INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH & DEVELOPMENT

ISSN: 2278 – 0211 (Online)

Power Aware Dynamic Source Routing Protocol To Increase Lifetime Of Mobile Ad Hoc Networks

Md ShahidAkhter
Research Scholar , Department of ECE , Bhabha Engineering Research Institute , Bhopal , India
Vijay Prakash Singh
Professor & H O D , Department of ECE , Bhabha Engineering Research Institute , Bhopal , India

Abstract:
Mobile ad hoc network (MANET) is infrastructure less system of communication. Many remote areas where infrastructure based systems are not feasible. MANETs provide the perfect solution for that situation. Although, MANETs use various routing protocols but Dynamic Source Routing (DSR) is the widely used routing protocol among them because of the flexibility and efficiency of the protocol. MANET usually takes battery power for the operation and it determines the lifetime of MANET. In this paper, we have proposed two modifications in the algorithm of traditional DSR to increase the lifetime of MANET. It will prevent the network from being partitioning and helps node from being sinking down. Initial energy of node will determine the behaviour of the MANET. We have simulated our proposed methodology in ns2.35 and results are found impressive. It works perfectly at lower initial energy of nodes.

Key words: *MANET, DSR, Lifetime, Nodes, Energy, Routing Protocol.*

1.Introduction

Power failure of a mobile node not only affects the node itself but also its ability to forward packets on behalf of others and thus the overall network lifetime. A mobile node consumes its battery energy not only when it actively sends or receives packets, but also when it stays idle listening to the wireless medium for any possible communication requests from other nodes. Thus, energy-efficient routing protocols minimize either the active communication energy required to transmit and receive data packets or the energy during inactive periods. The transmission power control approach can be extended to determine the optimal routing path that minimizes the total transmission energy required to deliver data packets to the destination. For protocols that belong to the latter category, each node can save the inactivity energy by switching its mode of operation. The main goal is to balance the energy usage among the nodes and to maximize the network lifetime by avoiding over-utilized nodes when selecting a routing path. The fig. 1 shows an ad hoc network having four nodes with is ranges. Among the energy-efficient routing protocols, DSR has been found to be very useful especially in developing new power-aware routing protocols. However, the continuous flooding of route request (RREQ), route reply (RREP) and route error (RERR) packets by the DSR algorithm brings with it high routing overhead that causes substantial energy exhaustion of the nodes. While previous research has looked at minimizing routing overhead as a means to saving node energy in DSR, few if any have looked at controlling the frequency of flooding the RREQ packets. This paper proposes an extension of DSR that looks at controlled and periodic flooding of RREQ packets as opposed to that in the original DSR algorithm based on energy of the node. Two modifications have been done to implement the algorithm in traditional DSR. Firstly, Change the routing algorithm of DSR so that given two nodes between which it necessarily establishes a multi hop path. Statistically you choose, among all the possible ones that passing through the nodes at a given moment have a higher level of energy. Secondly, modify the algorithm so that when the energy of a node that is forwarding data within multi hop path reaches a level less than or equal to a certain threshold percentage of initial energy. The node will ask the neighbours to look for another path for such data to avoid consuming the residual energy in a short time.

2.Related Work

A number of routing protocols have been projected and implemented for wireless ad hoc network in order to enhance the bandwidth utilization, higher throughputs, lesser overheads per packet, minimum consumption of energy and others. All these protocols have their own advantages and disadvantages under certain situations. The major requirements of a routing protocol was proposed (ZuraidaBintiet al., 2003) that includes minimum route getting hold of delay, quick routing reconfiguration, loop-free routing, distributed routing approach, minimum control overhead and scalability.Wireless ad hoc network Routing Protocols possess two properties such as Qualitative properties (distributed operation, loop freedom, demand based routing & security) and Quantitative properties (end-to-end throughput, delay, route discovery time, memory byte requirement &network recovery time). Clearly, most of the routing protocols are qualitatively permitted. A simulation studies were carried out in the paper (Mohammed Bouhorma et al., 2009) to review the quantitative properties of routing protocols.A number of general simulation studies on various routing protocols have been performed in terms of control overhead, memory overhead, time complexity, communication complexity, route discovery and route maintenance (ZuraidaBinti et al., 2003). Though, there is a severe lacking in implementation and operational experiences with existing Wireless ad hoc network Routing Protocols. The various types of mobility models were recognized and assessed by (D. Johnson et al., 2001) because the mobility of a node will also affect the overall performance of the routing protocols.

