Performance Analysis of Routing Protocol With Mobility Constraint

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ABSTRACT

Wireless Ad hoc networks have gained great importance due to unprecedented growth in wireless communication technologies. Mobile Ad hoc network (MANET) is an infrastructure less and decentralized network. In MANET, the challenges faced are due to shared nature of the wireless medium, limited transmission power & range, node mobility, battery life, bandwidth limitation etc. In recent years several protocols targeted at MANET are introduced to address above mentioned challenges. Prominent among them are DSDV, TORA, AODV, & DSR. This paper does the analysis of proactive and reactive protocols i.e. DSDV and AODV using NS2 simulator. The analysis suggests that DSDV protocol performs better in the small networks with less mobility of nodes. AODV is more adaptable to large scale networks.

Keywords

Routing protocols, NS2 Simulator, mobility

1. INTRODUCTION

Use of wireless technology is growing with a tremendous pace in various applications. The Mobile Ad hoc Network (MANET) is a network which has no infrastructure and de-centralised control. Reliable communication in a network depend on number of factors like the position of the node, mobility or movement of the node during communication, number of nodes in the network, topography etc.[1][2]. Routing plays vital role in wireless communication. There are several routing challenges that affect the communication in MANET. Some of them are scalability, security, node co-operation, aggregation, high power consumption, low bandwidth, high error rates , arbitrary movements of nodes, multicasting and energy efficiency. Study of these challenges reveals the need of certain methods that should be adopted for communication [3]. Thus several routing protocols are designed for ad hoc networks to deal with these challenges.

2. OVERVIEW OF ROUTING PROTOCOLS

2.1Review of Previous work

Qian Feng compared and analyzed the performance of four wireless network protocols in Ad hoc Network [9] AODV, DSR, DSDV and OLSR. According to author DSDV and OSLR perform better in the small networks, where as AODV and DSR are more adaptable in large scale network.

Md. Monzur Morshed compared AODV & DSDV on the QoS Metrics such as delay & jitter [10]. The performance has been analyzed on the basis on network load, speed and network size.

Yi Lu , analyzed the performance of AODV and DSDV by varying maximum speed of mobile host, network size and number of connections[11]. The correlation between network topology change and mobility is investigated by using linear regression analysis. Author observed that network congestion is dominant reason for packet drop in both protocols. Hence he proposed new protocol to minimize congestion

Sabina Barakovic used packet delivery ratio, normalized routing load and average end to end delay to compare AODV, DSDV and DSR[12].

Asma Tuteja compared AODV, DSDV and DSR together and individually [13]. The performance matrix included PDR, throughput, end to end delay, routing overhead.

2.2Routing Protocols

2.2.1. DSDV (Destination Sequenced Distance Vector)

Destination Sequenced Distance Vector is a proactive routing protocol that solves the major problem associated with the Distance Vector routing, by using destination sequence numbers. Destination sequence number is the sequence number as originated by the destination. The DSDV protocol requires each mobile station to advertise, to each of its current neighbours, its own routing table (for instance, by broadcasting its entries). The entries in this list may change fairly dynamically over time, so the advertisement must be made often enough to ensure that every mobile node can almost always locate every other mobile node. In addition, each mobile node agrees to relay data packets to other nodes upon request. At all instants, the DSDV protocol guarantees loop-free paths to each destination as the sequence number distinguishes stale routes from new ones[4].

Routes with more recent sequence numbers are always preferred as the basis for making forwarding decisions, but not necessarily advertised. If the paths have same sequence number then those with the better metric is used.

The routing updates are sent in two ways: a “full dump” or “incremental update”. A full dump sends the full routing table to the neighbours whereas, in an incremental update send only those entries from the routing table that has a metric change since the last update. It must also fit in a packet. When the network is relatively stable, incremental updates are sent to avoid extra traffic. Full dump are relatively infrequent. In a fast changing network, incremental packets can grow big, so full dumps will be more frequent.[4]

The updates can be time triggered (periodic) or event triggered. Newly recorded routes are scheduled for immediate advertisement to the current mobile host's neighbours. Routes which show an improved metric are scheduled for advertisement at a time which depends on the average settling time for routes to the particular destination under consideration.

