Performance Analysis of Voice Traffic Using Proactive and Reactive Routing Protocols in MANET's

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Summary
For the past decade, Mobile Ad hoc network (MANET) is gaining popularity and is now on the way of becoming emerging technology of the global world. Nowadays, MANET is accounted for the applications in time sensitive multimedia which is the most desired and needed area of research. Present study is a comparative study that uses the voice traffic to analyze and measure both reactive and proactive protocols. OMNET++ 4.2, AODV (Ad-hoc On-Demand Distance Vector developed at Uppsala University) and OLSRETX (Optimized Link State Routing Extended Transmission) are used as simulator, proactive routine protocol and reactive routing protocol (by using the only mobility model known as Gauss Markov model of mobility) respectively. By setting the parameters of Delay, Throughput and Packet Delay Variation, the performance has been minutely established as a result having different nodes number and iteration.
Key words:
MANET, AODV, Gauss Markov Model of Mobility, OLSR

1. Introduction

The researchers of our era are finding MANET (Mobile Ad hoc Network) as a challenging task. Operation of MANET does not require an infrastructure which is composed and fixed, instead, it is a combination of wireless mobile nodes. Every mobile node in MANET works independently, on an arbitrary basis in self-arranging and self-organizing manner. Mobile nodes in MANET are non-static in nature, which are non-centralized and works on the phenomena of peer-to-peer or end-to-end transmission in their formation. Nodes of MANET acts as a host and a router for transferring information to various non-similar inter-connected nodes at the same, as a result performing multiple tasks at the same time. Routing protocols on the principal for providing a non-disruptive route or strategy to every node. Routing protocols also direct nodes, how they should perform in wireless mediums. Different routing protocols have been tested i.e. AODV, DSR, DSDV, and TORA they have sent the VOIP over a MANET [10]. DSR perform best in six different mobility models scenarios for VoIP communications over MANET. Generally, three standard strategies are followed for the nodes namely, proactive routing protocol, reactive routing protocol, and hybrid routing protocol. In the present study for the purpose of research analysis, a VOIP (Voice over Internet Protocol) traffic is used. VOIP (Voice over Internet Protocol) traffic, renowned as AODV (Ad-hoc On-Demand Distance Vector) and OSLR (Optimized Link State Routing) which idealizes the performance of reactive and proactive routing protocols. The essence of VOIP is its accuracy of time with the regular intervals and rates. VOIP has to be at its peak and should be available at all the time.

2. Literature Review

There are some limitations found in Ad-hoc networks which have not been sorted out till present day. One of the problems is Bandwidth optimization which restricts the increase of desired bandwidth, issues of power and the channel quality which is required to be resolved in the coming days. In the present time, MANET, VANET and other routing protocols have widened the range of Ad-hoc networks. Both the reactive routing protocol and proactive routing protocol are of great interest nowadays. Some parameters and methodologies can be used for optimizing the performance of MANET [1]. These parameters and methodologies include the selection of audio codec and routing protocols etc. [1]. This study shows a comparison between multiple routing protocols, DSR and WEAC. After comparison, it has been found that WEAC is working better on greater networks, seeking and consuming less energy. This study also spotted that, CODEC G.729 [2] can initialize voice traffic with considerable output and channel quality over MANET using WEAC protocol. Also, for sending voice transmission over MANET, CODED G.729 is more efficient and suitable. The presented study discusses [2], delay-related and transmission of voice capacity to jitter. It shows the relation of the channel quality (QoS) on the number of sources through which voice is being transmitted. It also shows that when the time medium access is neutralized there exists an effective increase in the maximum number of voice traffic. In [3], Domenico et al, have analyzed AODV (Ad-hoc on-demand distance vector) and MAC layer on the voice transmission over the network

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of MANET. The metrics have been selected firstly, as the frequency of the loss of route implying how much or how many time losses of route occurred and secondly, the duration, implying for how long and at approximately what time it has occurred. The simulated results of this study prove that there does not exist any significant effect of node mobility and node density on the performance of this protocol. In this study, it is also analyzed that MAC layer plays a significantly effective role in the route loss. In comparison to simple AODV protocol, for increasing the proficiency and effectiveness of sending voice transmission over the ad-hoc network, a new stable routing protocol EA AODV (Extended Ad-hoc on-demand distance vector) has been implemented [4]. While minimizing the congestion and interference of the channel, this protocol is more efficient in usage of idle channel routing. In this study, it is assumed that voice traffic over MANET is actually based on the MAC layer. The associated problems which occurred during the study in the application of voice traffic in multi-hop or multi-node ad-hoc network [5] are also presented.

