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Review Article

A REVIEW OF ENERGY EFFICIENT MULTIPATH ROUTING PROTOCOLS FOR MANETS

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A B S T R A C T

Mobile Ad hoc network (MANET) is group of self-routing enabled devices that transmit among themselves without any certain network infrastructure. Routing in MANETS has routes between nodes in a topology with many unidirectional links using minimum resources. Since routing protocols have role in MANETS, their energy-awareness make greater network lifetime by efficiently using of the available energy. In all existing single path routing schemes a new path-discovery process is meant once a path failure is detected and it causes wastage of node measure. A multipath routing scheme is the alternative to maximize the network lifetime. Energy, distances are the fitness values used in the previous work to find the optimal path in multipath routing. In this work, it is proposed to use the network resource bandwidth as a fitness value. The calculations for selecting routes towards the destination will be according to energy, distance and also bandwidth. The proposed work is expected to improve the performance of mobile ad hoc networks by prolonging the lifetime of the network. The performance will be evaluated in terms of throughput, packet delivery ratio, end-to-end delay, routing overhead ratio and then compare with the results of existing AOMDV protocol

INTRODUCTION

At present computer performance and technologies in mobile system to communicate are being advanced.Nodes communication can be done through links in the ad hoc networks.Battery capacity of node is depleted which means network security is needed. Routing protocol made the node energy effective that represent the lifetime of network. There are 3 generations in MANETs: first generation is the Packet Radio Network in 1970's.Survivable Adaptive Radio Network is developed by PRNET in 1980's. To maintain MANETs there are standards like Bluetooth, IEEE 802.11. The path which is effective to send packets is taken and the route that is efficient can be find using Route Request. Route reply gives the view about the hop, residual energy and bandwidth. These are the control packets in the protocol to get the required information about the route. First the route selection isdone based on the control packets. The path with less distance and the residual energy of the node can be considered. When this occurs the source transmit the package over the path to the destination without any interruption. This can be done with the multipath routing protocol which ispreferred to the onepath routing protocol.

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In one pathrouting once the link splits the packets will not transmitwhereas in multipath, paths are made tosend the data packets. Fitness function is derivedfrom Particle Swarm Optimization (PSO) algorithm.

Fitness Function is mostly used to find the ideal route. The optimal path is the one with:

- Less distance and
- Exhaust less energy.

The optimal path minimizes the energy loss and increases the network period. The multipath routing protocol has several routes and if one breaks the other is used to transmit the data packets. The optimal path isfind based on the parameters. Remaining energy of the node is calculated along with the distance of the link. Path with higher energy level and with less distance is to be find to get the optimal path. HereAODV (ad hoc on-demand distance vector) is the protocol from which AOMDV can be taken i.e., AOMDV creates the multipath between the source and destination. AOMDV has route _list which is not present in AODV and it has advertised_hopcount. As in AODV the route reply contains the information regarding the node in AOMDV. Damage in link happens by which multiple paths are required to send the data packets.All the process in AOMDV is done through control packets (RREQ, RREP and RERR). Protocol can be designed based on distance, energy and bandwidth factor. Thus the proposed FF-AOMDV performance in maximizing the network lifetime is possible in comparison with the AOMDV.

Existing System

Energy Efficiency

Group Key distribution mechanism

Tejpreet Singh *et al*. [1] demonstrate that to maintain a routing protocol, security and energy efficiency are the important factors. Energy-efficient Secured routing protocol is implemented to reduce the task. Safety for the protocol is done by secure optimized link state routing system. To get the new route, power status of the node is verified in the route table.Node representation to the process is done and nodes are accessed through safe system. Access control entity gives aa private key Ki, public key Ki and the certificate Ci needed to get the group key by an approved node. Group key is finding by the message send through round leader. After getting the Order message process is terminated with response message. A group key is obtained by the multipoint relays (MPRs). The group key distribution mechanism admits alternative of the group key when a node is eliminated. Non-authorized friend is able to make the resources when the groupkey is send by the authorized user.

