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Review of Various QoS Multiple Paths/trees Based Routing Protocols in Mobile Ad-hoc Network

Kadambri Agarwal[1] & D. K. Lobiyal[2]

[1]*RKGITW, Ghaziabad, India*

[2]*JNU, New Delhi, India*

E-mails: kadambri- _agarwal@rediffmail.com, dkl@mail.jnu.ac.in

Abstract: Mobile Ad-hoc Network (MANET) is a collection of mobile wireless nodes, in which the communication is carried out without any centralized control. MANET is a self organized, self configurable network having no infrastructure, and in which the mobile nodes move arbitrarily. Routing is a critical issue and an efficient routing protocol makes the MANET reliable. There are several routing protocols available and their performance comparisons are made by many researchers. In this paper, we presents a performance comparison of Qos multiple paths routing protocols based on metrics such as throughput, packet delivery ratio, average end-to-end delay and Jitter.

This paper provides an overview of these routing protocols by presenting their overview and then makes their comparative analysis to analyze their performance. The study will be useful to identify which protocol is best suited for MANET and how the performance of this protocol can be improved. In the future, MANET, the densest use with the increasing number of applications, therefore, the study will be of great interest to researchers get an idea of the protocol should be considered in environments of small/dense medium for efficient and stable routing.

Keywords: MANET, Routing protocols, Performance metrics.

1. INTRODUCTION

A mobile Ad-Hoc network (MANET) is networks of mobile nodes that communicate through wireless links without the use of any existing network infrastructure or centralized administration [1-12]. The most important features of MANET are self configuration, self-creation and self administration [1]. Each node can work as a host or a router and is responsible for forwarding messages for its neighbor. Typical application areas include battlefield, emergence search rescue sites, and data acquisition in remote areas.

Multicast communication refer to simultaneously sending the same message from a source to agroup of destination. The Qos routing is needed in multimedia group meeting or real time multimedia dissemination.

Qos Multiple Tree based routing is to find a tree rooted from the source node and spanning to all destination nodes and every path from the source to the destination satisfies the Qos requirement.

Quality of service is more difficult to guarantee in ad-hoc network than in most other type of network, because the network topology keeps on changing.QoS needs a set of service requirement to be met by the network while transporting a packet stream from source to destination. The ability to provide QoS is heavily dependent on how well the resources are managed at the Mac layer. Among the QoS routing protocols proposed so far, some use generic Qos measures and are not tuned to a particular MAC layer [2,6]. Some use CDMA to eliminate the interference between different transmission. In some protocols TDMA have been used.

The rest of this paper is organized as follows: in section 2, performance metrics for multiple path routing protocols are presented. Various related work proposed in past and five QoS multicast routing protocols are studied in section 3, a comparison and evaluation of studied protocols are made in section4 finally section5 includes conclusion and suggestion.

2. PERFORMANCE METRICS OF ROUTING PROTOCOL IN AD-HOC NETWORK

Generally, there are four main metrics presented as parameter of QOS [9] which are reliability, delay, jitter and bandwidth. Performance matrices are classified to qualitative and quantitative which are listed in Table 1.

Table 1
Routing Protocol Performance Issues

Qualitative metrics	*Quantitative metrics*
Delay	Distributed operation
Throughput	Loop-freedom
Efficiency	On-demand/ Proactive
Overhead	Security
Out of order delivery	Unidirectional link support
Sleep period operation	

3. RELATED WORK

Routing protocols could be classified according to different aspects .They can be classified into three groups with respect how they manage their routing information.

Proactive-In this routing table is maintained at every node. In this method routes to all destination are determined at the start and maintained by using periodic route update Example optimized link state routing (OLSR), topology based reverse path forwarding (TBRPF), Ad-HOC multicast routing protocol (AMRoute), Forwarding group multicast protocol (FGMP), and multicast core extraction distributed Ad-Hoc Routing Reactive(on-demand – In this route is determined whenever it is required This method do not require the maintenance of the network topology when there is no traffic. Example Ad-Hoc on demand distance vector (AODV),dynamic source routing (DSR), on-demand multicast routing protocol and the Multicast Ad-Hoc on-demand distance vector (MAOV).

Hybrid-It uses both proactive and reactive methods. Example ZRP(Zone routing protocol), Zone-based Hierarchical Link State routing (ZHLS) and Hybrid Ad hoc Routing Protocol (HARP) will be discussed and analyzed.

Routing protocols may use a flat or hierarchical structure to store the network topology. In flat structure, all nodes are assumed to be at the same level. But in hierarchical model nodes are clustered into domain. Clustering reduces cost in ad-hoc network.

AMRoute is based on user multicast trees and dynamic cores. Data is distributed using a bidirectional shared tree where only the group senders and receivers can be tree nodes. It creates a bidirectional shared-tree for data distribution using only the group senders and receivers as tree nodes. Unicast tunnels are used as the tree links to connect neighbors on the' user-multicast tree.' Thus, AMRoute does not need to be supported by network nodes that are not interested.

