AODV and AntHocNet for Mobile Ad Hoc Networks Performance Evaluation Analysis

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1. Abstract

Different routing protocols used in MANET have impact on the performance of the network. Lack of knowledge is the cause of concern in decision making. In this paper we made a comparative study of two well known routing protocols such as Ad-hoc On Demand Distance Vector (AODV) and AntHocNet through simulations. We evaluate the performance of the two protocols by using ns-2.34 with different simulation environments. The metrics used to evaluate performance include packet delivery ratio (PDR), normalizing routing load, average delay, average throughput, average jitter, and routing overhead at different pause times, different number of nodes, different Simulation Time and different node speeds. Our extensive simulations revealed interesting results. AntHocNet showed poor performance in all aspects when compared with AODV.

Index Terms – MANET, routing protocols, AODV, ANTHOCNET

2. INTRODUCTION

Mobile Ad Hoc Network (MANET) is flexible, self organized and quickly deployable network that can be used for communications when there is a situation where normal communications are disrupted or demolished. MANET has become ubiquitous and used widely as and when required [1]. Ad-hoc On Demand Distance Vector (AODV) is one of the routing protocols in MANET which is widely used as it supports both unicast and multicast routing [2]. Reducing overhead in MANET is very important research area in MANET. Besides, energy efficiency is essential in the network as it is energy constrained [3]. Mobility has its impact on the routing protocols. Different routing protocols in MANET provide different performance with respect to mobility [10]. MANETs can be integrated with other networks including Internet for higher utility [12]. AntHocNet is another protocol which is being used in MANET. In this paper we compare these two protocols and evaluate their performance with different environments, different metrics at different nodes, pause times and areas.

Our main contribution in this paper is performance evaluation of AODV and AntHocNet in different simulation environments using various performance metrics such as PDR, normalizing routing load, average delay, average throughput, average jitter, and routing overhead at different pause times, different number of nodes, and different speeds. The remainder of the paper is structured as follows. Section II reviews relevant literature. Section III provides proposed methodology. Section IV presents experimental results while section V concludes the paper besides providing directions for future work.

2.1 RELATED WORKS

This section reviews relevant literature for useful insights. Kumar *et al*. [4] compared many routing protocols of MANET such as DSR, AODV, DSDV, and OLSR. Their observations conclude that AODV performed when with respect to average delay while DSR proved to be better in case of routing overhead and packet delivery ratio. Ade and Tijare [5] did similar kind of research. They made comparison between protocols in terms of multicast routes, distributed nature, unidirectional link support, multicast, periodic broadcast, QoS support, routes maintained and reactive or proactive nature. They concluded that AODV performed better in many aspects. For small number of nodes, they observed, the performance of DSDV was better. Year another research similar to that of [4] and [5] is in [15] where performance of DSR, AODV, DSDV and OLSR protocols were evaluated. Ning and Sun [6] explored AODV further to know its vulnerabilities for internal attacks. Rout discovery and route maintenance in AODV are reasonably efficient [7].

Khamayseh *et al*. [8] proposed a Mobile Aware AODV and proved that the new protocol outperforms original AODV in terms of packet delivery ratio and overhead. The mobility aware nature of the new protocol has improved the performance significantly. MANET is explored as Peer to Peer (P2P) network in [9]. The new protocol named MANET Anonymous Peer to Peer Communication Protocol (MAPCP) was proved to be good and resilient to passive attacks. Kaushik and Deshmukh [11] explored the effectiveness of the routing protocols such as DSR, AODV and DSDV in MANETs. They concluded that for real time traffic AODV is better than the other two protocols. When there is less mobility and less number of nodes DSDV performed better.

Park *et al*. [13] proposed a new protocol known as Cross-layered Multipath AODV (CM-AODV) that can support many routes on demand. Their experiments revealed that the CM-AODV performed better than other such protocols in terms of end to end delay and packet delivery ratio. Dhurandher *et al*. [14] proposed a protocol named Energy Efficient Ad Hoc On Demand Routing (EEAODR) protocol that focused on energy efficient routing and outperformed the original AODV protocol in terms of serving network with less energy consumed. Since the energy plays a vital role in energy constrained network, the EEAODR protocol can play a vital role in reducing energy consumption significantly. Migas *et al*. [16] explored mobile agents for the purpose of route discovery and route maintenance in MANET. The mobile agents could increase performance of the network.

3. PROPOSED METHODOLOGY

In this paper our aim is to evaluate performance differences between AODV and AntHocNet. Towards this end, our methodology described here guides to make empirical study through simulations to achieve the goal. Different environmental parameters might be able to have impact on the routing protocols. Therefore we determined to use various environments to evaluate the protocols. The performance metrics we considered for evaluation include PDR, normalizing routing load, average delay, average throughput, average jitter, and routing overhead. These metrics are used at different node speeds, different pause times, different

Simulation Times and different number of nodes in MANET. The rationale behind this is to bring about more useful insights between the two protocols.

4. SIMULATION RESULTS

Extensive simulations are made using NS2 to demonstrate the differences between the two routing protocols such as AODV and ANTHOCNET used in MANET. Simulations are made with different environments to capture the true dynamics of the protocols. The experiments are made in terms of packet delivery ratio (PDR), normalization of routing load, average delay, average throughput, average jitter, and routing overhead. The following are the simulation environments and the results when the aforementioned factors compared between AODV and ANTHOCNET.

4.1 Simulation Environment table when number of nodes increases

Routing Protocols	AODV,ANTHOCNET
Simulation Time	300
Area (sq.m)	1000x1000
Propagation Model	Two Ray
Traffic	CBR
Packet Size	512
Nodes	20,60,100,140,180
Antenna Type	Omni directional
Transmission range	250m
Receiver range	250m
Pause time	0sec
Minimum speed	1m/s
Maximum speed	15m/s
Node Placement Model	Random
Mobility Model	Random Waypoint

As shown in Table 4.1, when nodes are increases the environment is used to simulate MANET with two routing protocols AODV and ANTHOCNET in order to realize the performance difference pertaining to parameters are routing overhead, packet delivery ratio (PDR), normalization of routing load, average end to end delay, average throughput, and average jitter.