The result that, voice traffic is supported in IEEE is achieved by taking metrics of Bandwidth, Delay and Packet loss which is overestimated for voice transmission on MANET and simulated on OPNET application. In [6], researchers have extracted the measure of problems which occurred in the application of voice traffic in the multi-node or multi-hop ad-hoc networks. In [6], researchers considered a metric of bandwidth, delay, and packet loss. The consideration of these metrics is extravagant for voice transmission on MANET. The simulation on OPNET application provides the outcomes which form the opinion that IEEE 802.11 is supporting voice traffic at light traffic. However, on the other hand, though it is extremely difficult to maintain packet loss and delay in the multi-node network in IEEE 802.11, the delay and packet loss is getting high rapidly because of hidden node problems. In [7], researchers used the OLSR routing protocol for applying multimedia applications on MANET. It also analyzed its performance based on loss rate metric, jitter metric, bandwidth metric, and end-to-end delay metric. They have also evaluated the performance of QOS on sending voice communication through the OLSR protocol by using OPNET simulation software. From their results, it can be seen, that QOS gives good quality results in applying voice communication over MANET. At the same time, remaining nodes are mobile and some other traffic also occurs. In [8], researchers have compared various voice codec or encoder scheme. They have compared G.728, G.711, G.723, G.729, G.726, GSM-EFR and GSM-HR. They have estimated that the performance of VOIP varies when these voice codecs are applied on MANET while keeping identical conditions and scenarios for all the codecs. They used speech activity detection (SAD) and load condition as their metrics. Their findings suggest that G.711 is best suited for the scenario of small grade which possesses high data rate and GSM-EFR suits well for large grade scenario's as this codec possess low data rate. In [9], researchers have observed the evaluation of emergency ad-hoc networks and a VoIP performance comparison. Based on the extended E-model, they have taken the metrics of network performance and human perception. The main feature is the extension of the Human Obstacle Mobility Model (HOMM) which is workable for simulating node mobility in restricted geographical areas in the presence of obstacles. The Human Obstacle Mobility Model is equivalently ideal for the simulation of emergency ad-hoc transmission. In [11], researchers have differentiated between three routing protocols i.e. AODV, OLSR and TORA using VOIP over MANET. All the simulations are performed on OPNET modular application. The efficiency has been scaled by setting a delay, throughput, jitter, network load and the mean opinion load as a metric. The research concludes that TORA provides the optimum output in large-scale and small-scale networks when is compared with AODV. Whereas, OLSR performed well when compared with jitter and throughput. In [12], researchers are emphasizing on the importance of MANET. Researchers in [8] is of opinion that, MANET is of great importance in the field science technology and is of opinion that, it will be implemented more in the future as compared to its implementation in the present era. The author does discuss its limitation and flexibility in this comparative study. In this study, the author has only examined routing protocols which are in demand in a categorical manner. They have applied the features of on-demand routing protocols on the MAC layer and the physical layer. All the tests are performed on QUAL NET 5.0.2 simulation application software by setting the parameters of jitter, end to end delay, packet delivery ratio, error reply packet and throughput as a metric. With the help of these evaluations, the researchers have identified easily that, the AOD routing protocol is not match-able when compared to DSR and DYMO regarding its performance and flexibility. As per the author, DSR gave bad performance because of its excessive usage of the cache. The author also analyzed DYMO's performance and concludes that its performance is better than the above two routing protocol in the only throughput because of its selection of routes.

