

# ***AODV Routing Protocol Performance Analysis for Variable Bit Rate Traffic***

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## ***Abstract***

*Ad hoc network dynamically demands change in topology. AODV is a reactive efficient protocol with high performance, as in AODV no resources are required when no route is needed. The paper focuses on the analysis of a prominent on demand routing protocol- Ad Hoc On-Demand Distance Vector Routing on basis of QoS metric such as average end to end delay, packet loss, throughput and jitter under variable bit rate traffic. The graphical analysis is used for increasing the network performance under VBR traffic for different node density.*

***Keywords:** - VBR, CBR, AODV, Jitter, Delay, QoS, MANET, Node density.*

## **INTRODUCTION**

In wireless Ad Hoc networks, the often-random change in network topology and multiple hopping at unpredictable time affect the connectivity. A mobile ad-hoc network is a collection of infrastructure less dynamic mobile devices that can leave and join the network at any time without the assistance of a centralized structure. The change in topology causes rapid reaction in AODV protocol which offers less network utilization, less processing and memory overhead and create unicast route to the destination within the ad-hoc network [1]. This is a routing protocol for mobile ad hoc networks designed to accommodate small and large networks even if the nodes in the network are as many as several thousand nodes [1].

AODV uses the concept of route discovery and route maintenance of DSR and the concept of sequence number's and sending of periodic beacon's from DSDV [2]. There are two categories of routing protocol: Reactive routing protocol and Proactive protocol. AODV lies in the category of reactive routing protocol in which routes are discovered on demand whereas in proactive routing protocol each node has to maintain table including node information in the network. Periodic global broadcasting increases the control message and bandwidth requirements [3]. When nodes want to locally communicate then only it create and maintain the route. They broadcast a hello message packet to discover

neighbor node along with some time to live value which bounds the broadcasting to its neighboring nodes only. The time for which valid route is present is termed as ART. Routing table will remove the route that has not been used for some time [4-5]. Time to delete expired route is determined by delete period constant.

## **SIMULATION PARAMETERS & SCENARIO**

In this paper for the simulation purpose, we have used IEEE 802.11/b MAC protocol with omnidirectional antenna model having height of 1.5 m with 0.8 antenna efficiency [3]. Two ray path loss model is used with number of channels as 1(2.4 GHz) considering maximum propagation distance to be 200 m. The scenario parameters like terrain size assumed to be 1000 x 1000m<sup>2</sup>, source to destination pair is fixed to 12, transmission power is generalized to 15dbm, random waypoint mobility model is used, maximum and minimum speed assumed to be 10 m/s and 1 m/s respectively with pause time of 30 sec. For analysis we have used 20,40 and 60 nodes placed randomly. The application layer parameters like packet size are assumed to be 1024 Bytes with 10Kbps data rate and VBR traffic.

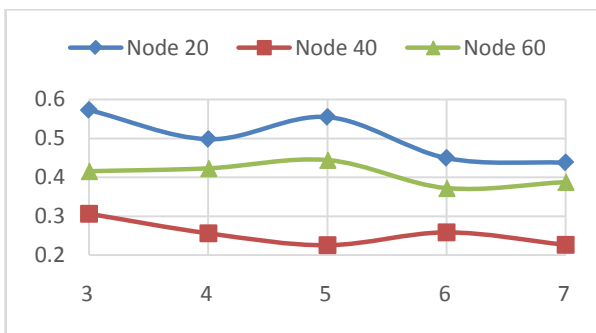
The AODV parameters like node traversal time is taken as 0.04 s, maximum route request retries 2, maximum number of buffer packet to be 100 and allowed hello loss time to be 2 s.

**SIMULATION RESULTS**

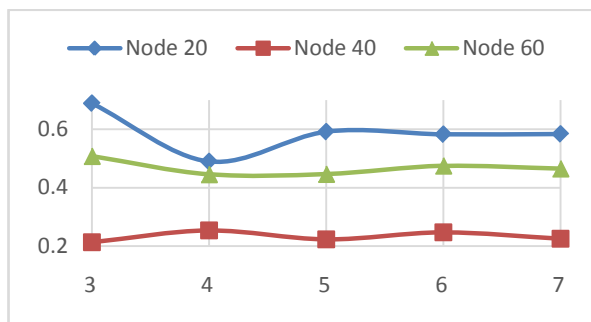
The Quality of Service for the assumed scenario is computed using QualNet simulator under variable bit rate traffic. Previously the constant bit rate traffic was analyzed [4-6] but VBR is generating the real time traffic and result can be useful for deciding best combinational value of route maintenance parameter.

