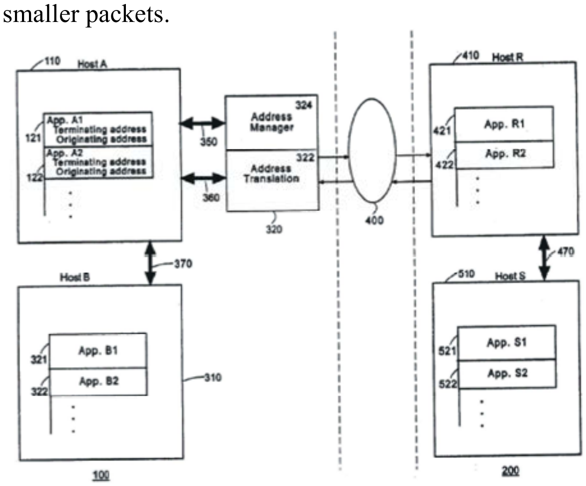

Fig. 1: Network Generation of Peer to Peer

Independent Proxy Caches: A cache is deployed near the gateway routers of ASs that choose to employ caching to reduce the burden of P2P traffic.

The advantage of a deployed cache and to avoid modifying the source code of P2P client software, the cache should work in a transparent mode.

The gateway router detects HTTP requests and forwards them to the Web cache. Detecting P2P traffic, however, is abit more involved because many P2P systems use dynamic ports and some of them even encrypt control packets. The primary goal of caching P2P traffic is to reduce the load on backbone links and hence, reduce the operational costs of ISPs.

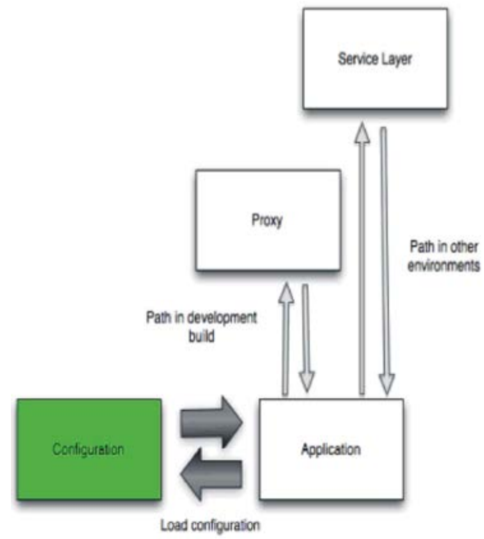

Fig. 2: Proxy Configuration

Cooperative Proxy Caches in Different Ass: Caches deployed in different ASs cooperate with each other to serve requests from clients in their networks.

The cooperating ASs may have a peering relationship to carry each other's traffic, or they can be located within the same geographical area such as a city where the bandwidth within the region is typically more abundant than the bandwidth on long-haul, intercity, links.

When a cache receives a request for an object that it does not store locally, it first finds out whether another cache in the cache group has the requested object. If any of them does have the object, the object is directly served to the requesting client. Communication and object lookup inside the cache group can be done in several ways.

Cooperative Proxy Caches Within the Same Ass: This module is suitable for a large ISP with multiple access/exit points. The network of such ISPs is composed of multiple points of presence (POPs) interconnected with high-speed optical links. ISPs provide Internet access to their customers at POPs. The links inside an ISP are usually over provisioned. ISPs are attached to the Internet through inter-ISP links. Inter-ISP links are usually the bottlenecks of the Internet and where congestion occurs. In addition, the inter-ISP links are expensive because an ISP either pays another ISP for carrying its traffic (in a customer-provider relationship) or it needs to mutually