In [13], researchers indicate the type of work that has been done in MANET and suggests the work that could be done on the MANET. The researchers also praise the simulators which provide results of MANET near to the real values. They also praised the approach which gives the easiness and calmness in predicting future values. Analysis in this study is obtained by applying ETX and the standard hysteresis routing metrics in the OLSR routing protocol in a special 7 x 7 grid network with a narrow space between the nodes of the Wi-Fi to approach the realistic values. The authors prove that ETX does not perform well enough to be able to get a stable position because of not giving the optimized routes. Whereas, the hysteresis metric performed immensely well under the same scenario of large mesh networks. In [14], the researchers analyzed the complexities and barriers of the routing in MANET of multi-services. They also discussed the implementation and adaption of the DSR. The performance metric used in the study includes an end to end delay, packet delivery ratio and routing load for both low intensity and low mobility model. The result of this study gives the sense that DSR works well under low mobility model and low-intensity level. Results also show that its delay packet delivery ratio and routing load is far better than when it comes to high mobility and intensity model. In [15], the authors aim to sort out the solution of throughput delay and stringent delay. In this study, the author used several different codecs to identify their behavior when the voice data transmission is applied to the WLAN. The conclusion is made about the performance over the criteria of the network which is based by setting up some parameters. The authors also conducted a comparative study between routing protocols such as AODV, DSR, GRP, and OLSR. After testifying the simulations and the results obtained by taking numerous tests, it has been shown that OLSR performs exceptionally well in the area of throughput. It is also in the least delay when compared with the above routing protocols. In [16], the researchers aim to emerge a new field of mobile ad-hoc networks and merges these vehicles, naming it VANET (Vehicular ad-hoc Network). As the author merges two vehicles there is a need for specialized routing protocol because of their agile ad-hoc network. Under the influence of the routing protocols i.e. AODV, OLSR and DSR, videos are transmitted on the MANET's and VANET's. However, parameters such as jitter, end to end delay, packet delivery variations are also considered to idealize the performance of the above routing protocol. It is concluded in the study that the DSR works well among all the above routing protocols.

3. Methodology

The present study uses both, the proactive routing protocol and reactive routing protocols (ADV UU & OLSRETX), however, Random Mobility Model used, is actually "Gauss Markov Mobility". The present study uses the UDP application as the testing application.

Two areas of 250 x 250 meters and 500 x 500 meters are used for the purpose of analyzation. The performance of proactive and reactive routing protocol along with the mobility model has been analyzed in these areas with a varying number of nodes. For ensuring dynamic outputs, each iteration has been simulated with a seed value which is different from the others. For ensuring dynamic outputs, each iteration has been simulated with a seed value which is different from the others. This study sets the speed of the node's constant in all areas. To analyze the performance in the present study, some parameters as end-to-end delay, packet delay, variation, and throughput have been defined. We considered two routing protocols and a single mobility model for the simulation in the present study. For enabling search of suitable results, parameters values such as area, number of nodes, seed values and node speeds have been changed initially. The present study uses protocols for transmission of data in source to destination, point-to-point, and for sending and receiving. For voice transmission, a set of parameters of UDPApp is used for transmitting data over nodes sound file.

In each iteration, the speed of every node will remain the same. To start, AODV routing protocol is adopted for simulation with mobility model (i.e. Gauss Markov Mobility) by considering an area of 250 x 250 meters. The nodes are set at a period of 10, 20 and 30 respectively. Speed of node is 1.5 m/s (Pedestrian) and simulation time of 1800 seconds is considered for every iteration. The second round of comparison is with OSLR routing protocols with mobility model (Gauss Markov Mobility) have the same area of 250 x 250 meters. The nodes are again set at a period of 10, 20 and 30 with speed of node 1.5 m/s and 1800 seconds of simulation time. Now, we consider AODV routing protocol with the same mobility model and nodal periods but different area i.e. 500 x 500 meters. All the node pairs are analyzed individually with various random seed number and 1800 seconds of simulation time as used above. The parameter is the set of point-to-point node destination. For instance, we considered 10 nodes for transmission of data and 5,5 nodes for sending and receiving portion respectively. It shows that we are considering half of the part for an end and the remaining for the other end and vice versa for the other nodes of number 20 and 30.