**A. Average End-To-End Delay**

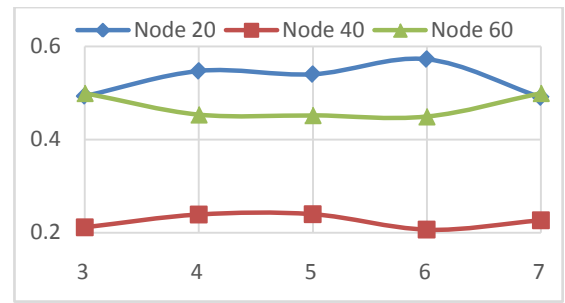
The time taken by any packet travelling across network from source to destination is called as end to end delay. Among 20, 40 and 60 nodes it can be seen from Fig. 1-5 that average end to end delay at different active route timeout is minimum for 40 nodes. From Fig. 1, for 20 nodes end to end delay is minimum (0.43759833) at ART=1 and DPC=7. As shown in Fig. 1, 60 nodes have the minimum value of end-to-end delay i.e., 0.372377 at ART=1 and DPC=6. In case of 20 nodes the separation between nodes is large, therefore the delay is more except at ART=3 and DPC=3. Here, congestion factor dominates the 20-node large separation factor. From Fig. 3, the minimum value of an end-to-end delay is achieved at DPC=6 i.e., 0.206348 as compared to DPC=5 and 7, due to more overheads. For 40 nodes at ART=3 and DPC=6 the probability of finding alternate path for successful delivery of the packet is high.



**Fig. 1: Average End to End Delay (Active route timeout =1 sec)**

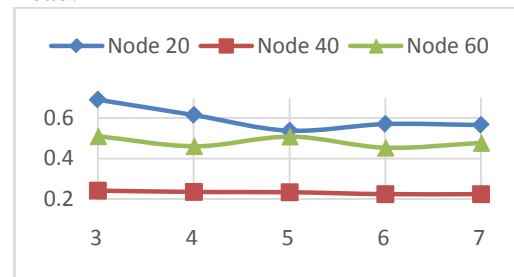


**Fig. 2: Average End to End Delay (Active route timeout =2 sec)**

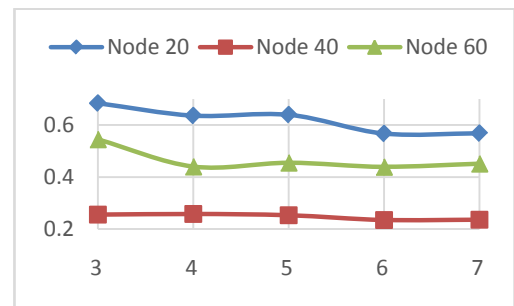


**Fig. 3: Average End to End Delay (Active route timeout =3 sec)**

From Fig. 3, we can observe that as compared to 60 nodes at DPC=4, 5 & 6, the 20 nodes have lesser average delay but at DPC=3 and 7 the value is more than 20 nodes. The reason is that the successful packet transmission route is unavailable at DPC=3 whereas at DPC=7, routing table occupies memory for larger time and creates more overhead.



**Fig. 4: Average End to End Delay (Active route timeout =4 sec)**



**Fig. 5: Average End to End Delay (Active route timeout =5 sec)**

**Average Jitter**

The difference in delay from one packet to next packet is called as jitter. The variation in latency of packets from source to destination is jitter. From Fig. 6-10, it can be concluded that with the increase in node density, the value of jitter also increases. For 60 nodes the value of jitter is larger than node 20 & 40. But for node 40, the value of jitter as compared to node 20 is lesser. From Fig. 6, for 60 nodes the minimum value of jitter is approximately 0.123344 sec at ART=1 and DPC=6.

