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RESEARCH ARTICLE

Study of Energy Consumption in DSR using NS2

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Abstract— A mobile ad hoc network is a self organizing temporary network. It consists of mobile nodes roaming here and there. Routing in such networks is a challenging task. Various routing protocols have been proposed since the origin of MANETS. DSR is the most popular routing protocol based on source routing. This paper is an extensive study of DSR taking various performance parameters. Effect of these parameters on energy consumption is studied in this paper. Efficient DSR is one which gives best route with minimum energy consumption and increases network lifetime.

Keywords— MANET, DSR, ad-hoc, Energy, NS2

I. INTRODUCTION

MANETs (Mobile Ad-hoc Networks) as the name suggests are the ad-hoc networks without the aid of centralized infrastructure. MANETS [Fig 1] consists of wide range of devices which are free to move in space. The devices vary in size, platform, operating system, speed etc. Each node is an independent router. In ad hoc network, all the nodes move freely and independently, so topology is highly dynamic. Due to limited transmission power of the dynamic nodes, multi hops may be needed to transmit data from one host to another. Maintaining continuous communication between these devices without a centralized infrastructure is a challenging task. In such case, efficient routing protocols are needed to fulfil our needs. DSR [1] is the most widely used reactive protocol. Being a reactive protocol, it is based on on-demand paradigm and avoids extra overhead. Moreover DSR is based on Source Routing [2]. In Source routing, the source has complete knowledge of the path to be travelled by the packet to reach its destination. The routing path is appended in the packet header. This paper is extensive study to analyse DSR in terms of energy consumption using NS2.35 [4].

This paper is organised as follows: Section II defines DSR overview; section III introduces related work carried out by different authors to optimize it. Section IV shows the simulation scenario and parameters. Section V shows results and analysis for DSR under various parameters vs. energy consumed. In section VI, a brief idea for future work to optimize DSR so that energy consumption can be minimized.

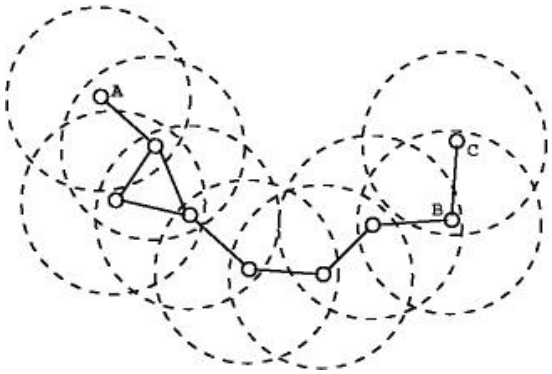

Fig 1: MANET Example

II. DSR OVERVIEW

DSR [3] is a simple and efficient routing protocol designed specifically for use in multi-hop wireless Ad-hoc networks of mobile nodes. The protocol is composed of the two main phases of "Route Discovery" and "Route Maintenance", which work together to allow nodes to discover and maintain routes to arbitrary destinations in the ad hoc network. These phases are summarized below.

A. *Route Discovery Phase*

This phase is initiated whenever a node wishes to send data. It generates RREQ (Route Request) packet containing Request ID, Source ID, Destination ID and Sequence Number. Sequence number is used for checking the freshness of routes and prevents looping. The source broadcasts this packet to all its neighbors. The neighbors append there ID in the RREQ packet header than rebroadcasts it to their neighbors. This process is carried out by all the nodes until RREQ reaches the destination. The destination node generates RREP (Route Reply) packet and unicasts it to the reverse path as shown in RREQ. When source receives RREP, it caches RREP and data communication is initiated.

B. *Route Maintenance phase*

This phase is used to manage the network in case of any failure. If any node discovers a link breakage, it generates RERR (Route Error) packet. Then is sends RERR to the source and deletes cache entry for that failed route. All the intermediate nodes also delete the entry for that particular route from their route cache.