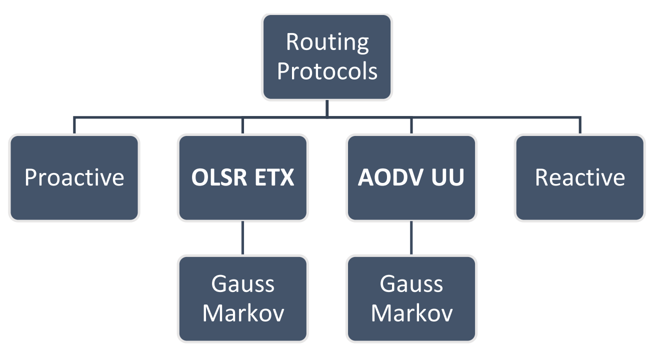


Fig. 1 Routing Protocol

Table 1: Simulation Parameters

Area	250x250 500x500
Routing Protocol	AODVUU OLSRETX
Mobility Model	Gauss Markov Mobility Model
Performance Matrices	Delay Packet delay Variance Throughput
Nodes Speed	1.5mps
Simulation time	1800sec

Fig. 2 Initially Nodes placement in the simulation area

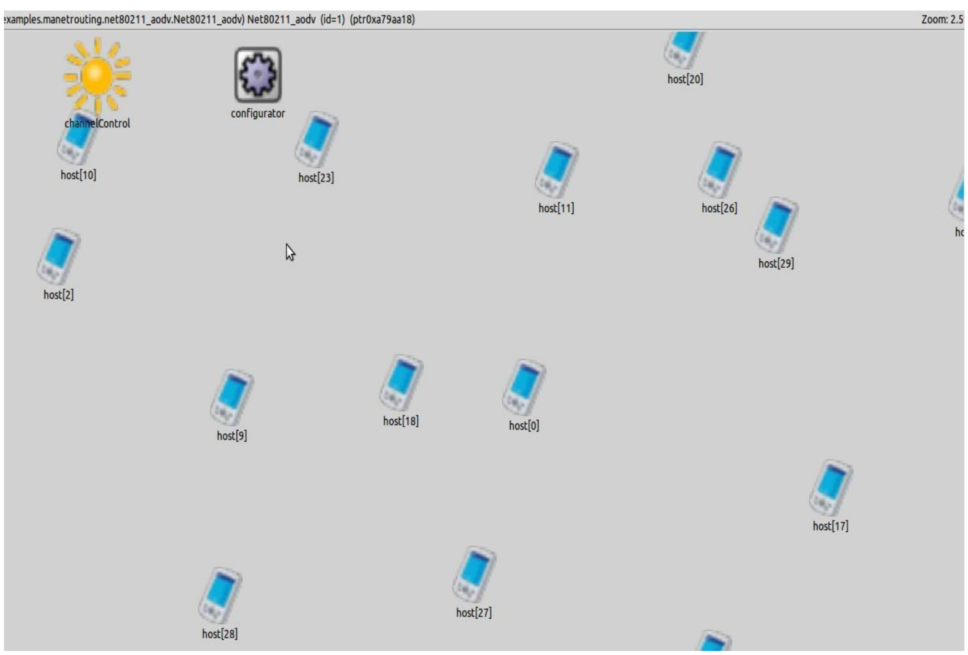


Fig. 3 Nodes Movement in Simulation Area

In the above Figure, we are focused on node mobility if we can compare the figure#3 and figure#4 can easily understand the Nodes are moving and change its location according to Gauss Markov mobility.

