Performance of MAODV and ODMRP Routing Protocol for Group Communication in Mobile Ad Hoc Network

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Abstract

A MANET is a self-conFigureuring system of mobile hosts connected by wireless links. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Routing is the process of exchanging information from one station to the other stations of the network. Multicasting is a popular mechanism for supporting group communication. In a multicast session, the sender transmits only one copy of each message that is replicated within the network and delivered to multiple recipients. This multicast routing is highly deal with self-organized network in recent days due to its broadcast characteristics. However, devising multicast protocols to provide group communications in mobile ad-hoc networks is significantly more complicated, because of the wireless medium, changing topology, battery power and available bandwidth as well. This paper, evaluates two prominent on-demand multicast routing protocols for group communication, namely, Multicast Ad hoc On-Demand Distance Vector (MAODV) and On-Demand Multicast Routing Protocol(ODMRP) as increasing number of multicast sources and receivers in both single-active multicast group and multi-active multicast group in the network.

Keywords: Ad hoc Networks; Multicasting; MAODV; ODMRP; Network Simulator (NS2)

1.Introduction

A MANET is an autonomous system of mobile routers connected by wireless links. These routers are free to move randomly and organize themselves arbitrarily; thus, the networks wireless topology may change rapidly and unpredictably. Routing is an essential component of communication networks, which defines act of moving information from source node(s) to destination node(s) in an inter network [3]. Generally, ad hoc networks nodes can communicate directly, if they are within the transmission range. Else, they communicate through their relay nodes[11]. Multicast is a type of routing scheme, which transmit datagram's to a set of desirable destinations identified by a single address [4]. In ad hoc networks, multicasting plays an important role due to its broadcast characteristics. However, multicast is hard in wired networks, and is even more challenging in ad hoc networks due to the dynamic topology, limited wireless network bandwidth and energy resources. In ad hoc networks, multicast support several envisioned advanced applications such as military operations (formations of soldiers, tanks, planes), civil applications (e.g. audio and video conferencing, sport events, telematics applications (traffic)), disaster situations (e.g. emergency and rescue operations, national crises, earthquakes, fires, floods), and integration with cellular systems[6]. Based on the topology the ad hoc multicast routing protocols are classified into two categories i.tree based ii.mesh based. The tree based routing scheme has only one path between the source to receiver. But, the mesh-based routing scheme has multiple redundant paths between the sources to receivers. Based on the ad hoc routing information update mechanism (routing scheme) multicast routing protocols are classified into three categories [4]. i. Proactive ii. Reactive and iii. Hybrid. The proactive protocol also called table-driven in which nodes are continuously evaluate routes to all reachable nodes and attempt to maintain consistent, up-to-date routing

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information. The reactive protocol also called on-demand routing since they don't maintain routing information or routing activity at the network nodes if there is no communication. The hybrid routing protocols is the advantage of both proactive and reactive routing protocols to balance the delay and control overhead. In this paper, we present a performance comparison of two on-demand multicast routing protocols, namely, Multicast Ad-hoc On-demand Distance Vector (MAODV) and On-Demand Multicast Routing Protocol (ODMRP) as increasing multicast groups and that sources or receivers. The reminder of this paper is organized as follows. Chapter 2 describes the related work for this paper. Chapter 3 presents the brief overviews of the operation of MAODV and ODMRP routing protocols. The chapter 4 has methodology and simulation environment. The chapter 5 deals with results and discussion and conclusion is in 6.

2. Related Work

Lee et al., [10] compare the performance of ODMRP, CAMP, AMRoute and AMRIS. Their simulations are based on 50-node networks with a variable number of multicast senders and receivers in single multicast group. Pandi Selvam et al., [11] compare the performance of MAODV and ODMRP with 200 nodes. Where, sources are varied 1-15 and receivers are varied 10-50 in single active multicast group. Aparna K [12] compare the performance of ODMRP,AMRIS and MAODV as increasing multicast sources or receivers and number of nodes in single group. B.Ravi Prasad et al.,[13] present an evaluation of four different routing protocols with 50 nodes to prove the delivery ratio and efficiency. Similarly, in recent years there are so many research works which have shown a number of routing protocols for ad-hoc networks [1-5].

