Analyze the impact of Transmission rate on the Performance of AODV and DSR Protocols in MANETs under Responsive and Non-responsive Traffic.

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Abstract— The massive boom in the wireless technology has led to heavy utilization. Due to the heavy utilization and shared nature of resources causes QoS problems in ad hoc networks. Providing QoS is a severe problem in mobile ad hoc networks. The main focus of this paper is to analyze the performance of AODV and DSR routing protocols in MANETs under responsive and non-responsive traffic by varying the transmission rate. Apart from that, this paper also discusses the various issues related to congestion in ad hoc networks. Simulations are carried out using ns-2. The QoS parameters used in this paper are throughput, End-to-End delay and Packet Delivery Fraction. From the experimental results it is found that impact of transmission rate shows significant changes on the performance AODV and DSR. By increasing transmission rate throughput also increase but at a particular transmission rate, it is observed that there is a plunge in throughput; this point is call converging point to predict the congestion and asses the performance of the protocol. The authors found that performance of DSR is better in terms of throughput when compared to AODV under TCP traffic. There is no major impact of transmission rate on throughput for DSR under UDP traffic.

Keywords- AODV; DSR; QoS; MANET; TCP

I. INTRODUCTION

This paper concentrates on the problem of predicting the congestion and analyzes the performance in mobile ad-hoc networks by varying transmission rate on AODV and DSR routing protocols under both responsive and non-responsive traffic. Ad hoc wireless networks are defined as the category of wireless networks that utilize multi-hop radio relaying and are capable of operating without the support of any fixed infrastructure. So these networks are called infrastructure less networks. The absence of any central coordinator makes the routing a complex task when compared with cellular networks [9]. Ad hoc networks have several applications, due to their quick and cost-cutting measure in establishing the network. Some of these applications include military applications, collaborative and distributed computing, emergency operations and wireless sensor networks.

To maintain and allocate network resources effectively and fairly among a collection of users is a major issue in MANETS. The resources shared mostly are the bandwidth of the links and the queues on the routers or switches. Packets are queued in these queues awaiting transmission. When too many packets are contending for the same link, the queue overflows and packets have to be dropped. When such drops become common events, the network is said to be congested [3].

The main aim of predicting congestion and congestion control is to make sure that the system is running at its rated capacity, even with the worst case overload situations. In certain systems, this is ensured by restricting certain nodes to transmit at the maximum capacity or to make use of certain resources monotonously [14]. Doing this enables optimal usage of resources for all the nodes in the system with a measurable quality-of-service (QOS). In some systems, there are integral mechanisms that does not allow congestion situation to take place and every node keeps track of system statistics and resources [16]. This is known as “Congestion prevention” or “Congestion Avoidance”.

Congestion control is necessary for systems, whose nodes do not keep track of such statistics or do not keep resource information [7]. In such systems, the nodes participate in the network, in which the topology changes very often and the network statistics also vary randomly.

Responsive and non-responsive flows are distinguished by their response to network congestion [13]. Congestion occurs when the aggregate load exceeds the capacity on some bottleneck link. When congestion occurs, a queue builds up in the router servicing the bottleneck link. The initial effect is simply poor performance in the form of increased end-to-end latency [17]. If the congestion persists, the queue overflows and packets are lost. The widely accepted appropriate response to this situation is to reduce the load in an attempt to match the available capacity of this bottleneck link. Protocols that follow this approach and use some form of congestion-control are referred to as responsive. The most common example of a responsive protocol is the Transport Control Protocol (TCP). Those protocols that fail to detect or choose to ignore congestion by simply maintaining (or even increasing!) their load is referred to as non-responsive [18]. The most common example of a non-responsive protocol is the Unreliable Datagram Protocol (UDP). The most widely used responsive mechanism is to decrease the generated load geometrically when congestion is detected and increase load linearly in order to probe for available capacity when the congestion subsides.

