Performance evaluation of AODV, DSDV and AntHocNet in video transmission

Neelam S. Labhade , S.S.Vasekar

Abstract— **Now a days wireless technologies are important in the world of communication due to its mobility, bandwidth & low cost. But as numbers of nodes are increases network complexity & bit error rate increases this lowers the transmission rate. This paper aims at performance evaluation of routing algorithms for ad hoc network for video signal transmission. It is based on ant colony optimization technique for finding shortest path through graphs. It uses swarm intelligence methods which are based on behavior of ants seeking a shortest path between their colony and source of food. Recently different kinds of routing protocol have been studied & implemented. In this paper video transmission evaluation in ad hoc network by AntHocNet is studied and the results are compared with AODV & DSDV protocol. From simulation results it is conclude that AntHocNet algorithm is better for video simulation because it has better throughput and packet delivery ratio. As AntHocNet uses an efficient route maintenance technique end to end delay will be less as compare to other two algorithms.**

Index Terms—**MANET protocols; Ad-hoc networks; routing algorithms; AOC; AODV;DSDV; AntHocNet**

I. INTRODUCTION

Due to price evolution of Laptops, PDA & Smartphone's or any other devices capable of communicating over Bluetooth and Wi-Fi for data transmission. Wireless technologies are becoming important in the world of communications. Mostly wireless networks are preferred for communication because of their mobility, flexibility, low cost and better bandwidth. Ad-Hoc network can be easily set up anywhere and they can withstand to any natural condition. Ad-Hoc networks are self-organized network which do not required any kind of central base station or fixed network infrastructure. A mobile unit within these networks connects to, and communicates with, the nearest base station that is within its communication radius. This is a network of mobile devices connected by wireless links as shown in figure 1. Since the nodes are mobile, the network topology may change rapidly and unpredictably over time. Each node of an ad hoc network is both a host and a router. This is the feature that makes difficult the communication between the participants off the network. Routing in mobile ad hoc network is particularly challenging task due to the fact the topology of the network changes constantly and paths which were initially efficient can quickly become inefficient.
A number of algorithms have been proposed for solving the problem of routing which is based on ant colony optimization technique

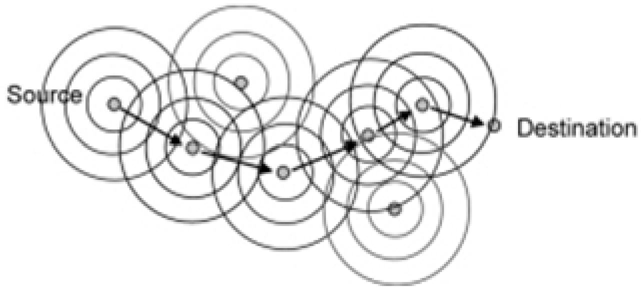

Fig. 1. Wireless ad hoc network.

II. ANT COLONY OPTIMIZATION.

Ant Colony Optimization (ACO) is proposed by Marco Dorigo in 1992 which is inspired by the behavior of ants in nature and it uses swarm intelligence [3].In nature ants moves randomly to find their food and return to their colony by depositing pheromone on the path. If other ants find such a path they follow the same path instead of moving randomly. While returning ants increases the pheromone value if they eventually find food. As time passes the pheromone starts to evaporate, thus reducing its strength to attract ants. The more time it takes for an ant to travel down the path and back again, the more time the pheromones have to evaporate. A short path, by comparison, gets travelled over faster, and thus the pheromone density remains high as it is laid on the path as fast as it can evaporate. Due to Pheromone evaporation larger paths are automatically cancelled by ants. If there were no evaporation at all, the paths chosen by the first ants would tend to be excessively attractive to the following ones. Thus, when one ant finds a short path from the colony to a food, other ants are more likely to follow that path, and positive feedback eventually leads all the ants following a single path. The idea of the ant colony algorithm is based on this behavior with artificial ants walking around the network. An ant is a simple agent in ant colony optimization algorithm. In this technique ants exchange the information in "stigmergy" way i.e ants indirectly communicate with each other via the environment.

