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Simulation Analysis of Route Establishment With Improved Aodv Protocol In Manet.

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Abstract

In everyday communication, wireless networks conduct a prominent role. Ad-hoc networks are one of the forms of this wireless network that belongs to infrastructure-less wireless networks. The ad-hoc network consists of mobile nodes freely moving around and communicating with each other. The ad-hoc wireless networks do not need any centralization and therefore can be formed anywhere anytime. Due to the mobile nature of the nodes it is difficult to design a proficient network. In this paper, I have compared and evaluated three routing protocols AODV, DSDV and DSR in terms of their performance parameters viz. end-to-end delay, throughput and packet loss by varying number of packets. Also, an improved AODV is proposed for route establishment by using the optimization techniques. The hybrid of bee colony and cuckoo search is used. It is seen that AODV used with hybrid optimization techniques showcases better performance than normal AODV in terms of end-to-end delay, throughput and packet loss as it uses the optimized path for routing between source and destination.

Keywords: AODV, Be-colony optimization, DSDV, Cuckoo search algorithm, DSR, Improved AODV.

I. INTRODUCTION

Mobile ad-hoc networks are self-configured networks that use the wireless connections to communicate with each other. Thus, are also known as infrastructure-less networks. Nodes in Mobile ad-hoc networks are free to move, this movement of nodes makes routing a great challenge. Also, due to random topology of manet, node mobility may change rapidly and unexpectedly [1]. A manet is becoming popular and consumer friendly because it allows the consumer to use the information at anytime from anywhere. As discussed earlier, mobility of nodes makes routing challenging task. Routing is the major issue that affects the performance of dynamic network. Routing is the selection of optimum path in a network. The aim of routing algorithm is to enhance the network performance whilst cutting the costs. Various protocols have been designed with the object of routing. The taxonomies of routing protocols are as: Proactive, Reactive and Hybrid [2-4]. *Proactive Protocols* maintain their up-to-date routing tables that contain routing information. In proactive protocols a mobile nodes broadcast its entire information in the network. The main aim is to maintain the global topology information. DSDV, OLSR are some examples of proactive routing protocols. *Reactive Protocols* compute the route to the destination when required. It does not maintain any routing table unlike proactive protocols. Since the routing is initiated only when packets are about to be transmitted and hence termed as on-demand routing protocols [5-6]. AODV and DSR are some of its examples. ZRP and ZHLS are some of the hybrid protocols employed for hierarchical routing.

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Researchers have recommended numerous protocols in order to provide wireless communication. In this paper, to choose the best protocol for routing, the comparison between AODV, DSDV, in addition to DSR protocols is done based on certain QoS parameters such as end-to-end delay, throughput and packet loss by varying number of nodes and no of packets. Also path establishment for AODV protocol is done by using optimization approaches. Optimization approaches are becoming hub for researchers as they are successful in executing complicated task of routing through simple agents. The various optimization techniques are swarm optimization, Ant colony optimization and Bee colonies etc. [6]. We aim to study routing algorithm for path establishment in Manet for AODV protocol using the hybrid of bee colony and Cuckoo Search.

II. RELATED WORK

Routing in manet is a stimulating task and has experienced tremendous recognition from researchers around the globe. Some of the previous related researches done in order to find the suitable routing protocol along with certain optimization techniques to enhance the performance of routing are discussed below:

Rahul Desai and B.P. Patil [1] evaluated the comparison between AODV and DSDV by comparing certain parameters like throughput, end-to end delay and packet delivery ratio under different load conditions and mobility pattern. The simulation environment used was NS-2. Random waypoint mobility model was opted for mobility at the rate of 200 sec per simulation. Different mobility patterns were recorded for distinguished pause timings. It was observed that DSDV returns poor results as number of nodes were increased. Also it was seen that AODV and DSR attains packet delivery ratio greater than 95%. Also it was observed that routing overhead was high for proactive protocols such as DSDV and OLSR thus, making them effective only for low loads and less mobility applications whereas reactive protocols were more effective in high traffic environment.

Tanya K. Araghi et. al. compared and analyzed AODV, AOMDV and DSR using NS-2 environment [2] and the results showed the performance enhancement in AODV and AOMDV. From the performance metric used it was observed that end to end delay provided by AOMDV was beneath AODV and DSR.

Savita Gandhi et. al. presented the execution of DSDV, AODV and ZRP. The simulations resulted in [3] performance variations across different network sizes. The performance analysis of AODV is superior from remaining two routing protocols also average e2e delay was less for DSDV and didn't alter even after increasing the number of nodes.

Jagdeep Kaur and Rupinder Kaur Gurm used intelligence optimization algorithm to find shortest path for sending data in the mobile ad-hoc network using Cuckoo search optimization (CSO) algorithm [4]. It was observed that CSO algorithm finds optimal route from start to end apart from reducing congestion in AODV routing protocol. It was examined that AODV with CSO consumed less energy.

S. Surendran and S. Prakash proposed QoS entrenched multipath routing in manet based on ACO-look ahead approach. The simulations were performed with NS-2 which showed that Proposed ACO algorithm performs 20%-30% better and completely satisfied the QoS constraints [5].

