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Based on Pause Time Comparative Analysis made among Bee-Ant Colony Optimized Routing (BACOR) Vs Existing Routing Protocols for Scalable Mobile Ad Hoc Networks (MANETs)

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Abstract

In this paper based on swarm intelligence a new approach for an on demand ad-hoc routing algorithm is proposed. The foraging behavior of Ant colony optimization and Bee colony optimization, which are the subset of swarm intelligence and considering the ability of simple ants to solve complex problems by cooperation. Several algorithms which are based on ant colony problems were introduced in the literatures to solve different problems, e.g., optimization problems. The proposed algorithm is compared and proven by results that the approach has the potential to become an appropriate routing tactics for mobile ad-hoc networks. The results were presented based on the simulations made with the implementation in ns-2.

Keywords:BACOR, Bee Routing, Ant Routing, Bee-Ant Routing

1. Introduction

Wireless mobile ad hoc network is a distinct kind of network which has a minimum or nullified backbone infrastructure. The characters such as flexibility and quickly deplorable of mobile ad hoc networks are due to this aspect. Yet, this property possesses major technological challenges which include issues of efficient routing, medium access, power management, security and quality of service (QoS). The nodes correspond over wireless links and so the nodes must be able to fight the unpredictable character of wireless channels and interference from the additional transmitting nodes. Though the user required QoS in wireless ad hoc networks are achieved, these factors lead to a challenging problem in the direction of data throughput.

Wireless ad hoc network is a wireless network without any central controlling authority. Either a direct link or a multi-hop route is used for the communication among source nodes and destination nodes. For this, it is necessary that all nodes should have some fundamental routing potential to make sure packets are delivered to their relevant destinations. While carrying out ad hoc networks, huge complications occur due to the frequent route changes, which is due to the mobility of the nodes and intrusion among nodes. Unequal transport layer and constrained amount of traffic is due to the high packet loss rates and recurrent topological changes in the network. The three well-known problems in ad hoc networks are the lack of reliable packet delivery due to the intrusion and movement of nodes, incomplete bandwidth due to the channel limitations and constrained node life span caused as a result of small battery size.

2. Related Work

Over the last few years, several routing protocols are proposed for mobile ad hoc networks. Several performance comparison studies have revealed that the on-demand routing protocols perform better in terms of packet delivery and routing overhead than proactive routing schemes especially in the presence of node mobility. Proactive and hybrid schemes do not perform well in dynamic topologies because of the following two major factors: Slow detection of broken links and periodic exchange of route updates even when routes are not needed.

Wesam AlMobaideen (2009) has presented a Stability-based Partially Disjoint AOMDV (SPDA) protocol which is a modification of the AOMDV protocol. SPDA finds partially disjoint paths based on links stability. The idea is that accepting partially disjointed paths that are more stable than other maximally disjoint ones could increase paths lifetime. This in turn improves MANET performance in terms of delay, routing packets overhead, and the network throughput.

Sh. Rahmatizadeh (2009) has proposed a Ant-Bee Routing (ABR) protocol which is to investigate the use of social insect metaphors to solve the adaptive routing problem. The idea behind this algorithm is that the ant will be moving in search of food (destination). Once the destination is reached, the ant will be killed and an artificial bee is born and randomly assigned to one of the group in bee.

Anuj K. Gupta., et., al (2010) has studied the performance analysis of on-demand routing protocols such as AODV, DSR and TORA with respect to the parameters such as average End-to-End delay and packet delivery ratio. Between which both AODV and DSR guarantees shortest path. Drop of packets or packet loss is considerable more in AODV and DSR at the time of route discovery between the source and destination.

Anurag Malik., et., al (2011) has compared the performance analysis of DSDV, DSR & AODV routing protocols based on different metrics. The results prove that depending on the number of nodes the performance differs among the routing protocols.

3. BACOR

BACOR is an on-demand unipath routing protocol. The proposed BACOR takes distinct features of ant colony optimization and bee colony optimization. As like the behavior of bees in real, we introduced a special bee packet and it is send to the neighboring nodes within the transmission range of the sending node. The bee packet collects the essential information about the neighboring nodes. In ant colony optimization, the pheromone trail is left when the forwarding ants move towards the food source. As like that, our proposed mechanism by using the robust node selection, establishes the link (pheromone). In our proposed BACOR, the route request packets (RREQ) are considered to be the forwarding ants (FA). The FA will find the efficient node and establishes the pheromone (link). The pursuing ants (PA) are the data packets which follow the same path towards the destination. When there is any change in the network topology (obstacle) due to the mobility of the nodes, the FA using the efficient node selection mechanism and start communicating the packets through the efficient node.

3.1 Adaptive Delay Estimation

It is significant to estimate delay in mobile ad hoc networks for effective and reliable data communication. Hence to establish the pheromone (link), we focused to evaluate delay in an accurate way. Each mobile node in the ad hoc network is considered as buffer.

3.2 Estimating Signal Strength and Residual Energy

The signal strengths while doing optimization will be calculated at the physical layer, and it is gained access at the top layers. In this section we describe about the estimation of signal strength of the neighboring nodes. In the physical layer the measured signal strength value is reassigned to the MAC layer. Also this value is stored in the routing/neighbor tables and is used for optimization when more than one node is present inside the transmission range. The signal strength is being used to perk up the performance of the mobile ad hoc networks when routing protocols are optimized protocols.

