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Node Replacement and Alternate Path based Energy Efficient Routing Protocol for MANET

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***Abstract* – In the recent years, the technology of wireless ad-hoc networks has gained a lot of importance. MANET is a special case of ad-hoc wireless networks. Mobile nodes have small batteries with limited power. Large number of sensor nodes in MANET makes it impractical to replace sensor node batteries. Thus the life time of Mobile nodes is an important attribute of wireless ad-hoc networks. The life time of a MANET network is the time spent from the deployment to the instant when the network is considered non-functional. Proposed methodology present a novel alternate route selection based routing protocol for multipath energy efficient routing over MANET based on linear regression. This approach helps to enhance the network survival. The simulation results also provide the batter results as compare to previous approach.**

***Keywords* – Wireless Ad-Hoc Networks, MANET, Routing Algorithm, Energy Efficient Routing, Linear Regression.**

I. INTRODUCTION

Mobile ad hoc network (MANET) [1] is a decentralized type of wireless networks in which the numbers of stations are more freely without any supervision of authority. This type depends on the mobile nodes and there is no infrastructure in such type. There are no access points or cables, routers and servers. In MANET nodes can move freely and in arbitrary ways, so it may change its location from time to time. Each node may be a sender or a receiver, and any node may work as a router and do all router functions. This means that it can forward packets to other nodes. Many applications of MANET's are implemented andused until today like in meeting conferences; military operations; search and rescue operations, all of them are examples of MANET networks. In MANET routing, if we apply AODV [2] or minimum intermediate hop, if we use DSR [3] after getting path sender sends actual data through single link but at the same time more than one sender share common link so congestion occur onto the network that is measure issue for MANET. Congestion control is the main problem in ad-hoc networks. Congestion control is associated to controlling traffic incoming into a telecommunication network. To avoid congestive crumple or link capabilities of the intermediate nodes and networks and to reduce the rate of sending packets congestion control is used extensively. So various researcher works in that filed for minimization of congestion from network. In this paper we focus on congestion minimization using multipath routing in ad-hoc network and transport layer base congestion control or rate analysis base congestion control in MANET.

In multipath technique sender sends data through more than one path to receiver node that increases the performance of the network are control the single share path congestion after that we also analyze data rate of sender if sender rate greater than the receiver node so we minimize the sending rate on the bases of transport layer technique..The process of discovering multiple routes among the distinct source and single destination at the time of single route discovery corresponds to multi-path routing [1]. In MANET, the prevailing issues such as scalability, security, network lifetime, etc can be handled by the multi-path routing protocols [4, 5]. This protocol enhances the end to end delay, throughput and offers load balancing in MANET. Multipath routing has some disadvantages:-

A. Route Request Storm

A huge quantity of route request messages are created by the multipath reactive routing protocols. When the intermediate nodes requires to process the duplicate request messages, there is a chance of unnecessary overhead packets be set up in the networks.

B. Inefficient Route Discovery

Certain multi-path routing protocols avoid intermediate node from forwarding a reply from its route cache in order to determine node-disjoint or link disjoint paths. Hence the source has to wait till it gets a reply from destination. Thus the process of route discovery performed by the multipath routing protocol needs more time when compared with unipath protocols.