Non-responsive protocols, intentionally or unintentionally, abuse the cooperative nature of responsive traffic. Sources using non-responsive protocols do not decrease their load in response to congestion indicators such as packet loss. As a result, congestion persists unless responsive sources continue to decrease their load below their fair share. The responsive sources stabilize their aggregate load at the difference between the true capacity of the bottleneck link and the load generated by the non-responsive sources. As a result, the non-responsive flows are able to use the lesser of their maximal bandwidth requirement or the capacity of the link. Thus in the extreme, non-responsive flows can starve responsive flows of bandwidth.

II. RELATED WORK

Large number of studies has analyzed the performance of various routing protocols to predict and control the congestion. Congestion is a severe issue in ad hoc networks. Different authors were proposed different methods to detect and control the congestion. Here few of the sample papers were summarized below.

Yi Lu, Yuhui Zhong, and Bharat Bhargava, explained about packet losses in Mobile ad hoc networks [4]. The effects of congestion and mobility in various network contexts are explored. Arain W.M and Ghani.S presented the performance review of OLSR, DYMO, AODV and DSR routing protocols in Mobile Ad-hoc Networks (MANET) using QualNet5.0 for conducting simulations. Packet Delivery Ratio (PDR) and end-to-end Delay were used as parameters to gauge the performance of a routing protocol over a range of mobile networking scenarios [5]. Payal, Sudesh Kumar Jakhar; does the comprehensive investigations on routing protocols Dynamic Source Routing (DSR), Ad-hoc On demand distance vector (AODV) and Destination-Sequenced Distance-Vector (DSDV) using ns2 simulator[6]. S.Santhosh Baboo,, B.Narasimhan; represents a genetic algorithmic approach to the congestion aware routing problem in Mobile Ad hoc Networks. Variable-length chromosomes (strings) and their genes (parameters) are the sources for encoding the problem [11].

III.ROUTING PROTOCOLS

Ad hoc wireless network consist of a set of mobile nodes that are connected by wireless links. The network topology in such a network keeps changing randomly. Routing protocols that find a path to be followed by data packets from a source node to a destination node used in traditional network cannot be directly applied in ad hoc networks. Ad hoc wireless networks due to their highly dynamic topology, absence centralized administration [1]. A variety of routing protocols for ad hoc wireless networks has been proposed in the recent past. The major challenges faced in designing the routing protocol for ad hoc wireless networks are mobility of nodes, resource constrains, error-prone channel state and hidden and exposed terminal problems [2]. Routing protocols for ad hoc wireless networks can be classified in to several types based on different criteria. These are Proactive or Table driven routing, Reactive or On-demand routing and hybrid routing.

A. AODV: AODV stands for Ad hoc On-demand Distance Vector, AODV uses on-demand approach for finding routes that is a route is established only when it is required by a source node for transmitting data packets[2]. It employs destination sequence numbers to identify the most recent paths. In AODV the source node and intermediate nodes store the next-hop information corresponding to each flow for data packet transmission. In AODV the source node floods the Route Request (RREQ) packet in the network when a route is not available for the desired destination. When the intermediate node receives the RREQ packet and if it is having the details of the destination, then it generates RREP packet. If a node identifies path breaks it will generate Route Error packet (RERR).

B. DSR: DSR stands for Dynamic source routing protocol, DSR is an On-demand routing protocol designed to restrict the bandwidth consumed by control packets in ad hoc wireless networks by eliminating the periodic table update messages required in table-driven approach[3]. The major difference between DSR and other on-demand routing protocols is that it is beacon-less and hence does not require hello packets. The basic approach of this protocol during the route construction phase is to establish a route by flooding route request packet in the network. The destination node, on receiving a receiving a route request packet, responds by sending a route reply packet back to the source, which carries the route traversed by the Route Request packet received.

