Fair Treatment of Multicast Sessions and Their Receivers

– Incentives for more efficient bandwidth utilization

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Abstract

Media-streaming services are rapidly gaining in popularity, and new ones are knocking on the door. Standard-definition *Internet protocol television* (IPTV) has already entered many living rooms, and high-definition IPTV will become common property in the not too distant future. Then even more advanced and resource-demanding services, such as three-dimensional and free-view TV, are next in line. Video streaming is by nature extremely bandwidth intensive, and this development will put the existing network infrastructure to the test.

In scenarios where many receivers are simultaneously interested in the same data, which is the case with popular live content, multicast transmission is more bandwidth efficient than unicast. The reason is that the receivers of a multicast session share the resources through a common transmission tree where data are only transmitted once along any branch. The use of multicast transmission can therefore yield huge bandwidth savings. There are however no really strong incentives for the *Internet service providers* (ISPs) to support multicast transmission, and the deployment has consequently been slow.

We propose that more bandwidth is allocated to multicast flows in the case of network congestion. The ratio is based upon the number of receivers and the bitrate that they are able to obtain, since this is what determines the degree of resource sharing. We believe that it is fair to take this into account, and accordingly call the proposed allocation *multicast-favorable max-min fair*. Further, we present two bandwidth-allocation policies that utilize different amount of feedback to perform allocations that are reasonable close to be multicast-favorable max-min fair.

We also propose two cost-allocation mechanisms that build upon the assumption that the cost for data transmission should be covered by the receivers. The mechanisms charge the receivers based on their share of the resources usage, which in general is favorable to multicast receivers. The two cost-allocation mechanisms differ in that one strives for optimum fair cost allocations, whereas the other might give discounts to some receivers. The discounts facilitate larger groups of receivers, which can provide cheaper services for the non-discounted receivers as well.

The proposals make multicast transmission more attractive to the users of media-streaming services. If the proposals were implemented in multicast-enabled networks, the rest of the ISPs would be forced to support multicast, to stay competitive.