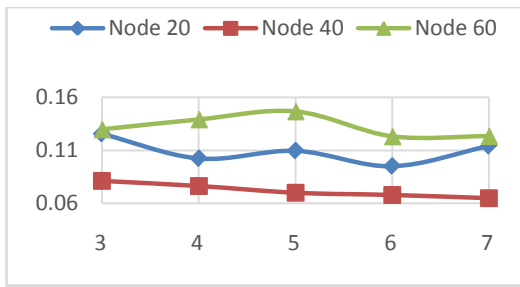


Fig. 6: Average Jitter (Active route timeout = 1 sec)

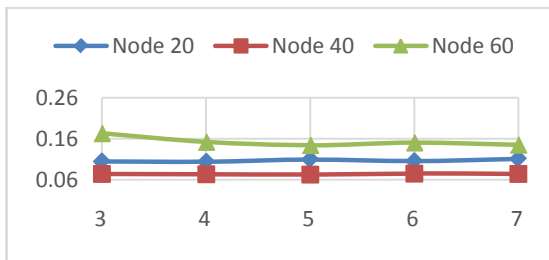


Fig. 7: Average Jitter (Active route timeout = 2 sec)

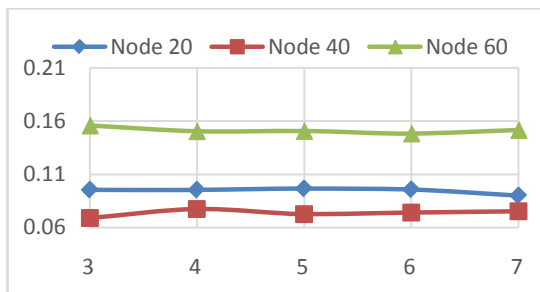


Fig. 8: Average Jitter (Active route timeout = 3 sec)

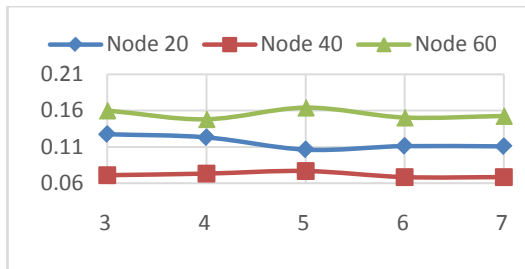


Fig. 9: Average Jitter (Active route timeout = 4 sec)

In case of 20 nodes, shown in Fig. 8 the minimum average jitter value is calculated to be 0.09001667 s at ART=3 and DPC=7. From Fig. 6 with 40 nodes the minimum value of jitter is 0.0647333 sat ART=1 and DPC=7. The high packet latency difference is generally observed in 60 nodes as the congestion increases, the probability of availability of link for transfer of packet decreases.

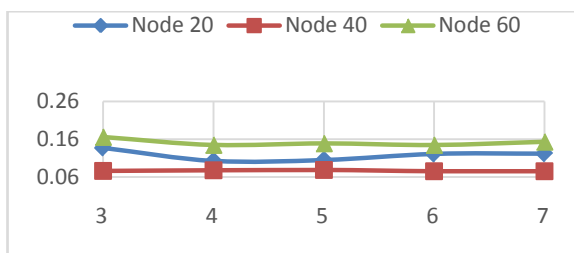


Fig. 10: Average Jitter (Active route timeout = 5 sec)

**Packet loss**

The packet left from the source doesn't received at destination, then the packet is called as a lost packet. Increase in network traffic intensity results in packet loss. It can be seen from Fig.11-15 that for 60 nodes, the packet loss is maximum as compare to 40 & 20 nodes. From Fig. 11 for 60 nodes the minimum packet loss is observed at ART=1 and DPC=6 and minimum fraction of packet loss is approx. 0.62896908. In case of 20 nodes the fraction is approx. 0.556571 at ART=3 and DPC=6, as shown in Fig. 13. From Fig. 12, for 40 nodes, the minimum fraction of packet loss is 0.46333333 at ART=2 and DPC=7.

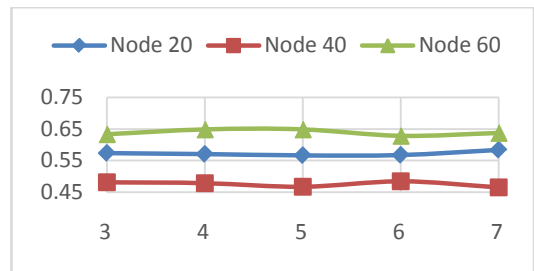


Fig. 11: Packet Loss (Active route timeout = 1 sec)

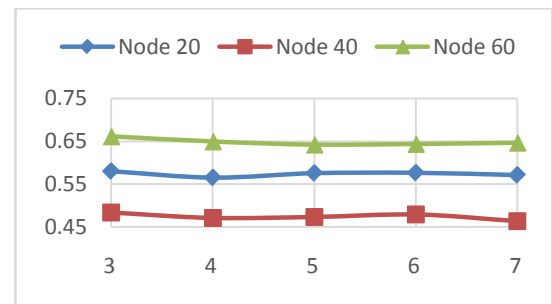


Fig. 12: Packet Loss (Active route timeout = 2 sec)

