A Mesh-Based QoS Aware Multicast Routing Protocol

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Abstract. Due to the rising popularity of multimedia applications and potential commercial usages of mobile ad hoc networks (MANETs), quality of service (QoS) in MANET has become necessary to support those needs. In this paper, we propose a QoS aware multicast routing protocol (QMRP) based on mesh architecture which offers bandwidth guarantees for applications in MANETs. Experimental evaluations are carried out in a simulated environment. The results show that the proposed protocol outperforms ODMRP, a mesh-based multicast routing protocol in a variety of environments.

Keywords: quality of service, mesh architecture, multicast routing protocol.

1 Introduction

Wireless mobile networks and devices are becoming increasingly popular as they provide supports for applications anywhere and anytime. Traditional wireless mobile communications are usually supported by wired, fixed infrastructure; a mobile node is only one hop away from a base station. In contrast, the class of Mobile Ad Hoc Network has no fixed infrastructure or central administration. Each mobile node acts either as a host generating flows, being the destination of flows from other mobile nodes, or as a router forwarding flows directed to other mobile nodes. Due to the unpredictable locations and mobility of mobile nodes in MANETs, classical routing protocols used on wired networks are not suitable for MANETs. Protocols defined for ad hoc networks are classified as reactive protocols and proactive protocols.

Reactive protocols are characterized by mobile nodes acquiring and maintaining routes on demand while proactive protocols are characterized by all mobile nodes maintaining routes all the time. Examples of reactive protocols are DSR (Dynamic Source Routing) [2] and AODV (Ad Hoc On-demand Distance Vector) [10]. Examples of proactive protocols are OLSR (Optimized Link State Routing) [5] and TBRPF (Topology Dissemination Based on Reverse-Path Forwarding) [9]. These protocols have been analyzed and compared in a number of papers. The main conclusion of these comparisons is that none of them is the best for all environments. Depending on several aspects such as mobility, load of the network, diameter of the network, a protocol may give better performance than others.

Nowadays in MANETs, network hosts work in group to carry out a given task, therefore, multicasting plays an important role in MANETs. Multicast routing

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protocols in MANETs include CAMP [6], AMRoute [1], AMRIS [13], and ODMRP [8]. Among these, ODMRP is considered a superior one. It is a mesh-based protocol instead of a tree-based. To establish a mesh for each multicast group, ODMRP employs the concept of forwarding groups [4]. However it does not support quality of service.

QoS is usually defined as a set of service requirements that need to be met by a network while transporting packets from a source application to their destinations. The network needs are governed by the service requirements of end user applications. A network is expected to guarantee a set of measurable prespecified service attributes to applications in terms of end-to-end performance, such as delay, bandwidth and jitter.

A few protocols have been developed for supporting QoS in MANETs. QoS-AODV [11] enables AODV routing decision based on QoS by adding an extension to messages during route discovery. QoS-Aware Routing protocol [3] considers bandwidth constraints for supporting real-time video or audio transmissions; focuses on exploring different ways to estimate available bandwidth; incorporating QoS into the route discovery procedure; and providing feedback to the application through a cross-layer design.

2 A Mesh-Based QoS Aware Multicast Routing Protocol (QMRP)

2.1 Multicast Mesh Creation

A multicast mesh is created when a source node needs to send data to receiver nodes. The source node broadcasts a RouteRequest packet as shown in Fig. 1. A combination of source address, sequence number and multicast address uniquely identifies the RouteRequest packet. An intermediate node will not rebroadcast the RouteRequest packet if the RouteRequest packet has the same source address, sequence number and multicast address as what it has received before by consulting its RouteRequest cache. When an intermediate node receives a RouteRequest packet, it updates its local RouteRequest cache and increases the HopNumber field in the RouteRequest packet before rebroadcasting the packet.

Once a receiver node receives a RouteRequest packet, it updates its RouteRequest cache and broadcasts a RouteReply packet. If the upstream node receives a RouteReply packet, it will set the Forwarding Flag and Forwarding Timeout fields in Forwarding table, and rebroadcasts the RouteReply packet. An upstream node of a receiver node is a node that sends the RouteRequest packet to the receiver. Thus, when an upstream node of a receiver receives a RouteReply packet, its node address must be similar to the upstream node’s address in the RouteReply packet that the receiver sends (i.e., a reverse path). However, if a receiving node is not an upstream node, it will set the Neighbor Flag and Neighbor Timeout fields, but it will not rebroadcast the RouteReply packet. When the source node receives a RouteReply packet, a route has been established and is ready to deliver data.

A multicast mesh consists of source nodes, receiver nodes, forwarding nodes and links connecting them [7]. Two proposed alternatives for the processing at a receiver when it receives a RouteRequest packet are: