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A Power Saving Intelligent Dynamic Source Routing (IDSR) in MANET

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Abstract: MANET (Mobile Ad hoc Network) is a temporary network of mobile nodes. The peculiar property of a MANET is that it lacks infrastructure. So it suffers from many constraints; one of them is energy. There is a need of such a routing protocol which not only finds an efficient route but also conserves energy of the network. DSR (Dynamic Source Routing) is a famous reactive protocol in MANET. This paper presents an optimization of DSR to make it intelligent in terms of selection of routes so that the overall network lifetime can be increased. The performance of our proposed protocol is validated using NS2.35 and found that our proposed protocol IDSR (Intelligent Dynamic Source Routing) outperforms traditional DSR.

Keywords: MANET, DSR, Ad hoc Network, Energy, IDSR

I. INTRODUCTION

Advancements in communication technologies are the need of today's world. Wireless communication has proved a boon to the communication industry but it has also produced many challenges to the researchers. Mobile Ad hoc Network (MANET) [1] is one such area which has undergone tremendous research. MANET is a self organizing network of mobile nodes forming a temporary network. MANET has many salient features which make it different from other networks and enforce many constraints on it. These features include lack of infrastructure, dynamic topology, bandwidth constraint, power constraint etc. The most challenging task in such a dynamic network is routing. Many routing protocols have been proposed and optimized till date and constantly undergoing further evolution. DSR (Dynamic Source Routing) [2, 3] is the most famous and basic routing protocol which works on on-demand paradigm. In this paper the basic functionality of DSR is appended with some intelligent decisions which ultimately lead to energy conservation. Thus this modified approach is called IDSR (Intelligent Dynamic Source Routing).

Rest of the paper is organized in six sections. Section II gives an overview of traditional DSR highlighting its shortcomings. Section III shows the related work done so far in this field. Section IV and V describes the proposed algorithm of IDSR. In section VI, simulation scenario and simulation results are discussed. Section VII concludes the motive of this paper and discusses future scopes.

II. TRADITIONAL DSR OVERVIEW

Wireless routing can be broadly classified into two types: Proactive and Reactive. DSR [2, 3] is a reactive protocol i.e. it works only when a node wishes to send data or whenever there is a link failure. This is called "on - demand" approach of routing protocol. This method is effective in contrast to proactive protocols which use table based approach producing large routing overhead. DSR is based on source routing [4, 5] in contrast to hop-by hop routing. In source routing the source collects the complete knowledge of the path to be travelled by the packet. The source appends this path information in the packet header. Thus every packet generated by source has complete path information specifying the identity of all the intermediate nodes to be visited before reaching its destination.

The traditional DSR consists of two phases: Route discovery and Route maintenance.

A. Route Discovery

This phase allows a source to dynamically discover a path to the destination node. The process begins with generation of RREQ (Route Request) packet. It contains Request ID, sequence number, source ID, destination ID. This packet is then broadcasted to all the neighbor nodes. A node which receives this packet appends its own ID in packet header and forward RREQ to its neighbors. Finally RREQ packet reaches its destination. The destination node generates RREP (Route Reply) and sends it to the reverse path travelled by RREQ packet. Each node maintains a route cache and caches the path when RREP travels through them.

B. Route Maintenance

This phase works whenever there is a link breakage/failure in the network. An intermediate node upon discovering a link failure generates RERR (Route Error) packet and sends it to the source using the path stored in its cache. All the intermediate nodes delete their cache entry for the failed link upon receiving RERR.

Traditional DSR works quite efficiently but there is always a scope of improvement. If any one of the internal nodes dies out of energy while the communication is established then the whole process will be interrupted and again the path has to be chosen for the specified source to destination. Moreover traditional DSR is based on minimum hop count; it does not bother about the nodes' residual energy and treat all nodes equivalent.

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III. Related Work

Authors in [9] proposed modified power saving DSR based on the pause time and jitter. The idea behind their algorithm is that delay at each node should be inversely proportional to a level of energy residual of node in that moment. Authors in [10] proposed Efficient-Dynamic Source Routing (E-DSR). E-DSR uses two levels of thresholds, each of two factors: node's battery power and received RF signal power. The path is then selected by choosing the path with the maximum lowest hop energy. In 2012, authors in [11] proposed an extension of DSR that reduces routing overhead by limiting the number of route discovery and maintenance packets in the MANET. Authors in [12] optimized DSR using Ant algorithm to find best path. In [13], authors simulated different routing protocols in NS2 and comparative performance is analyzed using varying network size.

