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LINK FAILURE AND ITS REVIVAL IN AOMDV PROTOCOL

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ABSTRACT

MANET comprises movable nodes empowered with the ability to possess agile motion in the network without any restriction. This dynamic network forms temporary connections and topology changes consequently. Lacking the central controller all the tasks regarding security, routing, retransmission, etc are performed by the nodes themselves. It results in a self configurable and self organized form of network. As the movement in the network increases, the probability of link failure also increases. Link failure reduces the effectiveness and performance of the network. More resources are consumed during the data retransmission. In this paper, the path is revived from the genesis point of link fault occurrence using participation of adjacent nodes.

Key words: Wireless Network, MANET, Routing, AODV, AOMDV, Single- hop, Mutli-hop, Link Failure, EAOMDV.

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1. INTRODUCTION

The term Network is described as the process of communication among the computer terminals; it can be a simple in teraction between two devices or a super complex system of sending information and data from a terminal to the cluster of devices. It can be of unicast or broadcast transmission in nature. Technology is advancing at a fast pace. The communication is occurring either in wired or wireless way. The devices or computer nodes are developed to accommodate both the methods but the wireless interaction being easy to use and handle becomes more popular.

2. WIRELESS NETWORK

Wireless network has the ability to transfer data from sender to receiver but within a range using radio waves. It may require few additional devices to increase its range to be accessible at far places and make it as successful communication channel. This network system is categorized into Infrastructure and Infrastructure-less networks [13][11].

Infrastructure network have a fixed topology in which the central controller plays the role of an administrator and did the task of routing, security, etc [6]. The sophisticated and delicate systems operate in the infrastructure network because such systems have to reliable and secured at all times; these features are not guaranteed in infrastructure-less networks. The infrastructure setup provides network administrator the ease to secure and operate the whole networking environment.

Infrastructure less network is devoid of any central controller, hereby the computer nodes are independent to interact in any criteria and are free to join or leave the communication environment at any instant. Hereby their participation is of dubious nature. Also, nodes play the double role acting as a terminal and the router in the same environment [6] [7] [2][16]. The task of the central controller are performed by the nodes themselves i.e. routing, security, quality of service, etc [16]. These are also called as Adhoc Networks as these are temporary interaction systems. The communication links changes with the mobility of the nodes. The source sends data to the destination; it could be either directly or indirectly using intermediate nodes [13]. This results in two types of [2] communication as

- *Single hop communication*: The sender and destination are in range of each other and interact directly.
- *Multi hop communication*: Sender and the destination nodes interact with the help of intermediate nodes.

Wireless networks are applied in various forms such as

1. MANET(Mobile Adhoc Network):

Composed of movable nodes that interact independently and move in a haphazard manner and thus possessing different topologies depending upon their location and movement. It has applications like Tactical networks, Data Networks

2. VANET(Vehicular Adhoc Network)

The network is used in vehicles that are in motion and [12] interacts at varied topologies. These may move at a variable and at high speed leading to connectivity problem. Its aim is to provide safety and comfort for passengers. It is used to provide weather information, internet access, traffic management and various multimedia applications [9] [11].

3. WSN(Wireless Sensor Network)

It involves network with power conscious sensor nodes that possessed the [1] potential to sense and measure the parameters in the system. These nodes are efficient enough to process signals and then communicate accordingly. It has complex applications like controlling temperature, etc [11].

3. MANET

Manet is a network known for movable nodes where they can join or leave the network space at any moment. Thus their location is not at all fixed and it culminates into a temporary and self configurable form of network [6]. Due to the movement of nodes, the network cannot maintain a single topology for the transmission process. They are wholly responsible for selecting the path and transmission process. The data is relayed from its sender to its destination with the aid of multiple hop links [16]. The nodes themselves are account table for perform routing, maintain security. It is a decentralized form of communication.