The IEEE 802.11 is reliable MAC protocol. The signal strength has reached every exposed node; it assumes the fixed maximum transmission power. When a sending node transmits RTS packet, it attaches its transmissions power. The receiving node measures the signal strength received for free–space propagation model while receiving the RTS packet.

It is assumed that all nodes are equipped with a residual power detection device and know their physical node position. The shorter distance between the transmitter and the receiver, the smaller amount of energy required.

3.3 Robust Node Selection Mechanism

Only after estimating the delay, signal strength and residual energy parameters the robust node selection will be carried out. The node with the maximum weight value is selected and the pheromone (link) is established.

4. SIMULATION AND MODEL PARAMETER

NS2 is used to simulate the proposed protocol; the channel capacity of mobile hosts is set to the same value: 2 Mbps. The distributed coordination function (DCF) of IEEE 802.11 is used for wireless LANs as the MAC layer protocol. It has the functionality to notify the network layer about link breakage. In our simulation, 50 to 150 mobile nodes move in a 1500 meter x 1500 meter region for 100 seconds simulation time. We assume each node moves independently with the same average speed. All nodes have the same transmission range of 250 meters. In our simulation, the speed is set as 5m/s. The simulated traffic is Constant Bit Rate (CBR). The simulation settings and parameters are given in table1.

4.1 Performance Metrics

4.1.1 Pause Time

Once the destination is reached, the node takes a rest period of time in second and another random destination after the pause time.

4.1.2 Routing Overhead

Routing Overhead can be defined as the total number of messages transmitted during the simulation.

4.1.3 Delivery Ratio

Packet Delivery Ratio can be defined as the number of received packets divided by the number of generated data packets.

4.1.4 Delay

This represents the average delay based on packet rates.

4.1.5 End-to-End Delay

The End-to-End delay is averaged over all surviving data packets from the sources to the destination. This includes all possible delays caused by buffering route discovery latency, queuing at the interface queue, retransmission delays at the MAC and propagation and transfer times.

4.1.6 Packets Dropped

It is the number of packets dropped.

4.1.7 Energy Consumption

The total consumed energy divided by the number of delivered packet.

4.1.8 Throughput

It is the number of packets received successfully. It can also be defined as the total amount of data a receiver actually receives from sender divided by the tome taken by the receiver to obtain the last packet

4.2 Result Graphs

Performance metrics is simulated using ns2 simulator and the comparative analysis is made between the proposed and the existing algorithms. The result of the comparative analysis is made as graphical representations.

5. Conclusion

This paper presented a delay, signal strength and energy conscious routing approach based on ant colony optimization and bee colony optimization. An adaptive and accurate delay estimation, signal strength estimation and residual energy estimation mechanisms are proposed. Based on the estimated delay, signal strength and residual energy of the nearby nodes BACOR finds the efficient node and sends the data packets through that node.

References

Charles E. Perkins and Elizabeth M. Royer (1999), "Ad-hoc On-Demand Distance Vector Routing", in proceedings of 2nd IEEE Workshop on Mobile Computing Systems and Applications, New Orleans, LA, USA, February 25- 29, pp: 90- 100. DOI: http://www.computer.org/csdl/proceedings/wmcsa/1999/0025/00/00250090-abs.html

David B. Johnson and David A. Maltz (1996), "Dynamic Source Routing in Ad Hoc Wireless Networks", in proceedings of International Series in Engineering and Computer Science, vol. 353, pp: 153- 181. DOI: http://www.cs.rice.edu/~dbj/pubs.html

Xiaobing Hou and David Tipper (1990), "Impact of Failures on Routing in Mobile Ad Hoc Networks Using DSR", in proceedings of IEEE Journal on Selected Areas in Communications, December, vol. 8, no. 9, pp. 1696-1708.

Hossam Hassanein and Audrey Zhou (2001), "Routing with Load Balancing in Wireless Ad hoc Networks", in proceedings of 4th ACM International Workshop on Modeling, Analysis and Simulation of Wireless and Mobile Systems, Rome, Italy, pp: 89- 96. DOI: http://dl.acm.org/citation.cfm?id=381614

Ihab El Kabary., et. al. (2006), "Weighted Critical Path Routing Protocol for Mobile Ad Hoc Networks", in proceedings of International Conference on Wireless Information Networks and Systems, Portugal. DOI: citeseerx.ist.psu.edu/viewdoc/download?**doi**=10.1.1.132...