II. RELATED WORK

Here we are presenting related work about existing work done in the field of MANET routing protocol, congestion control. Amjad Ali et. al. [1] proposed NCLBR, a protocol to deal with load balancing in MANET. They use AODV as its basic structure. In this approach RREQ packets are only delayed for a period of time and then broadcasted. Apart from that, it uses periodic hello messages which further add to the routing overhead generated throughout the network. Kezhong Liu, Layuan Li et. al. [4] combines the multi-constraint QoS mechanism with the load balancing scheme to search the satisfying path between the source node and destination node. The researcher main objective is to develop a load balancing strategy that could monitor any changes to the load status of the neighborhoods and be able to choose the least loaded routes with the knowledge of the surrounding load status. The AQRL protocol makes an extension on the AODV and utilizes the node's resolvable bandwidth and load information to distribute the network loads, which can prevent network from getting into the sate of congestion, and avoid the power of congested node to be exhausted. Yi, J., Adnane, A., David, S. and Parrein, B. [5] in algorithm gains great flexibility and extensibility by employing different link metrics and cost functions. In addition, route recovery and loop detection are implemented in MP-OLSR in order to improve quality of service regarding OLSR. Multipath routing protocols for MANET address the problem of scalability, security, lifetime of networks, instability of wireless transmissions, and their adaptation to applications. G.Vijaya Lakshmi C.Shoba Bindhu. [6] they proposed the queuing mechanism hence improves the network metrics such as overall network throughput, reduces the route delay, overhead and traffic blockage probability. The approach is generated over a routing scheme in ad-hoc network. S.Santhoshbaboo and B.Narasimhan, [7] they propose to develop a hop-by-hop congestion aware routing protocol which employs a combined weight value as a routing metric, based on the data rate, queuing delay, link quality and MAC overhead. Among the discovered routes, the route with minimum cost index is selected, which is based on the node weight of all the in-network nodes. TuanAnh Le [8] they develop an energy-aware congestion control algorithm for multipath TCP, called ecMTCP. EcMTCP moves traffic from the most congested paths to the more lightly loaded paths, as well as from higher energy cost paths to the lower ones, thus achieving load-balancing and energy savings. Jingyuan Wang, Jiangtao Wen et. al. [9] in his work propose a novel congestion control algorithm, named TCPFIT, which could perform gracefully in both wireless and high BDP networks. The algorithm was inspired by parallel TCP, but with the important distinctions that only one TCP connection with one congestion window is established for each TCP session, and that no modifications to other layers (e.g. the application layer) of the end-to-end system need to be made. This work done only transport layer congestion control via TCP improvement method but congestion also occurs in routing time so that work enhance through routing base congestion control technique. Kai Chen et al [10] proposed "an explicit rate-based flow control scheme (called EXACT) for the MANET network". In EXACT, flow's allowed rate is explicitly conveyed from intermediate routers to the end-hosts in each data packet's special control header. As a result, EXACT reacts quickly and precisely to re-routing and bandwidth variation, which makes it especially suitable for a dynamic MANET network. Kazi Chandrima Rahman et al [11] proposed "explicit rate based congestion control (XRCC) for multimedia streaming over mobile ad hoc networks". XRCC addresses the problems that TCP faces when deployed over ad-hoc networks, and thus shows considerable performance improvement over TCP. Although XRCC minimizes packet drops caused by network congestion as compared to TCP congestion control mechanism, it still suffers from packet drops. HongqiangZhai et al [12] proposed "a novel rate based end-to-end Congestion Control scheme (RBCC)". Based on the novel use of channel busyness ratio, which is an accurate sign of the network utilization and congestion status, a new rate control scheme has been proposed to efficiently and reliably support the transport service in MANET. In RBCC, a sub layer consisting of a leaky bucket is added under TCP to control the sending rate based on the network layer feedback at the bottleneck node. Emmanuel Lochin et al [13] proposed "a complete reliable rate-based protocol based on TCP-Friendly Rate Control (TFRC) and selective acknowledgement (SACK) mechanisms". This design also introduces a flow control variable, which regulates the sender to avoid packet loss at the receiver due to a slow receiver. In this mechanism, there is no packet loss due to flow control, at the receiver, and applies a smoothness criterion to demonstrate that the introduction of the flow control inside TFRC does not alter the smoothness property of this mechanism. YuedongXu et al [14] proposed "A fully distributed congestion control algorithm to balance throughput and fairness for TCP flows in multi-hop ad hoc networks". The interactions between the hidden nodes and network congestion are mainly focused. A distributed algorithm to improve the end-to-end throughput, and at the same time, provide per-flow fairness by exploiting cross-layer information is proposed. In the link layer, each node uses a proportional controller to determine the ECN marking probability for the purpose of notifying incipient congestion. Then the rate based TCP sender adjusts its sending rate according to the feedbacks from the link layer. Yuanyuan ZOU, Yang TAO at el [15] proposed a "A Method of Selecting Path Based on Neighbor Stability in Ad Hoc Network" in this title they studies about routing algorithm based on the stability in mobile Ad-Hoc network and presents a routing mechanism based on neighbor stability.

It is seen that most of the previous approaches for chose alternate path directly when any node shout down that dropped performance and have relative higher complexity. As the mobile nodes operate on the limited power of battery therefore it becomes very necessary to develop techniques which can successfully maintaining lesser complexity. The objective of this dissertation is to develop a new approach which can successfully maintain the rout with lesser battery power in order to long survival of Sensor network.