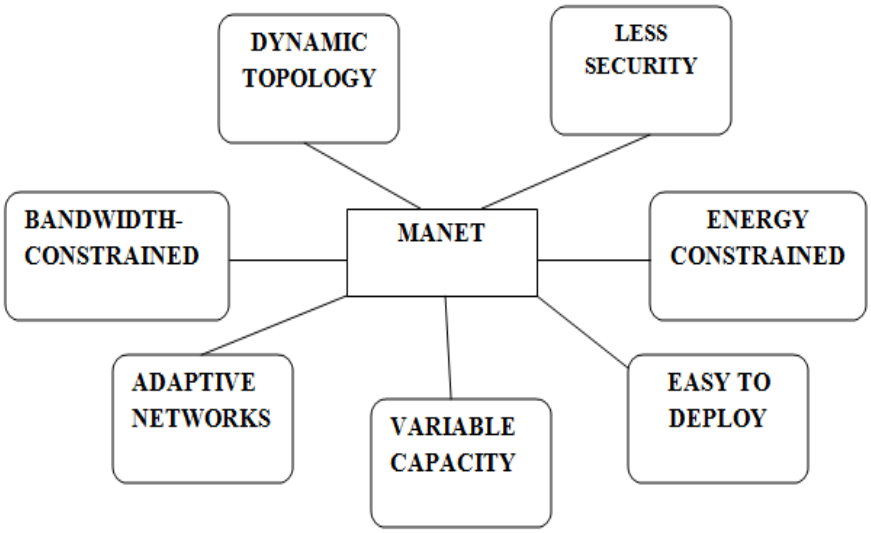

Figure 1 MANET characteristics

In MANETs the independent and free movement of nodes emerges as a boon at times but may also cause a muddle in the network. Having no central controller, it suffers from few challenges like routing, maintenance, security of data, etc [2].

MANET can be deployed instantaneously and at any place. The networks have dynamic links forming this network as flexible and adaptive in nature. This infrastructure-less networks are suitable for providing military applications, instant business network environment outside office, crisis management services or in any disaster recovery areas.

4. ROUTING IN MANET

The procedure that enables the source node to determine the suitable and robust path to the destination for the successful transmission of the messages in the network is called as Routing. Routing protocols are the rules followed by the nodes and these are of three types [4] [5] [6] [16]:

1. Proactive Routing Protocol

- Here, the network contains routing table for each and every node. During path establishment, the node refers to their respective table and generates the path from source to destination.
- As soon as any change occurs in the network, the message is broadcasted in the network and such changes are reflected in the table.
- The network has a high routing overhead. It has low efficiency and network consumption is high.
- Example: DSDV

2. Reactive Protocol

- In reactive protocol, the path is formed only when the sender initiated the process. The node itself decides the next destination using control messages on the basis of hop count and sequence number.
- It consumes less network bandwidth and save energy as the information is not retained as in Proactive protocols.
- It has certain limitations like initial delay, network congestion due to change in network, packet loss, etc.
- Example: AODV, DSR, AOMDV.

3. Hybrid Protocol

- Hybrid is an amalgamation of reactive routing protocol with the proactive routing protocol. In this, the whole network is partitioned into groups known as zones while each zone has a zonal head.

- Data is transmitted using proactive protocol if the transmission is to occur in a zone only. While it uses reactive protocol if the two zones have to transfer the data. Zonal head decides which technique is to be followed for reliable path finding.
- Example: ZRP

5. AOMDV PROTOCOL

Adhoc-on-demand multi path distance-vector routing protocol entails AODV routing protocol[6], where path discovery is initiated only when the request for path is generated from source[16]. While the search results in identification of multiple paths from source to destination. Highly dynamic networks where frequent occurrence of link failure takes place prefer to use AOMDV due to its enhanced properties than AODV. It results in loop free and link disjoint paths [6].

On route discovery, multiple paths are originated from source to destination using intermediaries. Among them, the parameters hop count and sequence number[10] are utilized to choose the supreme path. The former refers to the intermediate link between the nodes and the latter portrays the number denoting the freshness of the path [6]. The path is designated with the minimum hop count and maximum sequence numbe r[3].

The whole transmission process occurs in two phases: route discovery and route maintenance [5][10][15]. All the routing task is just based on these two: discovery of path, if error occurs rediscovery of path and the maintenance is done till the successful transmission.

This transmission is performed using some control messages[1] [10]by which the nodes interact with each other.