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B. Nancharaiah and B. Chandra Mohan proposed Ant Colony and Cuckoo search optimization [6] as hybrid optimization technique for AODV enhancement and average end-to-end delay.

III. MANET PROTOCOLS

1. DSDV: - DSDV proposed by C. Perkins and P. Bhagwat in 1994 uses a table-driven approach in which the routing information is stored in the forms of tables [1,7]. Routing information is transmitted steadily in order to sustain routing table consistency. To look after the looping problem, each item in the table is labelled by a serial number. The routing table in DSDV employs two kinds of table updates: full dump update and incremental update. These updates reduce the network traffic. Regular updates of DSDV's routing table consume more battery power. Small fraction of bandwidth is consumed despite the network is idle. Change in network's topology seeks a new serial number before the network converges and hence not suitable for highly random networks.

2. AODV: - AODV protocol relies on pure on-demand route acquisition system in which they decide the route to destination on demand. AODV avails sequence number which makes it different from other on-demand routing protocols. The sequence number ensures the loop-free routing and also assures the freshness of the packets [8]. In order to initiate the routing, AODV broadcasts the RREQ (Route Request) packets. The RREQ packet holds the address of start and end node, broadcast Id, source sequence number and the destination sequence number. The RREQ is in turn broadcasted to the neighbors until it reaches the destination via the intermediate nodes. Each neighbor satisfied with RREQ replies with RREP. The figure 1 shows the route discovery process: RREQ and RREP.

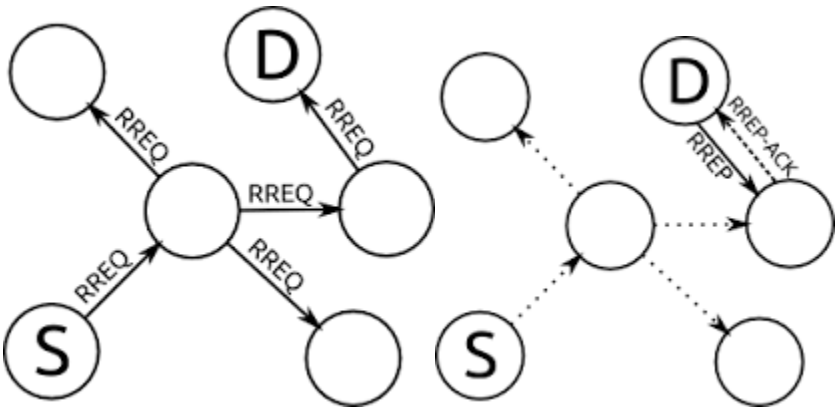

Figure 1-Route Discovery: (i) RREQ (ii) RREP

AODV permits motile users to acknowledge to path breakages and variation in network topology in a periodic way. The main power of AODV routing protocol provides iteration free routing in addition to destination sequence number to find the latest route destination. The main disadvantage is the more control overhead due to multiple route reply packets in response to single route request. Also, scalability is not possible in AODV protocol.

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3. DSR: - Dynamic source routing (DSR) is an effective and easy protocol that is specifically designed for multi-hop wireless networks [7,8]. Source routing is the distinguishing feature of DSR protocol. Source routing is the approach where sender completely governs the sequence of nodes from where the packet has to pass and it explicitly contains all the information related to the route on to its packet header. DSR comprises of two parts: Route discovery and Route maintenance [9]. Routing discovery method is used only when the source nodes want to send packet to the destination but it does not know the path/route to the destination node. So the source broadcasts the RREQ packet to all its neighbors in order to obtain the path to the destination. As shown in figure 2 the RREQ packets are flooded in to the network.

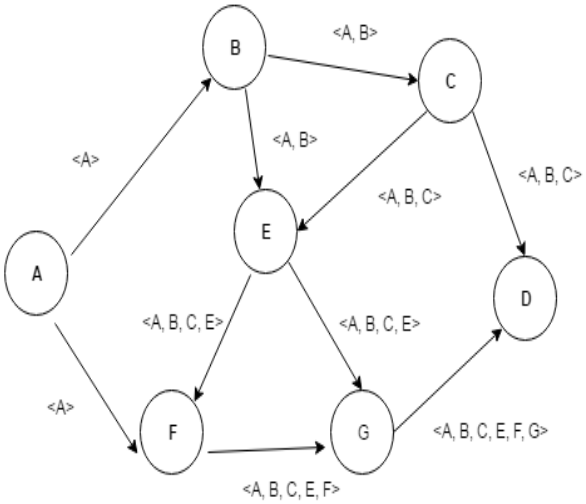

Figure 2- Route Request Flooding

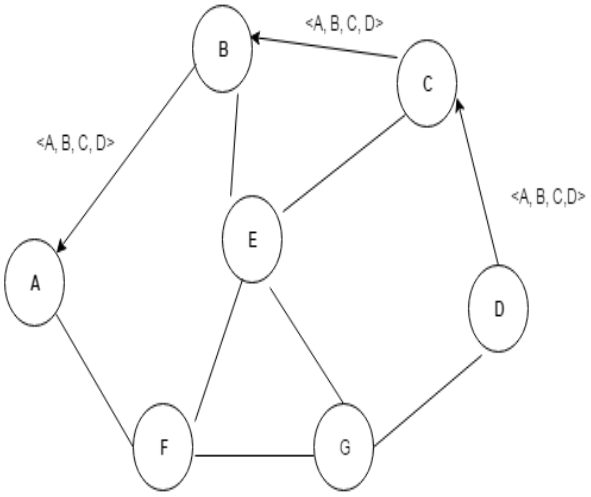

Figure 3- Route Selected between Source and destination.

