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PERFORMANCE ASSESSMENT OF REACTIVE ROUTING PROTOCOLS IN MOBILE AD-HOC NETWORKS UNDER CBR TRAFFIC USING NS2

Nimish Bhushan
Student
Dept. of Electronics
Amity University Noida

Michail Papoutsidakis
Assistant Professor
Dept. of Automation Engineering
Piraeus University of Applied Sciences
P.Ralli & Thivon 250, 12244,
Athens, Greece

Abhishek Srivastava
Assistant Professor
Dept. of IT
Amity University, Noida

Abstract—Mobile Ad-hoc Network (MANET) having no infrastructure is a physical network without fixed nodes where every single node in the network operates as router – routing data packets not in reach of direct communication, and discovering route for other nodes in the network. There are many known protocols associated with MANET till to date among which AODV, DSR, and DSDV are widely brought into use. This paper draws comparison among performance of reactive routing protocols under CNR traffic using NS-2.35. The performance is evaluated weighing parameters: packet delivery ratio (PDR), throughput, average end-to-end delay, normalized routing load (NRL). The results imply that AODV performs best in medium and large network; DSR performs best in small network.

***Keywords*: AODV, DSR, DSDV, MANET**

I. INTRODUCTION

Mobile ad-hoc network is a self-configuring network with collection of movable wireless nodes forms a temporary network having no centralized device. The setup makes network nodes mobile – Enter or exit the network dynamically. As a result, the change in network topology gets quickened. Every node in such networks acts as a router that facilitates peer nodes find route to establish connection to other mobile node; performing packet delivery out of direct wireless communication reach. There are many protocols known till to date, but the widely studied are ad-hoc on demand distance vector (AODV), dynamic source routing (DSR), destination sequenced distance vector (DSDV). The outline of this paper is as summarized below emphasizing existing research efforts on performance evaluation of MANETs routing protocols: (Refer: Section – 3). Section 3 outlines ad-hoc Routing protocols; section 4 - describes the performance evaluation and critical analysis; Section 5 – is all about result analysis; lastly, the last section concludes this paper.

II. RELATED WORK

This section briefly spotlights the existing performance comparison of ad-hoc routing protocols. In [1] the authors compared performance of three routing protocols: DSDV,
AODV, and DSR. Consequently, AODV among all performs better due to its reactive nature. The [2] other work reveals comparison of routing protocols (reactive and proactive) of mobile ad-hoc network. The simulations for both routing protocols were made through network simulator (ns-2).The protocols AODV and DSDV were tested for TCP congestion. Further, performance evaluation is done in [5]. Mobility - The [5] fundamental characteristic differentiating the ad-hoc network from other guided or unguided network is discussed in detail. In this article the researcher performs the comparison between different routing protocols: AODV, DSDV, DSR and OLSR against different mobility models. The performance evaluation of aforementioned MANET routing protocol had been done in the past [3, 4]. Recently, efforts are made to [6] present a depth simulation analysis aiming to investigate the performance of different MANET protocols: AODV, DSDV and DSR with UDP acting as a transport protocol, and CBR as the traffic generator. Consequently result revealed of the article that reactive DSR and AODV outguns proactive protocols DSR and DSDV.

III. OVERVIEW OF AD-HOC ROUTING PROTOCOLS

A. Ad-hoc on demand distance vector (AODV)

AODV [14], AODV is known to be highly energy efficient, and reactive in nature that makes it credible for large networks, that follows demand routing algorithm - Node discovers peers to build a route. The message traversed from source to destination is different, and vice versa - route request (RREQ), Source to destination, and (RREP) from destination to source. Whenever, a source node wants to send a data a RREQ happens that contains RREQ packet contains IP address, and current sequence number (SN) of destination node. The message will be channeled through different nodes and routes finally reaching to the destination node. The path which is traversed by the message to reach destination is recorded into the message. The message is send back to source node from the destination node - the process is known as root reply (RREP) that contains different routes information, of which shortest path will be chosen by the source node. If in case the link failure occurs in AODV than it uses the route error (RERR) message which is send to source and destination. In AODV, nodes will always pick a route of greater sequence number to communicate with the destination. Nevertheless, SN is used to prevent looping in network or find fresh path for the source node. AODV always uses an "expanding ring flooding" having route request issued with a limited TTL (time to leave). If no route reply is received then, again route request is issued with larger TTL, and vice versa; the packet gets dropped with failure of route establishment.