Lei Chen and Wendi B. Heinzelman (2005), "QoS-Aware Routing Based on Bandwidth Estimation for Mobile Ad Hoc Networks", in proceedings of IEEE Journal on Selected Areas in Communications, March, vol. 23, no. 3. DOI: http://ieeexplore.ieee.org/xpl/articleDetails.jsp?reload=true&arnumber=1402584&contentType=Journals+%26 +Magazines

Kaixin Xu., et. al. (2003), "Adaptive Bandwidth Management and QoS Provisioning in Large Scale Ad Hoc Networks", in proceedings of IEEE Conference on Military Communications, October 13- 16, vol. 2, pp: 1018- 1023. DOI: http://dl.acm.org/citation.cfm?id=1950714

Michael Gerharz., et. al. (2003), "A Practical View on Quality-of-Service Support in Wireless Ad Hoc Networks", in proceedings of the 3rd IEEE Workshop on Applications and Services in Wireless Networks (ASWN), Berne, Switzerland, July, pp: 185-196. DOI: http://web.informatik.uni-bonn.de/IV/Mitarbeiter/dewaal/aswn03.html

Geetha Jayakumar and Gopinath Ganapathy (2007), "Performance Comparison of Mobile Ad-hoc Network Routing Protocol", in proceedings of International Journal on Computer Science and Network Security, November, vol. 7, no. 11. DOI: http://paper.ijcsns.org/07_book/200711/20071113.pdf

E. Ahvar and M. Fathy (2007), "Performance Evaluation of Routing Protocols for High Density Ad Hoc Networks based on Energy Consumption by GlomoSim Simulator", in proceedings of World Academy on Science, Engineering and Technology, August, vol. 23. DOI: http://citeseerx.ist.psu.edu/viewdoc/summary?doi=10.1.1.193.1582

Changling Liu and Jorg Kaiser (2005), "A Survey of Mobile Ad Hoc network Routing Protocols", Technical Report, University of Magdeburg, October. DOI: http://www.minema.di.fc.ul.pt/reports/report_routing-protocols-survey-final.pdf

Duc A. Tran and Harish Raghavendra (2006), "Congestion Adaptive Routing in Mobile Ad Hoc Networks", IEEE Transactions on Parallel and Distributed Systems, November, vol. 17, no. 11. DOI: http://www.cs.umb.edu/~duc/research/papers/mobicom04.pdf

Jianbo Xue., et. al. (2003), "ASAP: An Adaptive QoS Protocol for Mobile Ad Hoc Networks", 14th IEEE proceedings on Personal, Indoor and Mobile Radio Communications, September 7-10, vol. 3, pp: 2616- 2620. DOI: http://www.zurich.ibm.com/~stu/papers/asap.pdf

Wesam AlMobaideen (2009), "SPDA: Stability Based Partially Disjoint AOMDV", European Journal of Scientific Research, vol.27 No.3, pp.342-348. DOI: http://www.eurojournals.com/ejsr_27_3_04.pdf

Sh. Rahmatizadeh., et. al. (2009), "The Ant-Bee Routing Algorithm: A New Agent Based Nature-Inspired Routing Algorithm", Journal of Applied Sciences 9(5): 983 - 987. DOI: http://scialert.net/fulltext/?doi=jas.2009.983.987

Anju K.Gupta., et. al (2010), "Performance Analysis of AODV, DSR & TORA Routing Protocols", International Journal of Engineering & Technology, April, vol 2, no.2, pp 226-231. DOI: http://www.ijetch.org/papers/125--T203.pdf

Anurag Malik., et. al. (2011), "Performance Analysis of Routing Protocol in Mobile Ad Hoc Network using NS-2", MIT International Journal of Computer Science and Information Technology, January, vol. 1 no. 1, pp 47-56.

Sunil Taneja and Ashwani Kush (2010), "A Survey of Routing Protocols in Mobile Ad Hoc Networks", International Journal of Innovation, Management and Technology, August, vol.1 no.3, pp279-285. DOI: http://www.ijimt.org/papers/52-M440.pdf

S.Santosh Baboo and B.Narasimban (2009), "A Hop-by-Hop Congestion-Aware Routing Protocol for Heterogeneous Mobile Ad-Hoc Networks", International Journal of Computer Science and Information Security, vol.3 no. 1. DOI: http://arxiv.org/ftp/arxiv/papers/0907/0907.5441.pdf

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TABLE I

SIMULATION SETTINGS AND PARAMETERS

No. of Nodes	50, 75, 100, 125, and 150
Area Size	1500 X 1500 meters
MAC	802.11b
Radio Range	250 meters
Simulation Time	100 seconds
Traffic Source	CBR
Packet Size	512 KB
Mobility Model	Random Waypoint Model
Speed	5 m/s
Initial Energy	0.5 Joules
Pause Time	0, 20, 40, 60, 80, 100