As embellished in Figure 2, the source node A overflows the network with route request packets. Every junction sums its ID in the packet header until it arrives to the target.

As demonstrated in Figure 3, the path is created between the source and end. The path is picked on the basis of number of hops and serial number [10-12]. The path with least number of hops and higher serial number is picked as the optimal path. The mechanism by which source node is able to detect the faults or broken routes is known as route maintenance.

Different optimization approaches have been employed for the enhancement of DSR. The use of route cache at intermediate nodes reduces the control overhead [10,13]. Unlike AODV, DSR consumes less bandwidth and low battery power.

IV. Optimization techniques based on natural phenomena

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Optimization techniques are those techniques which gives the appropriate solution. These techniques are helpful in solving the complex computational problems [14]. These techniques are usually inspired from natural phenomenon such as Ant Colony Optimization; Bee Colony Optimization etc.[6]. All these techniques are based on swarm intelligence. Swarm intelligence is an AI approach centered on the learning of joint functioning in self-structured and dispersed process. Many insects like bees, ants and wasps live in hive or colonies. The reason that each insect prefer swarm is the effective evolution. They are capable of organizing themselves and exhibit quite astonishing well developed social behavior.

1. Bee Colony Optimization: It is inspired from swarm intelligence approach and is used to find the optimal route from the number of the feasible results. These are large in number which work together and have specific role to play. There is one *Queen* of the bee colony that is responsible for laying eggs which hints to building of other new colonies. *Male Drones* are also in many numbers which intimate with female queen bee to build new colonies. Other bees are the *workers bees* which are hundreds and thousands in number [16]. These workers bees maintain and manage the jobs in the bee hive. The worker bees are of two types: *Scout bees* and *Forager bees*.

Scout bees are present in large quantities which go outside in the search of the food. These bees go randomly in search of the food source of good quality. When these bees are out of energy, they come back to hive. Then, they communicate with the forager bee to tell them the direction of the food. This process is repeated again and again. After the communication forager bees go outside for the collection of the food which is selected by the scout bees. *Forager bees* only go to that direction where best quality food is available [15]. So scout bees are used for the path exploration and forager bees are used for the path selection. Path testing is used in BCO algorithm for selecting paths. In BCO algorithm, maximum numbers of faults are detected in minimum number of time with the help of last forager bee. It is a global optimizer which has operational search process**.**

2. Cuckoo Search Algorithm: It is employed in distinct areas of AI. Previously it was opted for difficult calculus problems [4]. Later it was governed with PSO and Genetic algorithm to get enhanced results. CS algorithm hinge on the practices of obligatory brood parasitism of various species of cuckoo as they lay their eggs in the nest of other host birds of their own species. The three idealized rules that cuckoo search is based on are as follows:

- Each cuckoo lays egg and hovel its egg in an arbitrarily selected roost.
- The nest with high superiority of eggs will be taken to the next generation.
- The number of available host nest is fixed and the worst nests are dumped from further calculation.

Cuckoo search in manet is used for finding shortest path between source and destination. With the use of cuckoo search intelligence the source node finds the shortest path node that consumes less time in sending data to the destination node. It increases the lifetime and QoS of the network.

V. Proposed Methodology

The flowchart in the figure 4 illustrates the path establishment of AODV manet protocol by using the hybrid bee colony and Cuckoo search optimization techniques. Comparative analysis of proactive and reactive routing protocols is done based on QoS parameters such as throughput,

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end-to-end delay and packet loss by varying the number of packets. In this work, improved AODV protocol using optimization approach is proposed. Hybrid of Bee Colony and Cuckoo Search is employed with AODV protocol to demonstrate an optimized route from source to end. Let's suppose route linked from source to target using AODV protocol was 1,3,5,7. The hybrid Bee Colony in addition to Cuckoo search is executed for route connection and path established by them is 1,3,8,7. The source node sorts' junction who is similar in the route and uncommon junctions are analyzed based on interval from the source node. The junction having least interval will be sorted as the hop junction from source to end and the optimized route is established. Also it seen that the hybrid algorithm of intelligence techniques show better throughput and less packet loss as compared to normal AODV.