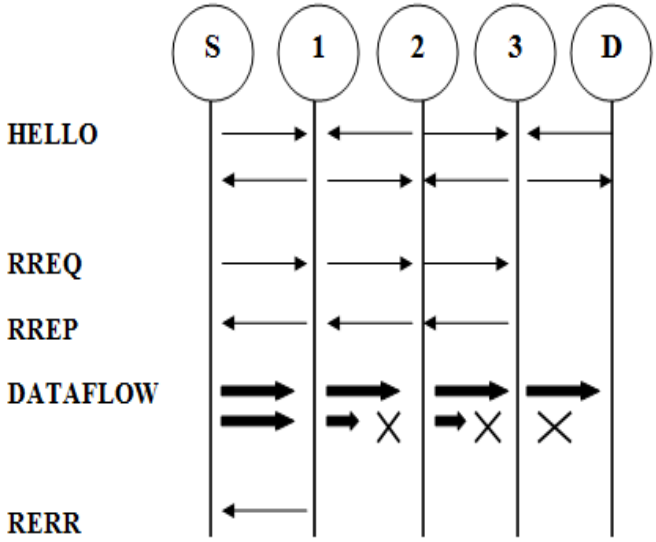

Figure 2 System of messages in AOMDV with link failure.

1. **HELLO:** Nodes introduce one another using these packets in a network and send them periodically. Absence of hello packets from a node gave the indication about its mobility.
2. **RREQ:** If the source in the network wants to emit the data to destination and no pre-existed route prevails, then the request (RREQ) is broadcasted to the adjacent nodes in the network in a controlled manner. The neighboring nodes further forward the RREQ packets till the destination is found.
3. **RREP:** Then the backward journey of the acknowledgement is initiated in the form of RREP. It is emitted by the nodes that have the direct approach to the destination. The source receives the RREP

from various nodes; then it selects the efficient path and starts the awaited transmission after comparing parameters.

4. **RERR:** When the smooth data flow got interrupted and error occurs, the outbreak of RERR packets takes place and the source along with other nodes in the network are made aware of this failure.

The performance of the EAOMDV basically depends upon the ability to discover the path and its maintenance in minimum time span. Initial delay occurs due to emergence of the data traffic when the source sends the route request in the AOMDV network

6. REVIEW OF LITERATURE

Pankaj Oli et al compare reactive protocols namely AODV and AOMDV. In AOMDV, route discovery leads to discovery of more than one path, where the efficient one act as primary path and others are referred as back up routes. It reduces the chances of link failure, also if it occurs then feature of multiple path discovery helps to regain the path. It helps in reducing unbalanced load. AOMDV surpasses AODV in terms of throughput, network bandwidth, optimal path length, delay, etc[6].

Radityo Anggoro et al add the concept of probabilistic relay in reactive protocols in VANET environment in the form of AODV-PR AND AOMDV-PR. Probabilistic relay deals with undelivered unicast transmission like RREP. AODV-PR as well as AOMDV-PR outplays their original ones. Also with multipath search feature, AOMDV-PR results better performance than AODV-PR.[12]

K.Vanaja et al investigated and compared the performance of AODV and AOMDV protocols in link failure environments using ns-2. Different network parameters are used to compare their working capacity and ability to bear and rediscover the lost path to destination. Simulation shows that AOMDV performs better that its fellow protocol with reduced packet loss ratio, end to end delay and improved throughput.[5]

Humaira Nishat at al proposed the modified AODV named as Reverse AODV (R-AODV), in this the destination on receiving RREQ initiates the reverse- discovery by flooding the network with R-RREQ with the intent to search source node. The data transmission takes place as soon as the source receives that reverse RREQ packets. R-AODV has better throughput, average delay and stable PDR. The chances of link failure are reduced as there is multiple route reply feature that enables the source to choose the path from multiple options.[4]