Figure 2 explains the working principle of ACO.

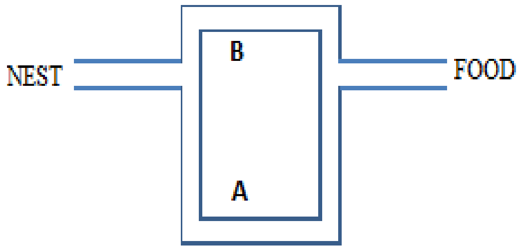

Fig.2. Ant Colony Optimization.

- In the beginning ants make a random choice between path A and B to find food source from colony.
- If it discovers a food source, it returns back to the nest by depositing pheromone on its path.
- Since the path B is shorter, ants traveling along the path faster thus the pheromone density become higher than path A.
- These pheromones are attracting nearby ants to follow the same path.
- Returning to the colony, these ants will strengthen the route by adding pheromone.
- If there are two routes to reach the same food source then, in a given amount of time, the shorter one will be traveled by more ants than the long route.
- The short route will be increasingly enhanced, and therefore become more attractive on the other hand the long route will automatically cancel because of evaporation of pheromone.
- Finally all the ants have determined and therefore select the shortest path.

III. CLASSIFICATION OF ACO ALGORITHMS

Due to intrinsic dynamic nature of wireless ad hoc networks, a large number of routing implementations have been proposed in recent year. These algorithms have the main characteristics of adaptively and robustness. There are mainly three types of algorithms are present which are:

A. Proactive routing algorithm

Proactive algorithms try to maintain all the information between all pairs of nodes present in the network at all the time. This algorithm mostly used for wired networks. All nodes send ants to all possible destinations, these forward ants update pheromone for the path to their source .When node mobility increases, performance of algorithm degrades and the number of looping packets increases. The continuous sending of ant between all possible pair of source and destination nodes is not possible due to limited bandwidth resources of the network.

B. Reactive routing algorithm

In reactive algorithm forward ants are sent out at the start of a communication and keeps on sending ants towards destination as long as the communication is going on. Due to this some new paths are detected in the network. These algorithms are more efficient and preferred when the network is large or highly dynamic.

C. Hybrid routing algorithm

These algorithms contains both reactive and proactive elements that is it gathers information of nodes that are involved in communication along with this it maintain, improve and extend routes while the communication is going on.

V. DESTINATION SEQUENCED DISTANCE VECTOR ROUTING PROTOCOL (DSDV)

Destination Sequenced Distance Vector routing is a table driven routing protocol for ad hoc mobile network which is based on the Bellman-Ford algorithm.it was proposed by C. Perkins and P. Bhagat in 1994. Each node maintains a view of network topology using routing tables. Each entry in the routing table contains a sequence number, the install time and number of hops for all known destinations. All this routing information must be updated periodically. The main disadvantage of this type of protocol is that it maintains routes which are never used. DSDV requires a regular update of its routing tables which uses battery power and a small amount of bandwidth even when the network changes, a new sequence number is necessary before the network re-converges. It has lower route request latency but higher overhead. Due to all these reasons DSDV is not suitable for highly dynamic network. There are mainly two operations are performed during transmission one is addition of new link and other is failure of any link.

A. DSDV routing table

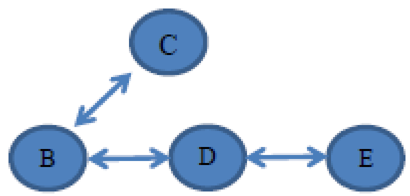

Fig.3. Example of DSDV Algorithm.

A sequence number in the routing table shown in table 1 are generally even if link is present otherwise an odd number is used and it is used for loop prevention and route freshness criteria. The number is generated by the destination and the emitter needs to send out the next update with this number. Using this new sequence number, the mobile nodes can distinguish old route information from the new and overcome the problem of routing loops.