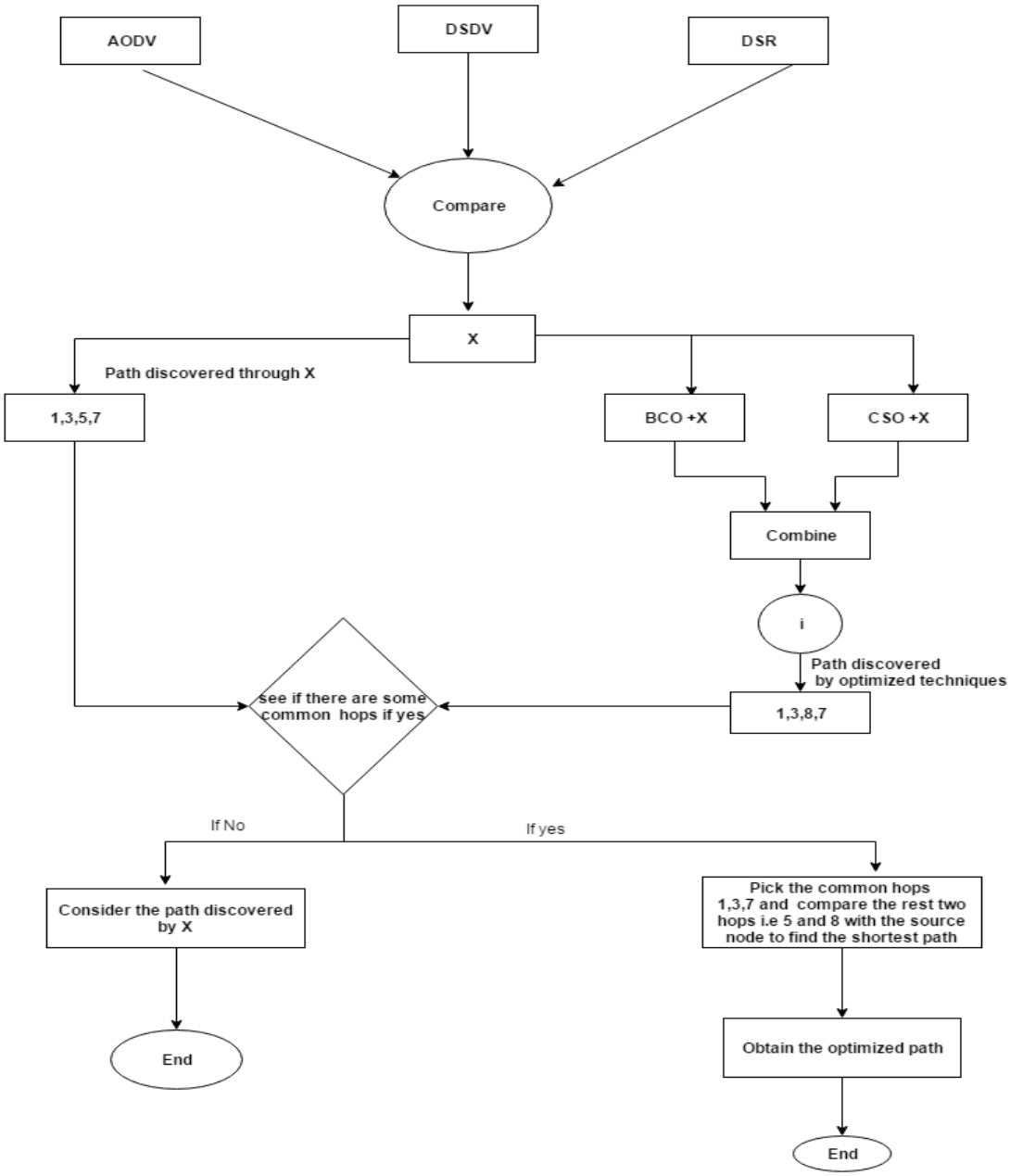

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Figure 4- Flowchart of Proposed Methodology

VI. PERFORMANCE METRICS AND SIMULATION ANALYSIS

1. Performance Metrics:

(i) End-to-End delay: Time taken by data packet to be transmitted across a network from source to destination. The average end-to-end delay is calculated by adding all the times taken by the received packets divided by their total number. Purpose of this paper is to reduce it.

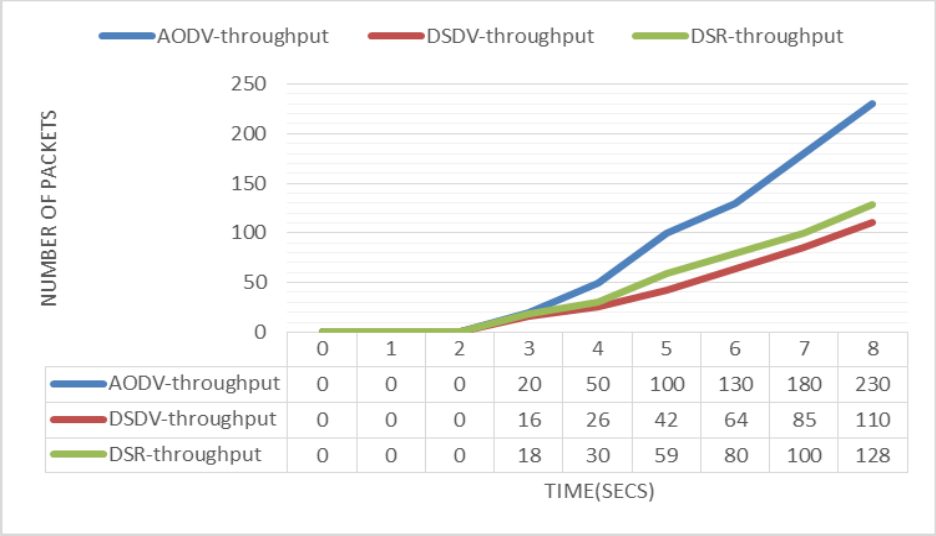
(ii) Throughput: It is defined as the total of data packets arrived at end node in the given interval of time. It is measured in bits per second or datapackets per second or datapackets per time slot. This paper deals with increasing its value.