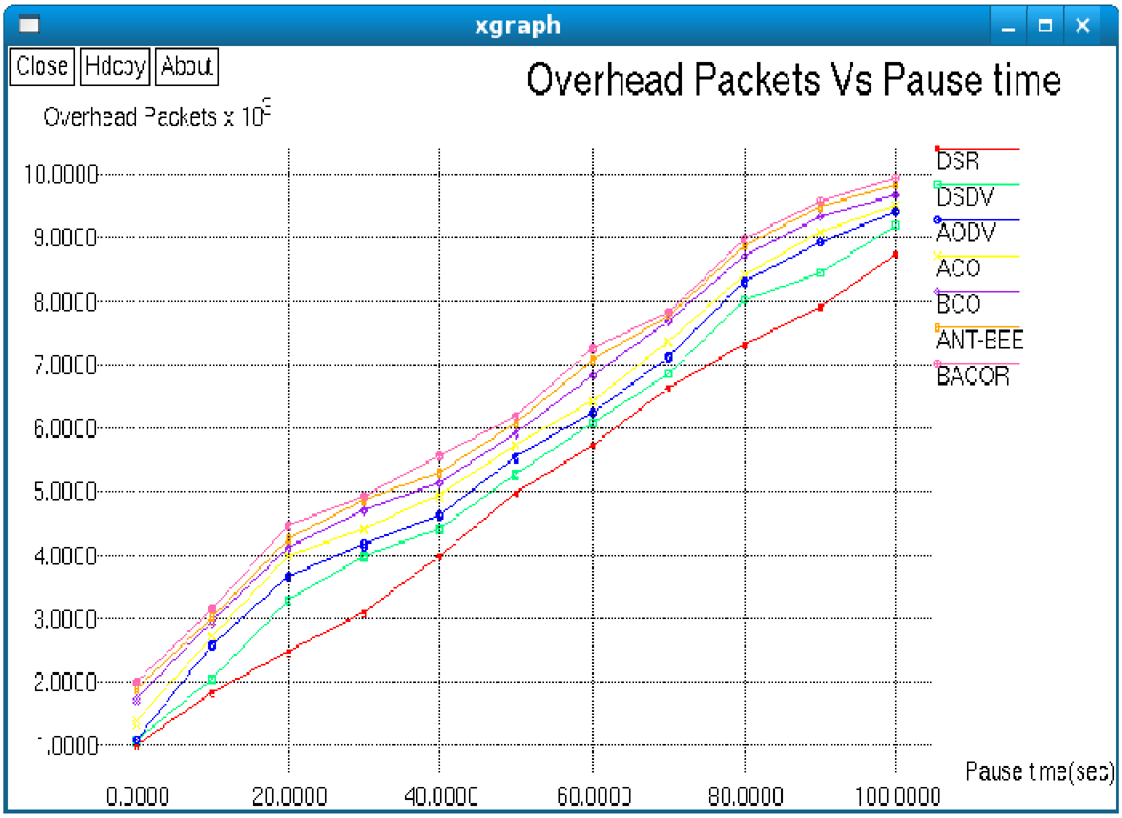

Figure1. Routing Overhead Vs Pause Time

From the figure 1 it is clearly represented that the number of routing overhead is better in BACOR than other existing algorithms.