3. Protocol Descriptions

MAODV [7] routing protocol is a hard state reactive tree based routing and it discovers multicast routes on demand using a broadcast route-discovery mechanism. A mobile node originates a route request (RREQ) message when it wishes to join a multicast group or when it has data to send to a multicast group. The ODMRP [8] is a soft state reactive mesh based and uses a forwarding group concept i.e. only a subset of nodes forwards the multicast packets. In ODMRP multicast group members are maintaining as soft state approach, No explicit control message is required to leave the group, and group membership and multicast routes are established and updated by the source on demand. As comparison observation, both the routing protocols have some salient characteristics. In particular both are use on-demand (only in the presence of data packets is needed) route discovery but with different mechanisms. However, there are several important differences between in considered routing protocols.

- MAODV uses shared bi-directional multicast tree while ODMRP uses a source based mesh topology.
- MAODV does not active a multicast route immediately but ODMRP does immediately.
- ODMRP broadcasts the reply back to the source when MAODV unicasts the reply back to the source.
- MAODV sends control messages to repair broken links and to manage network partitions. ODMRP uses a soft state approach and routes are periodically refreshed by the source node.
- MAODV uses a multicast group leader to maintain up-to-date multicast tree information but in ODMRP source nodes periodically send route request messages to refresh the multicast mesh.

Table 1: Comparison of MAODV and ODMRP

Characteristics	MAODV	ODMRP
Multicast Delivery Structure	Tree	Mesh
Routing info acquirement /maintenance	Reactive	Reactive
Loop free	Yes	Yes
Dependency on unicast routing	Yes	No

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protocol		
Control packet flooding	Yes	Yes
Periodic messages requirement	No	Yes
Routing hierarchy	Flat	Flat
Scalability	Fair	Fair

4.Methodology

4.1 Simulation Environment

We run several simulations of these designed routing protocols in NS2 version ns-allinone-2.26 under the Linux Red Hat 9.0 operating system. NS2, is an open-source event driven simulation tool which is used to simulate the wired as well as wireless network functions and protocols e.g., routing algorithms, TCP, UDP. The [14,15,16,17] were mainly used for this routing protocol implementation. The simulation environment is composed of:

Table 2: Simulation Environment

Area	1500 × 1500 m
Transmission Range	500 m
Number of Nodes	200
Physical/Mac Layer	IEEE 802.11 at 2Mbps
Mobility Model	Random waypoint model with no pause time
Maximum mobility Speed	10 m/s
Simulation Duration	500sec
Pause Time	0
Packet Size	512 bytes
Traffic Type	CBR (Constant Bit Rate)
Number of Packets	5/sec
Number of Multicast Sources	1×1×10, 1×5×10 and 1×10×10
	3×1×10, 3×5×10 and 3×10×10
Number of Multicast Receivers	1×1×5, 1×1×10 and 1×1×15
	2×3×5, 2×3×10 and 2×3×15
Number of Simulation	20

4.2 Performance Metrics

- **Packet Delivery Ratio**
  It is defined as the ratio of number of data packets delivered to the multicast receivers and number of data packets to be received by the receivers of multicast group.
- **Control Overhead**
  The total number of control packets originated and forwarded by the protocol.
- **Forwarding Efficiency**
  This defines the number of data packets delivered to multicast receivers over the number of total data packets forwarded in the multicast group.