IV. Proposed Approach

The energy performance of DSR can be enhanced by taking few intelligent decisions. We have exploited the residual energy of intermediate nodes to select a route. We made modification in the "Route Discovery" phase only while route maintenance phase is kept unchanged. During route discovery, a node receiving RREQ is enabled or disabled on the basis of its residual energy. A node's residual energy is compared with the average energy and lower energy nodes are disabled.

V. IDSR Algorithm

A. Route Discovery

IDSR (N,Nodes)
/* A Mobile Network is defined with N Number of Nodes with random position and energy specifications*/
{
1. Define the Source Node Src and Destination Node Dst
2. Generate the Distance Matrix over the Network Nodes.
3. Generate the Energy Matrix to analyze the energy required between node pairs under distance specification
4. Set curNode=Src
   [Set source node as current communicating node]
5. While CurNode!=Dst
   [Repeat Process till destination node not reached]
   {
6. Generate the Shortest Path over the Network
7. Identify the Average Energy Available over the Path
8. For i=1 to Length (Path)
   {
   if (Energy(Nodes(i))<AverageEnergy)
   {
9. Set Nodes (i).Enabled=False
   }
   }
10. Identify the Effective Neighbor with Maximum Energy called ENode
11. CurNode=ENode
}

B. Route Maintenance

This phase works same as conventional route maintenance phase which includes generation of RERR packets upon link failure.

VI. Results and Analysis

We simulated the proposed approach using NS2.35 [6-8]. Network Simulator (ver. 2.35) is an event oriented simulation tool used both for wired and wireless networks. A network of 50 nodes is taken. Energy model is used having initial energy of each node 50J. The transmission and receiving power of each node is also fixed. Rest of the simulation parameters are given in Table 1.

TABLE 1
Simulation Parameters

Sr. No.	Simulation Parameters	Value
1.	Network Topology	500x500 m^2
2.	Simulation Duration	100sec
3.	Node Pause Time	0.1 sec
4.	Initial Node Energy	50 Joules
5.	Transmission Power	0.25nW
6.	Receiving Power	0.25nW
7.	Traffic Agent	CBR
8.	Queue Type	Drop Tail
9.	Antenna Type	Omni Antenna
10.	Propagation Model	Two Ray ground
11.	MAC	802.11
12.	Traffic Source	UDP

The parameter taken here to compare the proposed protocol IDSR and conventional DSR is average energy consumed. Average energy consumption is calculated by dividing the total energy consumed by number of nodes. It is observed through simulation results that IDSR outperforms DSR [Fig 1]. Energy consumed in case of IDSR is about 49% of that is consumed by DSR. Thus the overall network lifetime will increase.

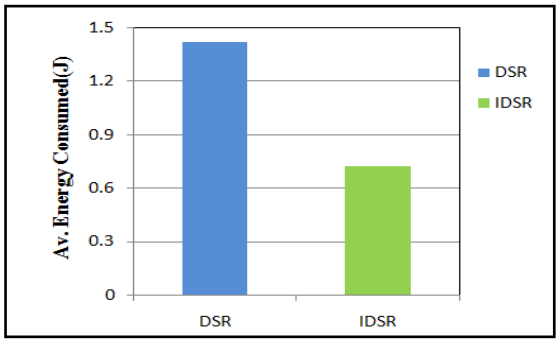

Fig 1: Av. Energy Consumed

VII. CONCLUSION AND FUTURE SCOPE

Energy conservation is a challenge in MANET. This paper describes a modified DSR approach called IDSR. The residual energy of neighbor node is compared with the average energy of the path and accordingly the node is disabled. This proposed algorithm showed positive results in terms of energy conservation when simulated using 50 nodes UDP traffic. Energy consumption in IDSR reduces to 49 % as consumed by DSR.

There are still various scopes for researchers to optimize DSR. The proposed approach can show interesting results in different scenario. In different application scenario, different approaches can be exploited. Future work can be carried out using different traffic type, different mobility models and changing more than one parameter at a time.

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