(iii) Packet loss: It defines the loss of packets during transmission which is the measure of dropped packets by the nodes. Less number of packets drops yields better performance. The aim is to reduce the number of packet loss.

2. Simulation Analysis and results:

The performance evaluation of AODV, DSDV and DSR is done using Network Simulator 2 which runs under LINUX operating system. The numbers of nodes are varied in between 10-100 and the area of 800m x 800m is used where are nodes are spread over. The simulation time used is 600 seconds and the packet size is 512 bytes. The performance comparison of AODV, DSDV and DSR is evaluated based on various QoS parameters such as throughput, end-to-end delay and packet loss ratio. Also an improvement in path establishment of AODV is proposed by use of hybrid optimization techniques bee colony optimization and cuckoo search algorithm.

The simulation analysis shows that reactive protocols have high value of throughput and less packet loss and e2e in comparison to proactive protocols. The figures 5, 6 and 7 show the comparison between AODV, DSDV and DSR by altering number of packets in the network for evaluation of throughput, end-to-end delay and packetloss. It is seen that AODV has higher throughput compared to other two protocols. Also have less packet drops and delay in comparison to DSR and DSDV. DSR conducts better apart from DSDV. DSDV performs poor under this network scenario for all the parameters.



	0	1	2	3	4	5	6	7	8
AODV-throughput	0	0	0	20	50	100	130	180	230
DSDV-throughput	0	0	0	16	26	42	64	85	110
DSR-throughput	0	0	0	18	30	59	80	100	128

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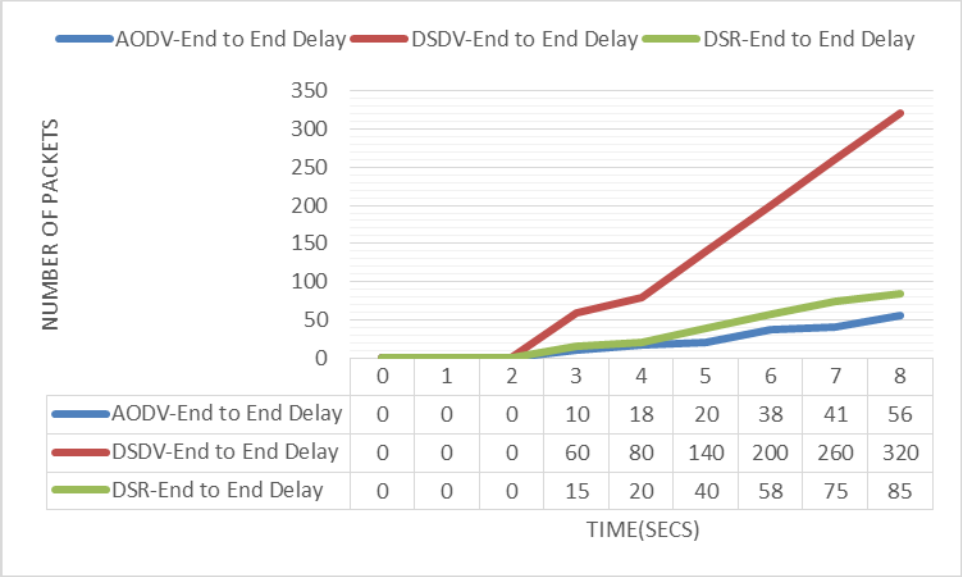
Figure 5- Analysis and comparison of throughput

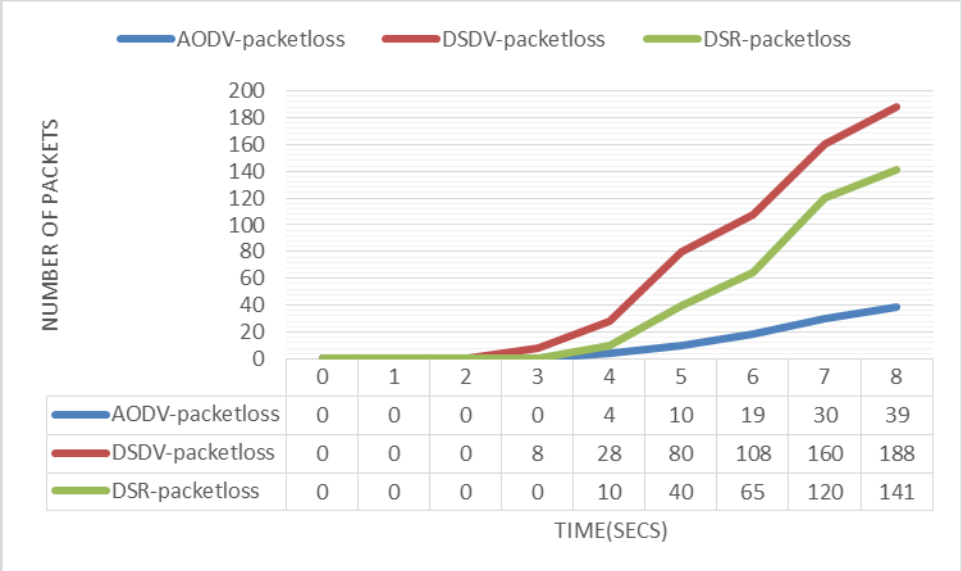
From the figure 5 it can be seen that AODV has excessive value of throughput compared to DSR and DSDV. As the number of packets are increasing the value of throughput also increases.