Table1 Description from Reviewed Reserch Papers

Author	Year	Description	Conclusion
Getsy S Sara et al	2009	Proposed the energy aware selection procedure E^2AOMDV, which also uses the maximal nodal surplus energy concept. It is an extension of AOMDV.[8]	E^2AOMDV results in enhancement of node's battery capacity, avoids route rediscovery for each occurrence of route failure, preserves battery capacity of nodes
May Cho Aye et al	2014	Proposed a modified energy constrained routing protocol, MEC-AOMDV. It is based on combination of load balancing approach and transmission power control.[2]	Delivers reduced energy consumption of nodes and enhanced network's lifetime. Ergo, it performs better than AOMDV in all network size in terms of performance metrics.
Kulbir Kaur Waraich et al	2015	Under DDOS attack, AOMDV consumes more power and bandwidth, thus decreases its reliability. Proposed EAOMDV that contains trusted entries only.	EAOMDV results in formation of trust based network as it does not allow any flooding attack to enter the network. It outperforms AOMDV in all network parameters.[14]
Ruchi Gupta at al	2013	Proposed a location based protocol, DREAM protocol which is used with AOMDV to find location of mobile nodes. Only the forwarding neighboring nodes are allowed in routing and rest remain in idle state.[10]	Enhance bandwidth and energy efficiency. Simulation results prove that with addition of DREAM protocol in AOMDV, route lifetime increases and overhead decreases.

Er Punardeep Singh et al	2012	The ns-2 is utilized to evaluate the performance of routing protocols. [7]	AODV surpass AOMDV and TORA in dynamic network environment while AOMDV outperforms its counterparts in static network. TORA has better end to end delay than AODV and AOMDV in both static and dynamic networks.
Humaira Nishat at al	2011	Proposed Reverse-AODV(R-AODV) protocol in which the destination also starts route discovery on receiving RREQ.	R-AODV has better throughput and average delay with increasing node velocity. Multiple route reply results in better PDR [4].
Romana Rahman Ema et al	2014	Analyze AODV, AOMDV, DSDV in Wireless Sensor Network using NS 2.34 and comparing them on QOS parameters.	Simulation depicts that AOMDV perform better than AODV and DSDV with regard to throughput, energy consumption, routing load, end-to-end delay.

7. LINK FAILURE

Link failure is one of the primary problems in AOMDV which results in the degradation of the network and packet lost. It causes delay in transmission, wastage of resources and energy in path rediscovery, low throughput excessive routing overhead, etc.

In MANETs, link failure occurs due to numerous causes such as [6] mobility of nodes, lack of resources, congestion, frequent attack by malicious nodes, etc. The most common cause of unsuccessful transmission of data packets is the node mobility that hampers the directed flow from source to destination.

The movement of nodes in the network necessitates it to update the routing table. More is the movement, more will be the modifications required to be done. Ergo, more will be the overhead and less efficiency in the network.

These movements may also cause a node to move out of the range of the sender node or a sender node moves itself at a significant distance. Such motions could lead to a link failure. On occurrence of node mobility as well as that of link failure, the adjacent nodes are made aware of this change. Thus the source takes the suitable decision either to reinitiate the whole procedure or to consider the same intermediate nodes

In figure 3, few nodes are incorporated in the network as shown. The path is devised from source to destination using respective route requests and respective route replies. In this case, node 2, the intermediate node, changes its position during data transmission. So packet loss happens at node 1. Here, the node 1 will propagate about the displacement of node 2 in the network. As soon as nodes are introduced with the change, they will modify their routing tables. It results in increased overhead and usage of resources.

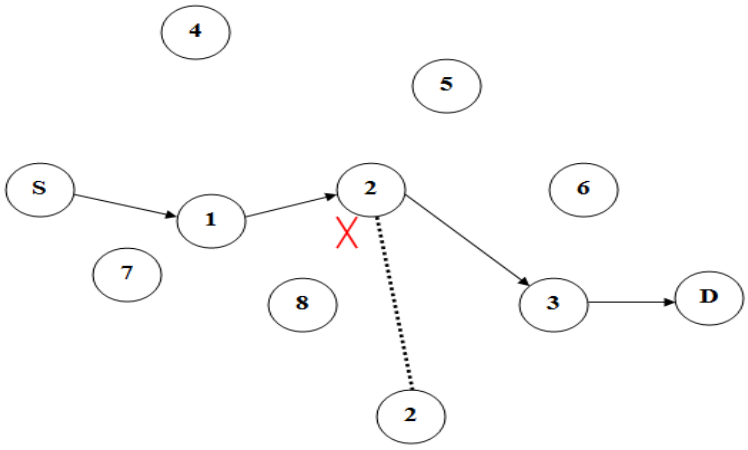

Figure 3 Link Failure in MANET

With dynamic character of nodes, the communication is hampered. Though the mobility cannot be avoided, but new techniques are applied to achieve the maximum utilization.