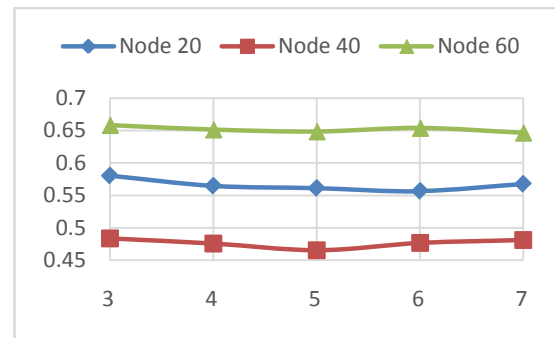


Fig. 13: Packet Lost (Active route timeout = 3 sec)

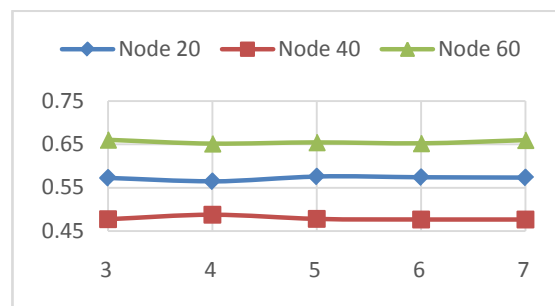


Fig. 14: Packet Loss (Active route timeout = 4 sec)

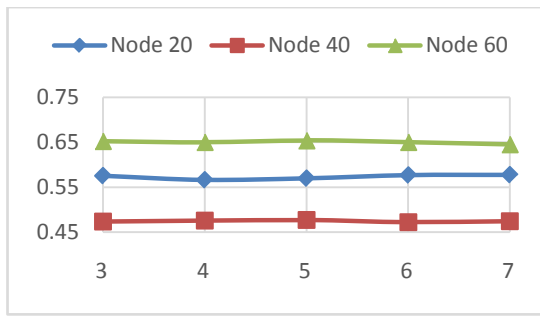


Fig. 15: Packet Loss (Active route timeout =5 sec)

**Received Throughput**

From Fig. 16 - 20 it is observed that as the number of nodes is increased the separation between two nodes decreases. Hence, it results in increase of throughput as node density increases from 20 to 40. If we keep on increasing nodes from 40 to 60, the network will experience congestion due to excess nodes and it will bring down the throughput value. From Fig. 17, for 40 nodes, the throughput value is maximum 43987.2167bits/sec as compared to 20 & 60 nodes. In case of 20 nodes the maximum possible throughput value is 37568.29 bits/sec at ART=3 and DPC=6, as depicted in Fig. 18.

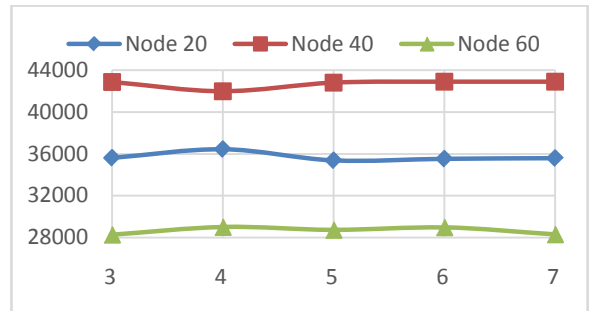
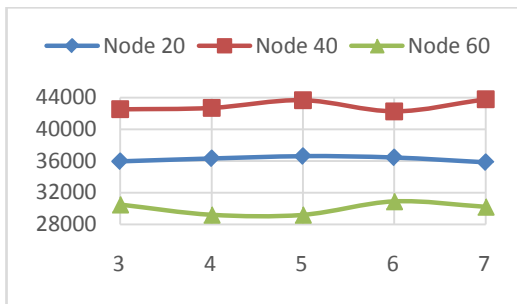


Fig. 19: Throughput (Active route timeout =4 sec)