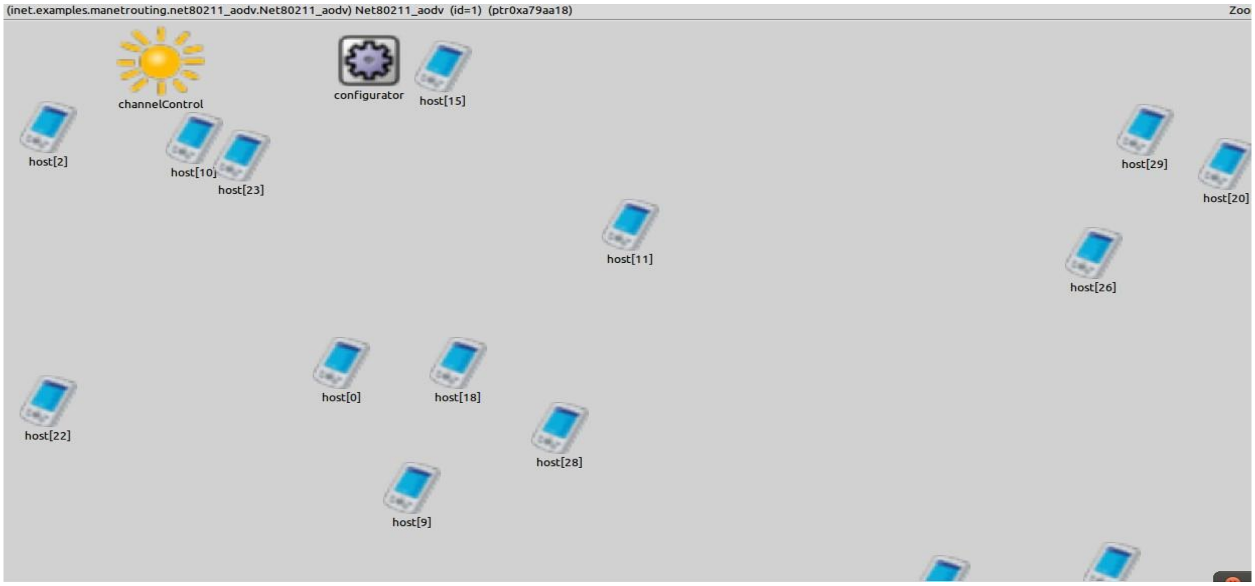
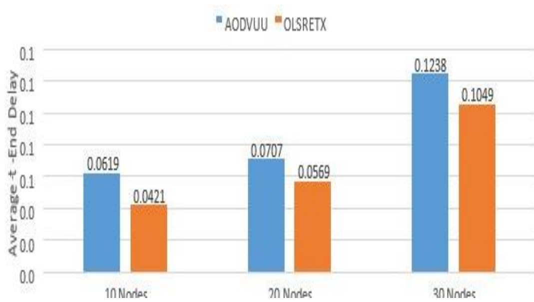


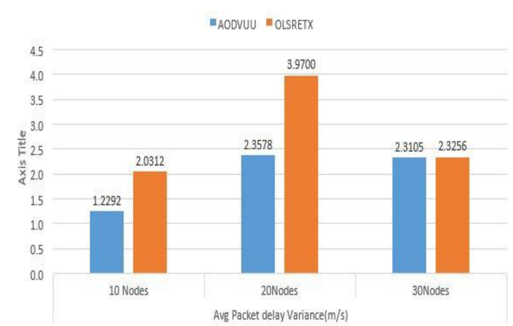
Fig. 4 Nodes are moving from one point to another point according to mobility

4. Results

Area 250x250 m



Graph. 1 End-to-End Delay (m/s)



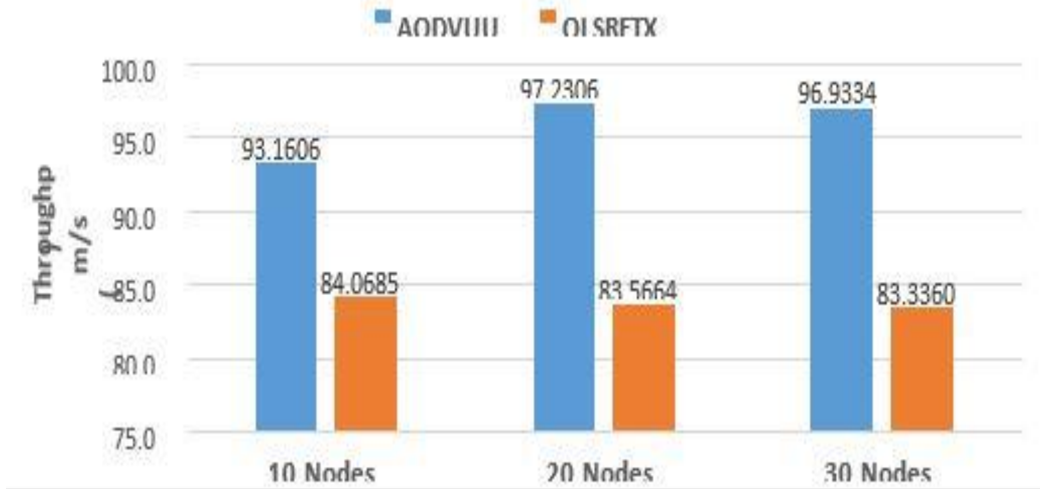
Graph. 2 Packet delay Variance (m/s)