8. PROPOSED METHODOLOGY

The AOMDV is the proposed methodology which is used to formulate the path from source to target terminus using hop count and sequence number. Due to high node mobility there is much chances of link failure due which reduce network performance. In this work, improvement is been proposed in AOMDV protocol for link recovery. In the proposed technique EAOMDV, nodes on detecting link failure will forward control message to its adjacent nodes in the network. The adjacent nodes will revert back with the information of their resources and energy. The source node selects the recovery node which has maximum energy and resources. And the communication is revived using these recovery nodes. This proposed approach leads to less delay, increase in network throughput and reduction in energy consumed by the resources.

Algorithm

1. Establish the network with A number of mobile nodes
2. Recognize the Sender and the Destination node as S and D respectively.
3. Routing Protocol is to be AOMDV.
4. Built the route from source to destination using Hop Count and Sequence Number.
   a) { if the route does exist, then evaluate the number of path.
   b) Compare the energy of each route and it should be greater than 20.
   c) Maximum 3 routes are to be selected.
   d) Route acknowledgement are sent through all existed path}
   e) Else{ Route is /unreachable }
5. When link failure is detected
   a) { Node will send message as (Ping message, adjacent nodes)
   b) { Adjacent nodes will reply back to respective node that will select them as recover node
   c) Source will check the resources of each node.
   d) Increment the Q
   e) Store the incoming Data}
   f) Receiver will receive the data from that recover nodes
   g) Send acknowledgement to Sender S}

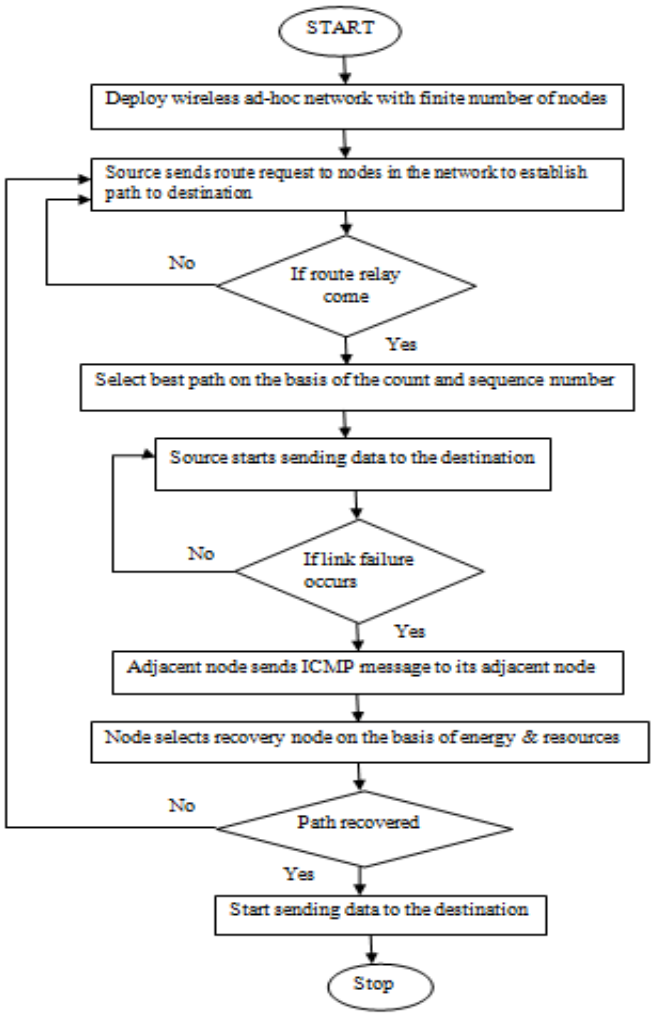

Figure 4 Flowchart of proposed work

9. PERFORMANCE RESULTS

9.1. Throughput

It is basically a rate at which something is processed [13]. It defines how skillfully and efficiently the network is being able to send the data to the destination without loss. It is the count of packet received by the terminal successfully per time period [3][5]. It can be improved with increasing node density [1].