3.DSR Protocol Overview

The Dynamic Source Routing is an on-demand protocol based on source routing. It consists of two main mechanisms that allow the discovery and maintenance of routes in the MANET. The figure 2 shows the detail mechanism of finding the route from source to destination. In the Route Discovery mechanism, a source node, S wishing to send a packet to a destination node, D obtains a source route to the destination. If the source does not have a route to the destination, it performs a route discovery by flooding the network with route request (RREQ) packets The RREQ packet contains the destination node address, the source node address and a uniqueRequest ID.Any node that has a path to the destination in question can reply to the RREQ packet by sending a route reply (RREP) packet. The reply is sent via the route recorded in the RREQ packet. The figure 3 shows the procedure of route request packet (RREQ) in DSR protocol and route cache (rc) reply. Several possible routes from S to D form a ‘route cache’. If the ‘route cache’ possesses multiple routes to the destination, the routing logic selects the route with minimum hop to the destination. In Route Maintenance, a node wishing to send a packet to a destination is able to detect, while using a source route to the destination, if the network topology and/or channel quality has changed. If this is the case then it must no longer use this route to the destination because a link along the route is broken. Route Maintenance for this route is used only when the source node is actually sending packets to the destination .In this case, route error (RRER) packets are sent to the source node via the intermediate nodes such that they update their caches by removing the route in error. A routing entry in DSR contains all the intermediate nodes of the route rather than just the next hop information maintained in other reactive protocols. A source puts the entire routing path in the data packet, and the packet is sent through the intermediate nodes specified in the path. To limit the need for route discovery, DSR allows nodes to operate their network interfaces in promiscuous mode and snoop all packets sent by their neighbours. Since complete paths are indicated in data packets, snooping helps in keeping the paths in the route cache updated. To further reduce the cost of route discovery, the RREQs are initially broadcasted to neighbours only, and then to the entire network if no reply is received. Another optimization feasible with DSR is the gratuitous route replies; when a node overhears a packet containing its address in the unused portion of the path in the packet header, it sends the shorter path information to the source of the packet. Another important optimization includes the technique to prevent "Route Reply Storms" because many route replies may be initiated simultaneously a delay time proportional to the hop's distance can be used in order to give higher priority to near nodes. DSR also employs "Packet Salvaging". When an intermediate node forwarding a packet detects through Route Maintenance that the next hop along the route for that packet is broken, if the node has another route to the packets destination it uses it to send the packet rather than discard it.

4.Proposed Techniques

Some changes have been made in traditional DSR protocol to make it power aware for increasing the lifetime of MANET. Two algorithms have been developed and implemented.

4.1.Methodology Employed For Power Aware DSR

In DSR algorithm, when a node receives a Route Request of which it is not on final recipient, before forwarding, it broadcasts to neighbouring nodes. It waits for a time interval pseudo random selected from uniform distribution of probabilities between 0 and constant "broadcast Jitter". The figure 4 shows the uniform distribution of probabilities in DSR. The idea behind PADSR is that this delay, instead of being random, should be inversely proportional to a level of energy residual of node in that moment. In this way the first RREQ that will come to node D (hypothetical destination) will be the one which was channelled through the best route from the overall energy point of view in the sense of the sum of energy levels of the intermediate nodes and maximum comparisons to all other possible paths from S(source) to D(destination).Consequently, the total delay between the sending of the RREQ by S and receiving by D is minimum. Despite these changes it is aimed at maintaining the connectivity between nodes not directly communicating. The PADSR does not guarantee that S will always choose the best absolute path from the energy point of view in an element where it remains probabilistic algorithm. The probabilistic algorithm is represented by the delay which is caused by sending the route reply to D by S. The delay turns out to be pseudo random being uniformly distributed between 0 and 0.01. So, if there are two similar paths in terms of energy, despite RREQ arrivals to D before sending of the corresponding RREP containing the path better from the energy point of view, is delayed more than another RREP containing path slightly less favourable. Furthermore, the length of the paths influence the delay forwarding for which paths with greater energy but more long paths can be penalized compared to more short but with less energy.