III. PROPOSED ROUTING PROTOCOL (ARAODV)

The proposed solution is going to provide supplement support the high junction lower energy node with lower junction high energy node. Proposed method used the method of bi-partite graph & swam intelligence for deciding which high energy node provide supplement support to high junction node without break its own connectivity. In proposed methodology uses to select node from low traffic area having middle resident energy limit to provide supplement support low energy node at high traffic zone. Initially proposed algorithm assume limit of low resident energy node and middle resident energy node. If any node in network degrades their energy limit below low resident energy node then its broadcast node replacement packet. If any neighbors node having energy above middle resident limit and reside in lower traffic region select for providing supplement support.

Proposed routing protocol alternate route AODV (ARAODV) is an proactive node disjoint multipath routing protocol. In ARAODV, MANIT is assumed to consist of several steps Sti = 1, i 2, ..., l based on the number of hops between the source and destination. The sink is a node St0 zero. Each node can communicate with the receiver node is St1. We assume that a node can communicate with nodes on the same stage StiStiSti and the next step + 1 but cannot communicate with Sti-1 nodes. This avoids looping paths. Initially, all network nodes have a very high value of the hop count with the exception of the receiving node. Initially, all nodes have their residence above the threshold energy level energy. Multiple paths from all nodes to the sink is generated in the construction phase of the road. In the process of building the packages Route (RCON) are exchanged between nodes. Each sensor node transmits the packet once RCON and maintains its own routing table. If there is no path to the sink node through the RCON received packet, then the node processes the packet RCON. If the path to flow from this node is already available in the routing table of the node, then the number of hops the packet is checked. If the hop number of packets is less than the value of the node and its residual energy jump is greater than the power threshold value, then it is RCON; otherwise the packet is discarded. The node receiving the RCON packet, updates the RCON packet. RCON is updated with incremental number of hops by one, updates the node ID before adding the node identifier in the way. The node receiving the RCON packet updates its routing table as the number of hops and path node to the receiver. Similarly, all nodes in the network receive the RCON packet and update their routing tables. Once they are all multiple paths are generated, the node disjoint multipath identified between the source and destination. When the source node to send the data from the target, extends the FFI trace data between nodes disjoint multipath based and long tail filled fill residual energy. If a path disjoint node fails due to the death of routing node movement or node, it informs the source node through the RERR packet.

Proposed Algorithm (ARAODV)

1. **Assumption**
2. Ni = Node ID
3. Si = Sender ID
4. Ri = Receiver ID
5. Ei = Energy
6. Ti = Threshold Energy
7. Xi = Initial X location
8. Yi = Initial y Location
9. Algorithm( )
10. Node Si uses AODV Broadcast Route Request
11. {
12. If (Node exist in Range && Node Energy ≥ ML)
    a. Match Ri ID to Self ID
    b. If (Not Match)
    c. {Initiate Ei of Node into Packet Header
    d. Forward Packet to Next Hop
    e. If(Ri ID = =Self Current Node ID)
    f. {Receiver Found}
13. Check all Available Path from Si to Ri
14. Select Maximum Energy Path
15. }
16. Else if (Node Energy ≥ ML)
17. {
18. Ri broadcast position replacement packet search node having higher node energy…
19. Each Neighbor node reply
20. Select node with maximum energy and lowest distance apart
21. }
22. Else
23. {
24. Node not Found
25. }
26. }

IV. ROUTE MAINTENANCE IN ARAODV

Figure 1 illustrates the operation of the route maintenance phase where given scenario having 15 nodes. Green level node is source and destination, Grey level node is intermediated node on selected route on green link as show in figure (a).

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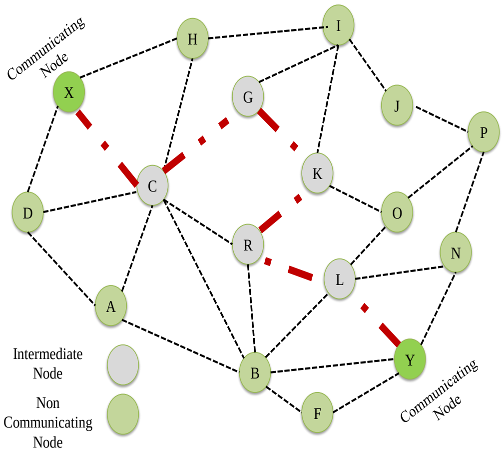
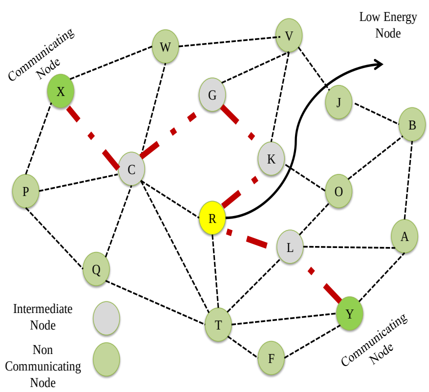