B. Dynamic Source Routing Protocol (DSR)

DRS is again a reactive routing protocol in nature like AODV [16] establishing route upon request. DSR mainly works with routes discover and route maintenance. Route request is the process which is originated by the transmitting node which further broadcasts a route request. If the process succeeds, then RREP occurs through the means of destination node, by which the route record is send back to the source.

C. Destination Sequenced Distance Vector (DSDV)

DSDV [17] is a proactive in nature or table driven routing protocol which by default allocates the route implying availability of route to send a packet directly whenever needed to send. In DSDV the route table entry is performed on each node. The route table will be maintained at each node enabling every node can transmitting data to other node in network.

IV. PERFORMANCE EVALUATION

This section is about the performance evaluation based on ns-2 [15]. We examine two MANET routing protocols: AODV and DSR. The simulation is performed for four different network sizes: 700 x 700m2, 800 x 800m2, 900 x 900m2, and 1000 x 1000 m2 with different number of source nodes: 50,100, 150, and 200 respectively that leads us to compare the assessment of these protocols under various scenarios. The performance of these two reactive routing protocols are found in 3 types of network; (i) for small size network of 50 and 100 nodes with area 700 x 700 m2, 800 x 800 m2 respectively, (ii) for intermediate size network having 150 nodes with area 900 x 900 m2, and (iii) for big network of 200 nodes with coverage of 1000 x 1000m2. *Table 1* shows the simulation parameters for small, medium and large size network respectively. The performances of reactive routing protocols are studied for the following performance metrics.

A. Packet Delivery Ratio (PDR)

PDR is the ratio (percentage) at which packet is delivered to the destination node that measures the efficiency of the routing protocols. It is directly proportional to the delivery rate. The performance gets higher with greater delivery rate. Equation 1 represent the PDR, the packet received is denoted by $\boldsymbol{\rho r}$ and packet sent is denoted by the $\boldsymbol{\rho s}$

$$\mathrm{PDR} = \frac{\rho r}{\rho s} \times 100 \qquad (1)$$

B. Throughput

The destination node receives total number of packets known as throughput. The source sends a packet however, the number of packet received by the destination is throughput. Equation 2 defines the throughput, whereas ρ is the size of packet in bits.

$$\mathrm{Thr} = \frac{(\rho r \times \rho size)}{1000} \qquad (2)$$

C. Average end-to-end delay

End-to-end delay can be defined as; the time occupied by the packets to reach from source to destination that also covers the delay caused by the route discovery wait time. Equation 3 measures the average end-to-end delay observed.

$$\mathrm{Delay} = \Sigma\, \frac{(\tau r - \tau s)}{\rho s} \qquad (3)$$

D. Normalized routing overhear

The amount of number of control messages are needed to transmit the packets or messages successfully to the destination.

$$\mathrm{NR} = \frac{\rho c}{\rho d} \qquad (4)$$

Where ρc is total control packets and ρd is total number of packets sent.

V. SIMULATION RESULTS AND ANALYSIS

This section shows detailed simulation analysis of AODV, DSDV and DSR in ns2. The simulation setting is shown in table 1. Fig. 1 and Table.1 shows Packet delivery ratio observed for the routing protocols. In small network, the packet delivery ratio of DSR is greater than that of AODV. This is because of the source node that re-initiates path discovery, declining the PDR. However, PDR is perceived with the increasing network resulting due to increase in count of source node, and increase in area. AODV achieve greater PDR in medium and large network size because of quick route discovery process, which allows the routing algorithm to quickly adapt to route changes in AODV.

TABLE I: Simulation settings

Parameter	Number of Nodes			
	50	100	150	200
Area (m²)	700 x 700	800 x 800	900 x 900	1000 x1000
Traffic	CBR	CBR	CBR	CBR
Interval	0.1	0.1	0.1	0.1
Tot. No of Packets	10000	10000	10000	10000
Packet Size (B)	512	512	512	512
Seed	1.0	1.0	1.0	1.0
Simulation time (sec)	100	100	100	100

Fig. 2 shows the average throughput observed for AODV, DSDV, and DSR. The average throughput of AODV outperforms DSDV and DSR in small, medium and large networks. This shows that AODV received more packets in the transmission than that of DSR and DSDV. DSR average throughput is not reasonable in all networks due to the link breakage to which is not good to deliver packets efficiently.