IV.SIMULATION ENVIRONMENT

Routing Protocols	AODV,DSR,
Simulation Time	300s
Area (sq.m)	1000 x 1000 sqm.
Propagation Model	Two Ray
Traffic	FTP,CBR
Packet Size	1024 MB
Nodes	50
Antenna Type	Omni directional
Transmission range	200m
Transmission rate	0.5MB to 5 MB.
Receiver range	200m
Pause time	0 sec
Min &Max speed	1 m/s to 10 m/s
Queue size	50
Mobility Model	Random Waypoint
MAC Protocol	802.11

TABLE I. 1. SIMULATION PARAMETERS

The experiment was conducted by using worldwide accepted simulator NS-2. NS2 is widely recognized and improved network simulator for Mobile Ad-hoc Networks (MANETs). Simulation environment was showed in Table 1. All simulations are performed on network dimension 1500 x 1500sqm consisting of different 50 nodes distributed randomly over the two-dimensional grid. The source destination pairs are randomly chosen from the set of nodes in the network. Transmission rate or offer load is varied from 0.5MB to 5MB and pause time of 0. Pause time 0 means each node moves constantly throughout the simulation. Traffic type is TCP-FTP and UDP-CBR. Packet size of 1024 Mb. Propagation model is two ray ground. The queue sizes are set to 50 packets to avoid frequent drop of packets due to buffering. We measured the performance metrics Throughput, End-to-End delay and Packet delivery fraction for predicting the congestion in the network.