III. RELATED WORK

Authors in [5] 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 [6] 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 [7] proposed an extension of DSR that reduces routing overhead by limiting the number of route discovery and maintenance packets in the MANET. Authors in [8] optimized DSR using Ant algorithm to find best path. In [9], authors simulated different routing protocols in NS2 and comparative performance is analysed using varying network size.

IV. DSR SIMULATION USING NS2

In this paper, relation of energy with various parameters in DSR is shown. Various parameters are number of nodes, traffic interval, nodes' speed and packet size. All these parameters are varied and the corresponding effect on node energy is studied. This paper considers average energy consumption which is calculated by dividing the total energy consumed by number of nodes. NS2 (Network Simulator 2) is a powerful tool for network simulation. It is event driven and object oriented. The simulation of DSR is carried out using NS2.35 over UBUNTU 13.10 platform. Other simulation parameters are shown in Table 1.

TABLE I
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	TCP

V. RESULTS AND ANALYSIS

The following results are drawn when DSR is simulated using NS2. A summarized report is given below.

A. *Number of Nodes vs. Average Energy Consumed*

A network consists of communicating nodes. In MANET, these nodes are mobile and there is no fixed topology. Fig 2 shows the impact of network size over average energy consumed. The network size is varied form 20 nodes to 80 nodes. The graph shows regularity as energy consumption decreases with increase in number of nodes. This behavior is observed because as network density increases, less power is consumed to transmit data to a nearby neighbor than a far away node. So multi hop communication needs less transmission power than unihop communication.

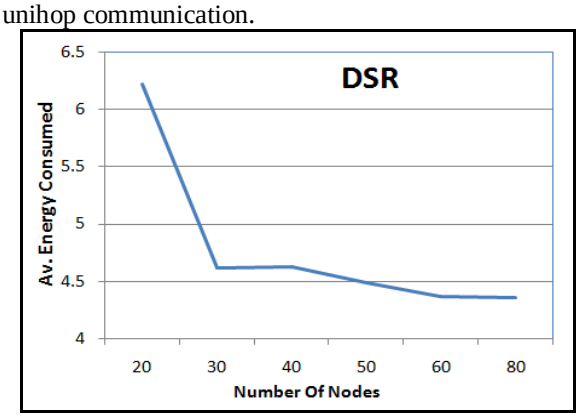

Fig 2: Number of Nodes vs. Av. Energy Consumed

B. *Traffic Interval vs. Average Energy Consumed*

Traffic interval is the interval between two consecutive transmissions. Figure 3 shows the impact of traffic interval over energy consumption. The results depict that as traffic interval increases energy consumption decreases. This is due to the fact that a node is transmitting data in large intervals and during this interval it may go to sleep to conserve energy.

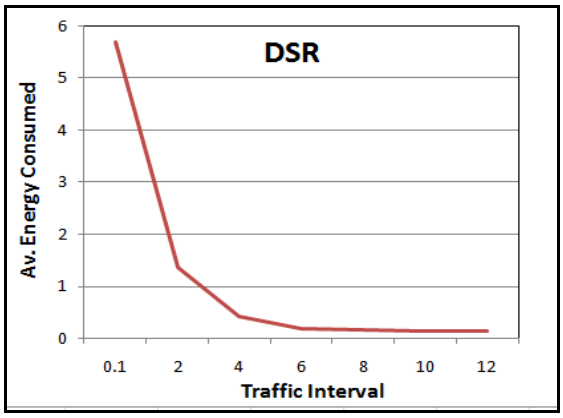

Fig 3: Traffic Interval vs. Average Energy Consumed

C. *Node Speed vs. Average Energy Consumed*

When node speed is increased from 10 m/s to 70 m/s, the energy consumption decreased. Here the simulation results can be seen in Figure 4 for 50 nodes in TCP traffic.