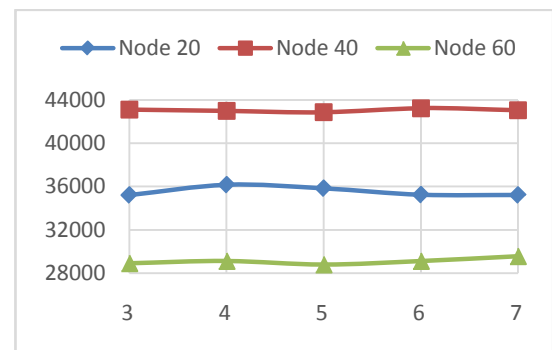


Fig. 16: Throughput (Active route timeout =1 sec)

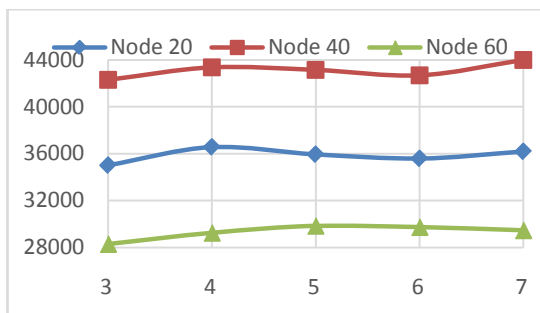


Fig. 17: Throughput (Active route timeout =2 sec)

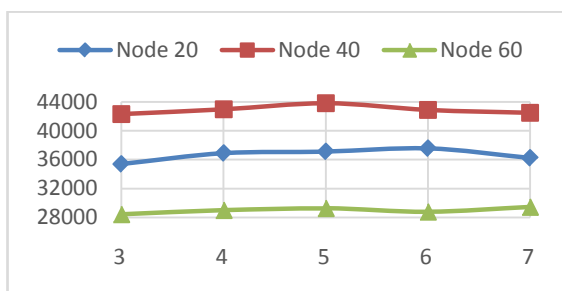


Fig. 18: Throughput (Active route timeout =3 sec)

From Fig. 16, the maximum throughput value for 60 nodes can be observed as 30894.2583 bits/sec. From Fig. 16, we can observe that at ART=1 and DPC=6 for 60 nodes throughput is highest as compared to different ART values. All other metric like packet loss, end-to-end delay and jitter are having least value for ART=1 and DPC=6. Therefore, in case of 60 nodes for the best performance ART=1 and DPC=6 value is recommended.

**CONCLUSION**

In this paper we have discussed AODV performance analysis based on different route maintenance parameter ART and DPC under variable bit rate traffic. To analyze QoS metrics like end-to-end delay, packet loss, jitter and throughput for VBR traffic we have used the QualNet simulator and extracted out the graphical representation for different node density. For 12 SD pair scenario, the value of average end-to-end delay is minimum i.e., 0.206348 sec for 40 nodes at ART=3 and DPC=6. The delay is approximately 0.333435 sec less than the default value of ART=3 and DPC=5. Therefore, DPC=6 should be used for designing a network considering end-to-end delay. For similar scenario to get the better network with less variation in latency, 40 nodes are preferred as it has the least value of jitter = 0.0647333 sec at ART=1 and DPC=7. In case of 20 nodes least jitter is found to be at ART=3 and DPC=7, whereas for 60 nodes, least jitter is observed at ART=1 and DPC=6.

To counter packet loss under VBR traffic, again 40 nodes are preferred as the fraction of loss is about 0.46333333 at ART=2 and DPC=7. Due to the availability of a greaternumber of alternate links, node 40 experiences least packet loss. This fraction increases with increase in node density due to network congestion. Therefore, 60 nodes have highest loss fraction as compare to 20 and 40 nodes. At ART=1 and DPC=6 the loss fraction at 60 nodes is least0.62896908and for 20 nodes least loss is 0.556571 at ART=3 and DPC=6.

The maximum throughput achieved is 43987.21667 bits/sec for 40 nodes at ART=2 and DPC=7. After comparing it with the default value i.e., ART=3, it can be concluded that for 40 nodes the memory overheads are 1 sec lesser than the default. Next is 20 nodes with throughput value of 37568.29 bits/sec that has been achieved at ART=3 and DPC=6. For 60 nodes, throughput came out to be approximately30894.2583 bits/sec at ART=1 and DPC=6 i.e. 2 sec lesser than the default ART value. Therefore, for 60 nodes under VBR traffic, it is highly recommended to avoid information storing of route state for larger time as it creates more memory overheads. All the QoS metric computed for the performance under VBR traffic is worst as compared to the CBR traffic metric because of its variable traffic.

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