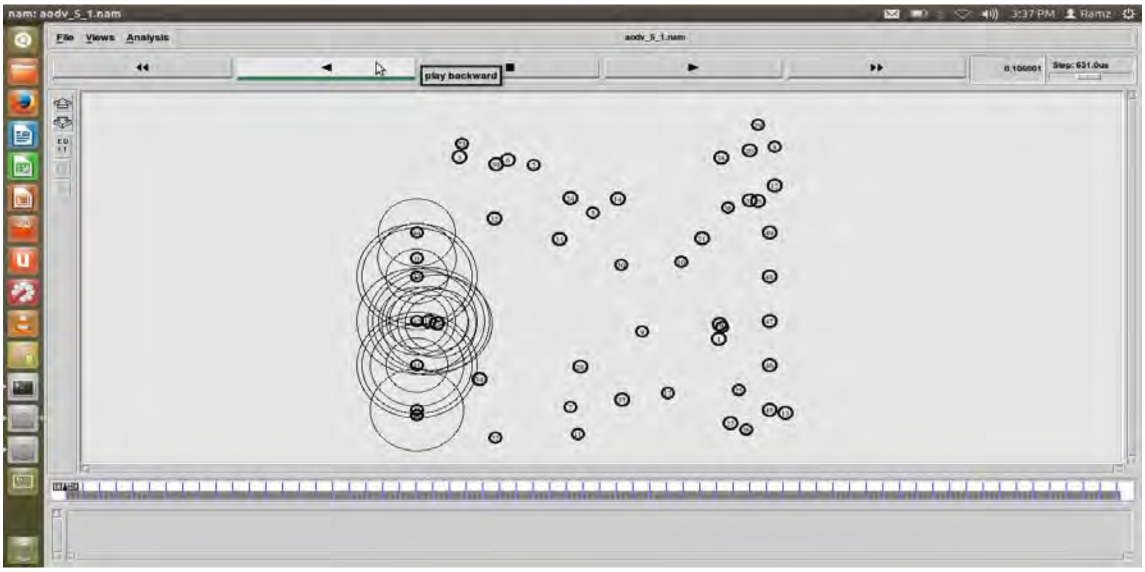

Figure1. Start-of-simulation for AODV- with 50 nodes

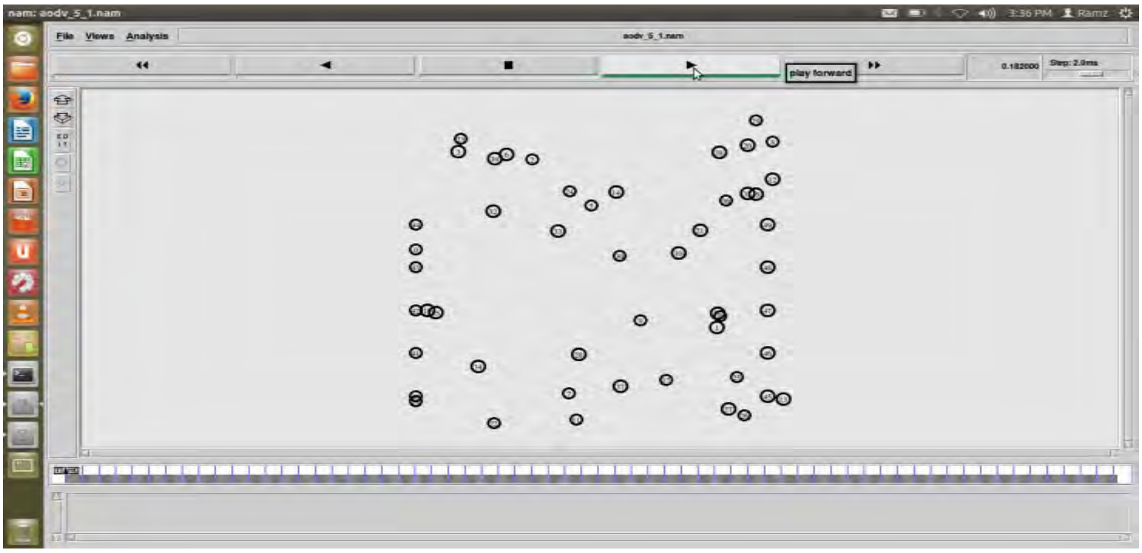

Figure2. Start-of-simulation for AODV- with 50 nodes

V. RESULTS AND DISCUSSIONS

Performance of AODV in TCP: In AODV throughput increases with increasing transmission rate up to 1MB (84.92bps), but when the transmission rate increases to 1.5MB, throughput suddenly decreases to 42.42bps and this is due to congestion in the network. There from we observed variations in throughput with increasing transmission rate. Throughput is maximum (216.02bps) at transmission rate 2MB.

DSR (TCP): In DSR when the packet size is 1024 and transmission rate is 0.6 MB, throughput is maximum (351.1bps). Further throughput is decreased with increasing in transmission rate. Throughput is minimum i.e. 156.85 bps when the transmission rate is 1MB.

Protocol: DSR Traffic: TCP, Simulation Time=300 m.sec, Packet size=1024 Mb			
Transm.Rate(MB)	Throughput	E2E delay	PDF
0.5	165.11	729.08	0.8679
0.6	351.11	1388.8	0.8879
0.7	226.59	1129.7	0.8679
0.8	297.07	1195	0.8769
0.9	325.65	1309	0.8779
1	156.86	869.27	0.8685
1.5	294.6	1334.41	0.9125
2	238.12	640.51	0.9227
2.5	203.08	838.904	0.8904
3	255.05	999.48	0.9181
3.5	419.77	1090.73	0.9370
4	174.83	1237.09	0.8914
4.5	335.32	1022.63	0.9279
5.0	178.38	722.056	0.8874

TABLE II. QOS PARAMETERS OF DSR UNDER TCP

Protocol: AODV; Traffic: TCP, Simulation Time=300 m.sec, Packet size=1024 Mb			
Transm.Rate(MB)	Throughput	E2E delay	PDR
0.5	37.14	578.231	0.6320
0.8	49.02	444.496	0.6725
1	84.92	426.519	0.7633
1.5	42.42	580.348	0.7224
2	216.02	572.974	0.8115
2.5.	69.74	543.731	0.6906
3.0	117.68	316.561	0.7587
3.5	107.58	470.593	0.7516
4	46.18	428.08	0.7316
4.5	58.04	575.574	0.6657
5	355.85	318.942	0.8359

