Comparing and Analyzing Routing Protocols (AODV, DSR and WRP) in QoS of MANET

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Abstract – Mobile Ad-hoc Network (MANET) is a network in which and every node is mobile and communicate with each other using wireless media, hence MANETs are adaptable to the changes in number of nodes in the network i.e. it will automatically adjust when numbers of nodes increase or decrease. In simple words, in MANET mobile devices bears random mobility patterns. In this work we have implemented the performance of three different routing protocols Ad-Hoc On-Demand Distance Vector Routing Protocol (AODV), Dynamic Source Routing Protocol (DSR) and Wireless routing protocol (WRP) with varying the number of nodes with CBR Traffic Patterns. For implementing the above mention work we used Glomosim Simulator. The implementation have been carried out by evaluating the value of Throughput, Average end to end delay and Packet Delivery Ratio (PDR), Drop ratio, routing overhead and retransmission attempt. From the result we observe that AODV routing Protocol is better in all metrics.

Index Terms – AODV, DSR, WRP, PDR, Throughput.

1. INTRODUCTION

A Mobile Ad-Hoc Network (MANET) is a self-configuring network of mobile nodes connected by wireless links, to form an arbitrary topology. The nodes are free to move randomly. Thus the network's wireless topology may be unpredictable and may change rapidly. Minimal configuration, quick deployment and absence of a central governing authority make ad hoc networks suitable for emergency situations like natural disasters, military conflicts, emergency medical situations etc.

Mobile Ad-hoc Network (MANET) is a network in which and every node is mobile and communicate with each other using wireless media, hence MANETs [1] are adaptable to the changes in number of nodes in the network i.e. it will automatically adjust when numbers of nodes increase or decrease. In simple words, in MANET mobile devices bears random mobility patterns. This undefined nature of pattern in mobility of devices in MANETs arises various challenges to the maintain network stability and overall system security. In such kind of network, each node plays dual nature i.e. host as well as router which manages route for from one node to the other and also include other dual nature entities of the network to transmit data. This dual nature depends that whether the node is sender or receiver or an intermediate node which participate in completing the topology. If node is sender or receiver it is known as host & if it is an intermediate node then it will act as router.

Ad hoc networks [8] engage their entities in dynamic topology as nodes are mobile and may join or leave the network without any intimation. Now a day's Ad-hoc networks application areas have wide range such as monitoring underwater life, monitoring wild life, monitoring, monitoring seismic activities, create a network of soldiers implanted in a war scene. All of these scenarios have entities which are mobile and are dynamic in nature, but they also share some common features due to which they reside near each other but they aren't arranged under any infrastructure, they provide the connectivity by forwarding packets over themselves. To support this connectivity, nodes use some routing protocols such as Bellman Ford, DSR and WRP. The network contains only mobile nodes, which creates topology in air & and transfer data to each other. As the network is scalable so it doesn't depend on any single node, it automatically adjust when one or more node leave or join the network Thus, this property of the network makes it both flexible and robust.

A routing protocol [9] which is intended for MANET must incorporate the special technique to deal with two thing special condition apart from normal routing features i.e. how to deal with a situation when nodes are not in any fixed topology & second is that how to deal with the situation when nodes may join or leave the network without any intimation. Because of this situation designing routing protocols for MANET are quiet challenging. Quality of Service [5] routing in MANETs is relatively untouched area. If a protocol wants to ensure quality-of-service, the protocol not only needs to map a route but also have to ensure the security of message as well as the resources required for transmission. Because of the availability of limited resources in terms of bandwidth & absence of any supreme which will handle all the issues related to routing & availability of resources, nodes have to devise a proper plan for resource management to ensure Quality of Service. Even if nodes somehow manage for a single time, the problem will again arise due to change in topology when a node enters or leave the network. Because of such limitations, Quality of Service routing is more demanding than best effort routing.

