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Performance Evaluation of Various Multicast Routing Protocols in Mobile Ad-hoc Network

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Abstract— MANETs is the abbreviation for mobile adhoc networks, play an important role in communications where topology and protocols changes frequently. To maintain the data delivery structure, robustness, etc multicast routing protocol categorized into two parts: tree-based and mesh based. Tree-based protocols have forwarding efficiency and low consumptions of bandwidth while mesh based protocols have high robustness for the links failure to provide alternate path. So to know in deep about the multicast routing protocols there is a need of comparison and implementation of them. In this paper, we study and compare the performance of four multicast routing protocol like ODMRP, PIM, MOSPF and DVMRP based on the different input parameters. Simulation results show that ODMRP achieve high packet delivery ratio, high throughput, low end-to-end delay for packet delivery that other protocols.

Keywords— MANET, wireless network, multicasting routing, ODMRP, MOSPF, PIM, DVMRP

I. INTRODUCTION

A Mobile network is one of the most effective public adhoc network. The main properties of this network are the mobility of nodes along with decentralized system. It means, the mobile nodes can move over the network perform the communication by using the intermediate nodes. This kind of network involves the mobile devices such as laptop, mobile phones, PDA etc. Each node of network behaves like a host or server or the router. The nodes are able to take the routing decisions without generating the specific communication network [8]. Multicasting is a mechanism for communication in which data is transmitted over the network from sender to many receivers (i.e. multicasting satisfies the one to many relationships). In the multicasting there is no confinement to join or leave the group. Any sender or receiver can left the network any time according to the rule of protocols. To multicast the data Class D IP addresses are used as multicast IP addresses. Unlike the broadcasting, multicast nodes receive the stream of packets only if they have elected for this work i.e. it is mandatory to be a member of multicast group. Membership of a group can be achieve either by sending the join request or by sending the data if any node have.

MANETS:

A Mobile Network is a globalize public network with large number of mobile users so that the bandwidth communication analysis over the network will be performed. Mobile network performs the communication without the presence of a centralized controller. The absence of this controller enables the network to perform the multi-hop communication cooperatively. To provide such communication there is the requirement to generate optimized communication path. MANET is also having its significance in indoor and outdoor forms. There are different technologies and protocols that increase the strengths of network under different scenarios and specifications.

II. MULTICAST PROTOCOLS OVERVIEW

Most applications in the MANET [3] are based upon unicast communication. Thus, the most basic operation in the IP layer of the MANET is to successfully transmit data packets from one source to one destination. The forwarding procedure is very simple in itself. In light of the importance of multicasting that provides a high packet delivery ratio even in extreme conditions (e.g., high mobility and high traffic load). It is equally important for such protocols to have a low overhead, because bandwidth and battery power are extremely precious in these kinds of networks, it is necessary to focus on the development of multicasting protocols which provide a high packet delivery ratio and low overhead in a wide range of simulation scenarios. In this paper, the approaches taken for evaluating the performance of Four popular multicast routing protocol (DVMRP,ODMRP,PIM,MOSPF)

ODMRP:

The On-Demand Multicast Routing Protocol is on-demand mesh topology based protocol where a mesh is formed by a group of nodes known as forwarding nodes which are used to send data packets from hop to hop. These nodes keep a message cache which helps in the detection of duplicate data and control packets. To create the mesh phase between the source and receivers, a JoinReq control packet is flooded by the sender periodically. The receivers give response to the

request by sending a Join Reply through the reverse path. Many join reply can be send by the receivers but source will take only which shortest timer value and shortest path. Each intermediate node that receives the JoinReq packet stores the Identity of upstream node before broadcasting the packet again. The Join Reply packet comprises the Source Id and the Next Node ID. An intermediate node on the receipt of a Join Reply packet sets a forwarding flag (FG) to become a member of the forwarding group.

