Performance Analysis of DSDV and MDSDV Routing Protocol in MANET Scenario

Arpita Mahajan[1] Prashant Bhati[2]
[1]M Tech Student[2]Assistance Professor and H.O.D
[1, 2] Patel college of science and technology, Indore, Department of Electronics and Communication Engineering, Indore – 452001 (M.P.) India

Abstract—*The routing protocol should detect and maintain a good route(s) between source and destination nodes in these dynamic networks. Many routing protocols have been proposed for mobile ad hoc networks, and none can be considered as the best under all conditions. This paper consist a systematic comparative evaluation of a new multipath routing protocol for MANETS. The new protocol, called Multipath Destination Sequenced Distance Vector (MDSDV) is based on the wellknown single path Destination Sequenced Distance Vector (DSDV) is compared with known protocol DSDV. This work evaluates the protocols on a range of MANETS with between 50nodes, 75nodes and 100 nodes. The protocol comparison metrics are Packet Delivery Ratio (PDR), End to End Delay and Routing Overhead.*

Keywords: - *MANET, DSDV, MDSDV and Network Simulator - 2 (NS-2)*

I. INTRODUCTION

Ad-hoc network is characterized by multi-hop routing and dynamic topology. Transmission is highly affected by path loss and signal/channel fading [1]. In order to reduce routing overheads, on-demand routing protocols build and maintain only needed routes. In on-demand protocol, a route discovery process is initiated whenever a route is needed. High route discovery latency together with frequent route discovery attempts in dynamic networks can affect the performance adversely [2]. Multipath on-demand protocols try to alleviate these problems by computing multiple paths in a single route discovery attempt [3]. Multiple paths could be formed at both traffic sources as well as at intermediate nodes. New route discovery is needed only when all paths fail [4]. Mobile Ad Hoc Networks (MANETs) have gained an increasing significance. Ad Hoc networking is needed in many applications such as military and battlefield operations, virtual classrooms or conference rooms, and rescue operations in natural disasters. These kinds of applications require a network regardless of any infrastructure, and this is the idea behind MANETs which can be considered as flexible networks and suitable for such applications. MANETs are typically characterized by high mobility and frequent link failures that result in low throughput and high end-to-end delay. The increasing use of MANETs for transferring multimedia applications such as voice, video and data, leads to the need to provide QoS support.

A mobile ad-hoc network (MANET) is a group of wireless mobile nodes dynamically establishing a short live network without any use of network infrastructure or centralized administration. In addition to the high degree of mobility, MANET nodes are distinguished by their limited resources such as power, bandwidth, processing, and memory. If two mobile nodes need to communicate with each other, they can communicate directly if they are within the transmission range of each other, otherwise intermediate nodes (nodes in between) should forward the packet from one of them to the other. Thus, each node in the network acts both as a host and router and must therefore be willing to forward packets to other nodes. All nodes in mobile ad hoc networks are free to move, and the link between two nodes is broken when one of them moves out of other's transmission range, and hence the network topology may change frequently.

II. APPLICATIONS

Mobile ad-hoc networks are used in many applications, ranging from small, static networks, to large, highly dynamic networks such as virtual classrooms, conferencing, emergency services, and military applications.

Military applications: Mobile ad hoc networks satisfy several military needs such as battlefield survivability. In such environments, setting up of an infrastructure for communication between soldiers in battlefield could be impossible. The wireless devices carried by soldiers can form a mobile ad hoc network to support communication among them.

Conferencing: perhaps the prototypical application requiring the establishment of a mobile ad hoc network is mobile conferencing. One common use is to create a temporary network to support a meeting in a conference room.

Disaster relief operations: Each year natural disasters (e.g., earthquake, flood), destroy people's lives around the world. As the importance of the Internet grows, the loss of network connectivity during such disasters will be a more noticeable effect of the misfortune. So, it is important to find ways to enable the operations of networks even when infrastructure elements are disabled as a result of the disaster.

Personal area networks: The idea of a Personal Area Network (PAN) is to create a network that consists of nodes which are associated with a single person. These nodes may be placed in a person's clothes, belt or carried in handbags.