4.1 Simulation Environment figures when increases number of nodes

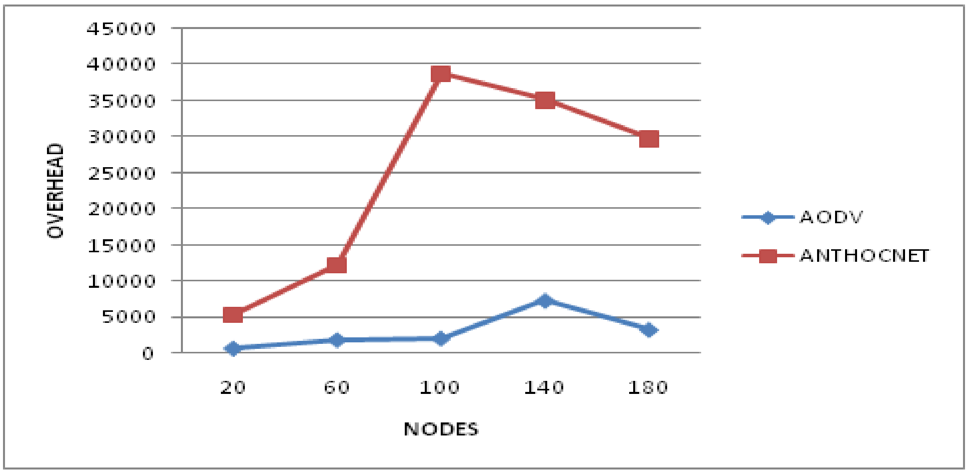

Figure 4.1.1 Overhead for AODV and ANTHOCNET

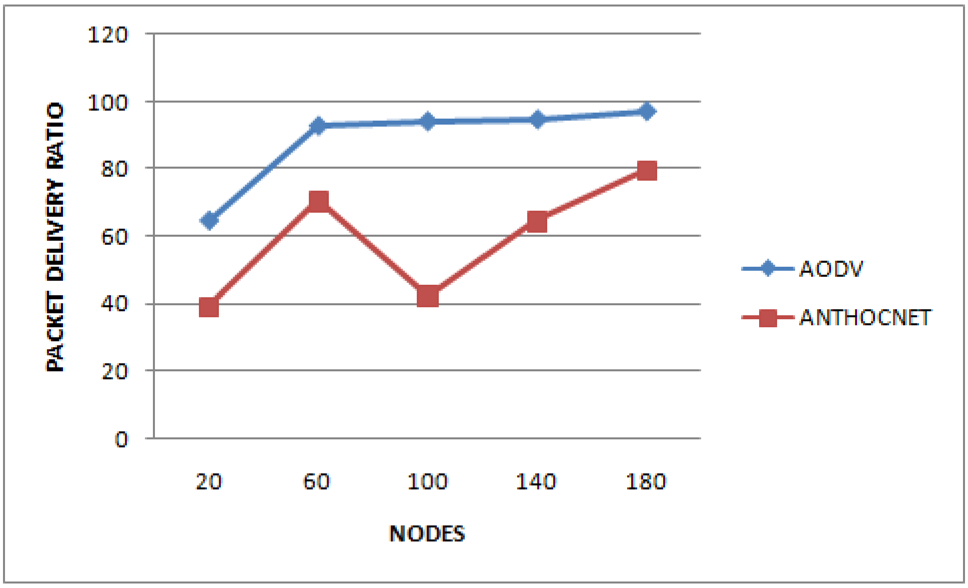

Figure 4.1.2 Packet Delivery Ratio for AODV and ANTHOCNET

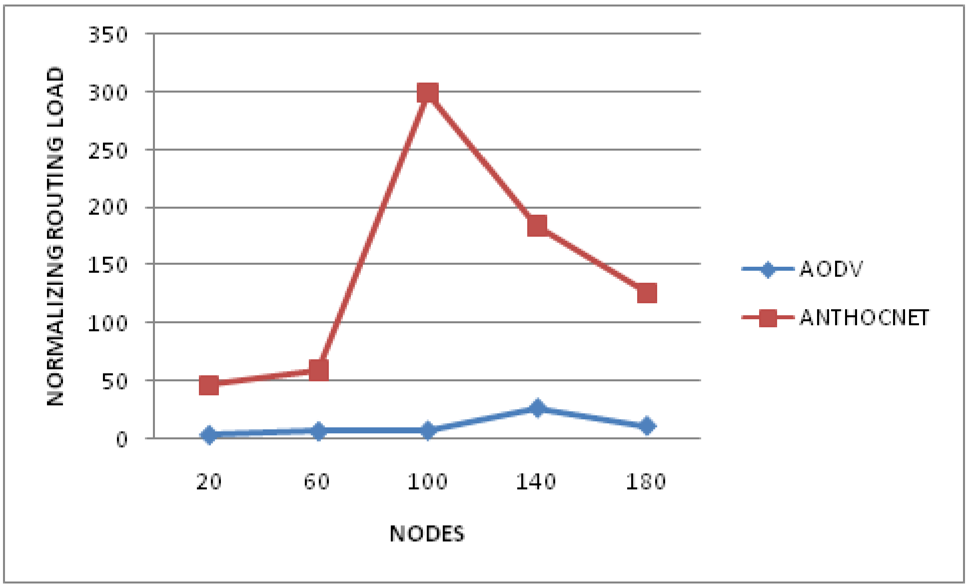

Figure 4.1.3 Normalizing Routing Load for AODV and ANTHOCNET

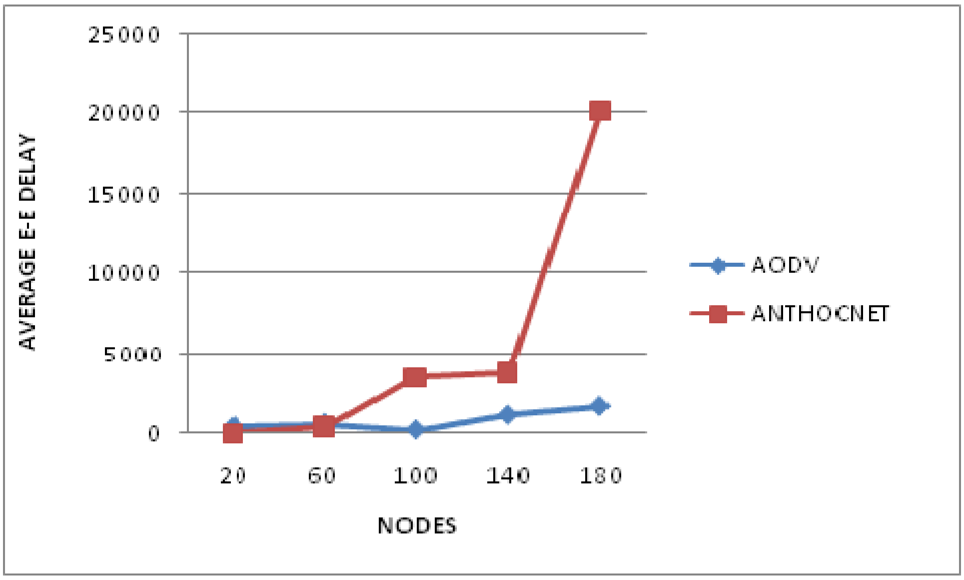

Figure 4.1.4 Average E-E Delay for AODV and ANTHOCNET

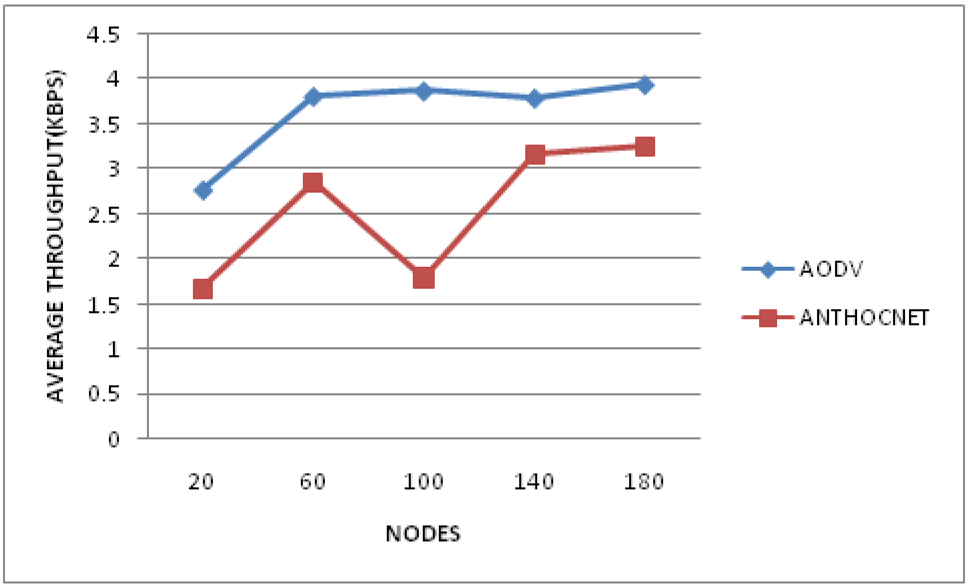

Figure 4.1.5 Average Throughput for AODV and ANTHOCNET

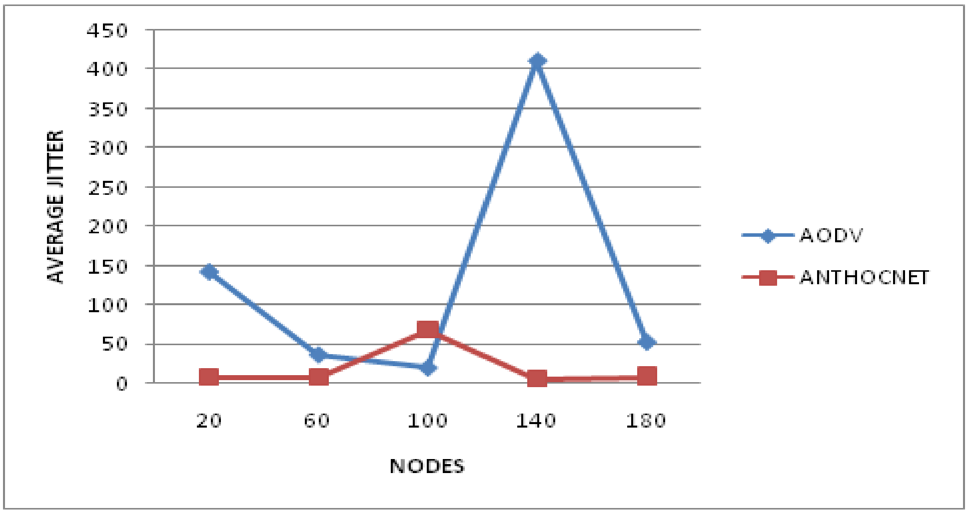

Figure 4.1.6 Average Throughput for AODV and ANTHOCNET

In the above figures 4.1.1, 4.1.2, 4.1.3, 4.1.4, 4.1.5 and 4.1.6 shows that there is significant performance difference between AODV and ANTHOCNET. The horizontal axis represents number of nodes while the vertical axis represents routing overhead, packet delivery ratio (PDR), normalization of routing load, average end to end delay, average throughput, and average jitter respectively. The figures 4.1.1 to 4.1.5 show the performance of AODV is better than the performance of ANTHOCENT. The figure 4.1.6 shows that the average jitter value of ANTHOCNET is better than AODV when nodes are increased (above 100 nodes). So, the results reveal that the AODV protocol is outperforming ANTHOCNET with respect to all parameters below 100 nodes.

4.2 Simulation Environment table when node speed increases

Routing Protocols	AODV,ANTHOCNET
Simulation Time	300
Area (sq.m)	1000x1000
Propagation Model	Two Ray
Traffic	CBR
Packet Size	512
Nodes	100
Antenna Type	Omni directional
Transmission range	250m
Receiver range	250m
Pause time	0sec
Minimum speed	1m/s
Maximum speed	5,10,15,20,25m/s
Node Placement Model	Random
Mobility Model	RandomWaypoint

As shown in Table 4.2, when nodes speed increases the environment is used to simulate MANET with two routing protocols AODV and ANTHOCNET in order to realize the performance difference pertaining to parameters are packet delivery ratio (PDR), normalization of routing load, average delay, average throughput, average jitter, and routing overhead.