4.2.Algorithm For Power Aware Dynamic Source Routing

- Step1 If the Source node S wants to send data to the destination node D, it will first send REQ message to all its neighbour nodes.
- Step2 When neighbour nodes receive REQ message they will check their Route Cache.
- Step3 When a node receives a Route Request of which it is not on final recipient, before forwarding, it broadcasts to neighbouring nodes
- Step4 Node waits for a time interval which should be inversely proportional to a level of energy residual of node in that moment.

4.3.Methodology Employed For Power Survival DSR

In the traditional DSR algorithm, once a certain path is chosen for sending a stream of packets to a certain destination it tends to be used until one or more nodes that composing are no longer available (consume all their energy, moving outside the range of neighbouring nodes etc...).A node consumes more energy in transmission and in reception. The difference in consumption changes from NIC to NIC but the otcl class "Energy Model" allows you to specify these values in phase of creation of nodes. Since a node consumes more energy in transmission and reception. The phenomenon may not be desirable. This is so because some of these nodes could have data to transmit and due to lack of energy would not be able to do so. It is desirable to maintain a balance in the energy consumption of nodes. Sooner or later, the consequent connection loses leads to the division of the network into two or more partitions not taking part in communication. To end this, it is introduced a second enhancement for DSR in which the node accepts the packet depending on certain threshold percentage of initial energy. Think of this process as a sort of "survival instinct" of each node when it reaches a low level of energy.

4.4.Algorithm for Survival Dynamic Source Routing

- step1When the energy of a node X that is forwarding data reaches a level less than or equal to a certain threshold percentage of the initial energy the node will broadcast a special packet.
- step2 DSR header contains a flag "low energy" which tells his neighbours that Y is going to consume your energy, asking implicitly not to continue to forward packets to him, if there are other routes to destination node available.
- step3 Near each Y that receives the broadcast packet of "low energy" excludes from the Route Cache paths containing the link Y-> X, which is considered to be "virtually" fallen (although of the fact it is still working, having no X yet completely exhausted their energy).
- step4If in the output queue of Y are packages that have yet to be forwarded along the Y-link > X, they are still sent, to avoid destabilizing the network too.
- step5 If one of the nearby Y receives a packet to be forwarded, containing in its path link Y-> X, Y will attempt to save the package or will generate a Route Error to be sent, so that it reaches the source of this package which will attempt to re-send the package using a different path not containing a link Y-> X.

- step6 If the source cannot find other routes in its Route Cache and the node X is still active, appears to be the only node bridge towards a certain destination, it will still use to forward packets.

5.Simulation

Simulation was done using NS-2.35 Simulator in Windows operating system using Cygwin. Cygwin provides emulation of Unix like environment in windows operating system. This involved preparation and derivation of OTcl scripts. It also involved generation of nodes, node movement and traffic patterns. This helped in implementing the protocol with a combination of C++ and OTcl scripts were added into the NS-2's source base.Simulation process involved the description of the simulation in an OTcl script and actual introduction of the algorithm and parameters into the simulation set up. It involved the practical simulation and derivation of the research data and results.

5.1.Simulation Scenario

The reference topology of the simulations, conducted in order to verify the advantage deriving by the use of Power Aware DSR and Power Survival DSR. It consists of a ad-hoc network of 11 nodes. They are in a fixed position. There is FTP traffic between the node most left (client node 0) and the most right (server node 10) not directly communicating. The node 0 (client) attempts to contact the node 10 at time 0.1 s establishing a TCP connection to the above which is made to pass the FTP traffic. The whole process takes as long as the network partitioning.

