Considering Network Heterogeneity in Global Application Layer Multicast Provision

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As an alternative approach to the non-yet widely available IP Multicast, Application Layer Multicast (ALM) has recently become subject of intense research. Running on top of existing transport layers, most proposed ALM protocols assume homogeneous underlays, not taking into account the continuing availability of more and more different access technologies like e. g., DSL, cell-based mobile networks and (wireless) local area networks. Also, techniques not yet available globally (quality of service support, IP Multicast, ...) may be employed in parts of the Internet by certain ISPs. We present an approach that enhances a specific ALM protocol by considering several factors concerning attributes of member nodes' underlay specifications as well as their capacities and properties, configurable through the employed application that uses the protocol for data dissemination. The ALM protocol is part of the Future Internet architecture *SpoVNet* [2].

Our approach is based on the NICE approach [1] that is able to adapt to underlay properties and to be configurable, concerning the specific application's demands. NICE arranges member nodes in a hierarchical clustering formation, limiting protocol overhead to clusters and thus ensuring good scalability. Originally, NICE aims at light-weight streaming applications like stock market newstickers. To optimize cluster memberships, the protocol measures connection latencies and clusters nodes situated near each other. There is no consideration of underlay properties, what could lead to inefficient protocol behavior, given the situation in today's internet as stated above. If e. g., participating nodes reside in the same wireless LAN segment while being connected to an Internet-wide NICE instance, employing the original protocol overhead and unicast transmissions could occupy the shared medium to a greater extent than necessary. In these parts, other dissemination strategies like broadcast could be used to improve efficiency. Also, additional metrics like link reliability, node uptime, failure rates, node bandwidth capacity and many more could be used to create the hierarchical NICE structure. This adds the flexibility to configure the protocol in terms of current application's service demands. The application is able to communicate these service demands to the protocol instance during initiation, including e. g., latency and reliability requirements.

The protocol then decides which preferences to consider while building the dissemination structure. This is accomplished by employing a service metric consisting of a function evaluation all factors to be considered. These factors may be weighted, reflecting their importance in the specific case. A latency-sensitive application like a realtime-game prefers a latency-optimized structure while a single-source video streaming application would benefit from a tree-based structure that assigns more children to nodes with higher bandwith capabilities.

The protocol is able to obtain such cross-layer-information with help of a component that is part of the SpoVNet architecture. The component collects this information and makes it available throughout the framework. With knowledge about access technologies or enhanced techniques in specific parts of the overlay network, different strategies for disseminating data in these party may be used, additionally. In wireless environments with high numbers of participants, broadcasting data would save medium occupation and overhead. In domains with quality of service support available, the protocol could try to delegate the application's demands to these mechanisms. Also, this applies to IP Multicast domains, saving the performance drawbacks that come with Application Layer Multicast.

Our talk presents an approach for enhancing an existing ALM protocol to efficiently consider today's network heterogeneity for providing a global group communication service. As a first step, wireless domains have been integrated into the dissemination structure. The protocol is part of the Future Internet architecture SpoVNet.

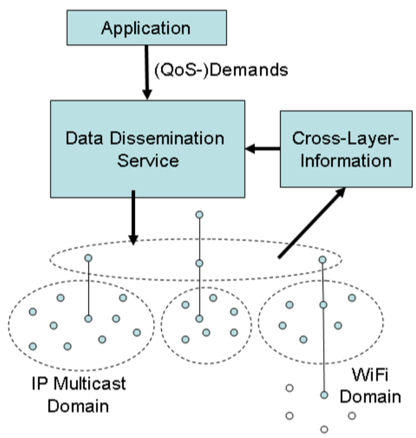

Figure 1: Example of component interaction and dissemination structure

References

[1] S. Banerjee, B. Bhattacharjee, and C. Kommareddy. Scalable application layer multicast. In *SIGCOMM02*, Pittsburgh, Pennsylvania, USA, August 2002.

[2] SpoVNet Consortium. SpoVNet: An Architecture for Supporting Future Internet Applications. In *Proc. 7th Würzburg Workshop on IP: Joint EuroFGI and ITG Workshop on "Visions of Future Generation Networks" (EuroView 2007)*, Würzburg, Germany, July 2007.