4.2 Simulation Environment Figures when node speed increases

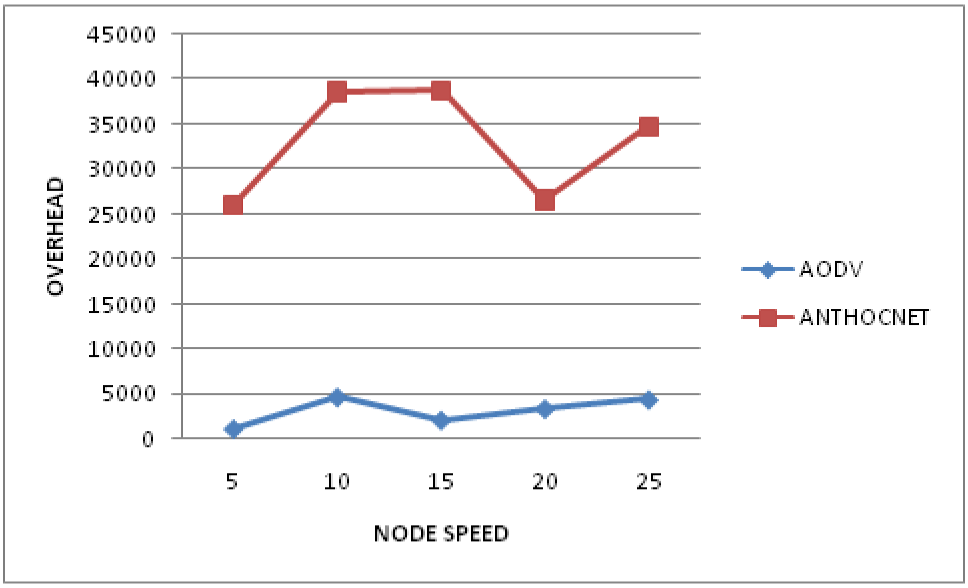

Figure 4.2.1 Overhead for AODV and ANTHOCNET

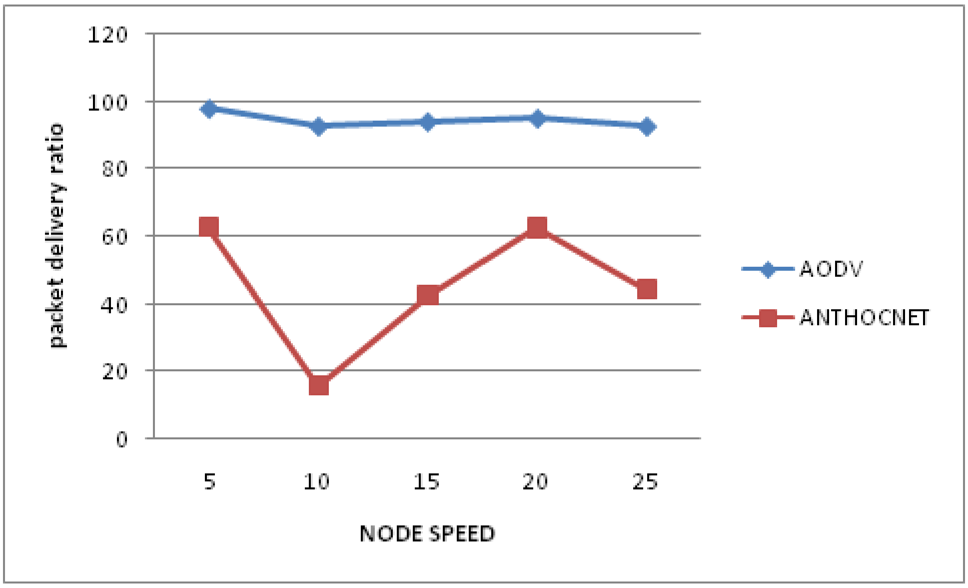

Figure 4.2.2 Packet Delivery Ratio for AODV and ANTHOCNET

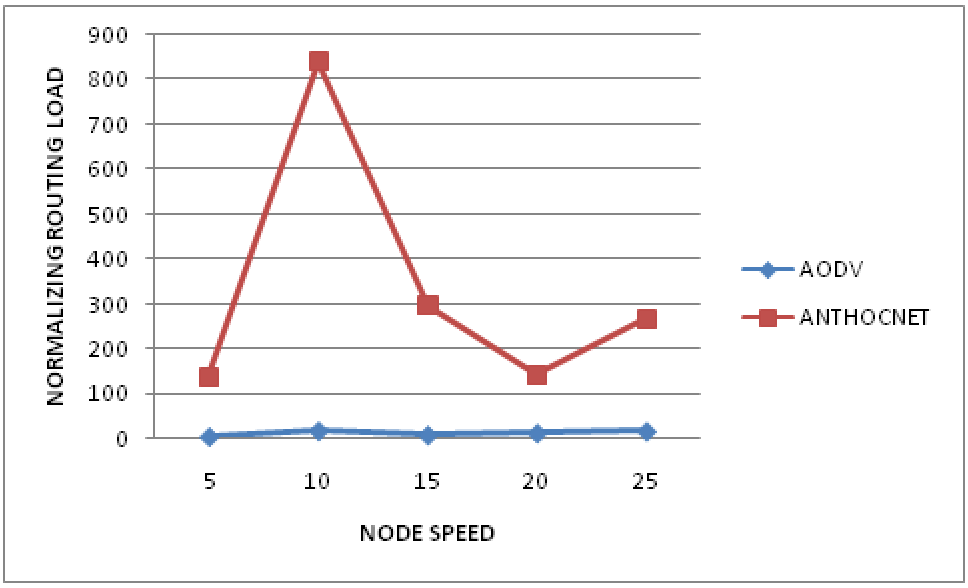

Figure 4.2.3 Normalizing Routing Load for AODV and ANTHOCNET

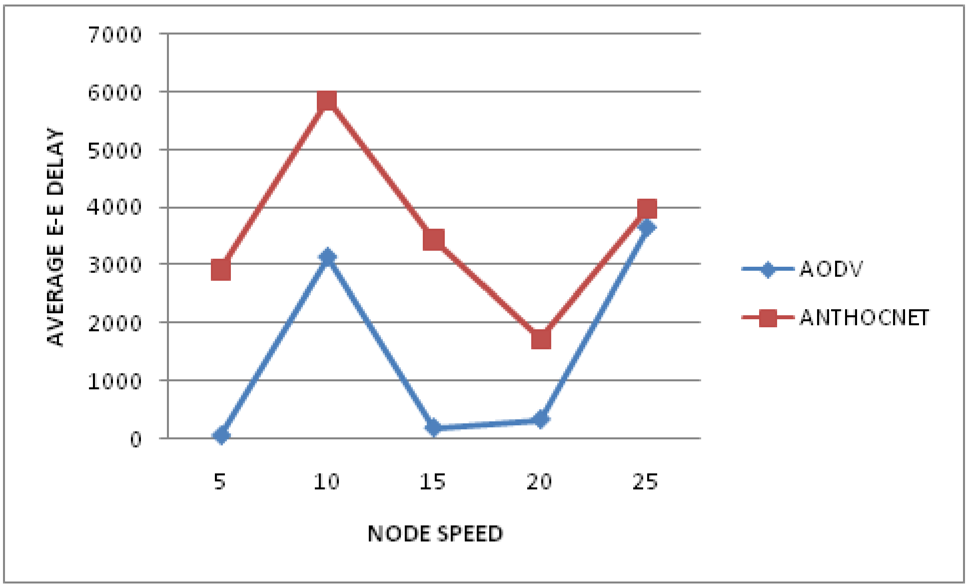

Figure 4.2.4 average delay E-E Delay for AODV and ANTHOCNET

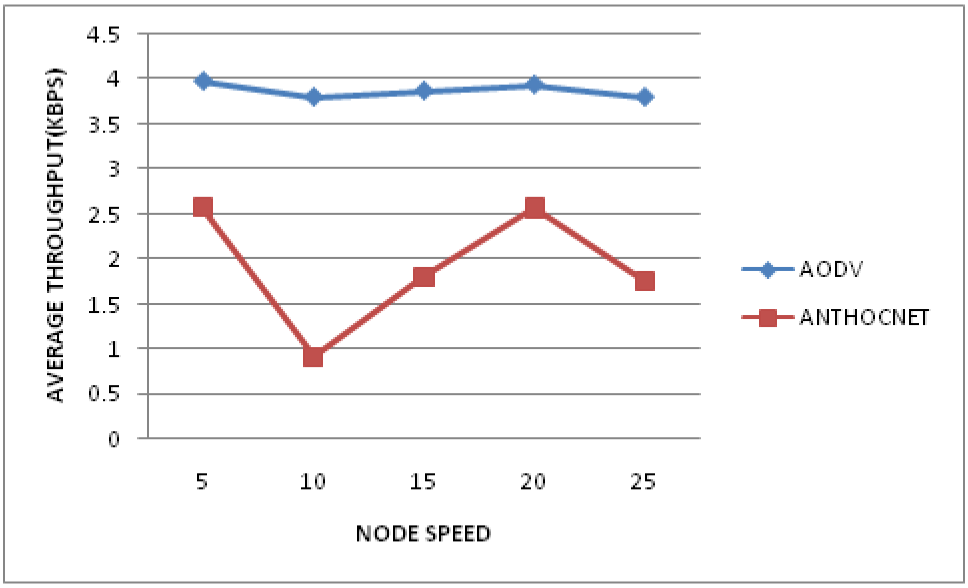

Figure 4.2.5 Average Throughput for AODV and ANTHOCNET

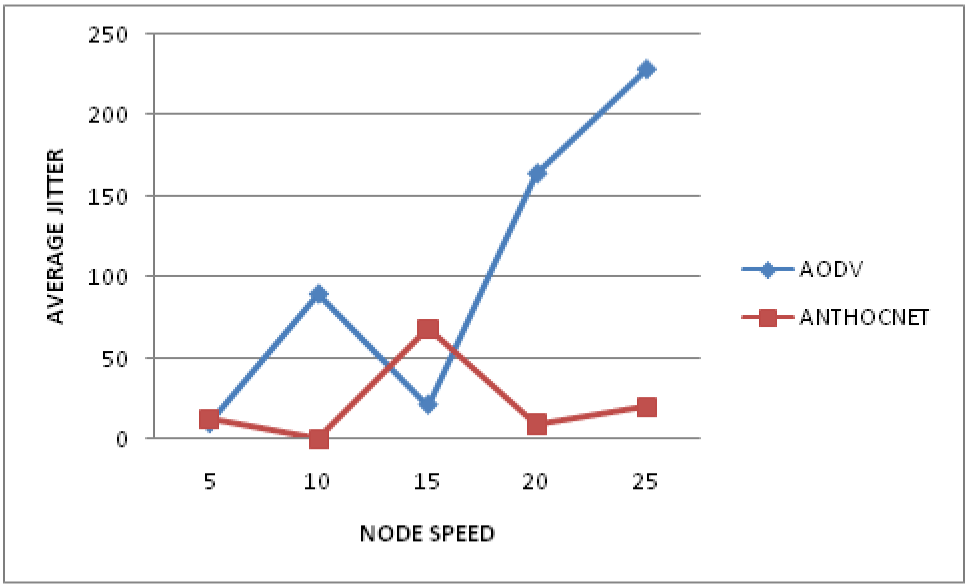

Figure 4.2.6 Average Jitter for AODV and ANTHOCNET

In the above figures 4.2.1, 4.2.2, 4.2.3, 4.2.4, 4.2.5 and 4.2.6 shows that, it is an evident that there is significant performance difference between AODV and ANTHOCNET. The horizontal axis represents number of nodes while the vertical axis represents routing overhead, packet delivery ratio (PDR), normalization of routing load, average end to end delay, average throughput, and average jitter respectively. The figures 4.2.1 to 4.2.5 show the performance of AODV is better than the performance of ANTHOCENT. The figure 4.2.6 shows that the average jitter value of ANTHOCNET is better than AODV when node speed values are increased (node speed value is above 15). So, the results reveal that the AODV protocol is outperforming ANTHOCNET with respect to all parameters below node speed value 15.

4.3 Simulation Environment table when pause time increases

Routing Protocols	AODV,ANTHOCNET
Simulation Time	300
Area (sq.m)	1000x1000
Propagation Model	Two Ray
Traffic	CBR
Packet Size	512
Nodes	100
Antenna Type	Omni directional
Transmission range	250m
Receiver range	250m
Pause time	0,60,120,180,240,300sec
Minimum speed	1m/s
Maximum speed	15m/s
Node Placement Model	Random
Mobility Model	Random Waypoint

As shown in Table 4.3, when pause time increases the environment is used to simulate MANET with two routing protocols AODV and ANTHOCNET in order to realize the performance difference pertaining to parameters are packet delivery ratio (PDR), normalization of routing load, average delay, average throughput, average jitter, and routing overhead.