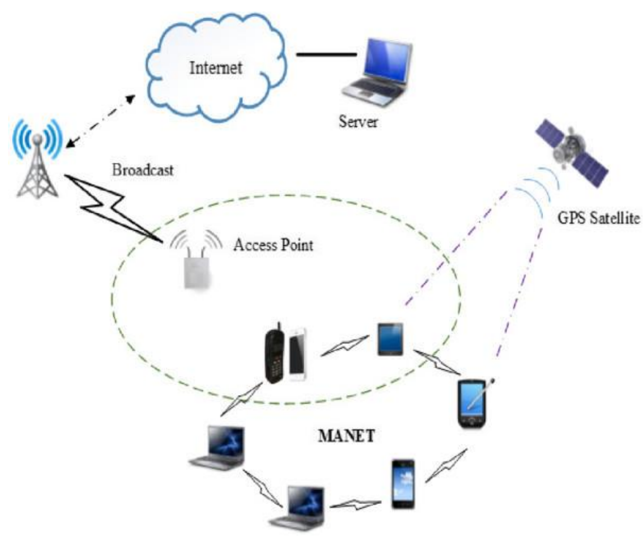

Figure 1 Mobile Ad hoc networks

2. RELATED WORK

Abdalftah Kaid Said Ali, Dr. U.V. Kulkarni [1] in his paper title" Comparing and Analyzing Reactive Routing Protocols (AODV, DSR and TORA) in QoS of MANET" published in 2017 IEEE 7th International Advance Computing Conference. In this paper author work with AODV, DSR and TORA routing protocols with varying the number of nodes 25, 50, 75 and 100 and FTP traffic pattern. And they conclude that every protocol behaves differently than others under different environments because there are different parameters that have been differed under varied situations. So, according to our simulation results, we can say that AODV outperforms others.

Satyam Kumar Sainy, Ravi Rai Chaudhary, Ajay Kumar [2] in his paper title “Performance Evaluation of Routing Protocols Based on Different Models in MANET” IEEE International Conference on Recent Trends in Electronics Information Communication Technology, May 20-21, 2016, India. In this work author work with AODV, DSR and LAR1 routing protocols with three models node model, pause time and speed model and they have taken Throughput (Bits/Second), Packet Delivery Ratio, Drop Packet Ratio, and Average End to End Delay these performance metrics. And they conclude that LAR1 has better throughput in comparison to both AODV and DSR routing protocols in all three scenario. In Node Model throughput increases as the nodes increases and after certain point it again decreases with increasing number of nodes. In Pause Time Model throughput increases as the pause time increases and after certain point it again decreases And in Mobility Model throughput decreases as the speed of node increases. Packet delivery Ratio behaves like throughput, LAR1 has better PDR in comparison to AODV and DSR. Drop ratio is also similar to PDR, actually it is reverse of PDR so we can say that LAR1 has lower drop ratio in comparison to AODV and DSR. AODV and DSR have lower delay in comparison to LAR1. LAR1 routing protocol has higher delay, And from the graph it is also observe that as we increase the nodes, pause time and mobility delay is also increase.

Ankit Chopra and Rajeev G. Vishwakarma [3], “Comparison of Ad hoc Reactive Routing Protocols: AODV and DSR with Respect to Performance Parameters for Different Number of Nodes” published in IEEE in 2014. They have worked with AODV and DSR routing protocols with the performance metric Packet Delivery Ratio and End to End Delay. They have concluded DSR uses source routing and route caches and does not depend on any periodic or timer based activities. DSR exploits caching aggressively and maintains multiple routes per destination. AODV, on the other hand, uses routing tables, one route per destination, and destination sequence numbers, a mechanism to prevent loops and to determine freshness of routes. We used a detailed simulation model to demonstrate the performance characteristics of the two protocols. The general observation from the simulation is that for application oriented metrics such as delay and throughput, AODV outperforms DSR in less "stressful" situations, i.e., smaller number of nodes and lower load and/or mobility. DSR, however, outperforms AODV in more stressful situations i.e. higher number of nodes, with widening performance gaps with increasing stress (e.g., more load, higher mobility). DSR, however, consistently generates less routing load than AODV.

Ashish Bagrani, Raman Jee, Pankaj Joshi, Sourabh Bisht [4], "Performance of AODV routing protocol with increasing the MANET nodes and its effects on QoS of mobile adhoc networks," IEEE International Conference on Communication Systems and Network Technologies, Shri Mata Vaishno Devi University Katra, India, pp. 320-324, June-2012. They have worked on QoS with AODV routing protocol.

From the above mentioned studies, we can conclude that although routing protocols has been compared from each other with respect to performance under different number of nodes. From the above studies we have decided to go through the implementation of Routing Protocols like AODV, DSR and WRP with Respect to Performance Parameters like packet delivery ratio, throughput, end-to-end delay, drop ratio, routing overhead and retransmission attempts. So we choose the topic Comparing and Analyzing Routing Protocols (AODV, DSR and WRP) in QoS of MANET for my work.

3. PERFORMANCE METRICS

The goal of this work is to compare the performance of the AODV, DSR and WRP routing protocols under different scenario. Comparing the different methods is done by simulating them and examining their behavior.

In comparing these protocols, with node density models the evaluation could be done in the following six metrics:

(1) Packet Delivery Ratio: Total received data packets is divided by total generated data packets known as packet delivery ratio [6].

(2) Average End-to-End Delay: it is defined as time required for transmitting a data packet from source node to the destination node which includes propagation, transmission, and queuing delay.

(3) Throughput: Throughput can be defined as the total number of packet which passes through the channel in a particular unit of time.

(4) Drop Ratio: Packet drop ratio is calculated by subtract to the number of data packets sent to source and number of data packets received destination through the number of packets originated by the application layer of the source (i.e. CBR source).