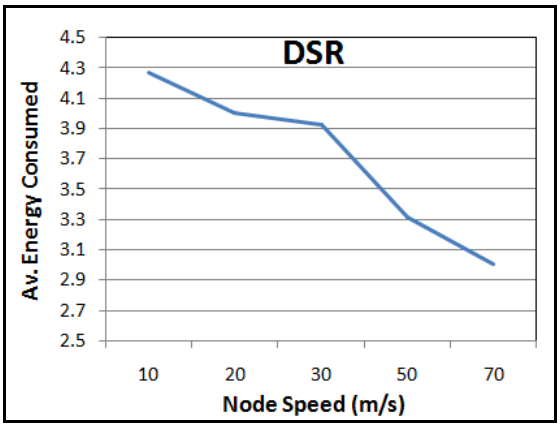

Fig 4: Node Speed vs. Average Energy Consumed

D. *Packet Size vs. Average Energy Consumed*

Bar chart [Fig 5] shows the impact of packet size over energy consumption. As packet size is doubled from 512 to 1024 bytes, the energy consumption also gets doubled approximately. This is because a sender needs more energy to transmit more number of bytes.

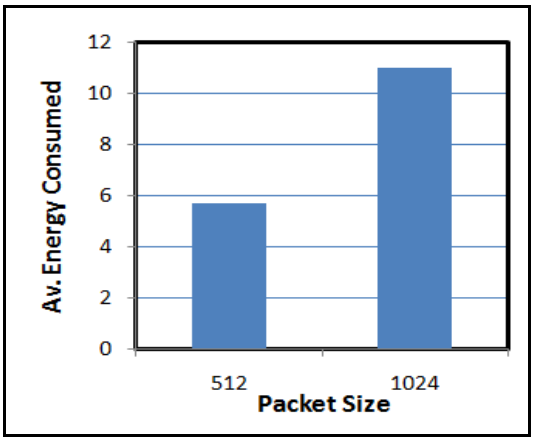

Fig 5: Packet Size vs. Average Energy Consumed

E. *Ratio of Different Packets Generated*

Figure 6 shows number of different types of packets generated in DSR. Here number of nodes taken is 50. It shows that DSR has very less control overhead as only 42 messages are generated for DSR control. This happens because DSR is a reactive protocol. It works on on-demand paradigm.

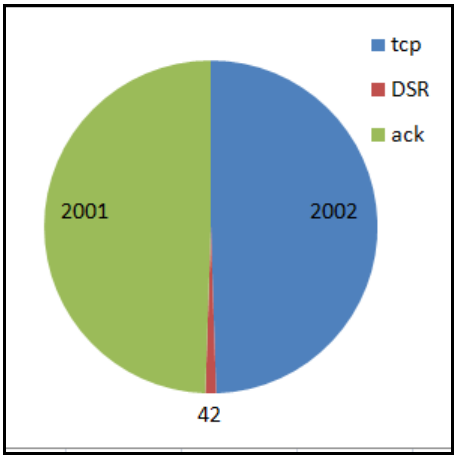

Fig 6: Different Packets Generated

VI. FUTURE WORK

Energy optimization in DSR can be done by choosing routing path intelligently. Modifications in the base protocol are possible. As energy in a MANET is limited and cannot be recharged, so energy optimization becomes a prime task. In future, we will focus our work towards increasing network lifetime. The basic idea is divided into two phases. First find the path matrix is developed between the source and destination. The second phase is to prioritize the nodes. Average energy is calculated for the whole network. A node is turned on (enabled) if its remaining energy is greater than average energy otherwise it is disabled. The disabled node will simply discard the RREQ packet and not participate in that route. This idea will help in saving energy of the network as nodes with less remaining energy will not die out and overall network lifetime will increase.

VII. CONCLUSION

The impact of various parameters on energy consumption is studied in this paper. The simulation results show how energy consumption depends on network size, traffic interval, node speed and packet size. During deployment, if these parameters are kept in mind then lifetime of an ad hoc network can be increased significantly. DSR shows very low routing overhead which means it is a successful reactive protocol. In future we will focus on energy optimization by disabling those nodes which have lower residual energy than average energy of the network.

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