FGMP combines shortest tree multicasting and flooding. There is one forwarding group for each multicast group. MCEDAR is a multicast extension to CEDAR architecture. Its main idea is to provide the efficiency of the tree based forwarding protocols and robustness of mesh based protocols by combining these two approaches. ODMRP is mesh based protocol which uses forwarding group concept (only a subset of nodes forwards the multicast packets). In ODMRP, group membership and multicast routes are established and updated by on demand. MAODV follows directly from unicast AODV, and discovers multicast routes on demand by using a broadcast route discovery mechanism employing the same route request and route reply messages that exists in unicast AODV protocol.ZRP limits the scope of the proactive procedure only to the node's local neighborhood .On the other hand, the reactive global search is done efficiently by querying only selected nodes in the network, as opposed to querying all the nodes.

Various multipath protocols for MANET have been proposed in [2-6]. The Lantern tree based QoS multicast protocol [2] first searches for lantern path and then merges them together to construct lantern tree.

In LTM, the main metric to provide QoS is bandwidth. It has been assumed that MAC sub layer uses CDMA-over-TDMA channel. Each node obtains necessary information about its local link state in order to identify any free time slot between itself and its neighbors. In this way, it can calculate the amount of free bandwidth for each link. No one tree is used as a backbone and multiple paths are only considered between two –hop neighbor node.

Table 2
Summary Attributes of Protocols

Protocol	*Routing structure (H/F)*	*Protocol (S/C/M)*	*Group (P/R/H)*	*Use of residual bandwidth*
AM Route	H		P	yes
MCEDAR	F		P	yes
ODMRP			R	
ZRP	H		H	
LTM	F	S	R	Yes
Multipath/trees	F	S	R	Yes
AODV-br	F		R	
SPREAD				
RoMR				
ODQMM	F	C	R	No

Routing structure (H:hierarchial, F: flat), Protocol (S: sublayer, C: complete, M: multilayer) group (P: proactive, R: reactive, H: hybrid).

Table 3
Comparison with Respect to Qos Metric

Protocol	*BW*	*Delay*	*Jitter*	*Overhead*	*Security*
AMRoute	+				
MCEDAR					
ODMRP					
ZRP					
LTM	+	+	*	+	–
Mutipath/trees	+	*	*	–	–
AODV-br					
SPREA					
DODQMM	+	*	*	*	–

+ : metrics which are observed explicitly in designing the protocol,* : metrics which are observed implicitly. : metrics which are not observed in designing the protocol.

Multipaths/trees (multiple paths/ trees) [3,5] Like LTM, this method tries to establish multipaths among nodes of multicast tree or establish multi trees among nodes of a multicast session to provide the required bandwidth for most

of sessions and as a result it reduces call blocking. Three algorithms namely SPTM (shortest path tree-based multiple paths), LCTM (least cost tree-based multiple paths) and MLCT (multiple least cost tree) are proposed to establish the suboptimal trees. Success ratio and metric cost are two metrics used for evaluation of this protocol.

The AODV-br protocol [4] is a backup routing protocol for the purpose of failure recovery and the split multipath routing is only for unicast. SPREAD protocol uses multiple paths to deliver multiple secret messages shares in order to enhance the data confidentiality. Few other protocols that uses multiple tree methods are Robust multicast routing protocol (ROMR) that builds multiple reliable multicast trees that adapt to topology changesin dynamic fashion.

ODMQM (on-demand QoS multicast routing and reservation for MANETs [8] protocol, is an improved version of MAODV, tries to integrate bandwidth reservation into a unicast or multicast routing protocols. The key feature of this protocol is that bandwidth reservation is done based on QoS requirements with one of two reservation styles: fixed filter (FF) or shared-bandwidth filter (SB). In FF, a distinct reservation is made out of each source, so FF is suitable for different applications such as video streaming. In SB, a single reservation is shared by flows within all senders at the same session, so it can be used in cases like audio conferencing. If those data which must be sent are not sensitive to QoS parameters, then it can be sent with a best effort (BE) manner.

4. EVALUATION AND COMPARISON

As we mentioned earlier, protocols can be classified with respect to the range of their operation into three groups: complete, multilayer and sulayer. Most of the protocol use reactive scheme to maintain their routing table. The following tables show a brief summary of this study. In Table 2, features of protocols Have been listed and in Table 3, protocols are compared with respect to QoS metrics. The proposed evaluation in Table 3 is concluded from the general approach and their method. It can be concluded that bandwidth is common criteria of concern for all the methods.

5. CONCLUSION AND SUGGESTION

In this paper, operation of five types of Qos multcast routing protocols for hybrid network have been studied. Each method has considered some of the QoS metrics. The bandwidth criteria have been concerned in all methods, whereas the techniques of providing them might be different. Because most of protocols have been designed for Medium network sizes, they have a flat structure and operate on demand on request to guarantee the quality of services, use of Artificial intelligence can be appropriate method to provide required bandwidth for various services. Moreover as most of the protocols studied above do not concern about the cost optimization as bandwidth is common criteria of concern. In hybrid network cost can be optimized using heuristic search where each node can maintain the list of its antecedent and descendents using minimal spanning tree approach. This is by utilizing a spanning tree from access point to all other nodes in its transitive transmission range.

Although the above studied method are quite flexible as compare to hierarchical method , the scalability of these protocols is not very reliable .In large networks use of hierarchical method can result in better performance than flat method.

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