5.2.Analysis Of Results

Results were analyzed via xgraph and NAM visualization using the generated trace files and nam files. Starting with initial energies of the different nodes (3J, 10J, 30J), and repeated each simulation 300 times, 100 for each routing algorithm defined. The detailed observations have been enumerated in table 1, table 2, table 3 with initial energies of 3J, 10J and 30J respectively. At the end of each set of 300 simulations, some procedures Tclanalyse the trace file generated. By calculating the mean values as well as the confidence intervals at 90% of some events, indicative of the capacity of the network to survive over time such as:

- The fall time of the last link between two nodes

- Energy depletion time of the first node.
- Energy depletion time of the last node.
- Last sequence number received from the node 10 and confirmed by ACK to node 0. This metric is used to assess the amount of data at the transport layer that are actually exchanged between the node 0 and node 10 not counting the traffic control and retransmissions.
- Life time of the network transport level, defined as the difference between the time of receipt of last ACK sent from node 10 to node 0 and the time of transmission of the first segment TCP from node 0 to node 10.
- Applying the Chebyshev inequality to calculate the bounds of the confidence intervals

$$P(\mu - \lambda\sigma \leq X \leq \mu + \lambda\sigma) \geq 1 - \frac{1}{\lambda^2}$$

6.Conclusion

A novel energy aware multipath routing protocol has been proposed (PADSR and Survival DSR). It has been integrated with different energy metrics. The proposed protocol is mainly useful for enhancing the lifetime of MANET regardless of the quantity of data exchanged. It has been tested under conditions of different initial energies of nodes. At lower initial energies, it behaves considerably better as compared to higher energies of the concerned nodes. The performance of PADSR is better than Survival DSR as it induces less instability. We have shown that it is feasible to build such a protocol to run on real embedded platform while there are many improvements that can be made to our design and implementation. The protocol does not seem to behave effectively at higher energy of nodes. There is a limitation of the protocol that under different conditions of initial energy, even PADSR seems to behave worse than traditional DSR. In order to maximise the lifetime of a node, the selection of optimal path is based entirely on the initial energy of the node. This point is considered valid in the proposed protocol to increase the overall lifetime of MANET.

7.Reference

1. ROYER, M., E., AND TOH, C-K. 1999. A Review of Current Routing for Ad Hoc Mobile Wireless Networks. In IEEE Personal Communicat-ications, 46-55.
2. DJENOURI, D. AND BADACHE, N. 2006 . New power-aware routing protocol for Mobile Ad Hoc Networks. In The International Journal of Ad Hoc and Ubiquitous Computing (IJAHUC), vol. 1,no. 3, Inderscienc Publisher, 126-136
3. DOSHI, S., BHADHARE, S., BROWN, T., X. An On-demand Minimum Energy Routing Protocol for a Wireless Ad Hoc Network. In Mobile Computing and Communications Review, vol.6, no.3.
4. TARIQUE, M., HOSSAIN, A., ISLAM, R., AND HOSSAIN, A. 2010. Issues of Long-Hop and Short-Hop Routing in Mobile Ad Hoc Network: A Comprehensive Study. In International Journal of Network Protocols and Algorithm ISSN, vol. 2, 1943-3581, (July 2010)
5. AnkitBhardwaj, Divya and SanjeevSotat, "An efficient Energy Conserving Scheme for IEEE 802.11 ADHOC Networks" , IEEE Vol. 3,Issue 7, 2007
6. Santashil Pal Chaudhuri and David B. Johnson, "Power Mode Scheduling for Ad Hoc Networks" ,IEEE International Conference on Network Protocols, 2002
7. J. Li, D.Cordes and J. Zhang “Power – Aware Routing Protocols in Ad Hoc Wireless Network” IEEE Wireless Communication – December 2005
8. S. Singh, M. Woo, and C.S. Raghavendra, “Power-Aware with Routing in Mobile Ad Hoc Networks,” Proc. Fourth Ann. ACM/ IEEE Int’l Conf. Mobile Computing and Networking,1998.
9. Z., Krishnamurthy, S.V., Tripathi, S.K, “A Framework for Reliable Routing in Mobile Ad Hoc Networks,” IEEE INFOCOM (2003).
10. Network Simulator (NS-2), http://www.isi.edu/nsnam/ns/.