Multicast Open Shortest Path First (MOSPF):

MOSPF protocol is a multicast overcome of OSPF (Open Shortest Path First) protocol to provide efficacious multicasting over a network. It provides the facility to forward multicast datagrams from one network to another. It forwards a multicast datagram on the basis of both source and destination address of the datagram. MOSPF constructs a distribution tree for each pair of source-group and computes a tree for active sources sending for group. when a link state change happens or when the cache has rancid data then the tree state is cached, and trees must be calculated again. IGMP (internet group management protocol) is used in MOSPF routers to identify membership in multicast group by broadcasting IGMP Host Membership Queries and receiving IGMP Host Membership Report. The group information is then transmitted in the network by flooding of OSPF link state advertisements (LSA). In this protocol source is the root and multicast receivers are the terminal nodes and this group information is used by the routers to build the shortest path tree where

Protocol Independent Multicast (PIM):

PIM comprise a group of multicast Routing protocols each of which is devoted for a different working environment. They are: PIM Sparse Mode (PIM-SM), PIM Dense Mode (PIM-DM), PIM source specific mul-ticast (PIM-SSM) and Bidirectional PIM. In sparse mode a few receivers are present while in the dense mode receivers are at most of the locations. In sparse groups [11], join request sent by the receiver, a receiver who wants to join the group is required to transmit a specific join request message to a different RP (Rendezvous Point) which is selected on the basis of address of the multicast group. Routers use PIM Prune and Join messages to leave and join multicast trees. By default PIM-SM follows the approach of shared trees, which are multicast distribution trees rooted at a selected node knows as Rendezvous Point and is used by all sources sending for that multicast group. In dense mode, Broadcasting is done by source node. If a node does not want to receive messages then it will send prune message to the router for that group. In this protocol loops are check by the Reverse-path forwarding techniques among routers. Periodically messages are sent by the routers to refresh the state information.. No explicit teardown mechanism is needed to remove states when a group ceases to exist.

Distance vector multicast routing protocol (DVMRP):

DVMRP uses flooding and pruning to build the multicast tree. The routers in the leaf subnets have group membership information. When a router receives a flooded packet, it knows whether that packet will be useful for its subnet or not. In case there is no group member on the subnet, the leaf router sends a prune message to its neighboring routers. In addition to, a leaf router can send a prune message through all interfaces except for the one on the reverse shortest path to the sender. When an intermediate router receives prune messages from all interfaces except for the reverse shortest path interface, it forwards the prune message upstream. This way, the unwanted branches of the spanning tree get pruned off. When a router sends a prune message, it maintains information about the (Source, Group) pair for which the prune message was sent. This state is used to prevent propagation of the data packets when they arrive at those routers.

III. PERFORMANCE EVALUATION AND COMPARISON

Scenario's Discussion:

In each scenario we have taken different number of nodes like 10, 20, 30 and 40. And for each scenario we have outputs parameter results for each routing protocols and have calculated the average of each parameter and have made a separate table for each output parameter which we will discuss later. Firstly we will discuss the output results. For the sake of convenience here we have shown output results of just one routing protocol that is DVMRP in each particular scenario.

3.1 SCENARIO 1:

Table 1: Scenario configuration

Parameters	**Value**
Simulation Tool	Qual net Network Simulator
Protocols Used	DVMRP.MOSPF,ODMRP,PIM
No of Nodes	10
Topography Dimension	1500 m x 1500 m
Traffic Type	MCBR (Multicast Constant Bit Rate)
Topology	Random
No of Packets Send	100
Packets Size	512 Bytes

Application Layer Performance Metrics:

1. Average End to End Delay:

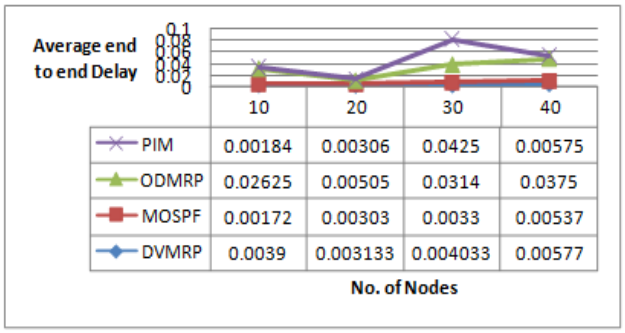


Figure 1: Performance of Routing Protocols for Average End to End Delay

From the figure we can see that performance of ODMRP is better than other routing protocols in case of Average End to End Delay. From this figure we can see that performance of ODMRP is better than other routing protocols in case of Average End to End Delay. This simulation experiment showed us that PIM, MOSPF and DVMRP protocols are having higher end to end delays than ODMRP, indicating that the speed of simulation in large scale networks will be affected by this. This analysis exclusively deals with the network speed and communication effectiveness. Higher the delay, lower is the speed and possibility of packet drop and so needs the fault tolerance approach of selecting these protocols.

2.Multicast Received Throughput (bits/second):

Throughput is the rate of successful message delivery over a communication channel.