III. MANET ROUTING PROTOCOL

Routing is an important and challenging issue in dynamic multi-hop networks. Thus, many routing protocols algorithms have been proposed in recent years. A routing protocol is used to discover routes between nodes allowing communication within the network. The main goal of such a routing protocol is to establish a correct and efficient route between a pair of nodes, so that messages can reach their destination in a timely manner. During the last two decades, many mobile ad hoc network routing protocols have been proposed because of their importance in dynamic networks [4]. It is not possible to consider a particular algorithm or class as the best for all scenarios. Each protocol has its own advantages and disadvantages and may only be suited for certain situations [1]. Due to a variety of challenges, designing a mobile ad hoc network routing protocol is a tough task. Firstly, in mobile ad hoc networks, the topology changes frequently because of node mobility. Secondly packet losses may occur frequently because of the variable and unpredictable capacity of wireless links. Furthermore, the broadcast nature of the wireless medium introduces the hidden terminal and exposed terminal problems, mobile nodes have limited power, limited bandwidth resources and require effective routing schemes.

IV. PROACTIVE ROUTING PROTOCOLS

A proactive routing protocol is also called a "table driven" routing protocol. Using one of the proactive routing protocols, nodes in a mobile ad hoc network continuously evaluate routes to all reachable nodes and modify routing information. Thus, a source node can get a routing path immediately as soon as it needs one. In proactive routing protocols, each node maintains routing information to every node in the network. The routing information is stored in a number of tables. These tables are periodically updated and updated if there is a significant change in the network topology. The difference between existing proactive routing protocols lies in the way that the routing information is updated, and the type of information stored in each routing table. Moreover, each routing protocol may maintain a different number of tables. Several proactive routing protocols have been proposed, such as Destination Sequence Distance Vector (DSDV) [8].

V. DESTINATION SEQUENCED DISTANCE VECTOR (DSDV)

DSDV is a proactive routing protocol which maintains routes regardless of their usage. It is based on the Bellman-Ford routing algorithm, which can become unacceptable in mobile ad hoc networks because of its long convergence time. Numerous extensions or modifications to DSDV have been proposed to improve its performance such as [9] DSDV is a distance vector routing protocol and it solves the major problem associated with the Distance Vector routing of wired networks (i.e., Count-to-infinity), by using destination sequence numbers. Also, at all times, the DSDV protocol guarantees loop-free paths to each destination.

Using DSDV, each mobile node maintains a routing table that lists one route for each destination. Each routing table entry consists of the destination node, the first hop towards the destination, the metric (number of hops to reach the destination), and the sequence number which is originally generated by the destination node. Sequence numbers are used to distinguish the new routes from the stale routes. The routing table is used to transmit packets between the nodes of the network.

Multipath Destination Sequenced Distance Vector (MDSDV)

The majority of multipath ad hoc routing protocols are based on an on demand model, for example [30] so in this thesis we present a new proactive multipath routing protocol to investigate the strengths and weaknesses of this type of protocol. Providing multiple routes helps to keep the route recovery process short and control packet overhead. We believe utilizing multiple routes is beneficial in network communications, particularly in mobile wireless networks where routes are disconnected frequently because of mobility and poor wireless link quality. In this chapter, we develop a new table-driven multipath distance vector protocol for mobile ad-hoc networks. Specifically, we present multipath extensions to a well known single path routing protocol known as Destination Sequenced Distance Vector (DSDV). The resulting protocol is referred to as Multipath Destination Sequenced Distance Vector (MDSDV) which guarantees loop freedom and disjointness of alternative paths. MDSDV extends the DSDV protocol to store multiple node-disjoint paths for each destination in the network.

Two new fields called second hop and link id are added to the routing table. The link id is a unique number that is generated by the destination node. Both the second hop and link id are used to insure these paths are disjoint from any source to any destination. MDSDV employs a unique method for creating routing tables containing the best and disjoint paths to every destination.