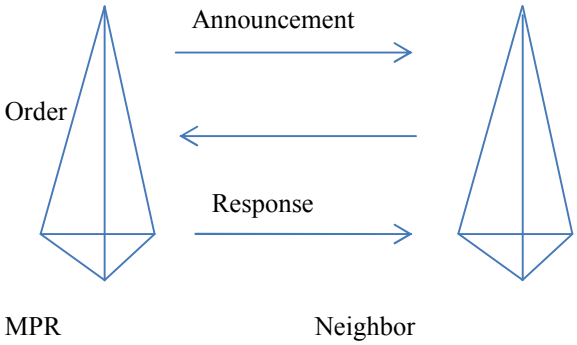

Fig 1 Group key distribution mechanism

ED-Based Enhanced EnergyEfficient Cross LayerModel

Sudhakar Pandey *et al* [2] Network accomplishment can be enriched by using cross-layer approach. Application of sending power charge method to arrange communication power issues in decline of energy consumption. ED is examined to consult the weight assisted with each node. D views for degree and E views for energy.System usage is increased and energy consumption is reduced by control overhead reduction.Energy method of Wireless network is stated as the entire energy usage of the network and the units like sensor elements, routings energy usage. For a protocol creating a model i.e., energy model to its growth is the best method. N mobile sensor nodes, one sink node is taken with in a network. Energy used by sensor device: sensor tool consists of processing units, sensing unit, memory unit and transceiver unit.
Energyusage of single unit taken is:

E Sensor Device = E processor + E sensor + Ememory+Etransceiver (1)

Where ESensorDevice is the energy consumed by a sensor device, Eprocessor is the energy depleted by the processing units, Esensor is the energy use up by the sensing unit, E memory is the energy spent by the memory unit and Etransceiver is the energy consumed by the transceiver unit. Sensor nodes exist many years and nearly 75% of networks energy is used for communication. Thus the energy usage of node must be reduced because for every device energy is utilized. So, energy usage is more and it should be decreased.

Cluster and Energy Efficient Secure Routing Algorithm

S.Muthurajkumar *et al* [3] In MANETs, two vital issues are Energy consumption and Security. With key management, trust management, firewalls and intrusion detection the security is maintained. As the security and energy are essential for communication they are studied in routing algorithms. When the security attacks in routing protocols are blocked energy usage is reduced. Trust score evaluation, routing and threshold setting using the trust values are the phases in trust based secure routing algorithm. In trust score evaluation process the trust score for distinctive nodes are calculated depending on factors like nodes thatare really able to send their acknowledgement to neighbors when the packets are taken can be considered as first group and the nodes that leave many packets are treated as group two nodes.By this the trust score will be calculatedthrough the Eq which shows the percentage of acknowledgements.

$$TS_{1i} = (\frac{ACK}{RP})*100 \quad (2)$$

ACK = No. of acknowledgements transmit to the neighbors TS_{li}= First trust score in percentage for ith node, RP = No. of packets accepted from neighbors.Second trust score is estimated using Eq (3) which counts the dropped packets

$$TS_{1i} = 100 - ((\frac{DP}{TDP})*100) \quad (3)$$

DP = No. of packets dropped, TDP = Entire packets dropped in network.TS_{2i} =Second trust score percentage for ith node.The total trust score of the particular node is considered using Eq. (4)

$$TS_i = \frac{(TS_{1I} + TS_{2i})}{2} \quad (4)$$

TS_{1i} = First trust score for node i, TS_{2i} = -Second trust score for node i, TS_i = Entire trust score for node i.

For establishing a cluster based network a clustering scheme is evolved with clusters. A Cluster based Energy Efficient Secure Routing Algorithm (CEESRA) is proposedfor maintaining efficient routing. Malignant nodes should be prevented and traced applying the trust score.A dynamic clustering techniquenot only uses low mobility nodes, energy usage, trust values and distance termsin maintaining the energy efficient secure routing algorithm.