(5) Routing Overhead: Total number of routing packets divided by total number of delivered data packets. Here, we analyze the average number of routing packets required to deliver a single data packet. This metric gives an idea of the extra bandwidth consumed by overhead to deliver data traffic.

(6) Retransmission Attempts: Total number of packets retransmitted due to CTS and ACK time out [1].

4. SIMULATION RESULTS

The wireless network consists of varying the number of nodes 20, 40, 60 and 80 with traffic pattern CBR. The nodes are distributed uniform in a tertian area of 1250m X 1250m. The data packet size is of 512 bytes. The simulation time is 500sec. In this work we have used random waypoint mobility model. The simulation model [10, 11] with parameters is listed in table 1.

To compare our result from previous known protocols we used six performance Constraints for comparing the concert of AODV, Dynamic source Routing and Wireless Routing Protocol Routing Protocols. The simulation results are shown in the form of graph that represents (i) Packet Delivery Ratio (ii) Throughput (iii) Average End to End Delay (iv) Drop Ratio (v) Routing overhead and (vi) Retransmission Attempt.

Table 1 Parameters for simulation evaluation

Parameter	Value
Traffic Pattern	CBR
Simulation Time	500 Seconds
Terrain Dimensions	1250*1250
Number of Nodes	20, 40, 60 and 80
Node Placement	Uniform
Mobility	Random-Waypoint
Min. Speed Of Node	0 M/S
Max. Speed Of Node	20 M/S
Pause Time	30 Sec
Mac-Protocol	802.11
Routing-Protocol	AODV, DSR, and WRP

Figure 2 shows the graph of AODV, DSR and WRP routing protocol for packet delivery ratio between varying numbers of nodes.

Figure 3 shows the graph of AODV, DSR and WRP routing protocol for throughput between varying numbers of nodes.

Figure 4 shows the graph of AODV, DSR and WRP routing protocol for end to end delay between varying nodes. End-to-end delay includes the delay in the send buffer, the delay in the interface queue, the bandwidth contention delay at the MAC, and the propagation delay.

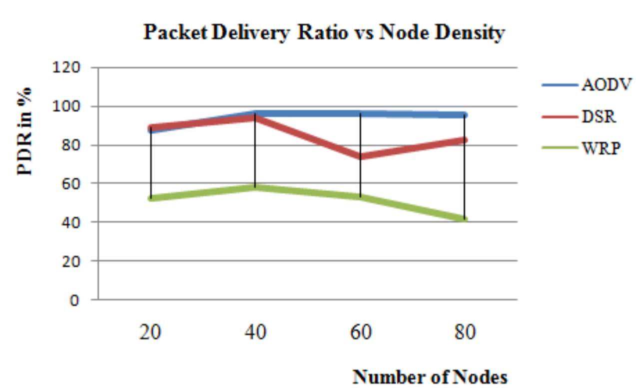

Figure 2 Packet Delivery Ratio vs. Node Density

Figure 5 shows the graph of AODV, DSR and WRP routing protocol for drop ratio between varying nodes.

Figure 6 shows the graph of AODV, DSR and WRP routing protocol for routing overhead between varying nodes.

Figure 7 shows the graph of AODV, DSR and WRP routing protocol for retransmission attempts between varying nodes.