Graph No.1 and Graph No. 2 shows the result obtained after analyzing the area of 250 x 250 meters with the proactive routing protocol and reactive routing protocol. In this metric of comparison performance, end-to-end delay result can be easily identified. The output shows a clear difference between the routing protocol of AODVUU with 10 nodes and OLSRETX by adopting the same scenario. The output of the result can be interpreted to declare that the end-to-end delay of AODVUU is greater than that of OLSRETX. It can also be analyzed that, if we simultaneously increase the number of nodes from 10 to 20, the reactive routing protocol has a higher value of end-to-end delay than the proactive routing protocol. In the 3rd iteration when 30 nodes are being analyzed, similar results as above occurred indicating end-to-end delay value of AODVUU ahead of the OLSRETX.

In the packet delay chart, variance graph consists of 10, 20 and 30 nodes respectively, along with two MANET's routing protocols. The area of 250 x 250 meters is analyzed for comparative purposes showing low packet delay variance (PDV) on 10 nodes for AODVUU values than the OLSRETX packet delay variance (PDV). For the similar protocols and pattern, when nodes increase to 20, in order to measure the depth in more detail, the results depicted in the graph shows that values of AODVUU are less than OLSRETX values. For the iteration with 30 nodes with same parameters and protocols, results indicated that AODVUU performed well as compared to OLSRETX implying OLSRETX packet delay variance is larger as compared to AODVUU.

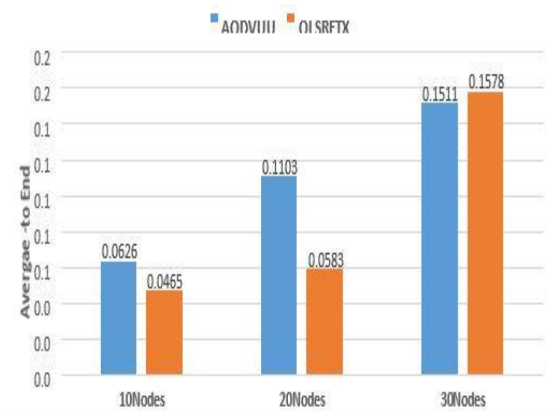
In Graph No. 3, average throughput graph has been analyzed for the area of 250 x 250 meters with the performance metrics of proactive routing protocol and reactive routing protocol by comparing with the assistance of different pairs of nodes. Firstly, 10 node results indicate that AODVUU routing protocol has higher throughput than

OLSRETX. The same analyzed result is observed for 20 nodes showing that AODVUU performs better than OLSRETX. Again, in the same result is analyzed in the last iteration, showing high throughput of AODVUU as compare to the OLSRETX with 30 nodes.

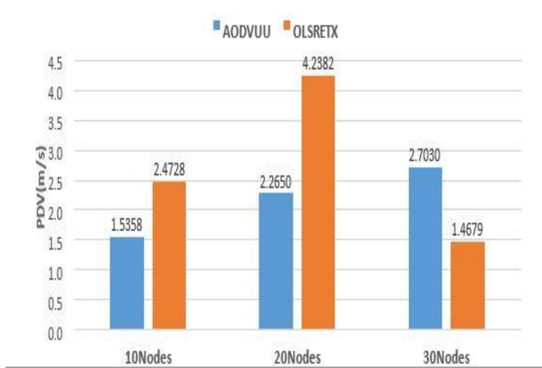


Graph. 3 End-to-End Delay (m/s)

Area 500x500m



Graph. 4 Average End-to-End Delay (m/s)