Wireless recharging and localization

N.Magadevi *et al* [4] The nodes in Wireless Sensor network has finite power resource. Batteries of nodes can be recharged by charging. Single mobile anchor is used to define the charging of nodes and localization. Static node batteries are recharged whenever it is less than the threshold limit. Sensor networks main unit is sensor node that has microprocessor, transceiver, memory and power supply. Wireless Sensor Network is nothing but the adhoc network with group of nodes. There are plenty of fields like disaster rescue, intrusion detection and in health care applications.Sink node is nothing but the portal between the WSN and network. WSN has some advantages like robustness, greater efficiency and scalability.However there are some tasks to design WSN such assoftware development, deployment, localization, hardware

design, routing protocol.Both the data and current location is sent by each sensor node.For efficient data transfersensor node is to be accurate.If the sufficient localization system is made there is development in networks. Distance calculation, position estimation are the elements of localization algorithm. Distance can be computed by taking the distance between nodes. Received Signal Strength Indicator is the technique implemented to obtain the distance of nodes. Wireless charging is also discussed which is an important factor.

Sensor sight the information and exchange information to the base station through Multi hop communication.Sometimes low energy makes the sink of node which affects the networkthus an energy controlling scheme is to be designed in Wireless Rechargeable Sensor Network. This is beneficial to improve the network's lifespan.

Branch and bound algorithm

Wen-KuangKuo *et al* [5] The energy consumption of battery-powered mobile devices can be increased by measured in bits per Joule for MANETs. By jointly considering routing multimedia applications the energy efficiency (EE) is an essential aspect of mobile ad hoc networks (MANETs). Based on the cross-layer design paradigm EE optimization is, traffic scheduling, and power control a non-convex mixed integer nonlinear programming is modeled as a problem. Branch and bound (BB) algorithm is devised to efficiently solve this optimal problem.

EnergyEfficiencyOptimizationProblem*:*

A MANET comprised of one set of stationary nodes N connected by a set Lof links. Everylink is consideredto be directional.

Mathematical model for the EnergyEfficiency Optimization Problem:

For every link *l* at every time slot *t*, binary variable x_t^l as

$x^l_{t=}\begin{cases}1; & \text{if link l is allowed to transmit at timeslot t}\\ 0; & \end{cases}$

$(\forall l \in L, t \in \lceil), \quad (5)$

Where $\lceil = (1,\ldots,T)$ and Tis the total number of scheduled time slots. Transmission power on link lat time slot t,i.e.$p_t^l$is continuously adjusted in given interval$[0,p_{max}]$.
Constraint

$$p^l_t\begin{cases}\in[0,p_{max}], & \text{if } x^1_{t=1}\\ =0 & \text{if } x^1_{t=0}\end{cases}$$

$(\forall l \in L. t \in \lceil) \quad (6)$

Note that being allowed to transmit does not necessarily mean a transmission actually occurs, which is decided by the optimization algorithm. With recent advances in information and communication technology (ICT), MANETs become a promising and growing technique.Multimediaservices like video on-demand, remote education, surveillance, and health monitoring are supported using MANETs. Energy is a scarce resource for mobile devices, which are typically driven by batteries. Using cooperative multi-input-single-output transmissions authors maximized EE for the MANET. By designing resource allocation mechanisms cross-layer optimization can substantially enhance EE. By jointly computing routing path, transmission schedule, and power control to the network, link, and PHY layers across-layer optimization framework is proposed to enhance EE.The transmission power of every active node in each time slot is specified by the power control problem. In terms of computational complexity proposed algorithm outperformed the reference algorithm. By exploiting the cross-layer design principle a solution to determine the optimal EE of the MANET is provided. Distributed algorithms and protocols are designed to find the optimal EE. Any technique which can optimize nonconvex MINLP problem in a distributed manner is not proposed. Thus distributed algorithms and protocols are developed using approximation algorithms. The guarantee for acquiring the optimal solution is the disadvantage of approximation algorithm. A customized BB algorithm for the optimization of the problem is proposed. A novel lower bounding strategy and branching rule is designed and incorporated in the proposed BB algorithm. To optimize EE of MANETs distributed protocols and algorithms are implemented. To improve EE of MANETs novel distributed protocols and algorithms are developed.