4.3 Network Parameters

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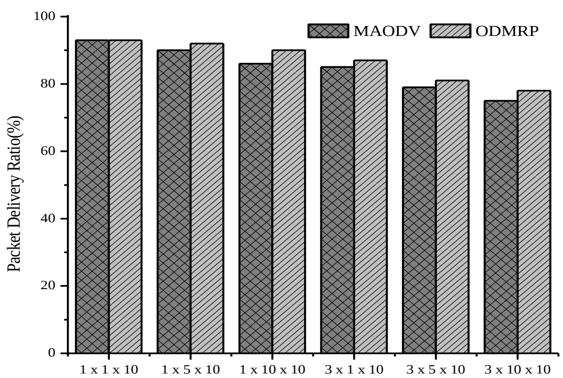
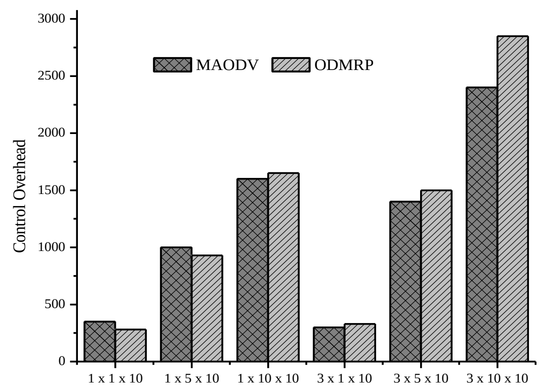
The set of experiments was designed to explore the effect on routing protocol performance of the number of sources and receivers within a multicast group. Hence, we use the notation G x S x D, where G is number of multicast groups, S is number of multicast sources and D is number of multicast receivers. We used three single source and three multi-source, multi-group scenarios. In which the number of sources are progressively increased: 1×1×10, 1×5×10, 1×10×10 and 3×1×10, 3×5×10, 3×10×10. And, numbers of receivers are increased: 1×1×5, 1×1×10, 1×1×15 and 2×3×5, 2×3×10, 2×3×15.

5.Results and Discussion

This section contains two set of results, one for increasing sources and another one for increasing receivers as varying multicast groups.





Figureure 1: Packet Delivery Ratio with increasing sources Figure 2 : Control Overhead with increasing sources

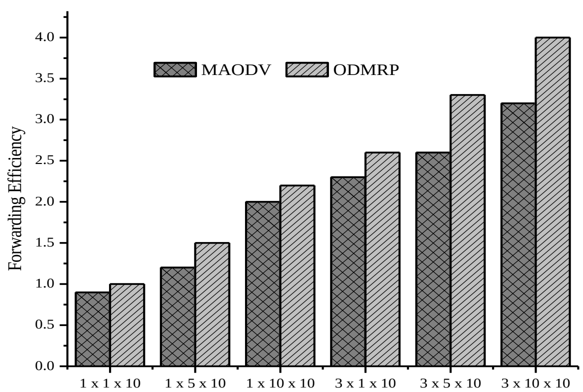


Figure 3: Forwarding Efficiency with increasing sources

Figure. 1 proves that the packet delivery ratio as the function of increasing multicast groups and those sources which proves ODMRP achieves better delivery ratio while MAODV decreases. In the multi-source scenarios, delivery ratio is decreases due to increased congestion and packet loss of the protocol. Figure.2 shows the control overhead of both MAODV and ODMRP, which shows when the number of sources are minimum the MAODV generates higher overhead than ODMRP. However, MAODV maintain that control overhead while ODMRP increases. This is more noticeable because of that periodic control packet request and response initiation. Figure.3 shows the forwarding efficiency, which proves as the number of sources small both are achieve almost equal efficiency. However, in the multi-source scenarios, ODMRP achieves better efficiency than MAODV because of that topology and immediate multicast route activation and refreshment.

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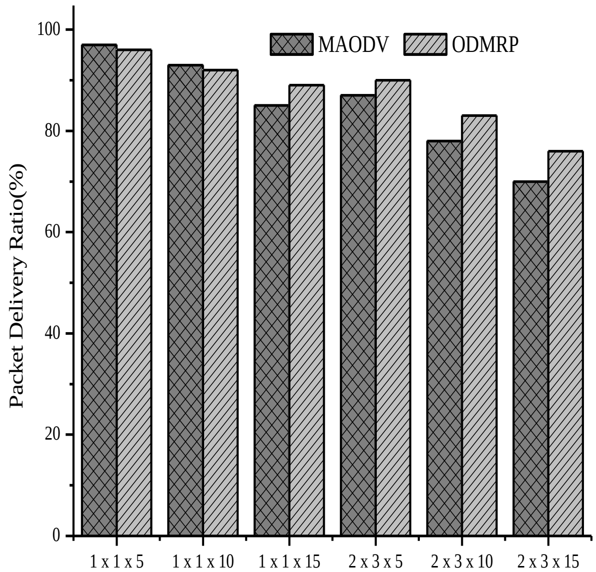