TABLE I. ROUTING TABLE ENTRIES

Destination	Next Node	Metric	Sequence Number	Install Time
B	B	0	B102	001000
C	C	1	C104	001200
D	D	1	D106	001200
E	D	2	E108	001500

When two routes to a destination received from two different neighbors then route with greatest destination sequence number is selected On other hand if routes are equal then route with smaller metric (number of hops) is selected

B. DSDV link addition

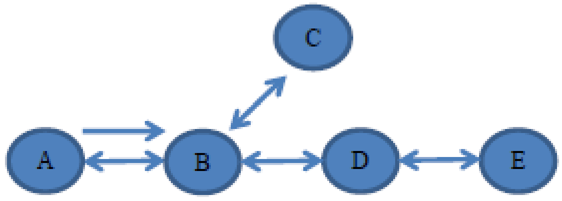

Fig. 4. DSDV link addition

- When node A joins the network shown in figure.4.
- Node A transmits routing table: A,100,0
- Node B receives transmission and inserts:A,100,A,1
- Node B propagates new route to neighbors: A,100,1
- Neighbors update their routing tables: A, 100,B,2 and continue propagation of packets.

C.DSDV link failure

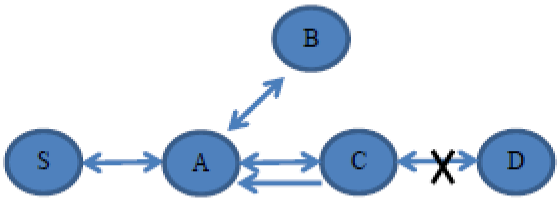

Fig.5. DSDV link failure.

- When link between B and D breaks as shown in figure 5.
- Node B notices break, update hop count for D and E to be infinity and increments sequence number for D and E
- Node B sends updates with new route information with (D,206,infinite) and (E,156,infinite)

VI. AD HOC ON DEMAND DISTANCE VECTOR ROUTING PROTOCOL (AODV)

Ad hoc on demand Distance Vector routing protocol is a reactive type of protocol i.e. it only requests a route when needed and does not require nodes to maintain routes to destinations that are not actively used in communications. AODV improves on DSR by maintaining routing tables at nodes instead of in data packets. The algorithm uses different messages to discover and maintain links. Whenever a node wants to try and find a route to another node, it broadcasts a Route Request (RREQ) to all its neighbors. The RREQ propagates through the network until it reaches the destination or a node with a fresh enough route to the destination. Then the route is made available by unicasting a Route Reply (RREP) back to the source.

The algorithm uses Hello messages that are broadcasted periodically to the immediate neighbors. If hello messages stop coming from a particular node, the neighbor can assume that the node has moved away and mark that link to the node

as broken and notify the affected set of nodes by sending a link failure notification to that set of node.

A. AODV route discovery

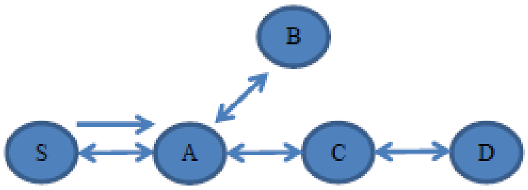

Fig. 6. AODV route discovery

Steps in route discovery for AODV are explained with the help of figure 6.

- Node S needs a route to node D.
- Node (S) creates the route request (RREQ) in which IP address and sequence number of destination (D) and source (S) is added. This RREQ is then broadcast to all the neighbors.
- When node A receives RREQ it makes reverse route entry for S. if it has route to D it unicast (RREQ) otherwise it broadcasts RREQ to all the neighbors. This step continue till RREQ reaches to D
- This route is made available for communication by unicasting a Route Reply (RREP) back to the source and data packets are sends on the route to D.