	0	1	2	3	4	5	6	7	8
AODV-End to End Delay	0	0	0	10	18	20	38	41	56
DSDV-End to End Delay	0	0	0	60	80	140	200	260	320
DSR-End to End Delay	0	0	0	15	20	40	58	75	85

Figure 6- Analysis and comparison of end-to-end delay

From the figure 6 it is analysed that reactive protocols have less end-to-end delay than proactive protocol. The comparison is done by varying number of packets. As number of packets are increasing the value of delay for AODV and DSR decreases while for DSDV it increases with increase in number of packets.



	0	1	2	3	4	5	6	7	8
AODV-packetloss	0	0	0	0	4	10	19	30	39
DSDV-packetloss	0	0	0	8	28	80	108	160	188
DSR-packetloss	0	0	0	0	10	40	65	120	141

Figure 7- Analysis and comparison of packet-loss

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More the number of packets are transferred from source to destination. Less is the packet loss for AODV and DSR than DSDV. Thus, we can say that AODV has less packet-loss apart from other manet protocols. The simulation results shown above prove that AODV outperforms DSR and DSDV. Thus, it can be considered as one of the most suitable protocol for routing. In this paper, we suggest an improvement in path establishment for AODV which in turn will give better results than the normal AODV in terms of throughput, end-to-end delay and packet-loss. The improvement is done with the help of optimization techniques such as bee colony and cuckoo search algorithm. The hybrid of these two techniques has been used for optimal path establishment between source and the destination. The following figures show that the use of hybrid optimization techniques for improvement in AODV gives better results than normal AODV. The figure 8 shows the establishment of path by AODV routing protocol. Another path for AODV is chosen by optimized hybrid techniques. The figure 9 shows the path established by bee colony and cuckoo search. The figure 10 shows the path establishment of enhanced AODV by the use of hybrid optimization techniques. The use of optimal path for routing results in better throughput, end-to-end delay and packet-loss than normal AODV.

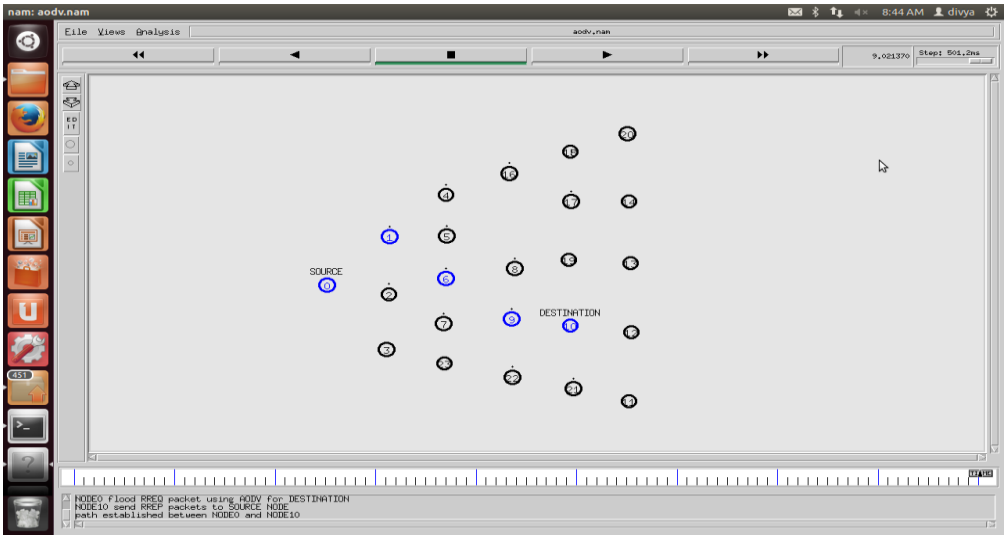

Figure 8- Establishment of path using AODV.

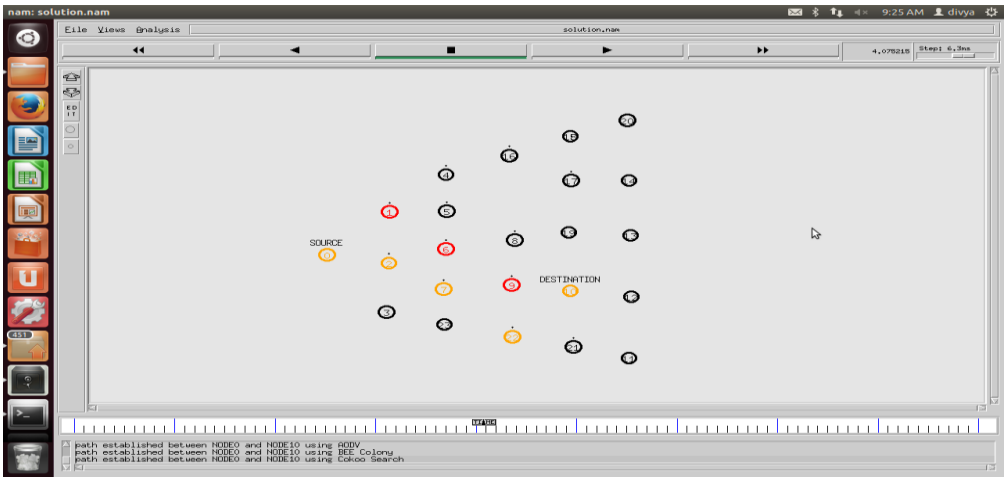

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Figure 9-Path obtained by hybrid optimization techniques.