Energy-efficient cooperative MAC protocol using Power control

Xiaoying Zhang *et al* [6] demonstrate that limited energy resource is the vital issue as batteries are able to power the MANETs. For the design of MANETs minimizing the usage of energy in mobile devices is an important issue. Network lifetime can be prolonged or the usage of energy can be minimized which is the purpose of protocols. Power-adjustable model and fixed-power model are the two energy models. Power adjustments can be made i.e., in the first model nodes transmission power is fixed and in the second model nodes transmission power can be fixed based on plenty of requirements. The broadcast nature of wireless channels helps cooperative communications to improve the performance of network. A change in network capacity, energy consumption is done based on the cooperative communications. A reactive network coding aware protocol is made by which source node data is forwarded by the relay node.

A distributed protocol is proposed to improve the networks. In MANETs nodes move with certain mobility and each node is formed with an Omni-directional antenna. When a homogeneous ad hoc network is taken all the radio parameters are same. Energy consumed is calculated in the data transmission and reception. Let transmission power of sender be$P_t$and reception power of receiver beP_r . P_r is defined as:

$$P_r = P_t G_t G_r \left(\frac{\lambda}{4\pi d}\right)^2 \quad (7)$$

Whereas in two ray ground reflection model,P_r is calculated as:

$$P_r = P_t G_t G_r \frac{h_t^2 h_r^2}{d^4} \quad (8)$$

Gt and Gr are antenna gains of transmitter and receiver. Finally P_{min} can be obtained as

$$P_{min} = \frac{P_t * RX_{th}}{P_r} \quad (9)$$

an energy-efficient cooperative MAC protocol in MANETs i.e., EECO-MAC is proposed to decrease energy consumption and to prolong the network lifetime.
Throughput is improved by power back off mechanism.

Energy efficient probabilistic broadcasting for MANET

Sumit kumar *et al* [7] In MANETs from one node to another route request is sent by the flooding method. Collision happens and congestion of packets happens while this method is going on. Broadcasting storm problem can be solved by probabilistic broadcasting. To send the information between nodes probabilistic broadcasting is the practice.In many protocols like dynamic source routing (DSR) and adhoc on-demand distance vector (AODV). For distributing messages broadcasting is the technique usedand it reduces the performance in MANETs. The probabilistic broadcasting makes the lesser overhead compared to other system. Probabilistic schemes are implemented in flooding to solve the broadcast storm problem. Nodes energy is first calculated and then route request is send with a threshold energy value. Energy of all nodes at a particular instant can be finding as

$$P_{iavg} = (P_{avg} + P_{lavg}) / I \quad (10)$$

WhereP_{avg} is the average energy of node in RREQ Packet. $P_{lavg}$the local average energy of node,P_{iavg} is the instantaneous average energy of network.The threshold energy of a node can be as

$$P_{th} = \alpha P_{iavg} \quad (11)$$

Where α is the network parameter and range is 0 < α< 1and it stands for safety levels.Here energy efficient Probabilistic broadcasting (EEPB) isimplemented to transmit the RREQ packet.

CONCLUSION

Energy efficiency (EE) is an important aspect of mobile ad hoc networks (MANETs). In the existing system group key distribution mechanism is proposed and several algorithms like Cluster and Energy Efficient Secure Routing Algorithm, Branch and bound algorithm, Energy-efficient cooperative MAC protocol using power control are implemented to reduce the energy consumption and to maximize the network lifetime.some models like ED-Based Enhanced Energy Efficient CrossLayerModel and localization is the mechanism for doing the task. Even then usage of energy is more in the networks.

Thus in the proposed system as the bandwidth is the other parameter the mathematical model is to be find based on the three parameters energy, distance and bandwidth. Route replies are sent from the specified intermediate nodes by which hop count, residual energy, Qlength, bandwidth values are taken. Let the formula be

$$\text{Optimum route} = \frac{ax1+bx2+cx3+dx4}{4} \quad (12)$$

where x1-> hop count,
x2-> Q length,
x3-> residual energy,
x4-> bandwidth.

and a,b,c,d are based on priority. By taking the values of the parameters(x1,x2,x3,x4) optimal path can be find. Thus the proposed work minimizes energy consumption and maximizes network lifetime.

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