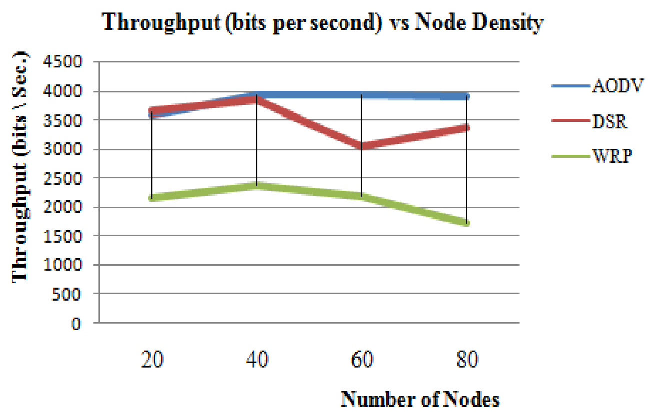

Figure 3 Throughputs vs. Node Density

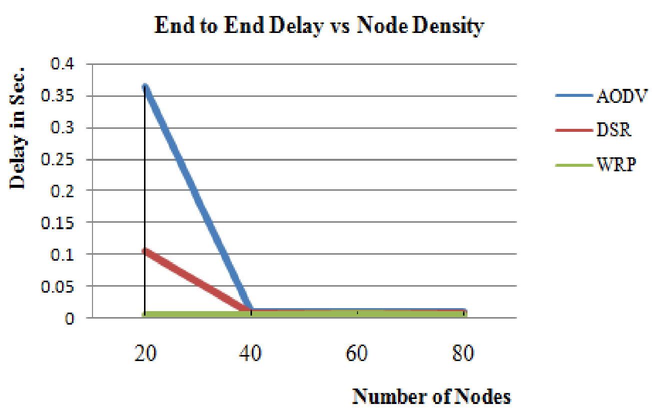

Figure 4 End to End Delay vs. Node Density

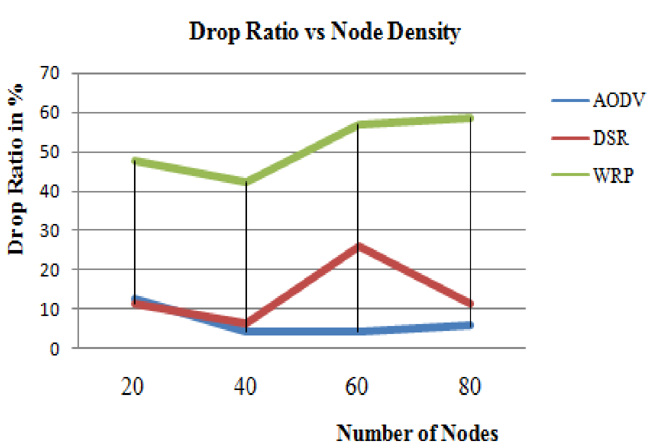

Figure 5 Drop Ratio vs. Node Density

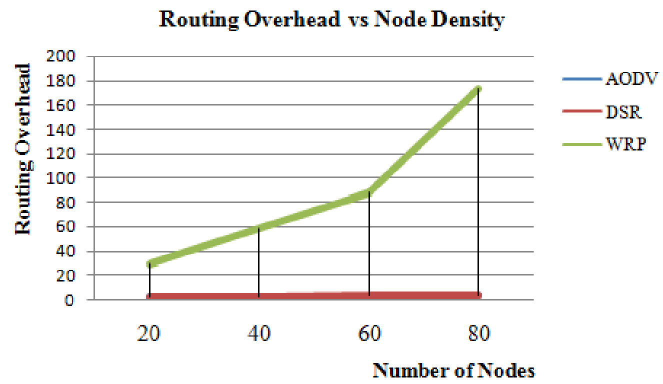

Figure 6 Routing Overhead vs. Node Density

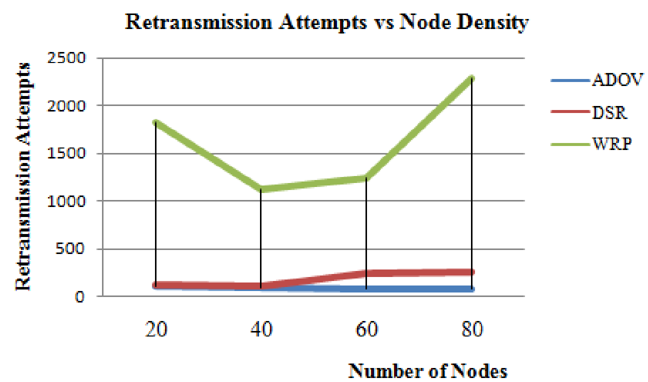

Figure 7 Retransmission Attempts vs. Node Density

5. CONCLUSION

In this work, analysis of AODV, DSR & WRP routing protocols is done to understand that which one performs well in which set of conditions. Focus is mainly done on the network parameters like packet delivery ratio, end to end delay and throughput, drop ratio, routing overhead and retransmission attempts. By changing the number of nodes. Here we conclude as:

AODV has maximum packet delivery ratio in comparison with DSR and WRP. Packet delivery ratio of AODV are constantly increasing while PDR of DSR increases with number of nodes and after certain number of nodes it decreases and again as we increase the number of nodes it again increases. WRP has minimum packet delivery ratio.

AODV has maximum throughput in comparison with DSR and WRP. WRP has minimum throughput. For a better routing protocol it should be maximum.

WRP has minimum delay in comparison to AODV and DSR. With minimum number of nodes AODV and DSR has maximum delay and as we increase the number of nodes delay also decreases. For a better routing protocol it should be minimum.

AODV has minimum drop ratio in comparison with DSR and WRP. WRP has maximum drop ratio. For a superior routing protocol this parameter should be minimum.

AODV and DSR has minimum routing overhead in comparison to WRP. AODV and DSR have a constant routing overhead while in WRP as we increase the number of nodes its increase. For a superior routing protocol routing overhead should be minimum.

AODV and DSR have minimum retransmission attempts while WRP has maximum retransmission attempts.

In future work we can use different routing protocols, different traffic pattern like FTP/GENRIC, TELNET, HTTP and so on and different mobility models like Freeway Mobility model, Manhattan mobility model etc. We can use other performance metrics.

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