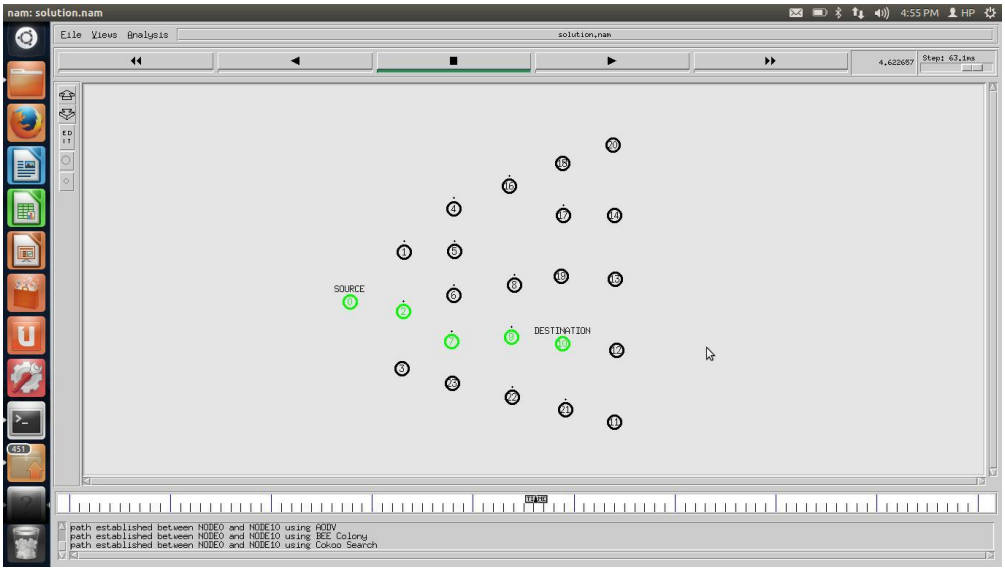
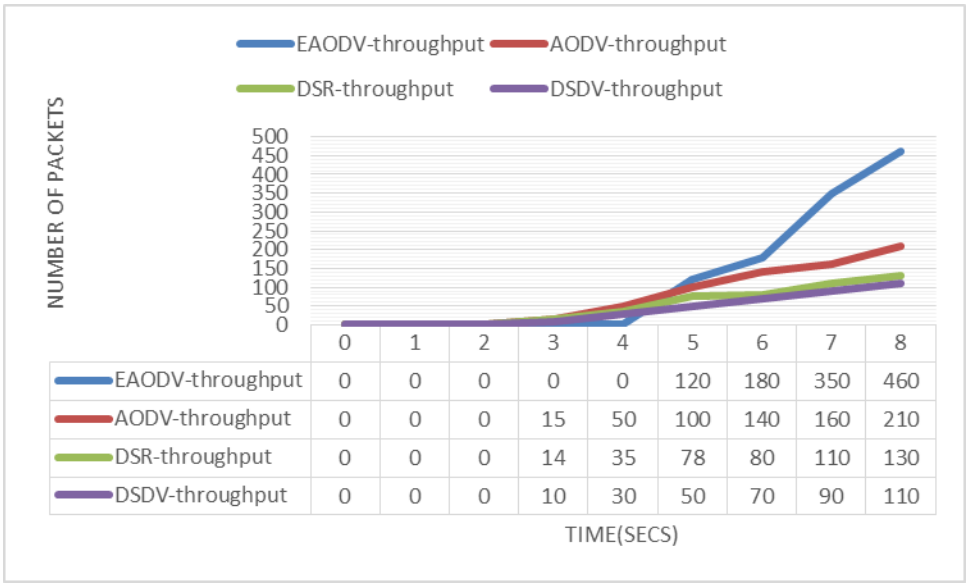


Figure 10- Final path established.

The simulation results of enhanced AODV after the establishment by use of hybrid optimization techniques are shown below.



	0	1	2	3	4	5	6	7	8
EAODV-throughput	0	0	0	0	0	120	180	350	460
AODV-throughput	0	0	0	15	50	100	140	160	210
DSR-throughput	0	0	0	14	35	78	80	110	130
DSDV-throughput	0	0	0	10	30	50	70	90	110

Figure 11- Throughput for enhanced AODV

From the above figure we see that improvement in path establishment of AODV yields better result than normal AODV and other routing protocols. EAODV has higher throughput than AODV.