The simulation results for average end-to-end delay are measured for the routing protocols are shown in Fig3. It is clear observed that the average end-to-end delay of DSR is better than that of AODV in small, medium and large networks. While AODV has higher end-to-end delay observed in all kinds of networks. AODV experiences high end-to-end latency in all conditions that is due to the use of source routing on a single path between source node and destination node. In AODV every node store the routes and link failure, which cause long end-to- end latency in delivering the packets across the network.

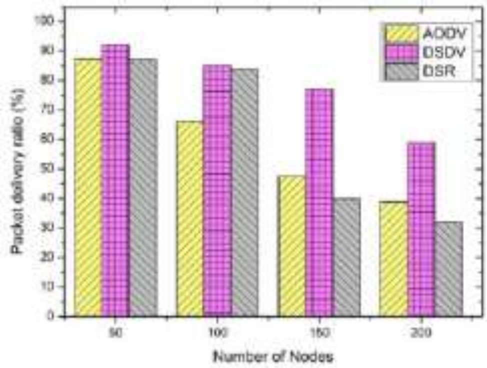

Fig 1. Packet delivery ratio of AODV, DSDV and DSR

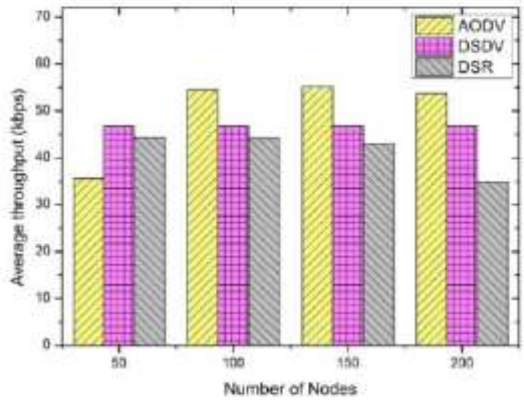

Fig 2.Throughput of AODV, DSDV and DSR

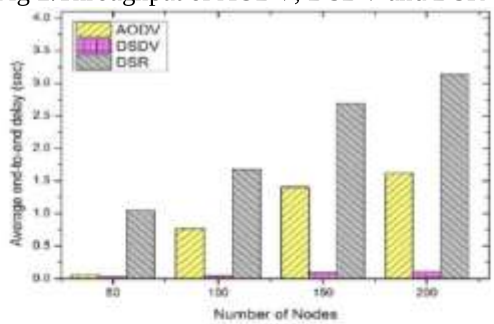

Fig 3. Average end-to-end delay of AODV,DSDV and DSR

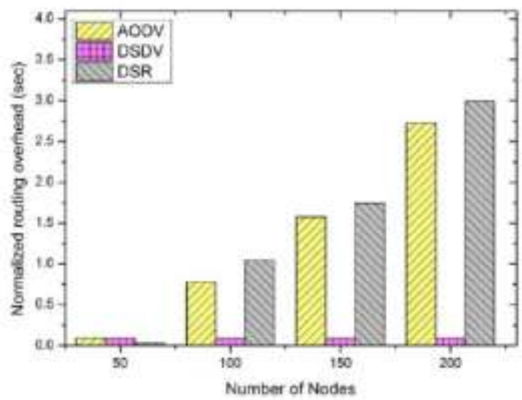

Fig 4. Normalized routing load of AODV, DSDV and DSR

Fig.4 describes the NRL performance for AODV, DSDV and DSR. In the viewpoint of small node batteries and less available bandwidth, the routing protocols must has a small NRL Mainly, when NRL is small, a high PDR, and low end-to-end delay is observed. However, it is observed from the fig.4 that AODV has a low NRL in small and medium networks than DSR in large network.

VI. CONCLUSION

In this paper, we have analyzed the behavior of reactive routing protocol of MANET under CBR traffic. The result of our extensive ns-2 simulation clearly indicates the significant impact which nodes mobility pattern has on routing performance. It was observed that, with the increase of mobility, the performance of protocols varies with small and large networks in all aspects. The selection of protocol is quite difficult for any network. Moreover, AODV can be the best protocol for all kind of network to adopt. The aim of this research was to develop an understanding of the effects of mobility designs on MANET routing protocols performance. These protocols can be tested for different conditions under CBR and TCP traffic by varying the mobility and also can be tested for mobility models. The results might vary than our work done in this research. In future, we intend to study the mobility models to determine the mobile adhoc protocols best suitable to soldierly ad- hoc networks.

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