TABLE III. QOS METRICS OF AODV UNDER TCP

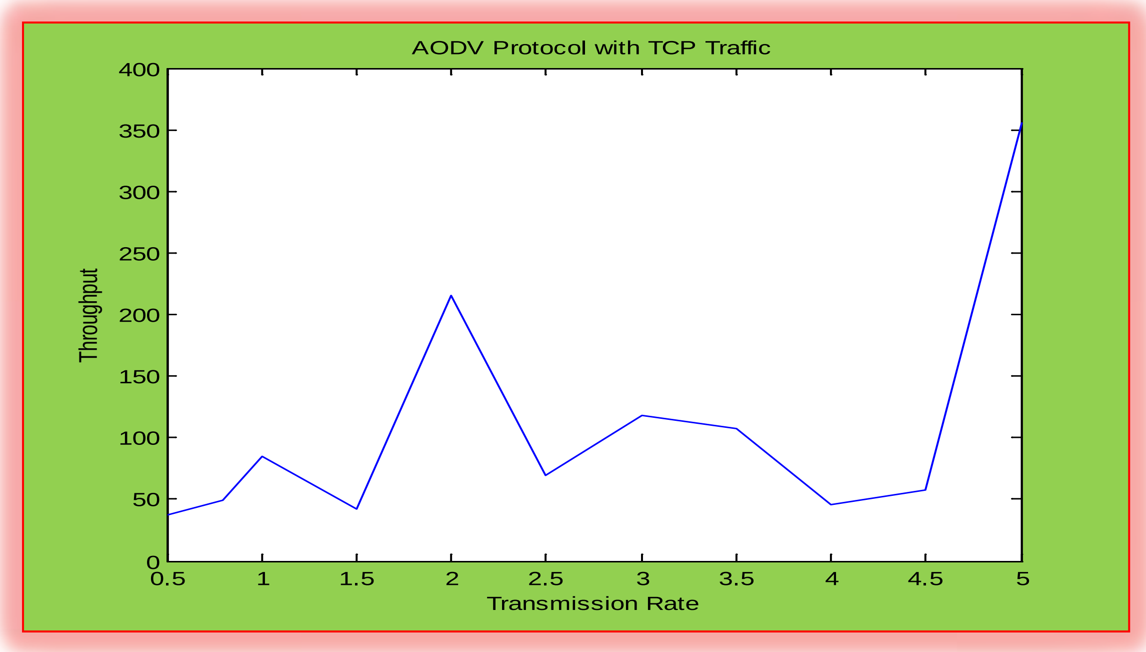

Figure 3. Transmission rate vs. Throughput for AODV (TCP)