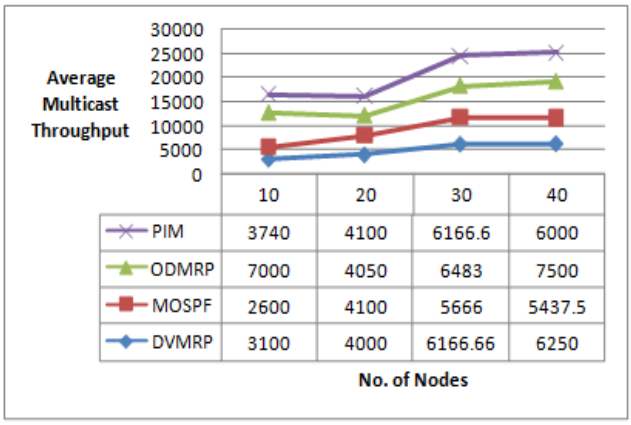


Figure 2: Performance of Routing Protocols for Multicast received Throughput

As the figure shows that throughput at the 10 nodes is maximum of ODMRP,but somes times it may be less like for 20 nodes because network range can be more in this case than other or topology can be differ from other protocols.From the figure we can see that overall performance of ODMRP throughput is better than other routing protocols in case of Multicast Received Throughput.

3. Average Multicast Jitter (seconds):

Time difference in packet inters arrival time to their destinations known as jitter time. TCP/IP is responsible for dealing with the jitter impact on communication problems. When a sender is sending packets at normal interval those packets can collide anywhere in the network and not arrive at the expected regular pace to the destined station. So we can say that expectation of packet to be its destination than in reality is jitter.

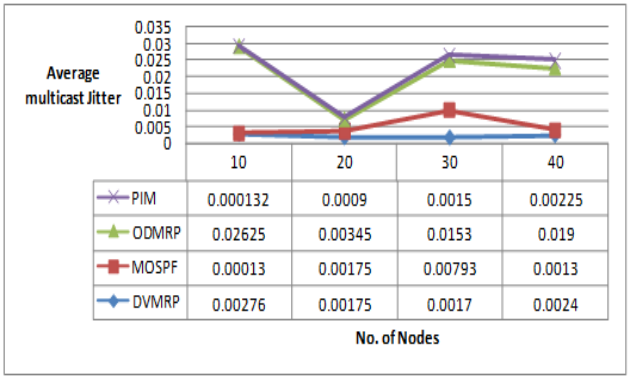
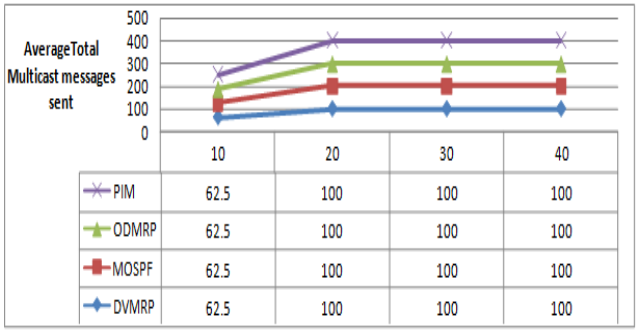


Figure 3 Performance of Routing Protocols for Average multicast Jitter

From figure we can see performance of PIM is better than other routing protocols in case of Average multicast Jitter.

4. Average Total multicast message sent:

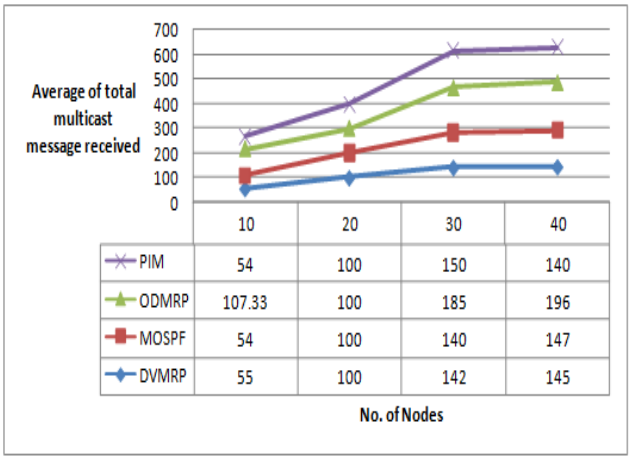


	10	20	30	40
PIM	62.5	100	100	100
ODMRP	62.5	100	100	100
MOSPF	62.5	100	100	100
DVMRP	62.5	100	100	100

Figure 4: Performance of Routing Protocols for Average Total Multicast Message sent

From figure we can see that performance of All is same as other routing protocols in case of Total Multicast Messages sent.