9.2. End-to-End Delay

It is narrated as the mean of the time taken to propagate the message from its respective source to respective destination in a network. This value include all type of delays aroused due to buffering, route discovery latency, retransmission of packets, queuing, propagation as well as transfer times[1]. It is calculated as the difference between the arrival time and the departure time with respect to packet. It should be less for enhanced performance [15][4].

9.3. Packet Loss

It is elucidated by the count of packets being sent unsuccessfully in the network or get lost in the way during transmission. Further it is computed as the difference between the number of packets send and received [13]. It should be minimize for the robust network.

Average Energy Consumption

It denotes the energy consumed overall by nodes participated during whole transmission process. It is the average of all the consumed energy [2][1] in the network system.

10. SIMULATION RESULTS

Simulation results are used to measure and compare both AOMDV and EAOMDV routing protocols using NS-2 in terms of different parameters as listed below. Results are evaluated using two colors, red and green; the former represents AOMDV and the latter one represents EAOMDV.

10.1. Throughput

Figure 5 reveals that the throughput parameter in EAOMDV outperforms existing AOMDV. In AOMDV, the link failure ceases the transmission once, so the reduced number of packets is to be received by the terminal. While in EAOMDV, the revival of path leads to enhanced number of packets received by the destination.

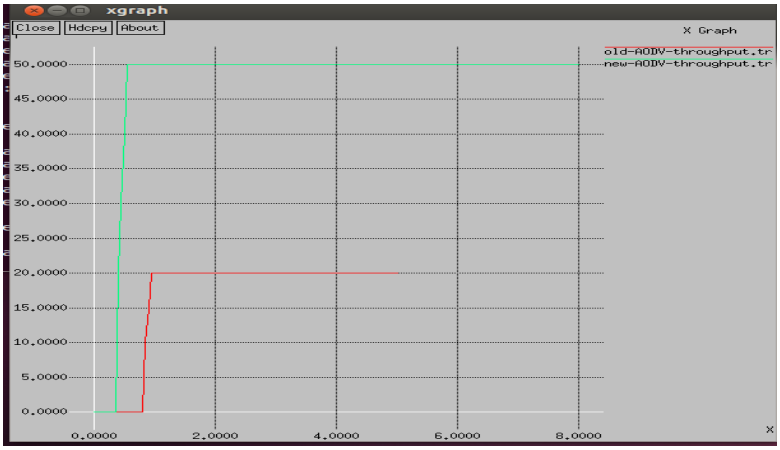

Figure 5 Throughput- AOMDV vs EAOMDV

10.2. End-to-End Delay

In this figure 6, the delay in new scenario is less as compared to the old scenario due to recovery of path. More time is consumed with the occurrence of link failure in AOMDV; it requires research and retransmission that enlarges the transmission time. In EAOMDV, the rejuvenate route allows the packets to reach their destination; ergo less delay is plotted on graph.