VI. MDSDV PHASES OVERVIEW

There are 4 phases that describe the MDSDV routing protocol as follows. These phases are specified as pseudo code and illustrated by example in the following section.

Routing Initialization: This phase allows a new node to get multiple paths to each node in the entire network. As soon as a new node joins the network or a node becomes isolated, it broadcasts a Hello Message. Hello Messages are not forwarded. Any neighbor (any node in the transmission range of the new node) that receives the message responds by adding an entry in its NT showing the new node as a neighbor and adding an entry in its RT as a direct route to this new node. The Link id and Time fields are set to 0, whereas the Timeout field is set to a certain time, after adding a route, each neighbor unicasts a Full Dump of its routing table to the new node. On receiving a Full Dump from its neighbors, the new node starts to create its tables (Neighbors and Routing Tables). Afterwards, the new node selects the entries that have link ids equal to 0, assigns a new link id to each of them, and then initiates and broadcasts Update Messages to all neighbors to update their link ids where the link id is 0, and to get new routes to the new node's neighbors.

New Route Propagation: This phase describes how other nodes can discover multiple paths to the new node and also how other nodes get new paths that pass through the new node. The new node uses its NT to initiate and broadcast Update Packets to its neighbors. The number of Update Packets depends on the number of entries where the Flag field = 1

Note: the difference between the sequence number and the link id is that the sequence number is used to distinguish between fresh and stale routes in the same way as DSDV, whereas the link id is generated by a new node to distinguish between links to each one hop neighbor.

Route Maintenance: When a link failure occurs, as detected by no packets being received in an interval or by it failing to forward a packet, the node that detects the failure updates its routing table by deleting any entry that uses the unreachable node as a first hop. Next, it initiates and broadcasts an Error Packet to its neighbors. The Error Packet includes: Address of the node that detects the failure, the unreachable node address, and the link id between itself and the unreachable node. Any node that receives this Error Packet checks its routing table and deletes entries where the link id is equal to the link id that included in the Error packet. If the received node deletes any entry, it should rebroadcast the Error Packet. By this means, all nodes in the network delete the routes that are using the broken link.

If a source node uses a route with a broken link to send data, the intermediate node that discovers the link failure, selects an alternative route to forward the data. Next, it initiates and sends a Failure Packet to the source node to stop using the broken link. The node that detects the failure includes in the Failure Packet its address, the First Hop that the source node used to send the data, link id for the broken link, and the unreachable node address. Table shows the Error Packet structure and table shows the Failure Packet structure.

Data Forwarding: When a node has ready data to send; it searches for the best route to the destination and uses it to send its data. The node includes the second hop in the header of the packet to force the intermediate node to use the route where the second hop in the header of the data packet is the first hop in that route. As the intermediate node receives and plans to forward a data, it searches for a route to the destination via the second hop that is included in the data packet's header.

Note: The best route is the one that has the least number of hops. If two routes have the same number of hops, the one with highest sequence number is the best.

VII. Implementation & Results

We have implemented our work i.e. Creation of MANET Scenario for NS-2 and then to create Different routing protocols with the use of Various performance matrices Like Packet Delivery Ratio, End to End delay, Residual Energy, Routing overhead and Overall Throughput. In our case firstly we have created scenario file for IEEE 802.11 standard which has to be used along with our TCL Script than we have created a TCL script consist of various routing protocols in our case these are DSDV and MDSDV than a particular MANET scenario or topology in our case it consist of 50, 75 and 100 static nodes with 30sec simulation time.

In this section, three scenarios are described with two different protocols which are DSDV and MDSDV, presented in tabular form.

A. Simulation Parameter:-

Simulation Tool	NS-2.35
IEEE Scenario	802.11
Propagation	Two Ray Ground
Number of nodes	50, 75, 100 nodes
Traffic Type	TCP
Antenna	Omni directional antenna
MAC Type	IEEE 802.11
Routing Protocol	DSDV, MDSDV
Queue limit	50 Packets
Simulation area (in meter)	2 KM
Queue type	Droptail
Channel	Wireless Channel
Simulation time	30 sec.