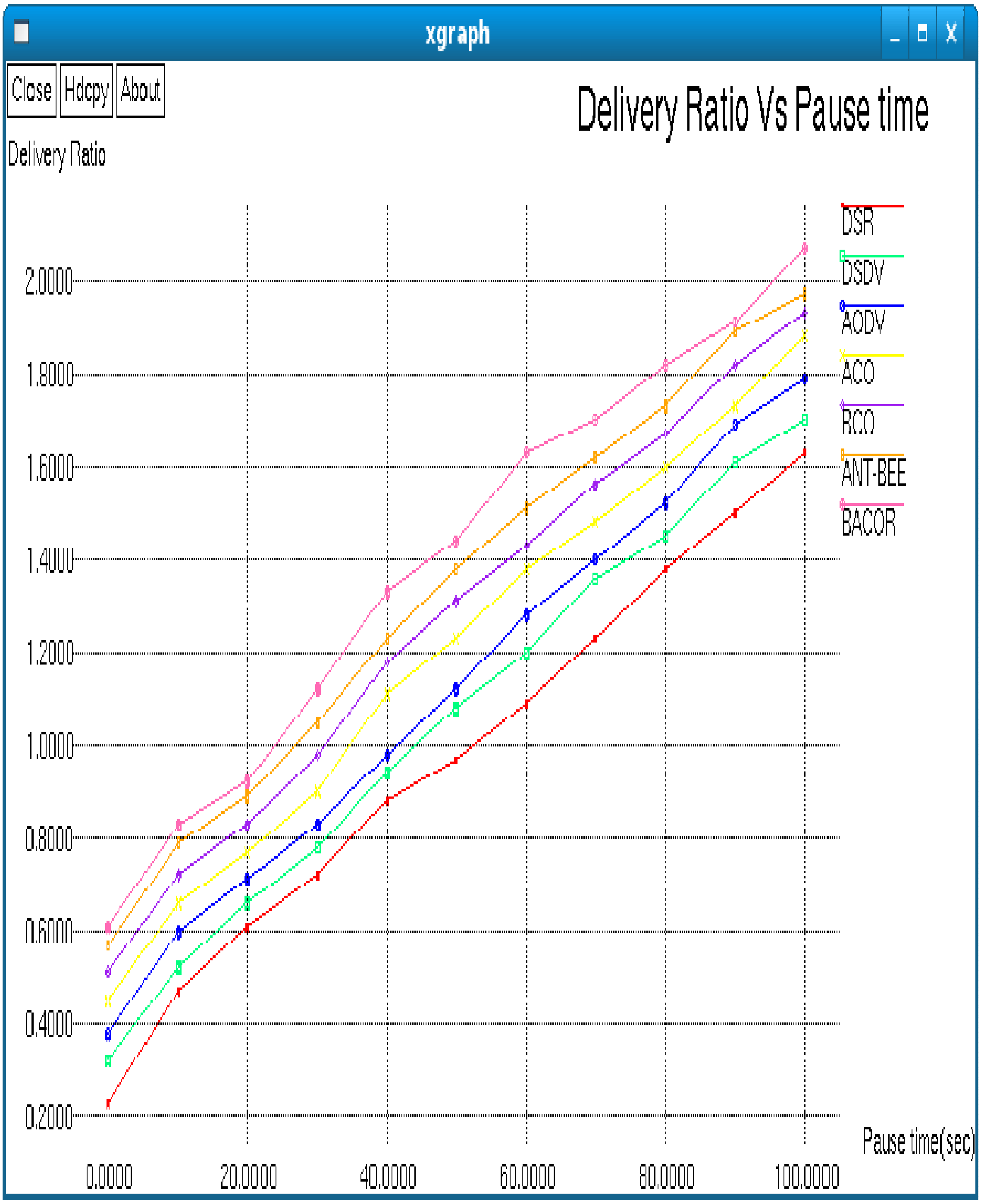

Figure2. Packet Delivery Ratio Vs Pause Time

From the figure 2 it is analyzed that the delivery ratio of packets is better in BACOR than other existing algorithms.

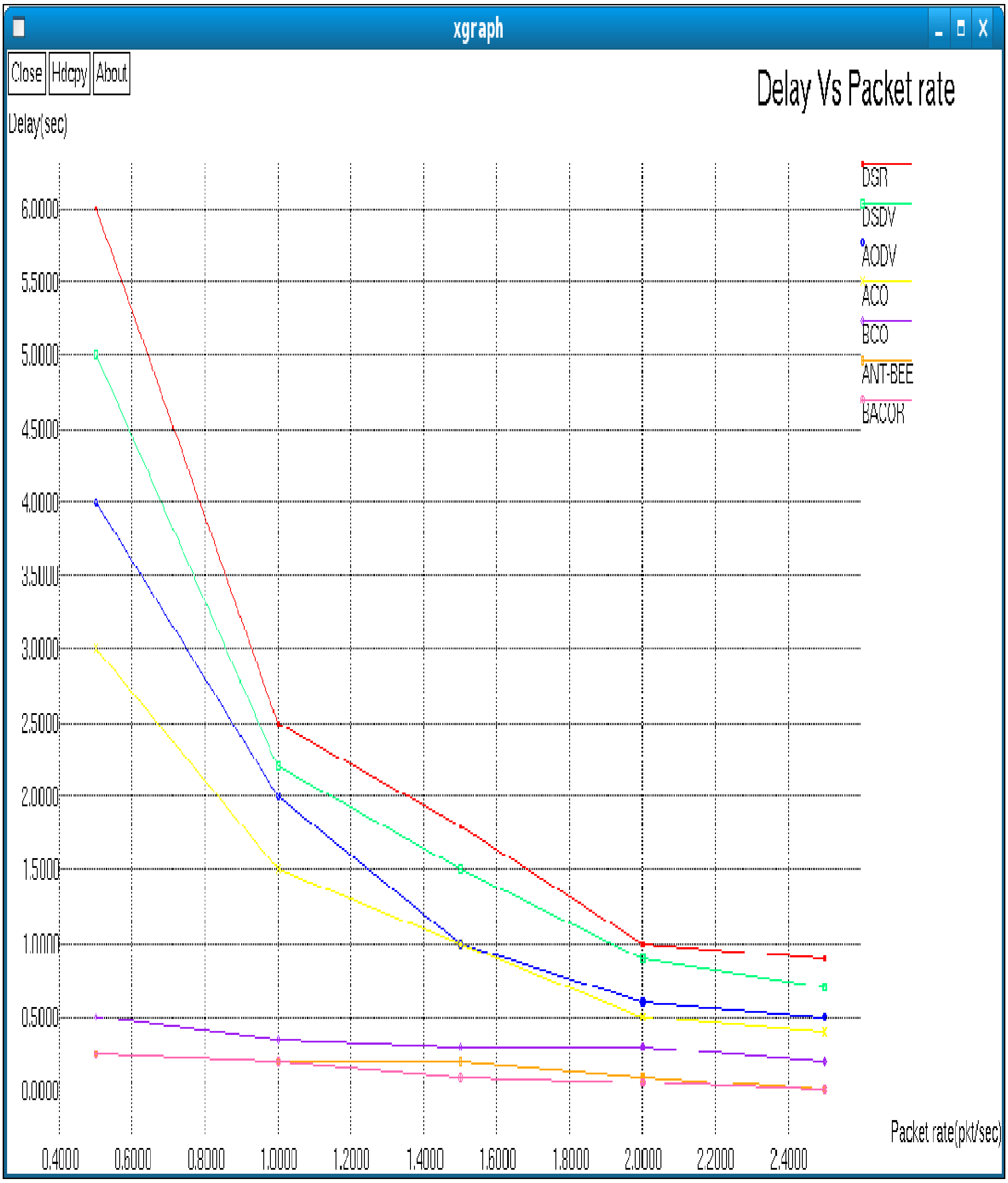

Figure3. Delay Vs Packet Rate

From the figure 3 it is shown that the delay in packets communication is better in BACOR than other existing algorithms.