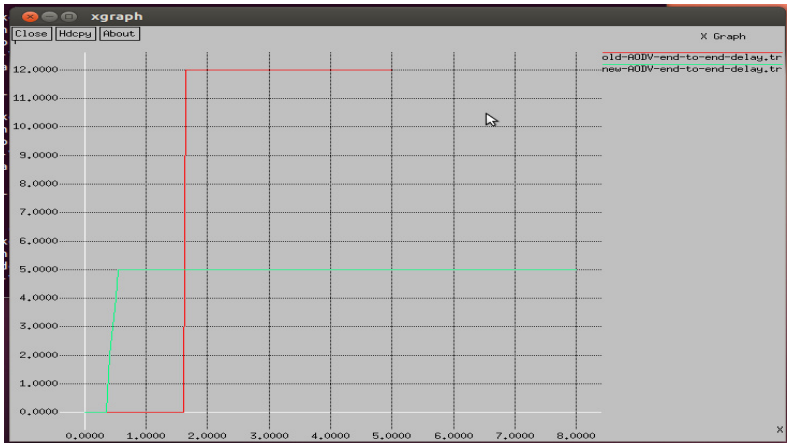

Figure 6 End-to-end delay - AOMDV vs EAOMDV

10.3. Packet Loss

As shown in figure 7, the packet-loss comparison is shown between scenarios. In AOMDV, packet-loss is more due to mobility induced link failure and the ceased transmission. While in the new scenario EAOMDV, packet-loss is less as the path is recovered from the link fault and thereafter the continued data transmission.

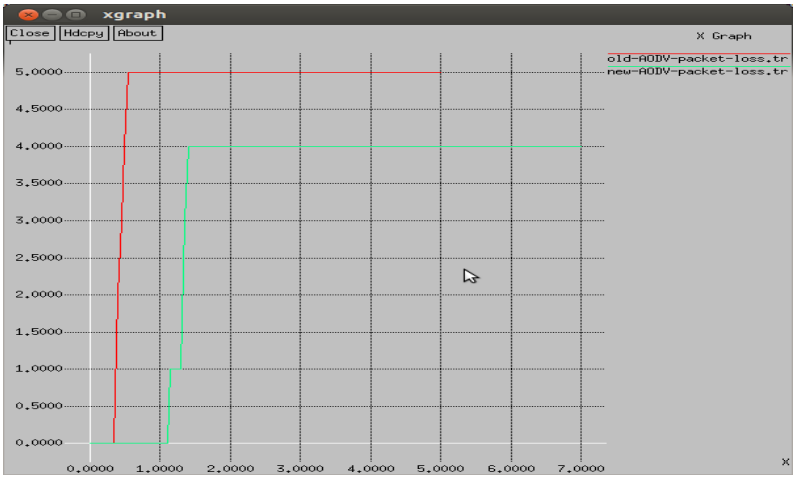

Figure 7 Packet Loss - AOMDV vs EAOMDV

10.4. Energy Consumption

In the figure 8, the energy consumed is compared between two processes where the red color calculates the energy consumed in link failure case while the green color covers the energy consumed in the path recovered case in EAOMDV. Thus the simulation results show that the proposed algorithm leads to less energy consumption as compared to the link failure in AODV.

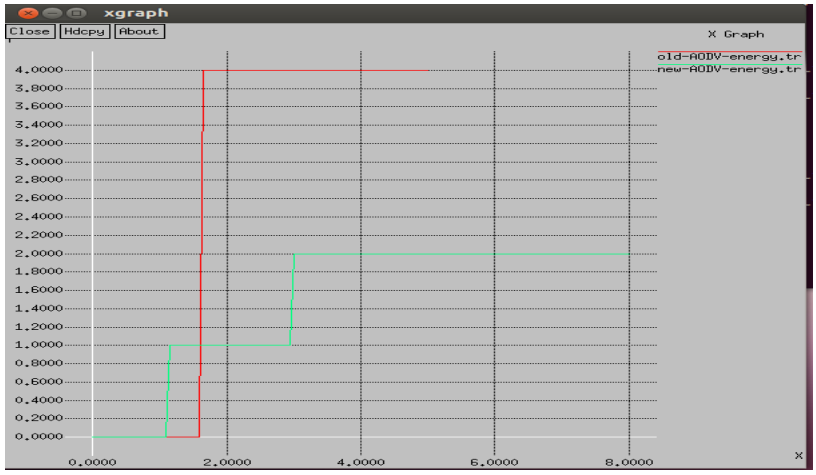

Figure 8 Energy Consumption – AOMDV vs EAOMDV

11. CONCLUSION

In Manet, the link failure is a normal phenomena but it has to be minimized and controlled such that the effectiveness of Manet holds for the transmission process. Link failure induces delays, packet loss, lower performance, etc in the network. Different techniques are followed to deal with this link failure. The link revival using energy resources of adjacent nodes has given improved results. It helps to save time by reinitiating the journey from the site of link failure itself rather than performing retransmission again from the first step.

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