B. AODV route maintenance

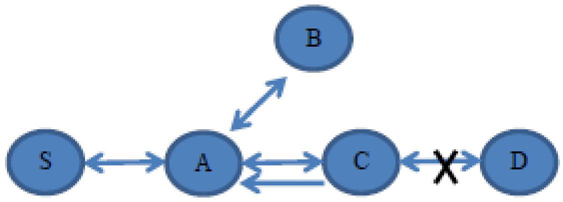

Fig.7. AODV route maintenance

Steps in route maintenance for AODV are explained with the help of figure 7.

- If link between C and D breaks then node C invalidates route to D in routing table and send route error (RERR) message and list of all destinations which are now unreachable.
- When node S receives RERR it checks whether A is its next hop on route to Deletes route to D and rediscovers route if needed.

VII. ANTHOCNET

AntHocNet is an adaptive routing algorithm for mobile ad hoc networks based on principle of ACO routing. It is multipath and hybrid routing algorithm for wireless network.[5] Hybrid algorithm means network which combines both proactive and reactive components. It does not maintain paths to all destination nodes all the time but set a path when they are required at the star of communication. Reactive forward ants are broadcast by the source to find multiple paths to the destination and backward ants come back to set up the paths.

All these paths are represented in pheromone tables indicating their respective quality and from this shortest path can be find out more the value of pheromone shorter will be the path. Once the path is set up data packets are routed on the path. Multipath routing protocol means protocol which finds, maintain and use multiple paths in transmission of data packets. These types of protocols can help in increasing the network lifetime. Each node maintains one pheromone table which has route from node to destination through different nodes and pheromone value. Other than this pheromone table each node has a neighbor table in which it has information of with which nodes it has a wireless link.

A. Reactive path setup

When a source (S) starts transmission it broadcasts a reactive forward ant towards the destination (D). Each ant used to find a path connecting S and D. At each node an ant is either unicast or broadcast, according to whether or not the node has routing information for when a node receives more number of ants of same generation, it compares the path travelled by each ant to that of the previously received ants of same generation. Every forward ant keeps a list of visited nodes while travelling towards destination. The routing information of any node i is in its pheromone table Ti . If pheromone information is available, the ant selects its next node n with probability Pnd .

$$P_{nd} = \frac{(T^i_{nd})^\beta}{\sum_{j \in N^d_i} (T^i_{jd})^\beta} \qquad (1)$$

Where N_i^d is set of neighbors of i over which a path to D. and β is the parameter value which can control the behavior of the ants.($\beta \geq 1$), T_{nd}^i is defined as the product of the estimate of the average time to send one packet.
After reaching at the destination D same ant is converted into backward ant which travels back to the source by retracing the node list (1…..n).

B. Proactive path probing and maintenance

During transmission the source node sends out proactive forward ants to select next hop according to pheromone density with the help of same formula as reactive forward ants. This way they serve main purposes of improving the quality of route and search for other path for destination. If no such paths are set up then whole process is repeated

C. Link failures

Each node in the network tries to maintain path to its neighbors at every time using "Hello" message to detect link failures. If the link is fail then node removes that neighbor from its neighbor list and all associated entries from its routing table. Then it broadcasts a link failure notification message. This message contains a list of destinations to which the node lost its best path, and the new best estimated end to end delay and number of nodes to this destination. All its neighbors receive the notification and update their pheromone

due to the failure; they also broadcast a notification, until all respective nodes are notified. If the path failure is detected due to failed transmission of data packet and no other path available for this packet, the node try to repair that path by broadcasting a path repair ant that travels towards the destination similar to reactive forward ant. It follows available pheromone when it can and is broadcast otherwise.