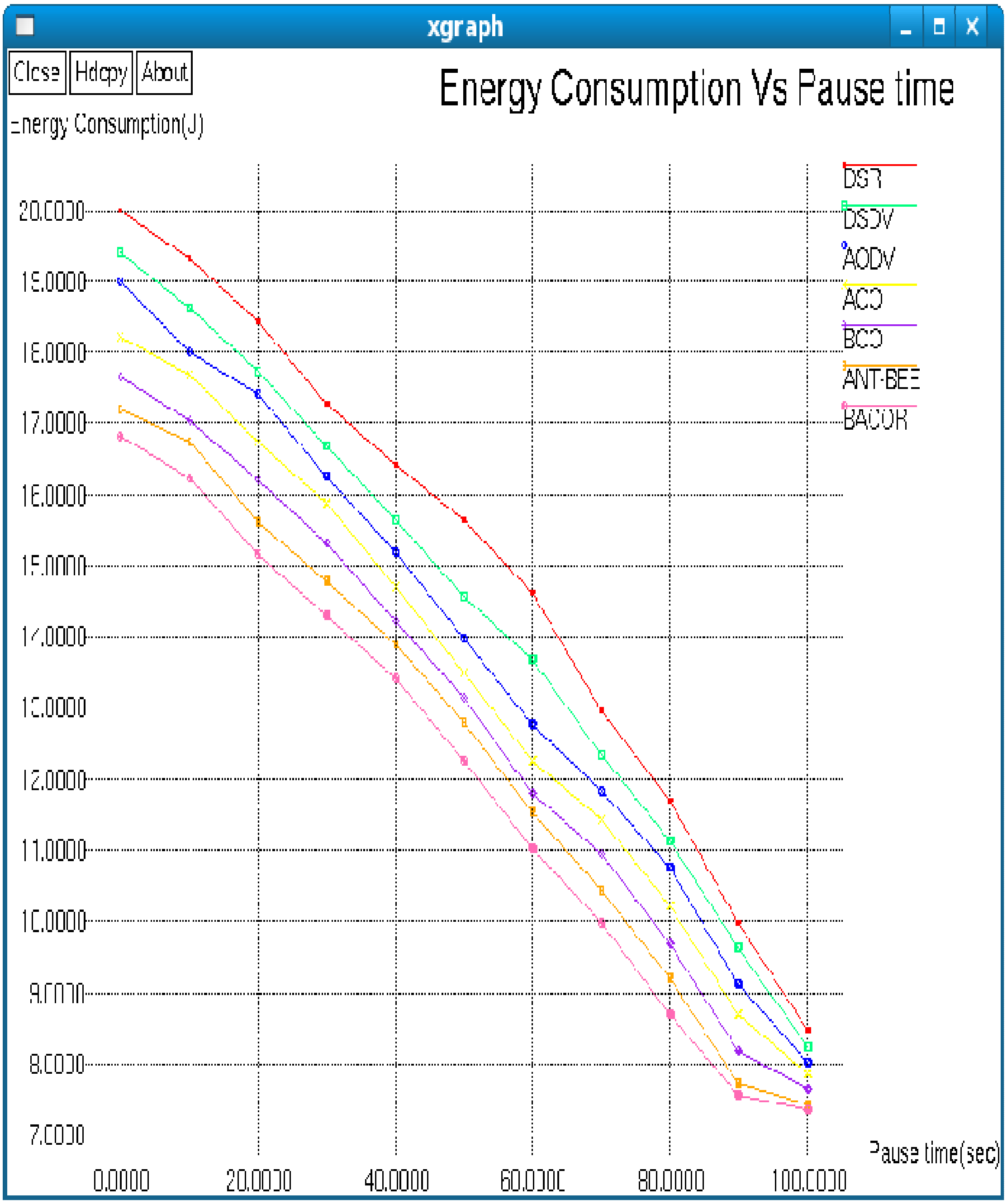

Figure4. Energy Consumption Vs Pause Time

From the figure 4 it is shown that the total energy consumption is better in BACOR than other existing algorithms.