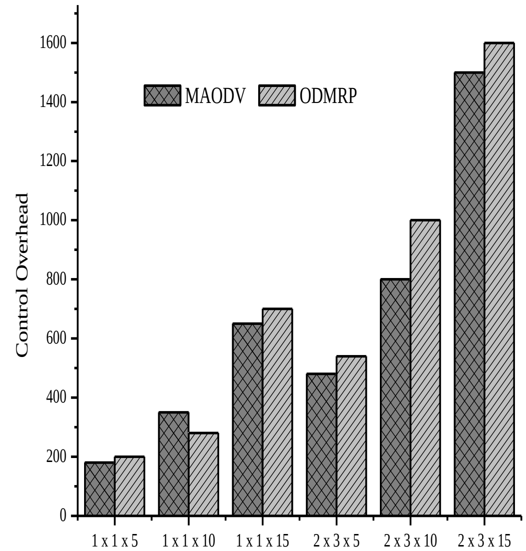

Figure 4: Packet Delivery Ratio with increasing Receivers Figure 5: Control Overhead with increasing Receivers

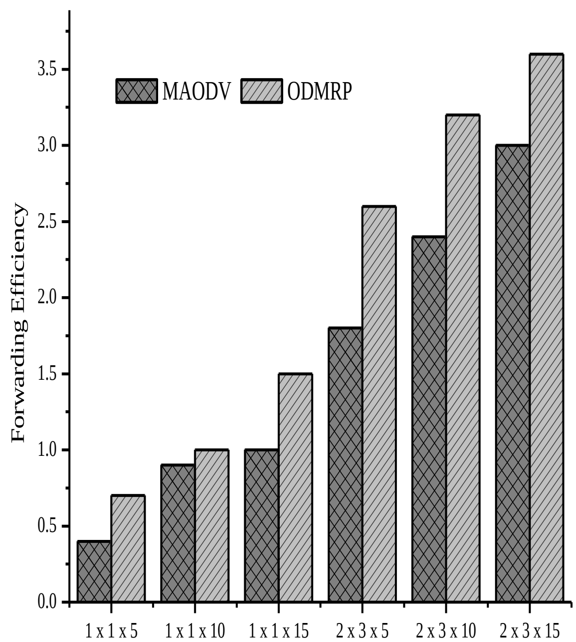

Figure 6: Forwarding Efficiency with increasing Receivers

Figure.4 proves that the packet delivery ratio as the function of increasing multicast groups and those receivers. In the single-source scenarios, both are have high packet delivery ratio and deliver almost equal number of packets. In the multi-source scenarios, delivery ratio is decreases due to network load, congestion and collision. However, ODMRP achieves better delivery ratio while MAODV decreases. This decrease is more noticeable for MAODV due to that longer data forwarding paths. Figure.5 shows the control overhead of MAODV and ODMRP. In single group

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MAODV generates higher overhead than ODMRP due to that periodic group leader floods. However, the ODMRP overhead is high because of that periodic source floods and that responses when there are more groups and receivers in the network. Figure.6 shows the forwarding efficiency, which proves ODMRP, achieves better efficiency than MAODV because of that topology and immediate multicast route activation and refreshment.

6.Conclusion

In this paper, we presented the performance evaluation of MAODV and ODMRP routing protocols for providing group communication as increasing sources and receivers in different multicast groups . The results shown that ODMRP out performs MAODV in terms of packet delivery ratio. However, ODMRP suffers from scalability issues as the number of sources and receivers increasing in the multicast group. Therefore, ODMRP have to orginates higher control messages than MAODV in both scenarios. Even though, ODMRP achieves better efficiency than MAODV due to that immediate route activation process.

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