VIII. SIMULATION RESULTS

This section describes the simulation model and present the results obtained using NS-2 network simulator. In all simulations the data at PHY layer is 11Mbps and the routing protocol is AODV.
This simulation is implemented on the NS2 simulator. For simulation wireless ad hoc network with 50 moving nodes is used. These nodes are moving in a 500×500 flat space for 10 seconds simulation time. The data packets used in simulations are 280 bytes and the data sending rate is 0.6Mbps. The MAC_802.11b Protocol for the wireless standard. Nodes present in the network are moving constantly and randomly. The radios use Two Ray Ground propagation model. Each node has its own specific radio range which is indicated by the circle as shown in figure. 8

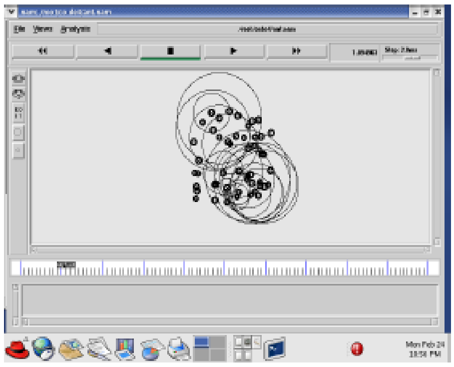

Fig.8 Node radio range.

A. Peak signal to noise ratio

Peak signal to noise ratio (PSNR) between maximum possible power of a signal and the power of corrupting noise that affects the fidelity of its representation.

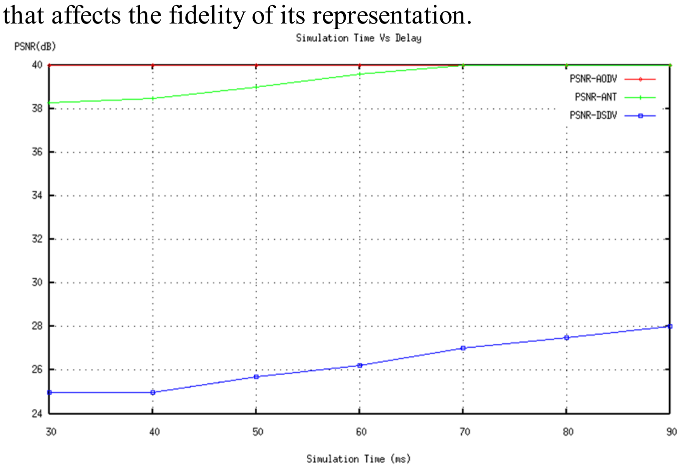

Fig.9. PSNR (dB) Vs. simulation time (ms)

It is most commonly used to measure the quality of reconstruction of data at the destination. Graph shown in figure 9 represents the performance of all three algorithms. As simulation time goes on increasing PSNR also increases and after some time it will almost remain constant. AntHocNet algorithm performs better than AODV and DSDV.

B. *Throughput*

It is the measure of number of packets sent in unit time. Throughput is average rate of successful message delivery over a communication channel. It refers to how much data can be transferred from source to destination in a given amount of time. Throughput is used to measure the performance of network communication. More the throughput better is the performance of the network. As simulation time goes on increasing throughput also increases. Graph shown in figure 10 represents that throughput of AntHocNet algorithm is better than AODV and DSDV.

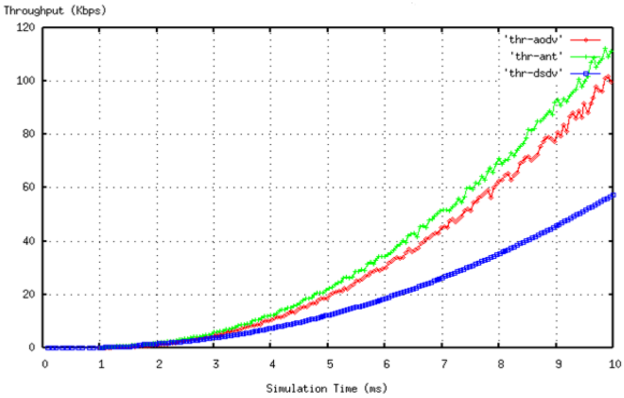

Fig.10. Throughput (Kbps) Vs. Simulation time (ms)

C. *Latency*

It is the most important element that affects the network speed. Low latency network connection is one that generally experiences small delay while a high latency connection generally suffers from long delays.