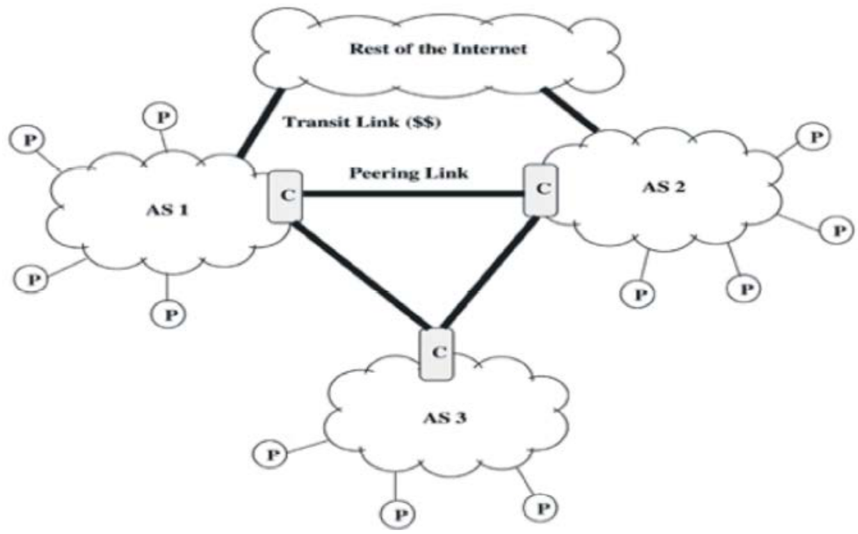

Fig. 3: Cooperative Proxy Caches in Different Ass

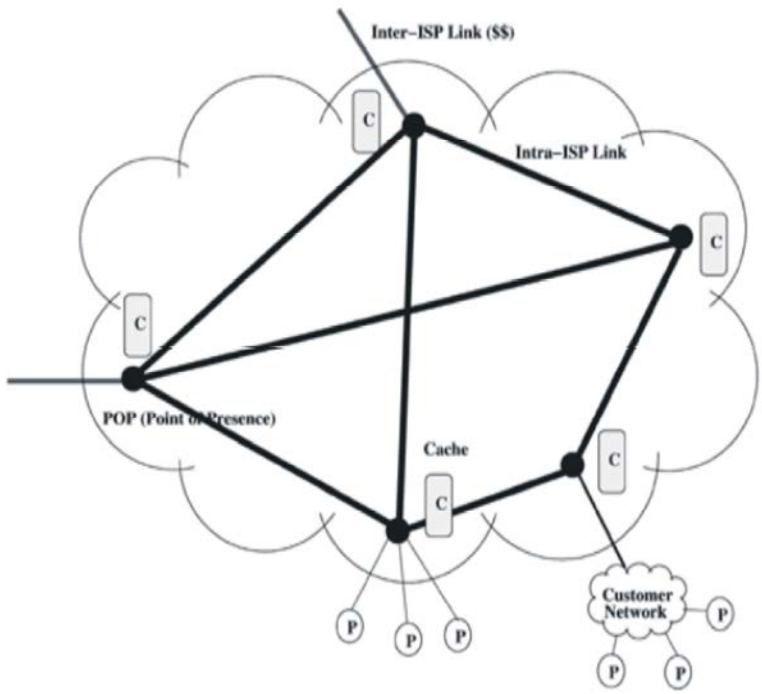

Fig. 4 Cooperative Proxy Caches within the Same ASS

carry the same amount of traffic from the other ISP (in a peer-to-peer relationship). Deploying cooperative caches in such large ISPs would save a huge amount of P2P traffic from going on the inter-ISP links and thus, would reduce the costs incurred by ISPs, because the cost of the internal links (between caches) is much smaller than the cost of inter-ISP links. Caching would also benefit clients because their traffic will traverse fewer inter-ISP links, which are more susceptible to overload and congestion.

Replacement Policies for Cooperative Caching: We propose a simple model for object replacement in cooperative caching. We call this model cooperative caching with selfish replacement. Under this model, a cache cooperates by serving requests issued from other caches in the cache group if it has them.

The object replacement policy, however, bases its decision to evict objects only on local information of individual caches. We apply the selfish model on the three object replacement policies described above.

CONCLUSION

For P2P traffic we analyze the potential gain of cooperative Caching. Here we propose two models for cooperation

- Among caches deployed in different Ass
- Among caches deployed within a large Ass.

In both models, caches cooperate to save bandwidth on expensive WAN links.To perform this analysis, we conduct an eight-month measurement study on a popular P2P system to collect traffic traces for multiple caches. Then, we perform extensive trace-based simulations to analyze different angles of cooperative caching schemes. Our results demonstrate that:

- Significant improvement in byte hit rate can be achieved using cooperative caching,
- Simple object replacement policies are sufficient to achieve that gain.
- The overhead imposed by cooperative caching is negligible.
- It proves that it is cost effect with improved performance and mainly focuses in congestion control.

In addition, we propose simple models for object replacement policies in cooperative caching systems. These models allow an individual cache to cooperate with other caches, but without harming its own performance. This is done by making the decision to replace an object from the cache based only on local information from that cache. We will validate the results from our analysis using simulations, where most of the assumptions made in the analysis would be relaxed.

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