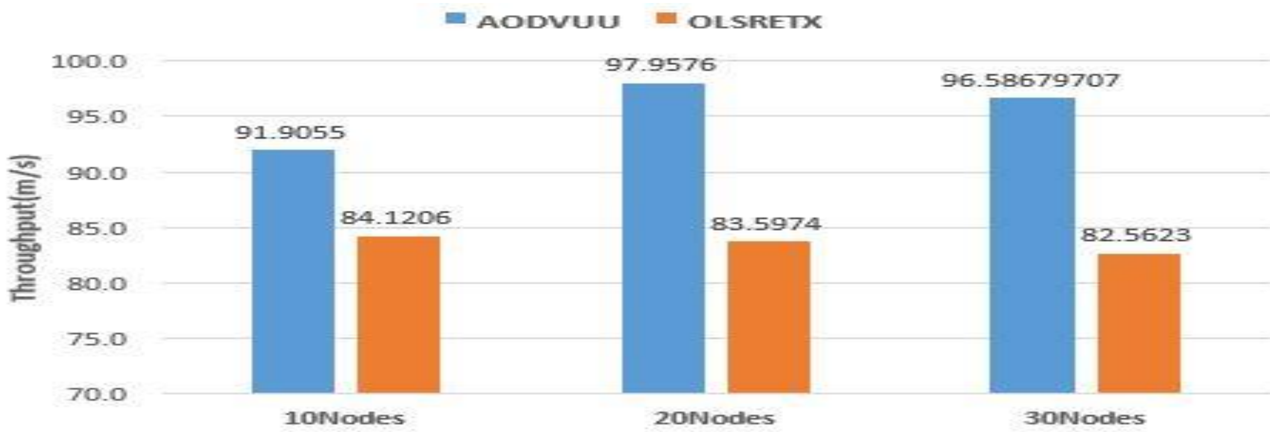


Graph. 5 Packet Delay Variation

Graph No. 4, depicts the area of 500 x 500 meters of the end-to-end delay results MANET routing protocols with a set of a node considered periodically at 10, 20 and 30 respectively. In the node values of 10 and 20, AODVUU provides higher delay than the OLSRETX. Keeping the same pattern when node values are increased from 20 to 30, there is an occurrence of slightly higher delay for OLSRETX than that of AODVUU values. Although the difference in the last iteration is minute, it cannot be ignored for the optimization purposes.

Graph No. 5 displays the comparative analysis of OLSRETX routing protocol with AODVUU routing protocol in an area of 500 x 500 meters. This graph shows the calculation of packet delay variance. Packet delay variation is one of the fundamental metric, whose importance can not be ignored in the perspective of QOS, especially in MANET when it comes to the application in VoIP. For 10 node values, OLSRETX packet data variant value is higher than the value of AODVUU. While in 20 nodes there occurs a big difference in values of the output indicating AODVUU performing better in the area of 500 x 500 meters for packet delay variant in comparison to OLSRETX routing protocol. The iteration of 30 nodes shows results indication change from the previous values as the packet delay variance of OLSRETX is lower on comparison to AODVUU.

Now in Graph No. 6, we want to analyze the throughput with the same scenario and parameters as used previously with the area of 500 x 500 meters. It can be easily viewed, that the performance of AODVUU with 10 nodes is better as compared to OLSRETX values. When 20 node values are analyzed reactive routing protocol AODV values are higher but when the node values are increased to 30 proactive OLSRETX protocol values are less as compared to the other.



Graph. 6 Throughput (m/s)5. Conclusion

The obtained results have been evaluated at a very minute level with great concentration and testing. Simulation is performed at two different areas which can also be considered as the geographical points for the present study. i.e. 250 x 250 meters and 500 x 500 meters. Iteration is performed for 10, 20 and 30 node values respectively. The nodes have a set the parameter for the evaluation of routing protocol. The parameters include end-to-end delay, packet delay variant, and throughput. The same conditions of analyzation are considered for both the routing protocols. The calculated results show that packet delay variation with 10 nodes is maximum at OLSRETX and minimum at AODVUU. As we move to 20 nodes in the area of 500 x 500 meters, AODVUU provides minimum delay variation as compared to the OLSRETX. Observation with 30 nodes is different from the previous one as the AODVUU holds high delay variation and OLSTREX have low packet delay variation. Afterward, we estimated the values of throughput with the constant area of 500 x 500 meters with node values of 10, 20 and 30 nodes. For iteration of all node values, the throughput is high in AODVUU as compared to that of OLSRETX. Therefore, the present study recommends that OLSRETX can be used for the purpose of least delay while AODVUU should be used for minimum packet delay variation and high throughput.

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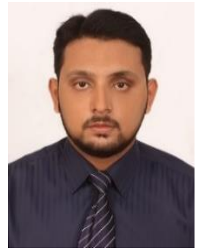

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