School of Computer Science

Master's Thesis Defense

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Improving Client and Channel Assignment in IPTV Multicast

In recent years Internet Protocol Television (IPTV) has become a viable alternative to traditional television broadcast mediums. This domain has a number of challenges that must be overcome to ensure that a quality service may be provided. These challenges range from efficient network usage to ensuring good Quality-of-Experience (QoE) for the end client users. To address these challenges we consider two related problems and provide solutions for them.

An overlay network consists of servers that are attached to Internet routers. The overlay network forms a topology that is designed by the IPTV network provider to suit its needs. Each link in the overlay network is an Internet path consisting of routers. The overlay network of servers is controlled and maintained by the IPTV network providers. Typically the IPTV network provider will form a multicasting tree rooted at some server s to distribute content (channels) to other servers in the tree. The clients (or IPTV users) connect to one or more servers (contact servers) to receive their requested channel. In a more general setting, several IPTV providers could share the same overlay network with each creating a multicasting tree to distribute content.

When a client requests a channel for viewing it first has to identify a node on the multicasting tree which can provide the channel. If the node identified does not carry the channel the request has to be sent along the path from that node to the root of the multicast tree. Any node in the path that has the requested channel will immediately reply with the content, which will then be passed to the client. The time it takes to receive the content after the request has been made is called the Zap Time. For a better QoE it is important to minimize zap time. One way to minimize zap time is to make available all channels at all nodes in the multicasting tree. However, this would require the availability of sufficient bandwidth on all links of the multicasting tree. We consider the following problems and their variants:

a) We are given a set of multicasting trees each serving a set of unique channels from its root. A set of clients demands a set of channels; these demands are satisfied by finding contact servers in the appropriate trees. That is a client c is connected to contact server s in a tree T if that client requests a channel served by the root of the tree T. The contact servers are chosen in a manner that optimizes one of several cost functions including minimizing zap time, minimizing total bandwidth usage, and maximizing residual link bandwidth (the bandwidth that is available after channels have been distributed).

b) The problem specified in a) assumes that the unique set of channels are fixed apriori at the roots of the multicast trees. We relax this assumption and seek solutions that will determine the set of unique channels that each multicast trees will serve based on the clients and their channel requests.

We have provided Integer Linear Programming (ILP) formulations for all problems under consideration. We have also provided polynomial-time heuristics for the problems and its variants. Our exhaustive empirical evaluations show that our heuristics provide a very fast and reasonable approximation to the op- timal solutions as determined by the execution of the ILP models.

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