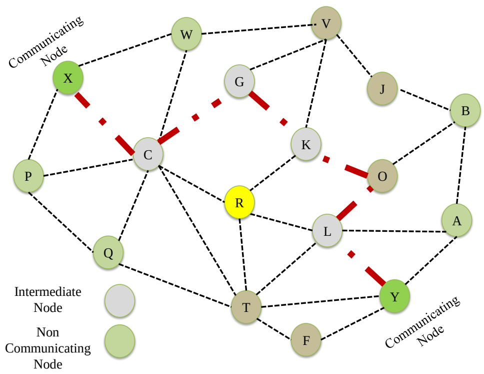
(A)

When node R drop their energy level below threshold then it broadcast responsibility overtake packet to their radio node and perform voting for responsibility overtake as show in figure.1(b) and chose on the basis of node having enough energy to transmit the packet and having lower load currently as case B. And simultaneously node before R node ie Node K transmits that packet from alternate Route as shown in figure 1(C) as case C.

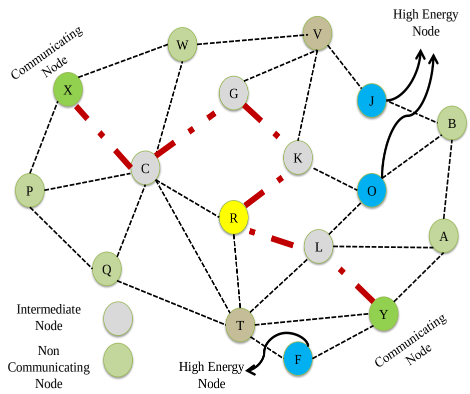


(B)

Communicating node K carried out by route discovery using alternate node and transmit the desire packet P as show in figure 1 (C).

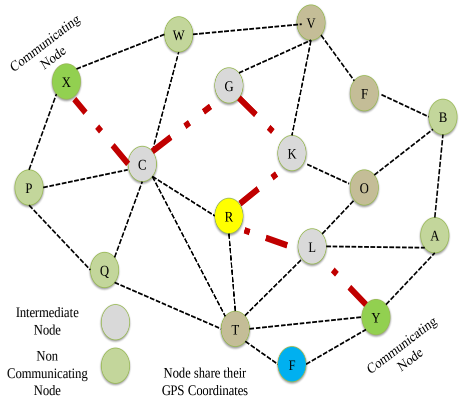


(C)



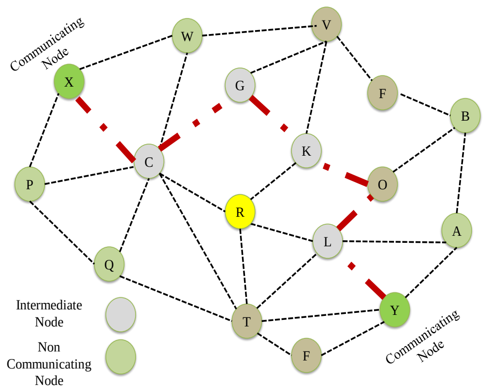
(D)

Whereas node P broadcast node supplement request packet over the network and node F, O and J reply for that. Node J checks its routing table to find the alternative path from node J to sink node and select the best route between the paths to sink node. Then node J generates and sends the RERR message to the source node.

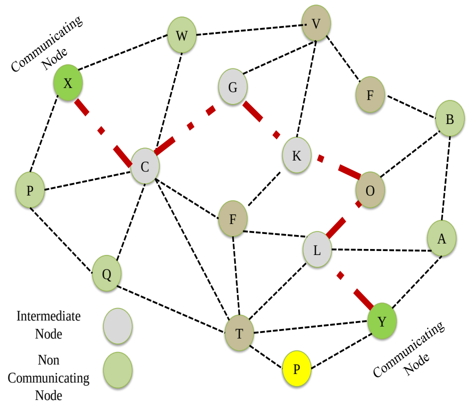


(E)

The RERR message provides information about the link failure and the alternative route between the node that generated the route error packet and the receiving node. Same process is repeated for node F and O. Finally node F is selected for supplement support after applying ARAODV.