4.3 Simulation Environment Figures when pause time increases

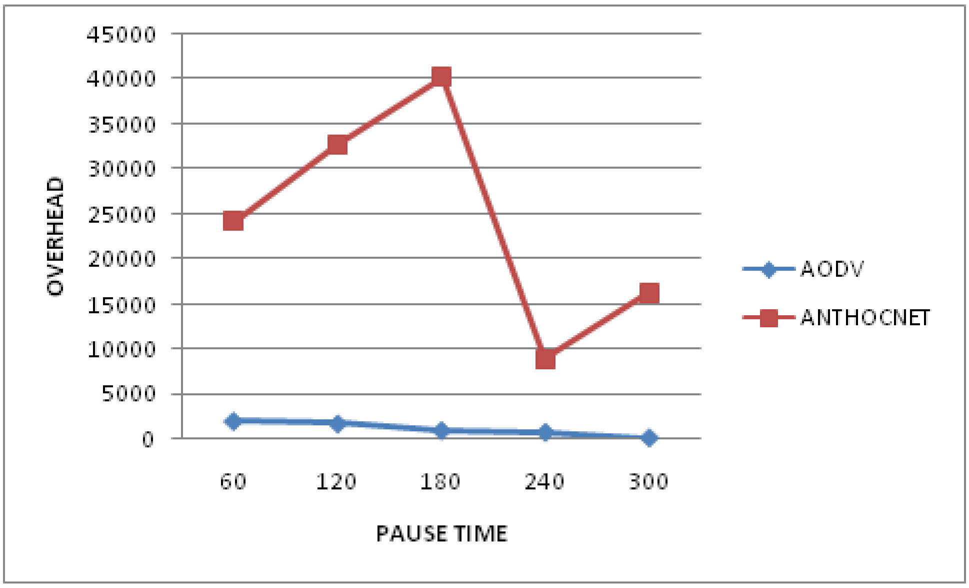

Figure 4.3.1 Overhead for AODV and ANTHOCNET

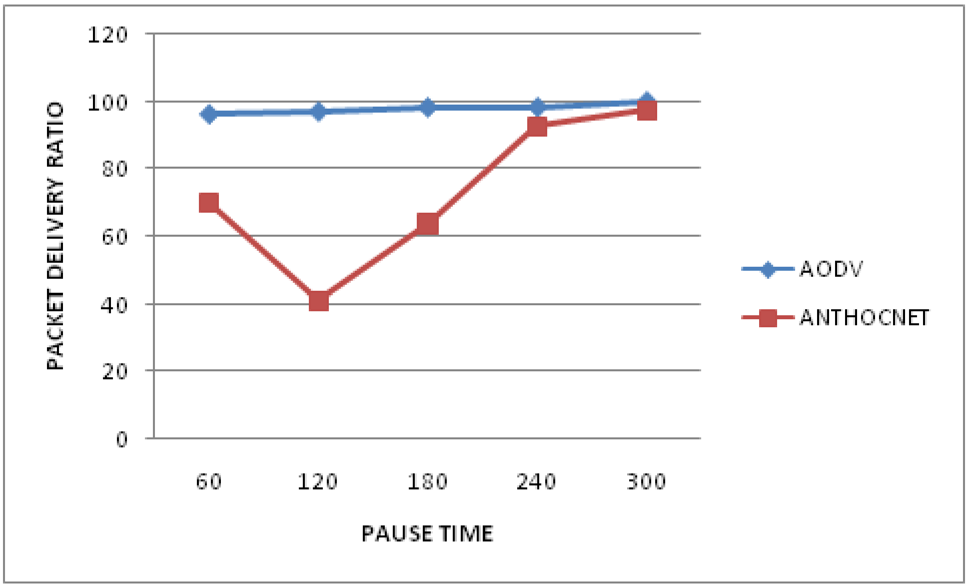

Figure 4.3.2 Packet Delivery Ratio for AODV and ANTHOCNET

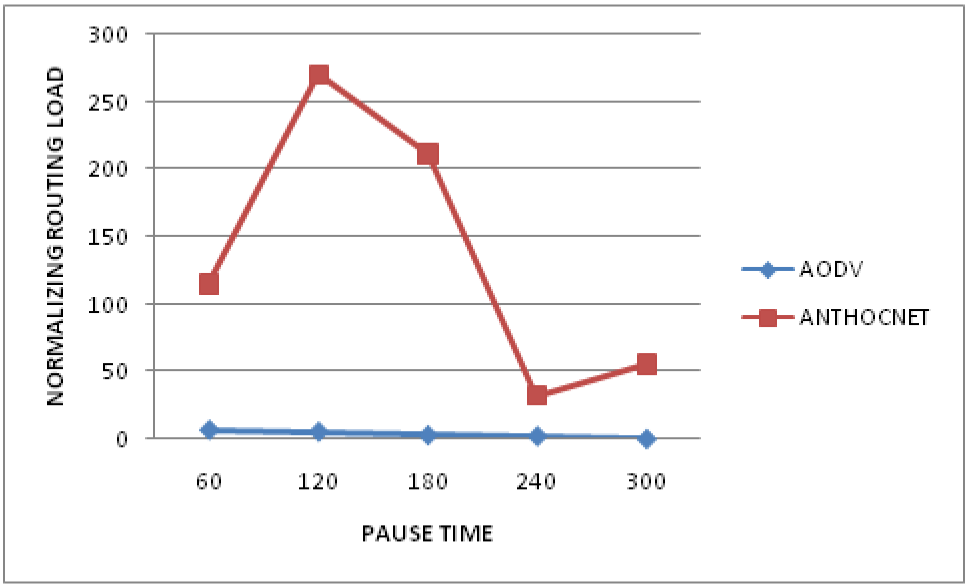

Figure 4.3.3 Normalizing Routing Load for AODV and ANTHOCNET

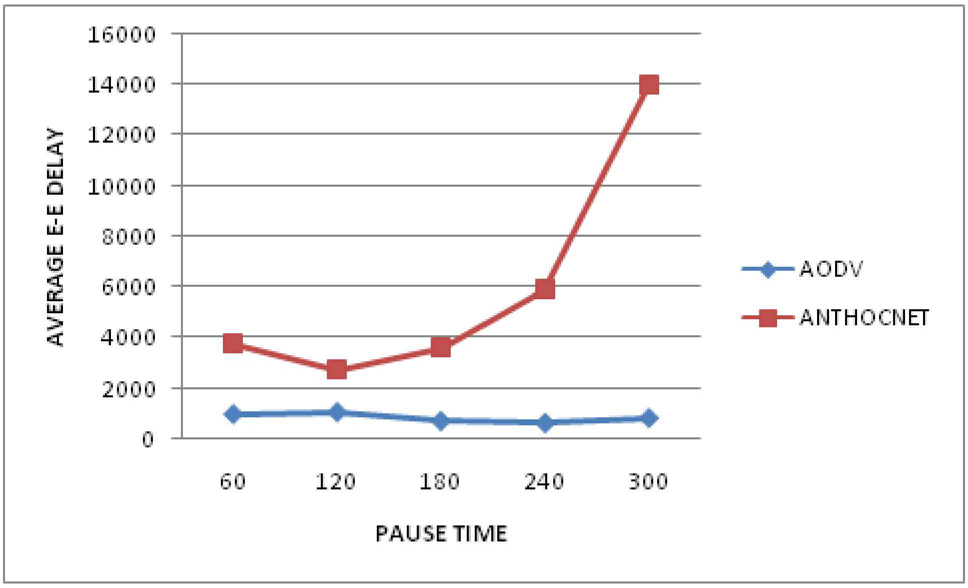

Figure 4.3.4 Average E-E Delay for AODV and ANTHOCNET

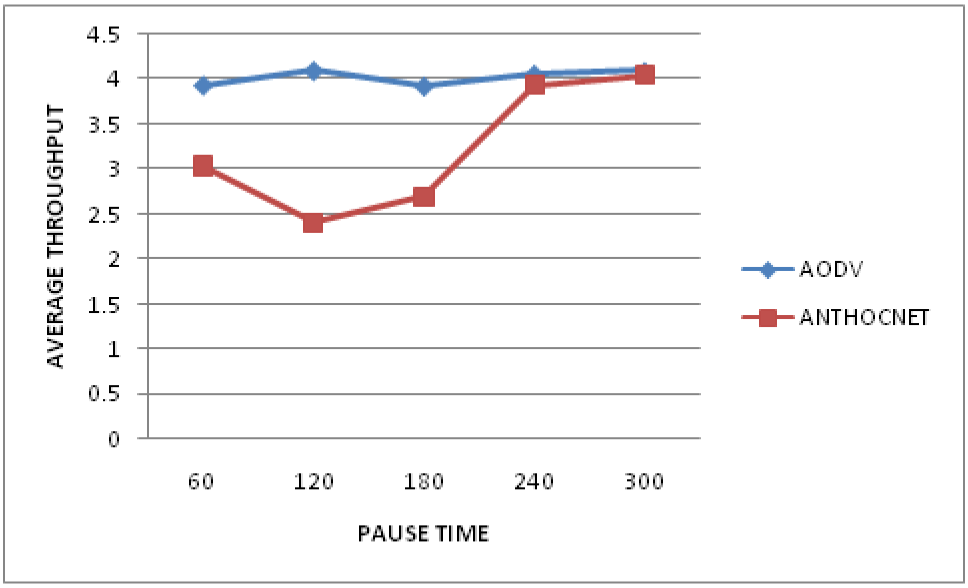

Figure 4.3.5 Average Throughput for AODV and ANTHOCNET

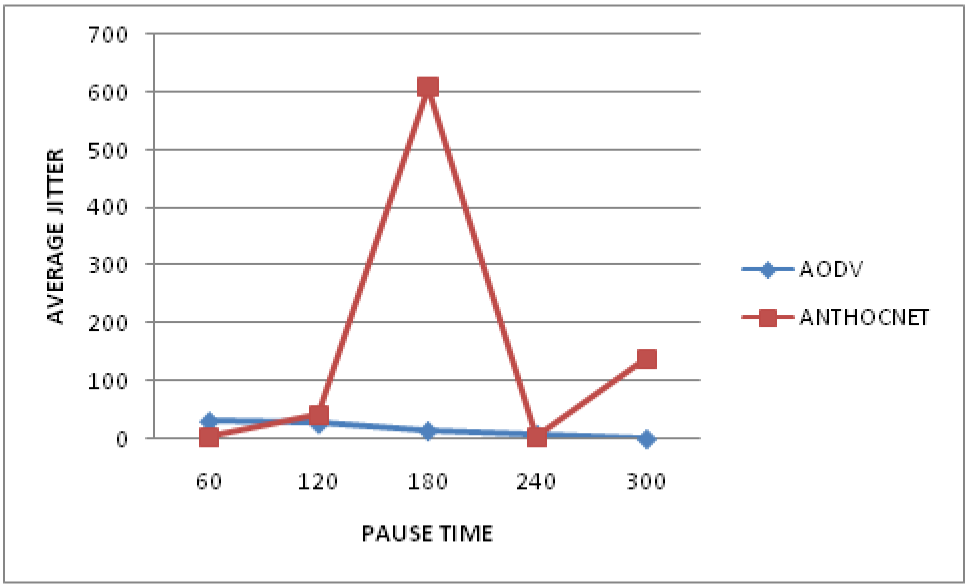

Figure 4.3.6 Average Jitter for AODV and ANTHOCNET

In the above figures 4.3.1, 4.3.2, 4.3.3, 4.3.4, 4.3.5 and 4.3.6 shows that, it is an evident that there is significant performance difference between AODV and ANTHOCNET. The horizontal axis represents number of nodes while the vertical axis represents routing overhead, packet delivery ratio (PDR), normalization of routing load, average end to end delay, average throughput, and average jitter respectively. So, the results reveal that the AODV protocol is outperforming ANTHOCNET with respect to all parameters.