B. Evolution of Results

For our work to be done successfully we have used MANET scenario with varying node density which are 50, 75 and 100 nodes and constant 30 sec under static scenario using various routing protocols. We have reached to the results with the help of various performance matrices for now we have used following performance matrices.

1. Packet Delivery Ratio
2. End to End Delay
3. Residual Energy
4. Throughput
5. Routing Overhead

A Detailed analysis of above mentioned matrices are

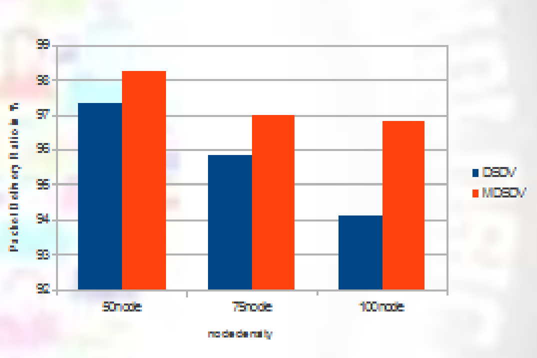

Fig. 1:

C. Packet Delivery Ratio

This is the fraction of the data packets generated by the CBR sources to those delivered to the destination. This evaluates the

D. Analysis of Packet Delivery Ratio:-

From the above figure we analyzed that the MDSDV routing protocol has better Packet Delivery Ratio as compare to the DSDV routing protocol for different node density scenario which are 50 nodes, 75 nodes and 100 nodes.

E. End to End Delay

This is the average delay between the sending of the data packet by the CBR source and its receipt at the corresponding CBR receiver. This includes all the delays caused during route acquisition, buffering and processing at intermediate nodes.

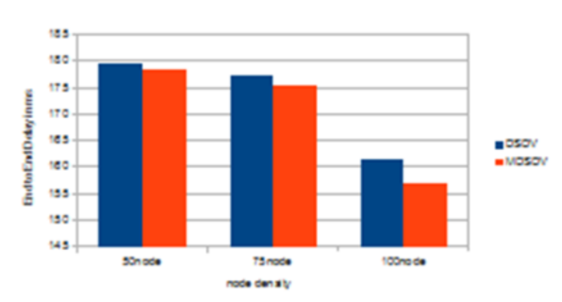

Fig. 2:

F. Analysis of End to End Delay:-

From the above figure we analyzed that the MDSDV routing protocol has less End to End Delay as compare to the DSDV routing protocol for different node density scenario which are 50 nodes, 75 nodes and 100 nodes.

G. Routing overload

This is the ratio of overhead bytes to the delivered data bytes. The transmission at each hop along the route is counted as one transmission in the calculation of this metric. The routing overhead of a simulation run is calculated as the number of routing bytes generated by the routing agent of all the nodes in the simulation run. This metric has a high value in secure protocols due to the hash value or signature stored in the packet

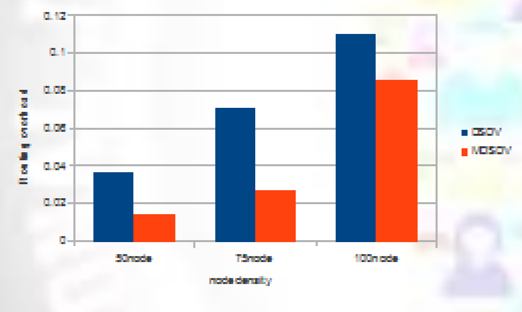

Fig. 3:

H. Analysis of Routing Overhead:-

From the above figure we analyzed that the MDSDV routing protocol has less Routing Overhead as compare to the DSDV routing protocol for different node density scenario which are 50 nodes, 75 nodes and 100 nodes.

VIII. Conclusion

In this work we analyzed all parameter which are Packet Delivery Ratio, End to End Delay, Routing Overhead and concluded that the MDSDV routing protocol is good as compare to the DSDV routing protocol for different node density which are 50 nodes, 75 nodes and 100 nodes with 30 sec simulation time for TCP traffic in IEEE 802.11 scenario with two ray ground propagation for Omni directional antenna.

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