A broken link is described by a metric of infinity (i.e., any value greater than the maximum allowed metric). When a link to a next hop has broken, any route through that next hop is immediately assigned infinity metric and assigned an updated sequence number. Since this qualifies as a substantial route change, such modified routes are immediately disclosed in a broadcast routing information packet.

2.2.2. *AODV (Ad-hoc On-demand Distance Vector)*

Ad-hoc On-demand Distance Vector (AODV) [5] is essentially a combination of both DSR and DSDV. It borrows the basic on-demand mechanism of Route Discovery and Route Maintenance from DSR, plus the use of hop-by-hop routing, sequence numbers, and periodic beacon from DSDV. It uses destination sequence numbers to ensure loop freedom at all times and by avoiding the Bellman-Ford "count-to -infinity" problem it offers quick convergence when the ad hoc network topology changes.

Route Requests (RREQs), Route Replies (RREPs), and Route Errors (RERRs) are the message types defined by AODV. These message types are received via UDP, and normal IP header processing applies.

As long as the endpoints of a communication connection have valid routes to each other, AODV does not play any role. When a route to a new destination is needed, the node broadcasts a RREQ to find a route to the destination. A route can be determined when the RREQ reaches either the destination itself, or an intermediate node with a 'fresh enough' route to the destination. A 'fresh enough' route is a valid route entry for the destination whose associated sequence number is at least as great as that contained in the RREQ. The route is made available by unicasting a RREP back to the origination of the RREQ. Each node receiving the request caches a route back to the originator of the request, so that the RREP can be unicast from the destination along a path to that originator, or likewise from any intermediate node that is able to satisfy the request.

If intermediate nodes reply to every transmission of a given RREQ, the destination does not receive any copies of it. In this situation, the destination does not learn of a route to the originating node. This could cause the destination to initiate a route discovery (for example, if the originator is attempting to establish a TCP session). In order that the destinations learn routes to the originating node, the originating node should set the "gratuitous RREP" ('G') flag in the RREQ if for any reason the destination is likely to need a route to the originating node. If in response to a RREQ with the 'G' flag set, an intermediate node returns a RREP, it must also unicast a gratuitous RREP to the destination node.

Nodes monitor the link status of next hops in active routes. In order to maintain routes, AODV normally requires that each node periodically transmit a HELLO message, with a default rate of once every second. Failure to receive three consecutive HELLO messages from a neighbour is taken as an indication that the link to the neighbour in question is down. When a link break in an active route is detected, a RERR message is used to notify other nodes that the loss of that link has occurred. The RERR message indicates those destinations which are now unreachable due to the loss of the link. In order to enable this reporting mechanism, each node keeps a "precursor list", containing the IP address for each of its neighbours that are likely to use it as a next hop towards the destination that is now unreachable broadcast routing information packet.

3.RESULTS

Net simulator (NS2) is used for simulation of routing protocols.

TABLE 1: SIMULATION PARAMETERS

Parameter Name	Value
Channel Type	Wireless
Radio Propagation model	Two Ray Type
Network interface type	Wirelessphy
Mobility Model	Random Way point
Traffic Time	CBR
MAC Type	802.11
Interface queue type	Droptail
Link Layer Type	LL
Antenna	OMNI
Max. Packet In ifq	50
Area	670X670 meter
Source Type	TCP
Protocols	DHDV,AODV

In order to obtain factual results, which will be relative to source node, this node is assumed to be static for the entire communication. Random motion of nodes is enabled throughout the simulation.

3.1Metrics

For comparison of the protocols we have chosen the following metrics to evaluate the performance.

Throughput: It is defined as total number of packets successfully received by the destination. It is a measure of effectiveness of a routing protocol.