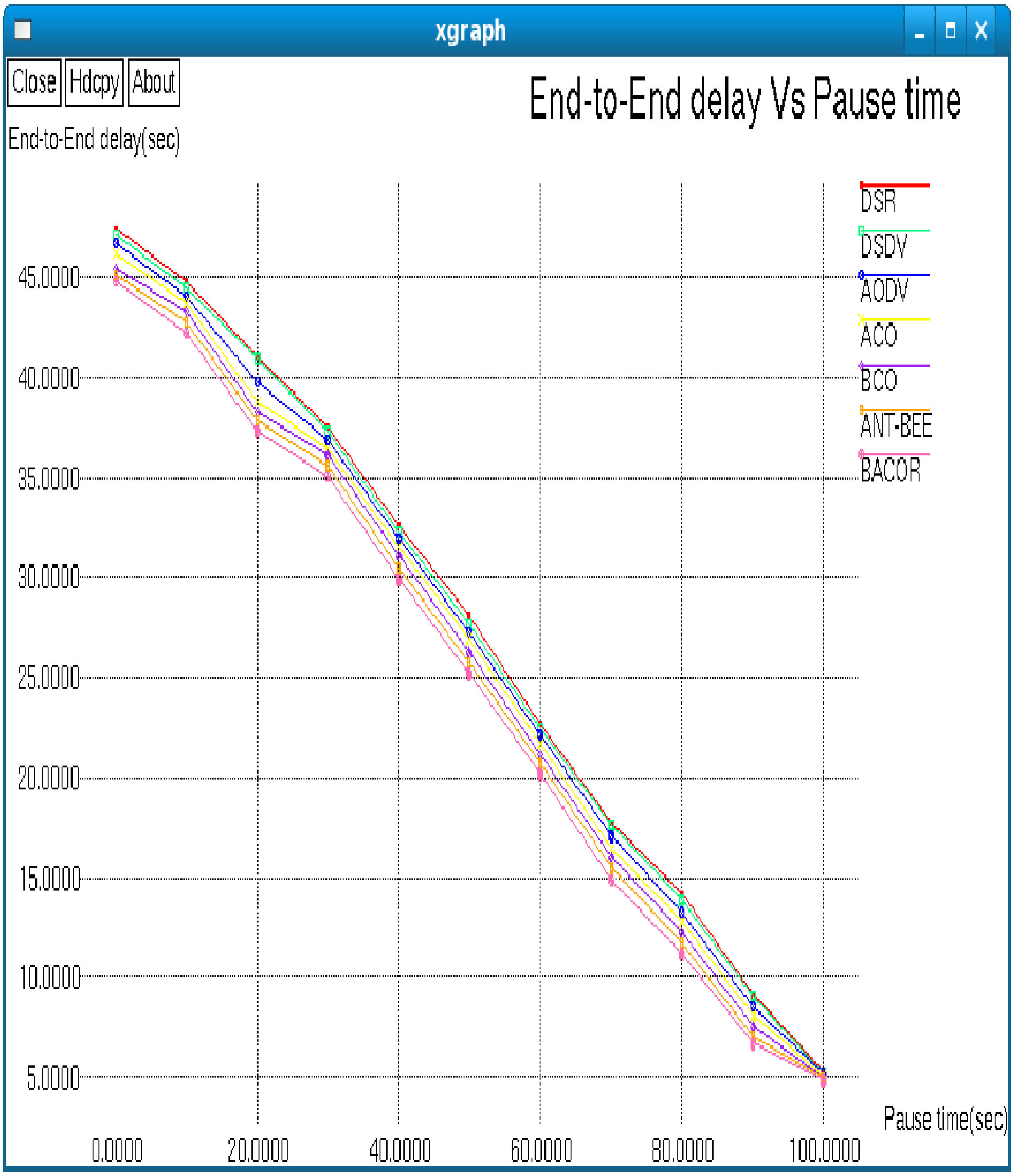

Figure5. End-to-End Delay Vs Pause Time

From the figure 5 it is shown that the end-to-end delay is better in BACOR than other existing algorithms.