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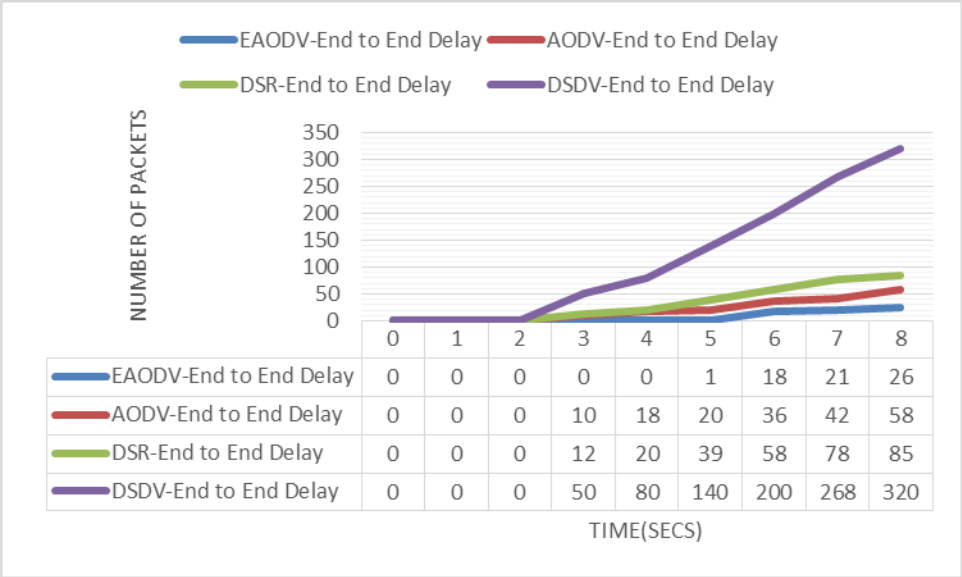
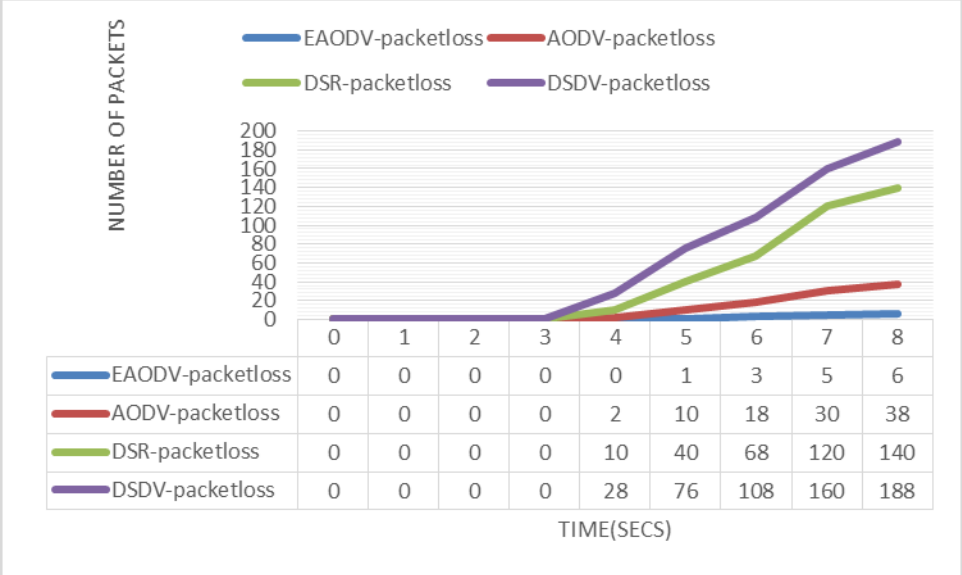


	0	1	2	3	4	5	6	7	8
EAODV-End to End Delay	0	0	0	0	0	1	18	21	26
AODV-End to End Delay	0	0	0	10	18	20	36	42	58
DSR-End to End Delay	0	0	0	12	20	39	58	78	85
DSDV-End to End Delay	0	0	0	50	80	140	200	268	320

Figure 12- End-to End delay for enhanced AODV



	0	1	2	3	4	5	6	7	8
EAODV-packetloss	0	0	0	0	0	1	3	5	6
AODV-packetloss	0	0	0	0	2	10	18	30	38
DSR-packetloss	0	0	0	0	10	40	68	120	140
DSDV-packetloss	0	0	0	0	28	76	108	160	188

Figure 13-Packet-loss for enhanced AODV

As illustrated in figure 12 and 13 EAODV shows less packet loss and e2e delay than normal AODV. Thus we can see that optimized path establishment gives good results than normal path establishment and hence increased quality of service.

VII. CONCLUSION

MANET is a self-organized infrastructure less network. Due to frequent changes in topology of network, manet has many challenges like security, routing, energy consumption etc. In this paper, various routing protocols have been analyzed based on performance parameters viz. end

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to end delay, throughput and packet loss ratio. In this work, comparative analysis is done among DSDV, AODV and DSR manet protocols. The comparison is done by altering number of packets. It is demonstrated that reactive protocols executes better than proactive protocols. The overall execution of AODV is superior to DSR for all parameters. Hence, improved AODV manet protocol is proposed using optimization approach. Bee Colony along with Cuckoo search algorithm are optimized approach. It is seen that use of hybrid bio-inspired technique for path establishment provide better results than normal in terms of packet loss, throughput and delay , improve networks performance and hence quality of service.

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