Packet Delivery Ratio (PDR): PDR shows how packets are delivered successfully from source to destination.

$$PDR\% = \frac{\sum_1^n CBR-Received}{\sum_1^m CBR-Sent} \text{ x } 100 \qquad (1)$$

Packet Lost: It is a measure of the number of packets dropped by the routers due to various reasons, like Collisions, time outs, looping, & errors.

4.Simulation Result

Simulation for the above mentioned performance parameters were carried out using the Net simulator NS2.34. The mobility of the nodes is the factor that has been emphasized. Various modes of mobility are introduced. The nodes are set to random destination in the topography. Also the speed by which the node moves is varied randomly. Thus highly random nature of the nodes in the topography has been considered during simulation. The simulation results show some of the important characteristics of the protocols.

The throughput of DSDV protocol is better than the AODV protocol Fig.1.This is because they are capable of maintaining the connection. Also the throughput of the former is better even when the mobility is increased. With more number of nodes, all nodes transmit at the same time. Hence congestion, frequent link break occur. In this case DSDV is less effective as seen in fig.2.

Due to mobility link break is more in AODV for 25 to 50 no. of nodes. Hence the PDR here is less.The packet delivery ratio almost remains constant for higher number of nodes Fig.3 & Fig.4. It is higher for DSDV compared to the AODV. DSDV is table driven protocol.

The number of packets lost at each node is plotted in Fig.5, Fig.6 and Fig.7. This comparison gives the nodes at which minimum packets are lost.

The number of nodes is varied to check the performance. Thus depending on the application certain amount of nodes can be selected so that optimal output can be achieved.The fig. 8 indicates that throughput of DSDV is better than AODV when mobility is varied slightly.

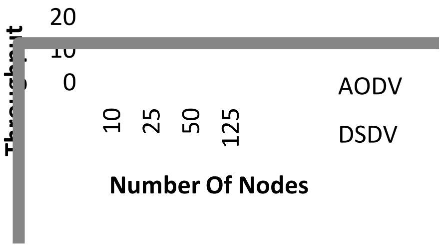

Fig. 1: No of Nodes Vs Throughput without mobility

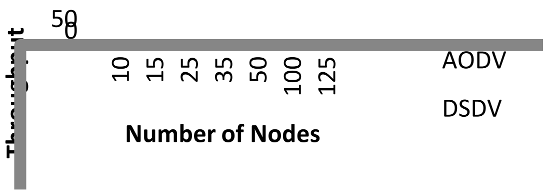

Fig. 2: No of Nodes Vs Throughput with mobility.

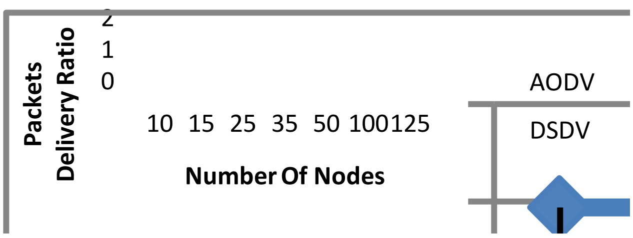

Fig 3: No of Nodes Vs Packet Delivery Ratio without mobility.

