AMul: Adaptive Multicast Routing Protocol for Multi-hop Wireless Networks

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Abstract. Wireless Networks have evolved as promising technology for numerous applications to provide Internet access to fixed and mobile wireless devices. Multicasting plays a crucial role in many applications of Wireless Networks. Several routing protocols have been proposed for multicast communication in mobile wireless networks. In this paper we propose a reactive and receiver initiated multicast routing protocol called Adaptive Multicast (AMul) to provide better Quality of Service (QoS) in Wireless Networks. Using simulations, we compare AMul with Protocol for Unified Multicasting through Announcements (PUMA) which is also a reactive and receiver initiated multicast routing protocol for Multi-Hop Wireless Networks. Based on the simulation results, we observe that AMul reduces the overall end to end delay while inducing negligible control overhead in the network.

Keywords: Control Overhead, End to End delay, Multicast Routing Protocols, Multi-hop Wireless Networks, QoS, Total Overhead.

1 Introduction

Tremendous growth in the number of mobile computing devices has lead to the widespread deployment of wireless networks. With the advances in recent technologies and an increasingly sophisticated mobile work force worldwide, content and service providers are interested in supporting group communications over wireless networks.

Data transmission modes are mainly categorized into unicast, multicast and broadcast. Majority of the applications use unicast transmission mode for data transfer. However if real-time multimedia applications such as live video streaming are shared among multiple clients using unicast communications, it could result in network resources starvation. Multicasting is an efficient method of supporting group communication as compared to unicasting or broadcasting since it allows transmission of packets to multiple destinations using fewer network resources [1], [2]. Moreover multicast communications over wireless networks have gained a lot of attention recently and have posed several important and challenging issues.

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Multimedia applications demand high Quality of Service (QoS) as compared to other applications such as file transfer and email, where per packet delay and control overhead have minimal impact. Thus to enhance the QoS for multimedia applications, multicast routing protocols must be tailored towards minimal packet delay and control overhead in the network.

In this paper we propose a reactive and receiver initiated multicast routing protocol named Adaptive Multicast (AMul) Routing Protocol which aims to provide better QoS in multi-hop wireless networks by minimizing per packet delay and control overhead. The proposed AMul routing protocol is implemented in Network Simulator-2 (NS-2) and the results are compared with Protocol for Unified Multicasting through Announcements (PUMA) in terms of average end to end delay, control overhead and total overhead.

The remainder of the paper is organized as follows. In Section 2 we discuss the basic guidelines of AMul protocol. Section 3 presents the Simulation Environment and Section 4 discusses the Results and Analysis. Section 5 concludes the paper with future directions.

2 Adaptive Multicast (AMul) Routing Protocol

2.1 Overview

AMul routing protocol is a mesh based, reactive, receiver initiated multicast routing protocol in which receivers join a multicast group using the address of a Core. AMul routing protocol aims to reduce the overall end to end delay of the network by minimizing per packet queuing delay.

AMul is a modification of PUMA[3-6] and thus eliminates the need for a unicast routing protocol and the pre-assignment of cores to multicast groups. The major difference between AMul and PUMA is that AMul uses average remaining queue as a routing metric while PUMA uses distance to core as a routing metric. The rest of the working of AMul is exactly similar to that of PUMA.

In AMul, every node of the network is expected to calculate its average remaining queue and send this information to other nodes by using Multicast Announcement Packet (MAP). MAP of AMul contains an extra field called average remaining queue as compared to multicast announcement of PUMA. Multicast announcement packets are used by nodes to notify other nodes about joining or leaving a group, maintain the group, elect core nodes and to establish routes for sources outside the multicast group.

The MAP formats of PUMA and AMul are shown in Fig. 1 and Fig. 2 below:

Core ID	Group ID	Seq. Num.	Dist. to Core	Parent	Mesh Member Flag

Fig. 1. PUMAs Multicast Announcement Packet Format