4.4 Simulation Environment table when simulation time increases

Routing Protocols	AODV,ANTHOCNET
Simulation Time	180,300,420,540
Area (sq.m)	1000x1000
Propagation Model	Two Ray
Traffic	CBR
Packet Size	512
Nodes	100
Antenna Type	Omni directional
Transmission range	250m
Receiver range	250m
Pause time	0sec
Minimum speed	1m/s
Maximum speed	15m/s
Node Placement Model	Random
Mobility Model	RandomWaypoint

As shown in Table 4, when Simulation Time increases the environment is used to simulate MANET with two routing protocols AODV and ANTHOCNET in order to realize the performance difference pertaining to parameters are packet delivery ratio (PDR), normalization of routing load, average delay, average throughput, average jitter, and routing overhead.

4.4 Simulation Environment Figures when simulation time increases

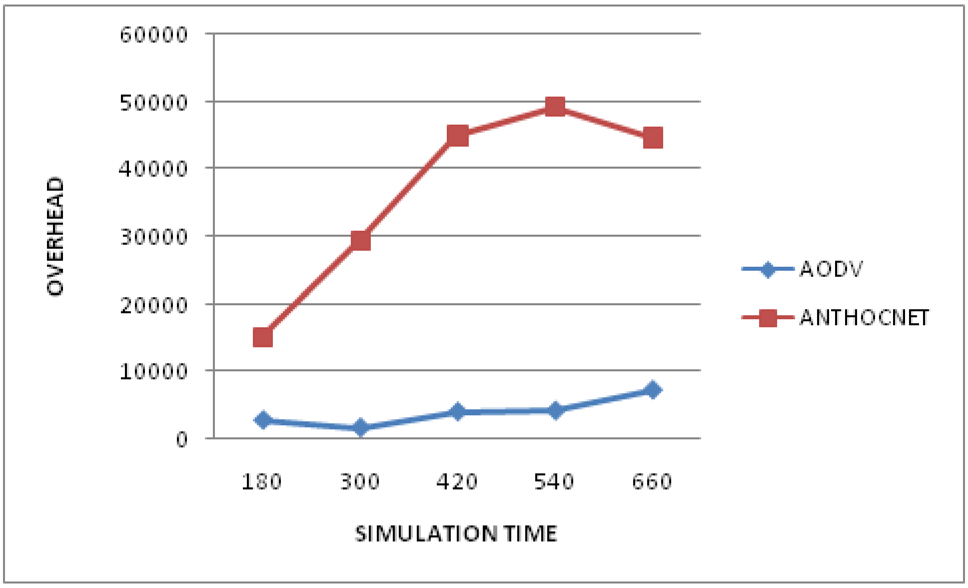

Figure 4.4.1 Overhead for AODV and ANTHOCNET

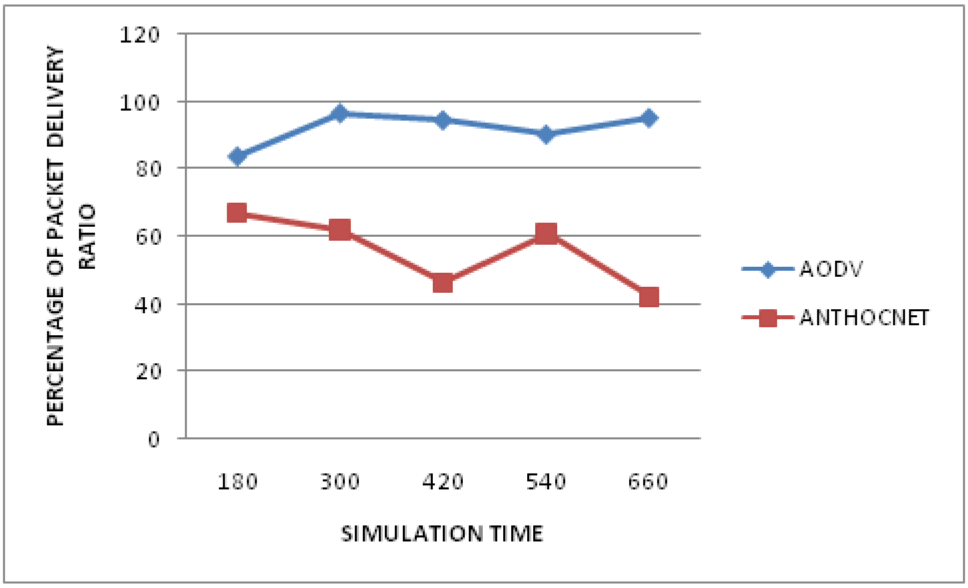

Figure 4.4.2 Packet Delivery Ratio for AODV and ANTHOCNET

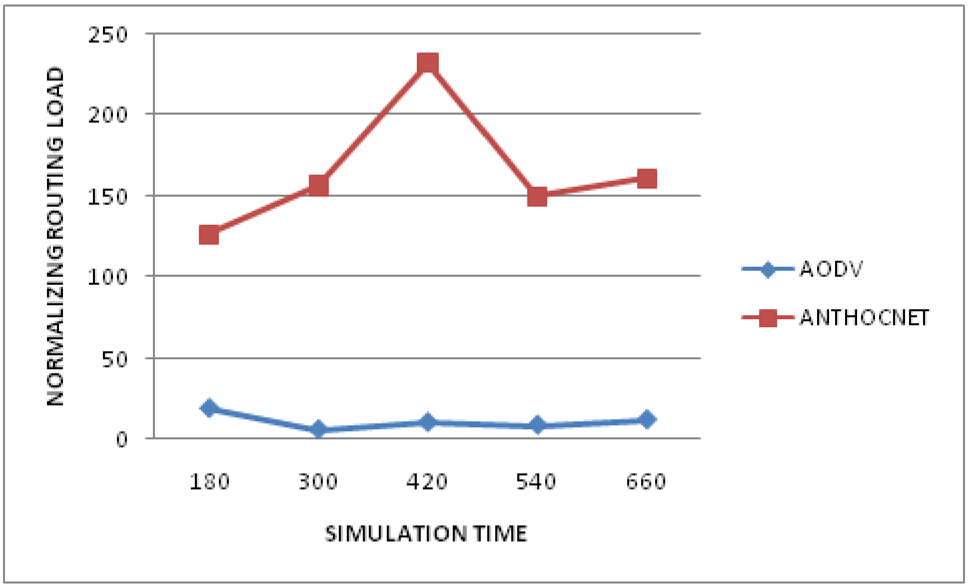

Figure 4.4.3 Normalizing Routing Load for AODV and ANTHOCNET

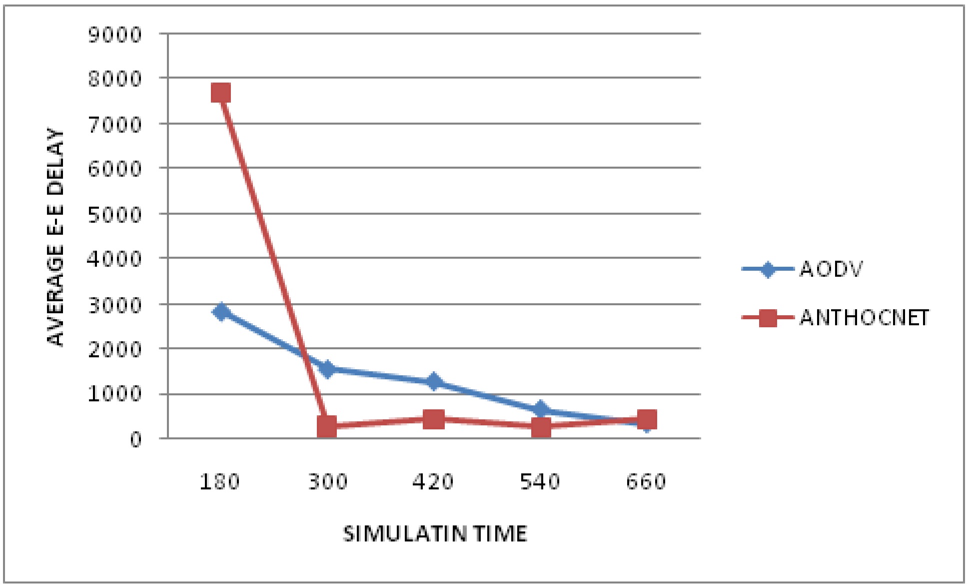

Figure 4.4.4 Average E-E Delay for AODV and ANTHOCNET

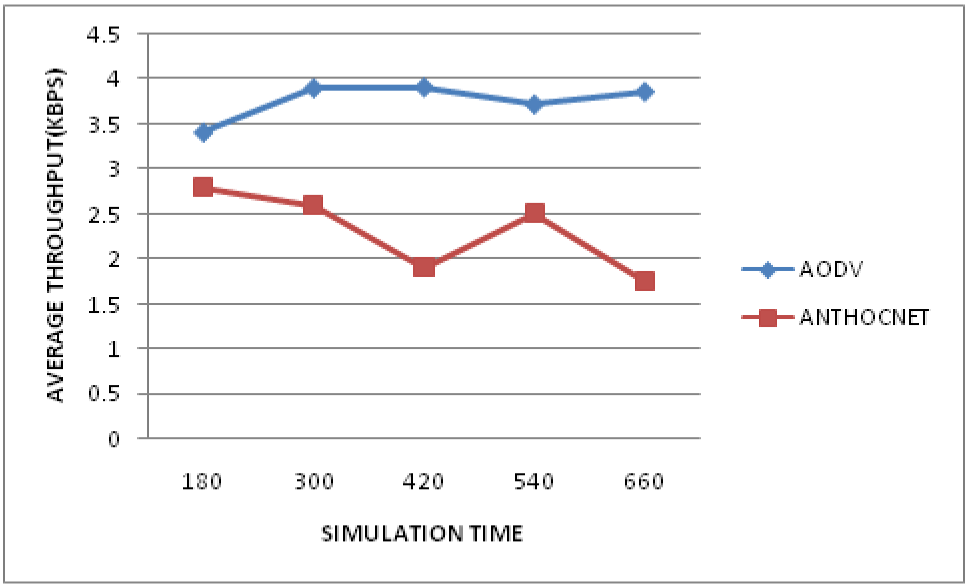

Figure 4.4.5 Average Throughput for AODV and ANTHOCNET

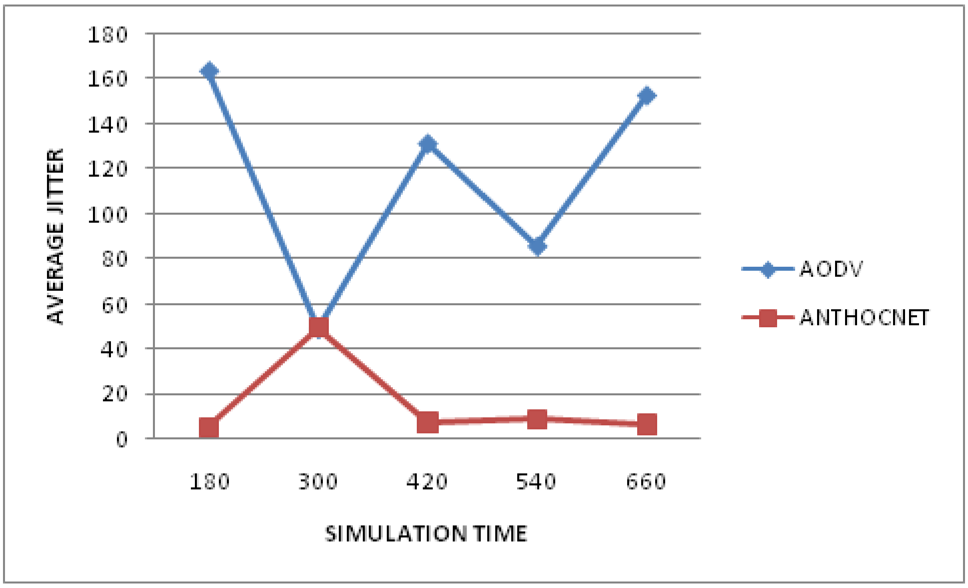

Figure 4.4.6 Average Throughput for AODV and ANTHOCNET

In the above figures 4.4.1, 4.2.2, 4.3.3, 4.4.4, 4.5.5 and 4.6.6 shows that, it is an evident that there is significant performance difference between AODV and ANTHOCNET. The horizontal axis represents number of nodes while the vertical axis represents routing overhead, packet delivery ratio (PDR), normalization of routing load, average end to end delay, average throughput, and average jitter respectively. The figures 4.4.1 to 4.3.3 and 4.4.5 show the performance of AODV is better than the performance of ANTHOCENT. The figures 4.4.4 and 4.4.6 show the parameters a value of ANTHOCNET is better than AODV when simulation time values are increased.

CONCLUSIONS AND FUTURE WORK

In this paper, we studied the two routing protocols widely used in MANET. AODV and ANTHOCNET are the protocols that were compared with respect to their routing abilities. The performance metrics considered in the simulation experiments using NS2 include PDR, normalizing routing load, average delay, average throughput, average jitter, and routing overhead. With respect to PDR, AODV shows high performance. With respect to normalizing routing load ANTHOCNET's performance is low when compared to that of AODV. In similar fashion when node speed value is increased, the most of parameter performances of AODV outperforms ANTHOCNET. In same way, pause time value increase then the performance of AODV is better than ANTHOCNET. Except average end-to-end delay and average jitter values are very performed ANTHOCNET then AODV, contrast the remaining parameters very better in AODV. These experiments were carried out in different simulation environments. From the results, it can be concluded that ANTHOCNET shows poor performance for smaller networks while AODV performance significantly better with many respects aforementioned. An important direction for future work is to investigate and improve ANTHOCNET protocol so that it can perform better for smaller networks as well.

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