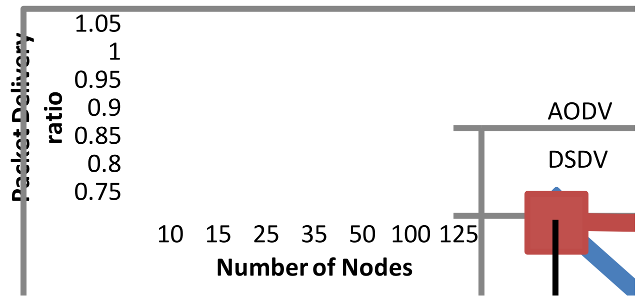

Fig 4: No of Nodes Vs Packet Delivery Ratio with mobility

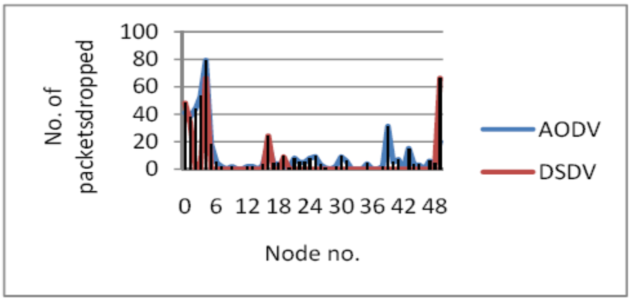

Fig. 5: Node No. Vs No. of Packets Dropped

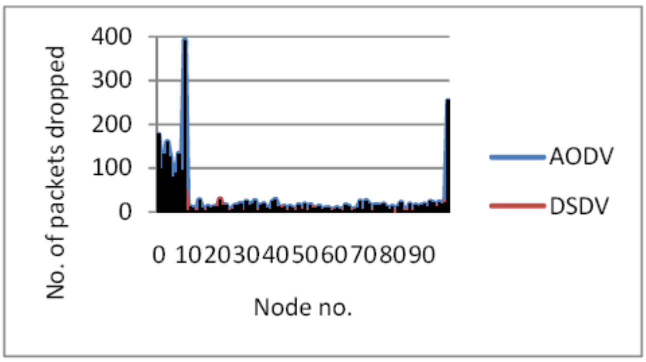

Fig. 6: Node No. Vs No. of Packets Dropped

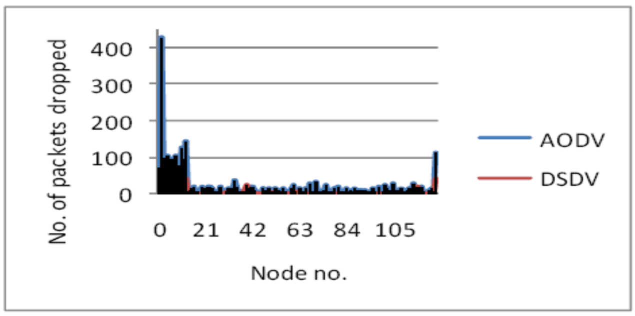

Fig. 7: Node No. Vs No. of Packets Dropped

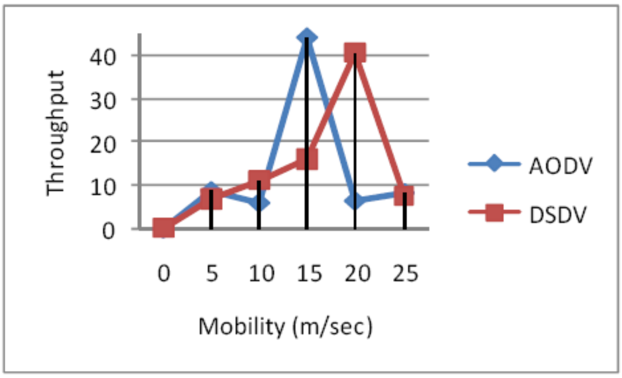

Fig. 8: Mobility Vs Throughput (no. of nodes 100)

5.CONCLUSION

DSDV Protocol uses proactive table driven routing. From all the graphs we analyze that DSDV protocols perform better than AODV for both static topology and when slight mobility is added.

Adding number of nodes results in more number of available links. Due to which the packets delivered at the receiver increases. Hence packet delivery ratio increases. Packet Delivery Ratio in DSDV is good compared to AODV.

For the scenario considered both in terms of mobility and number of nodes, once route is established, it is maintained. Number of packets dropped is less in both the cases. With less number of nodes, numbers of packets dropped are more. As the numbers of nodes are increased, packets dropped are less. This is because availability of links increases. In case of link failure, more number of alternative paths is available. Load on a particular link reduces, which in-turn reduces the congestion.

The slight increase in number of nodes and mobility, does not affect the performance of AODV. DSDV out performs AODV for performance parameters considered here for analysis

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