5. Average Total Multicast message received:



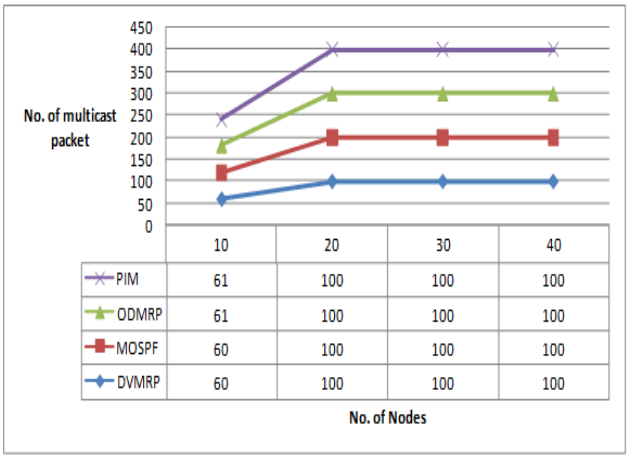
	10	20	30	40
PIM	54	100	150	140
ODMRP	107.33	100	185	196
MOSPF	54	100	140	147
DVMRP	55	100	142	145

No. of Nodes

Figure 5: Performance of Routing Protocols for Avg. Total multicast message received

From figure we can see that performance of ODMRP is better than other routing protocols in case of Average Total multicast message received.

6. Multicast packet sent as data source:



	10	20	30	40
PIM	61	100	100	100
ODMRP	61	100	100	100
MOSPF	60	100	100	100
DVMRP	60	100	100	100

No. of Nodes

Figure 6 Average of total multicast packet sent

Figure 6 shows the Multicast packet sent as data source at the network layer. All protocol send the packet 60-100 on average. The packet sending ratio is less because of mobile range. If we decrease the terrain size from 1500*1500 to 100*100 then it will immediately remove.

7. Total Multicast packet received:

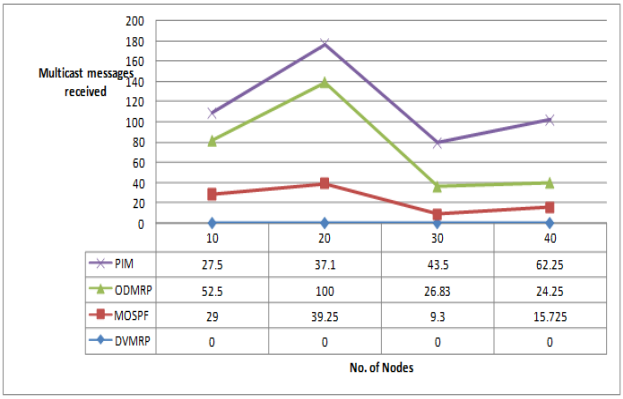


Figure 7 Average of Total multicast packet received

Figure 7 describes the average of total multicast message received from different nodes to the particular nodes (either source or intermediate). As shown in the figure all values of DVMRP protocol are Zero at different nodes because multicast message received formula is not applicable on it. As the diagram shows the PIM multicast routing protocol is performing best among all protocol given in the figure.

IV. CONCLUSIONS

In this paper we have studied MANETs, its properties and challenges of finding an efficient routing protocol for a particular network situation. In our dissertation various routing protocols- reactive, proactive and hybrid are studied and each of the algorithm is explained how they work using diagrams. We perform the analysis of some important tree, mesh and shared routing protocols is done using QualNet Network Simulator and through output graphs we get to know how efficient a routing protocol is performing in particular scenario. The graph we produced here using QulaNet show the various performance matrices – throughput, end to end delay, jitter, packets forwarded, packets received, packets dropped for no route etc. From the simulation results we get to know that each protocol performs well in some scenario yet has some drawbacks in other cases. In terms of throughput ODMRP performance is better than others whereas PIM performs poorly sometimes. Another disadvantage of MOSPF is that number of packets dropped is also significant higher. ODMRP throughput does not change even with change in increase in no. of nodes because of its mesh base nature. The performance of DVMRP is good in term of routing overhead and number of packet dropped due to no route availability. It can be concluded from the simulation results that the reliability of ODMRP and DVMRP protocols is better than other two protocols.

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