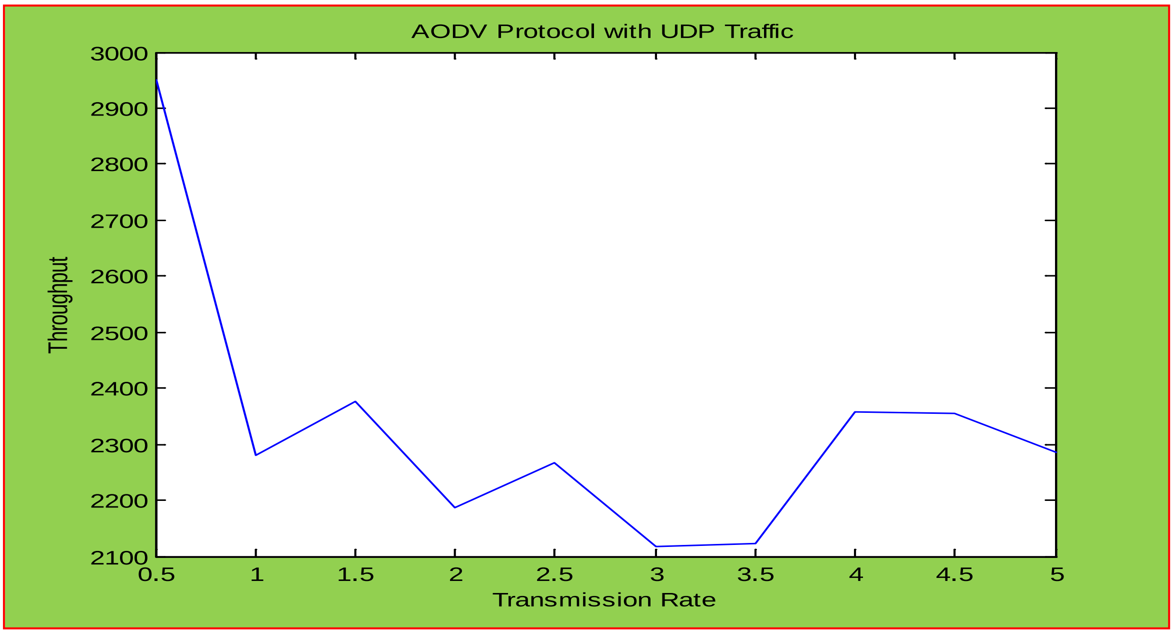

Figure 4. Transmission rate vs. Throughput for AODV (UDP)

The performance of DSR is better in terms of throughput when compared to AODV under TCP traffic. For DSR the average End-to-End delay is maximum (640.51ms) with transmission rate 2.0MB. For AODV delay is minimum (316.561ms) with transmission rate 3.0MB. In UDP traffic for AODV, throughput is maximum i.e2951.59 with transmission rate 0.5, but there is drastic reduction in throughput i.e. 2281.16 when the transmission rate is increases from 0.5 to 1.MB.

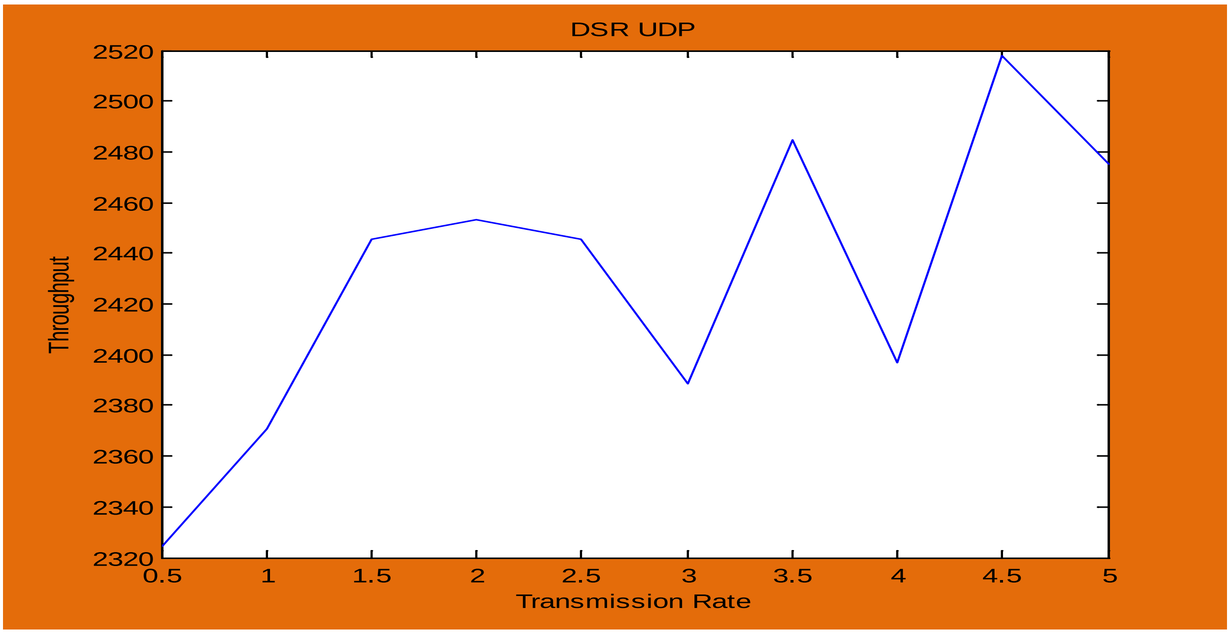

Figure 5. Transmission rate vs. Throughput for DSR (UDP)

