Multicast and Unicast ODMRP Routing in Ad hoc Networks Based on Quality of Service Support and Local Recovery Approach

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ABSTRACT

An ad hoc network is comprised of mobile hosts without any fixed wired infrastructure support. The primary concerns in ad hoc networks are bandwidth limitation and unpredictable dynamic topology. Therefore, efficient bandwidth utilization is crucial in routing protocols. Reliable multicast plays a significant role in many applications of mobile ad hoc networks (MANETS). The on-demand multicast routing protocol (ODMRP) was designed for multicast routing in ad hoc networks. However, ODMRP supports unicast routing too. It is very important to efficiently allocate and consume link bandwidth in this protocol, especially when many sessions are working concurrently. In this article, we propose a new method for estimating bandwidth in multicast protocols and also a new technique for supporting QoS routing in multicast and unicast ODMRP by making an acceptable estimation of available and required bandwidth. Also, we propose a local recovery approach to design a reliable multicast algorithm. Simulation results show that using QoS routing for ODMRP improves network performance in presence of mobility, by searching for suitable paths. By local recovery approach, nodes can join to multicast group in minimum time, and data delivery will be increased.

Keywords: Mobile Ad hoc Networks; Multicast Routing; On Demand Routing; Quality of Service; Route Recovery

INTRODUCTION

An ad hoc network is a dynamically reconfigurable wireless network with no fixed wired infrastructure. Each node can function both as a network host for transmitting and receiving data and as a network router for routing packets to the other nodes. Ad hoc networks have numerous practical applications such as military ap-
applications, emergency operations, and wireless sensor networks. In many applications, ad hoc networks carry diverse multimedia applications such as voice, video, and data. In order to provide quality delivery to delay sensitive applications such as voice and video, it is imperative that ad hoc networks provide quality of service (QoS) support in terms of bandwidth and delay (Xue & Ganz, 2003).

At the same time, the popularity of group computing has grown rapidly. Multicast is a very useful and efficient means of supporting group-oriented applications, especially in mobile/wireless environments where bandwidth is scarce and equipment has limited power. With the rapid growth of demand, the multicast technology in mobile ad hoc network (MANET) has attracted a lot of attention recently (Chandra, Ramasubramanian, & Birman, 2001; Gopal-samy, Singhal, Panda, & Sadayappan, 2003; Luo, Eugster, & Hubaux, 2003; Tang, Obraczka, Lee, & Gerla, 2002). Quality of service (QoS) is the performance level of a service offered by the network to the user. After receiving a service request from the user, the first task is to find a suitable loop-free path from the source to the destination that will have the necessary resources available to meet the QoS requirements of the desired service. This process is known as QoS routing. After finding a suitable path, a resource reservation protocol is employed to reserve necessary resources along that path (Siva, Murphy, & Manoj, 2004).

In addition to unicast routing protocols, several multicast routing protocols for ad hoc networks have been proposed in more recent years (Bommaiah, Lui, McAuley, & Talpade, 1998; Gerla, Lee, & Su, 2000; Royer & Perkins, 1999). Unicast is a special form of multicast and some proposed multicast routing protocols support unicast and multicast routing (Royer & Perkins, 1999; Gerla et al., 2000).

(Bommaiah et al., 1998; Royer & Perkins, 1999) are generally more efficient in terms of data transmission than mesh-based protocols, but they are not robust against topology changes because there is no alternative path between a source and a destination. Mesh-based multicast protocols (Gerla et al., 2000) provide alternative paths and a link failure need not trigger the recomputation of a mesh. Previous studies showed that mesh-based protocols are robust against topology change and are more suitable than tree-based protocols (Lee, Su, Hsu, Gerla, & Bagrodia, 2000). ODMRP is an ad hoc multicast routing protocol based on a multicast mesh (Gerla et al., 2000). Ad hoc networks have certain characteristics that pose several difficulties in providing QoS. Some of the characteristics are dynamically varying network topology, lack of precise state information, lack of central controller, limited resource availability, and hidden terminal problem. There are several studies for unicast routing protocols with QoS in MANET’s literature (Chen et al., 2002; Chen & Yu, 2004; Darehshoorzadeh, De-hghan, & Jahed Motlagh, 2006; Iiyas, 2003), but QoS support for a multicast protocol should be differently designed from the unicast QoS (Bur & Ersoy, 2004). In Royer and Perkins (1999), we proposed a new technique that supports QoS routing for ODMRP in unicast mode.

Because of the importance of reliability there are some reliable protocols in MANET, and we can classify them in three categories: automatic retransmission request (ARQ) based, gossip-based and forward error correction (FEC) based. The protocols are RMA (Go-palsamy et al., 2002), RALM (Xue & Ganz, 2003), and ReAct (Rajendran, Yi, Obraczka, Lee, Tang, & Gerla, 2003) belong to the ARQ-based category. In Royer and Perkins (1999), we proposed a new technique that supports QoS routing for ODMRP in unicast mode. In this article, we propose new methods for estimating bandwidth in multicast protocols, and we support QoS routing in ODMRP using good estimation of available and required bandwidth. We also propose a new local recovery approach in ODMRP. Local recovery method achieves fast recovery when route breakage happens, so destination can connect to source in new route or the same route.

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