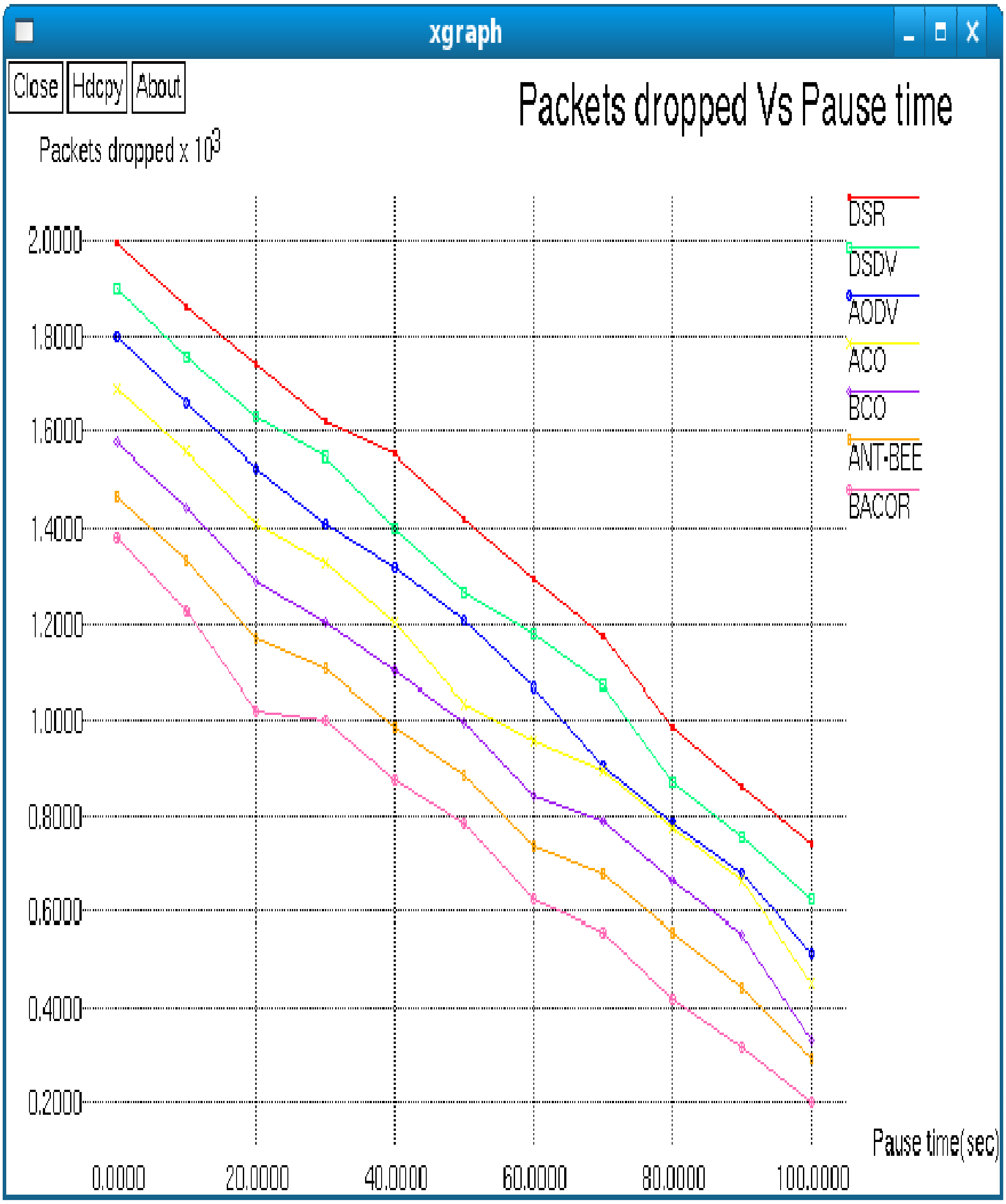

Figure6. Packets Dropped Vs Pause Time

From the figure 6 it is shown that the packets dropped is better in BACOR than other existing algorithms

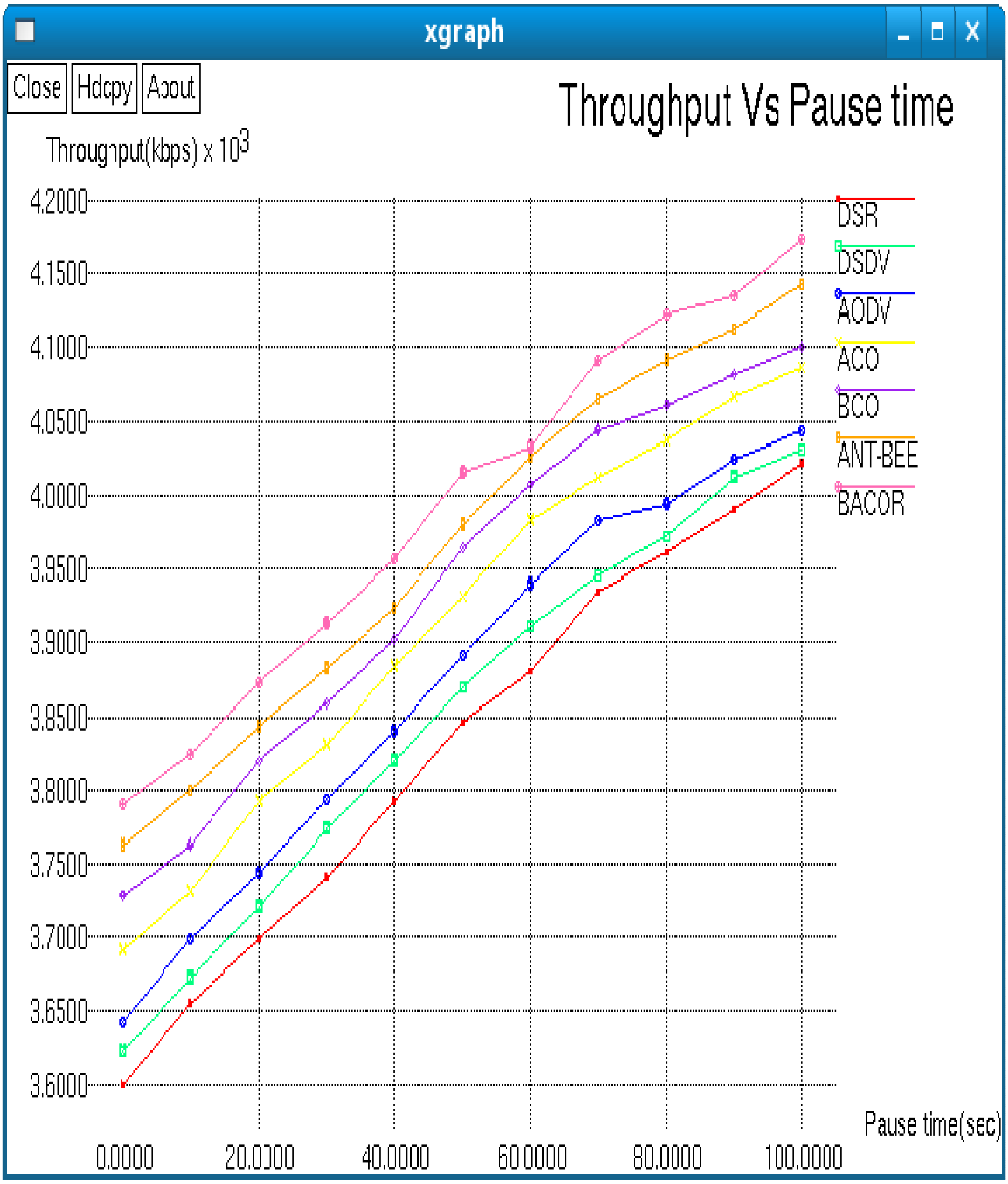

Figure7. Throughput Vs Pause Time

From the figure 7 it is shown that the throughput is better in BACOR than other existing algorithms.