Enabling Contribution Awareness in an Overlay Broadcasting System

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Public Review by Srinivasan Seshan

Enabling efficient multicast communication on the Internet has preoccupied the networking research community for the past two decades, if not longer. Through the late 1980’s and the 1990’s, the community published numerous papers on addressing the challenges of making IP Multicast practical. Unfortunately, satisfactory solutions for several problems were never developed and, as a result, IP Multicast was never widely deployed. By the late 90’s, it certainly seemed that multicast was doomed to become a footnote in Internet history.

Starting around 2000, a number of groups began developing systems (including the predecessor of the ESM system described in the paper) for supporting multicast efficiently at the application layer. These application-layer overlay systems renewed interest in solving the efficient multicast problem. As a result, we once again saw numerous papers published on the topic of multicast. Unfortunately, as with IP Multicast, we have yet to see little if any use of these designs or results in widely deployed systems.

Most of the effort over the past five or so years has focused on organizing the participating hosts into delivery trees without incurring too much overhead. Some of the key problems that have been explored include ensuring that the delivery tree is efficient and that the system tolerates the arrival/departure of clients. An important problem that has been largely ignored and is critical in real deployments is that the wide range of client capabilities. The core contribution of this paper is a design that nicely combines several previously proposed ideas, such as taxation, multiple delivery trees and layered codecs, into a single system that accommodates client heterogeneity. The design also incorporates some careful engineering to ensure stability, reasonable startup behavior, effective resource monitoring, and fair sharing of excess resources. The system design seems simple and straightforward which I view as an asset in a topic area that easily accommodates overly complex designs.

More than anything else, this paper highlights that we are still addressing relatively basic problems in making overlay multicast practical and widely used. The rate of progress in solving or even beginning to address some of these basic problems is certainly disconcerting. One factor that has certainly contributed to this issue is the lack of useable implementations of overlay multicast. Almost every review of this paper commented on how refreshing it was to see a real implementation and reasonably realistic deployment. This was certainly a key factor in the acceptance of this paper.

While I liked this paper overall, it does have a number of weaknesses. First, the design relies on layered coding of the source stream, making it largely only relevant for video data. In today’s world of TiVo and video-on-demand, it is unclear to me how critical it is to support live video streaming efficiently. However, there are many other applications that may benefit from overlay multicast – they just aren’t well supported by this system. Second, the paper also seems hampered by considering current uses of video on the Internet in other ways. For example, the paper only considers a 400kbps source rate. However, I suspect this commonly used source rate may well be a result of the fact that existing systems don’t support heterogeneity well (e.g., layered codecs are rarely used) and that server bandwidth is often constrained. The proposed design certainly eliminates both these issues and I wished the authors had considered
more futuristic scenarios. Third, while the deployment was “reasonably” realistic, it certainly was not real and it was unclear what the PlanetLab part of the deployment got them other than some headaches. For example, the trace playback certainly could have had some hiccups, as evidenced by comments such as “several clients are limited by the bandwidth near them... causing them to under-perform”.

In summary, while this paper makes some important progress towards making overlay multicast practical, we still have a ways to go. An interesting question to ponder is whether overlay multicast will succeed in the end or will we see papers titled “Revisiting Overlay Multicast” in the future.