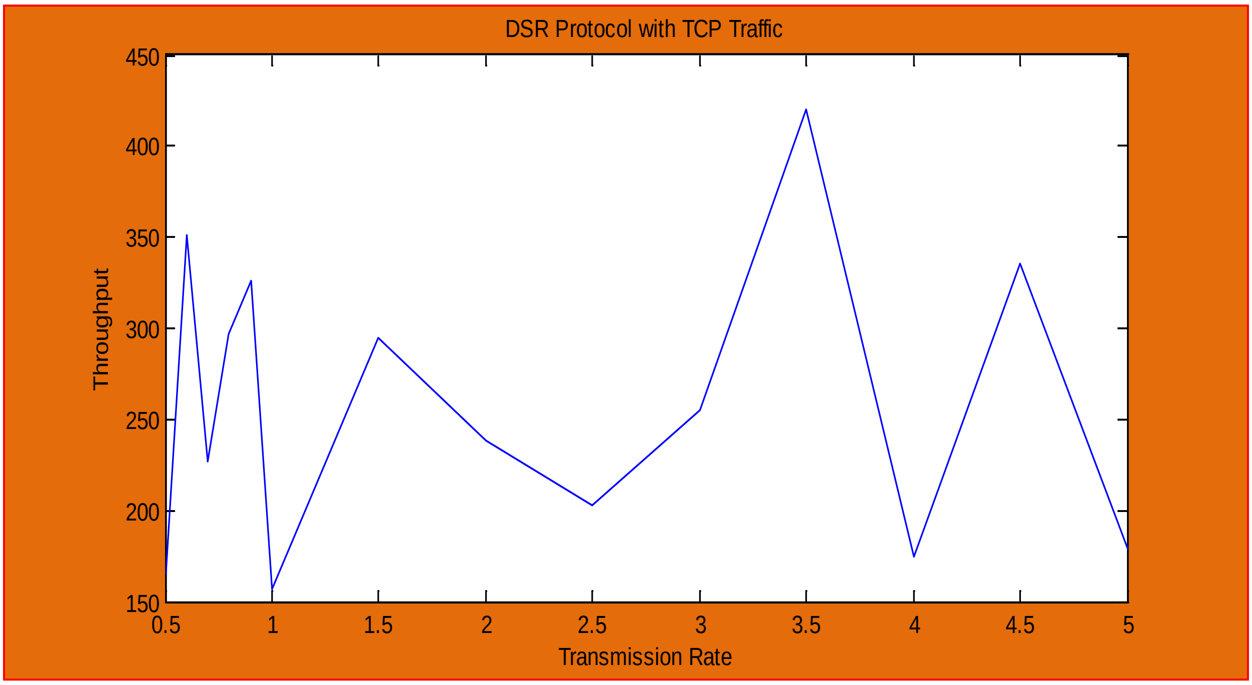

Figure 6. Transmission rate vs. Throughput for DSR (TCP)

VI. CONCLUSIONS

This paper analyzes the impact of transmission rate to analyze the performance of AODV and DSR routing protocols under responsive and non responsive traffic. Simulation experiments are carried out using ns-2. From simulations results we found that performance of DSR is better in terms of throughput when compared to AODV under TCP traffic. In UDP Traffic for DSR, there is no major impact of transmission rate on throughput. This paper also found that congestion probability is more for TCP, when compared to UDP. This work can be extended by analyzing the impact of mobility and transmission rate at physical layer on the performance of various familiar protocols to predict the congestion in the network.

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