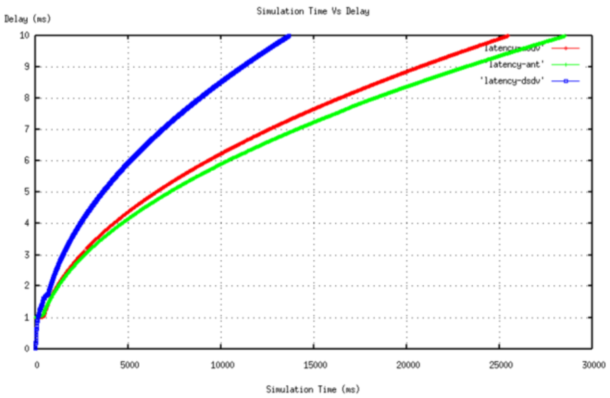

Fig.11. Latency (ms) vs. simulation time (ms)

Latency of the network can be measured by determining the time taken by a network to travel packets from source to destination and back to source. Figure 11 shows that latency increases as simulation time increase. AntHocNet have less latency as compared to AODV and DSDV means AntHocNet algorithm has less delay in transmission.

IX. CONCLUSION

AntHocNet is a hybrid algorithm, combining both proactive and reactive elements after a Reactive path setup phase, the algorithm probes, maintain and improves paths in proactive way. In this paper video transmission performance in Ad Hoc networks is analyzed by AntHocNet algorithm and the results are compared to AODV and DSDV protocol. AntHocNet is inspired by the stigmergy-driven shortest path following behavior of ant colonies. Series of simulation tests show that AntHocNet is better suited for transmission than AODV and DSDV over Ad Hoc networks in case of throughput, latency and PSNR.

X. REFERENCES

[1] H.Sivajothi and Dr.E.R.Nagnathan, "Video Transmission Performance Evaluations Of Ad Hoc Routing Protocol With Emphasis On Ant Colony Optimization Technique", International conference on computational intelligence and multimedia applications, 2007

[2] S. M. Girirajkumar et.al, " Real Time Applicatio of Ant Colony Optimization", International Journal of computer Application,Volume 3, PP 34-46,June 2010

[3] G. A. Di Caro, F. Ducatelle and L. M. Gambardella, "AntHocNet: an adaptive nature inspired algorithm for routing in mobile Ad Hoc networks", European Transactions on Telecommunications, Special Issue on Self-Organization in Mobile Networking, September-October 2005.

[4] C. Perkins and E. Royer , " Ad Hoc on demand distance vector routing", IEEE Workshop on Mobile Computing Systems and Applications, New Orleans ,LA,USA, PP 90-100, 1999.

[5] R.M.Sharma, "Performance comparison of AODV,DSR and AntHocNet protocol",IJSCR Volume1,PP 29-32,Sep 2010

[6] Giann Di Caro, Frederick Ducatellle and Luca Maria Gambardella, "AntHocNet: anAnt-Based Hybrid Routing Algorithm For Mobile Ad Hoc Network", Galleria2, CH 6928Manno-lugano, Switzerland,2 june2010.

[7] F. Ducatelle, G. Di Caro, and L. M. Gambardella. "An analysis of the different components of the anthocnet routing algorithm",In Proceedings of the Fifth International Workshop on Ant Colony Optimization and Swarm Intelligence (ANTS), September 2010

[8] Royer, E., Toh, C,"A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks". IEEE Personal Communications 6 (2): 46–55(April 1999).

[9] D. Martens, M. De Backer, R. Haesen, J. Vanthienen, M. Snoeck, B. Baesens, Classification with Ant Colony Optimization, IEEE Transactions on Evolutionary Computation, volume 11, number 5, pages 651—665, 2007.

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