(F)



(G)

Fig.1. Route Construction Phase in ESAODV

Then node F and P swap their respective GPS coordinates and generate new topology connect of network A for both the case Band case C as F and G.

V. Result Analysis

Proposed ESAODV show better result in term of packet delivery ratio, battery power consumption and control packet overhead.

- Packet Delivery Ratio: - Proposed ERAODV having higher packet delivery ratio as compare with SVMAODV has higher degree packet loss.

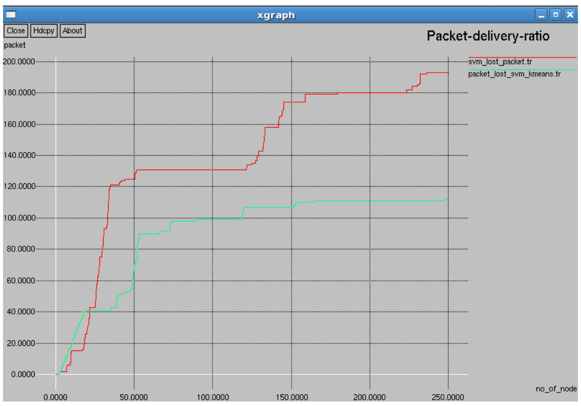


Fig.2. Packet delivery ratio of Proposed Protocol

Control Packet Overhead: For any ideal routing protocol it is required that it has lower control packet overhead, whereas existing SVMAODV have required higher control packet as compare to proposed ARAODV.

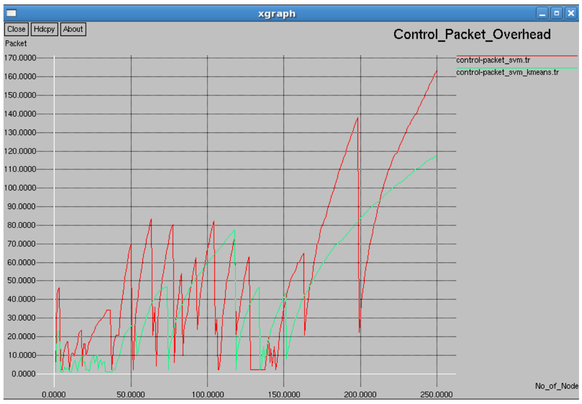


Fig.3. Control Packet Overhead of Proposed Protocol and Existing Protocol

Battery Power Consumption: Towards Energy saving routing protocol proposed protocol try to move lower energy node towards less traffic and higher energy node towards high traffic and reduce retransmission whereas existing approach only minimized redundant path.

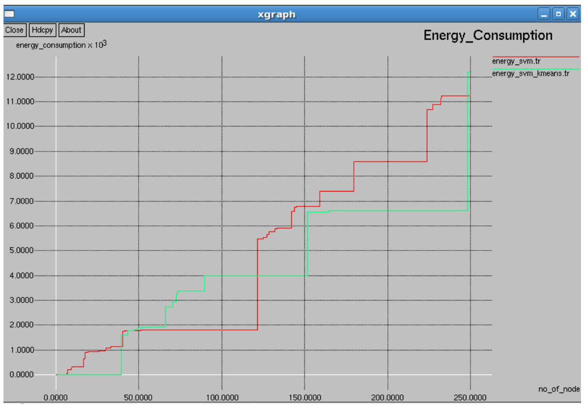


Fig.4. Battery power consumption of Proposed Protocol and Existing Protocol

VI. Conclusion

This Paper proposed the ARAODV Protocol for multipath energy efficient routing over MANIT is presented. This method encapsulate advantage of two different predefine method in order to overcome their limitation. First one is alternate path and second one is clustering approach. Proposed protocol tries to migrate lower energy node towards lesser traffic and distribute higher energy node over heavy traffic section of network.To improve the reliability through redundant paths in the network, it is suggested to have a maximum number of paths between the source and the destination. It is necessary to have a minimum number of nodes in each redundant path. Network reliability is increased in networks multipath disjoint nodes, where each node disjoint path has a maximum number of redundant paths and the minimum number of nodes in each redundant path. In the multi-path network node disjoint, the reliability is very high. The performance of proposed technique is depending upon network density and network traffic. In future work, ARAODV can be further enhanced by taking into consideration metrics related to QoS and time constraints.

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