Dynamic Shrink Route Optimization (DSRO) Technique For Preventing Link Breakage In MANET

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Abstract: MANET nodes are developed based on limited battery power. They may drain due to mobility and packet transmission. These nodes move away from their path without any acknowledgement. Because of the power utilization there may be enormous changes in the network. So the overall performance of the node slightly decreases. MANET routing protocols relay on node lifetime and link lifetime. This paper evaluates the node life time and link life time using a novel Dynamic Shrink Route Optimization (DSRO) mechanism. This mechanism considerably reduces the energy drain in nodes. These performance metrics are included by dynamic shrink route optimization technique. This DSRO algorithm is used to select the node with longest lifetime for packet forwarding, Node Lifetime and Route lifetime prediction methods and shrink mechanism to avoid link breakage. In this paper a novel Dynamic Shrink Route Optimization technique is introduced. The DSRO Technique outperforms the DSR protocols that are implemented with shrink mechanism in the node lifetime and the link lifetime algorithm and it is simulated using NS2.

Index Terms:DSRO, MANET, Lifetime, DSR, Shrink, Residual Energy.

1 INTRODUCTION

Mobile AdHoc Network is developed based on mobile nodes which do not depend upon an centralized base station. MANET is an autonomous system where each node itself acts routers for their neighboring nodes from source to destination. Often, the nodes in the Mobile Adhoc Network (MANET) operates with batteries and can move freely, and thus, node may exhaust its energy or move away from the range [2]. In the infrastructure less network rerouting is costly and time consuming. In MANET, the route are constructed using the series of multiple nodes link and the lifetime of a route relies on the lifetime of each adjacent nodes in the MANET. The main contribution in this paper is that, it combines both node lifetime and route lifetime prediction using DSRO technique, which explores the dynamic nature of mobile nodes. The Dynamic Source Routing protocol initiates to find the shortest path from the source node to the destination. The node lifetime and route lifetime are calculated. The shrink mechanism is applied for the reduction route length by dropping the least lifetime node from the route, creating a short-cut with the adjacent neighboring node in the desired route. The energy drain rate of nodes are predicted using the residual energy and then, stored in the route cache for the future use. The proposed Node lifetime prediction and Route lifetime-prediction in DSRO technique is implemented in Dynamic source routing protocol (DSR) for the improved performance in link breakage prevention [1].

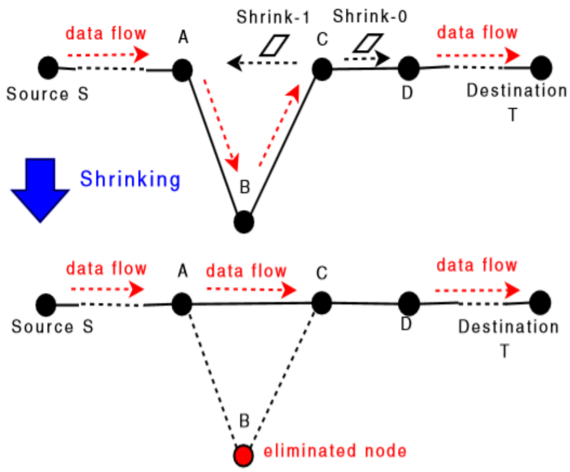
2 RELATED WORKS

The author of [2] proposed an optimized mechanism to for routing dynamically. This mechanism is based upon “shrink” method. In this proposed work shrink mechanism is constructed to detect the redundancy. Redundancy mainly occurs in optimal path and the routing path. The data packets are sending via RSS-Received Signal Strength. The main purpose of shrink mechanism is to reject repeated nodes in a path. Due to this, 2-hop connection is reduced to 1-hop connection. This gradually decreases the redundant nodes and improves the data forwarding rate. Moreover, there is no exchange between routing table. But still, shrink mechanism used in this proposed work has some limitations that improvement is needed. Xin Ming et al in [1] analyzed the dynamic nature of the MANET nodes for identifying the lifetime of the route in Mobile AdHoc Network. The author proposed ENDR- Exploding Dynamic Nature Routing. This mechanism is varied from DSR- Dynamic Source Routing. In ENDR protocol, initially the RSS and the time taken for Route Request (RREQ) is stored in a local memory of the node. Time taken for RREQ is appended as a piggyback at the header of Route Reply (RREP). Secondly, node life time is periodically updated by those nodes. while RREP packet is returned from a destination node to the source node with all information. Therefore ENDR is more efficient when comparing with DSR. In [3] the author came up with a Dynamic Route Optimization Algorithm (DROA). With the changing topology, the transmission path updates the optimal path in a particular time interval using DROA algorithm. In this method number of hops and delay are gradually reduced. But, energy consumption is increased. The problem identified in the existing mechanisms is energy consumption is for route discovery and optimal path choosing is high. In this paper a new Dynamic Shrink Route Optimization (DSRO) technique is proposed to gradually minimize the energy consumption during optimal path selection and avoid route discovery using modified shrink mechanism. The algorithm is tested and verified in NS2 simulation platform. DSRO algorithm is compared with existing ENDR mechanism.

3 PROPOSED DSRO TECHNIQUE

3.1 Dynamic Shrink Route Optimization in Dynamic Source Routing

Dynamic Source Routing protocol is one of the important routing protocols in MANET [4]. The proposed Dynamic Shrink Route Optimization (DSRO) mechanism is implemented on DSR protocol. Dynamic Shrink Route Optimization algorithm consists of three phases. They are discovery, route reply and route maintenance. Because of the on-demand nature of the DSR protocol, it waits for the route whenever needed and checks for availability of the optimal path to reach destination. If no routes are available then it starts with route discovery mechanism for finding route through flooding in broadcast manner. By sending RREQ, optimal route is discovered from initial node to destination node. RREQ packet is send to all its neighboring nodes by using flooding method. Each and every



node clarifies the RREQ ID whether it is new and the destination address is same as its own address. In case if the address varies, append the present node's address and send it to the next neighboring node. Once RREQ reaches the destination node, RREP packet is send by the destination node which appends the entire path information in the header of the packet. When alterations occur in the path, the route maintenance takes care of this alteration. Each time when link breakage happens due to shrink mechanism, the information about link breakage is broadcasted to make the update in route cache memory.Since a route is composed in series of multiple links, it is said to be broken if any single node link among its links is broken, and thus, the lifetime of the route is reduced when a single link is broken. In MANET two or more adjacent nodes are linked within a range. MANET nodes are limited in battery power. This link between nodes can break anytime due to out of range movement of nodes and energy drain [8]. In this paper the energy usage and link breakage rate is minimized by using modified shrink mechanism.

3.2 Node Lifetime Prediction

In the proposed Dynamic Shrink Route Optimization technique, the node lifetime are predicated to avoid link breakage in MANET. A connection of two nodes is established using link and the connection itself, and the link lifetime is inter-dependent on both the node lifetime and the connection lifetime. A link Li consists of a connection Co and two nodes $(Nd-1, Nd)$. Where Co represents the connection between nodes $Nd-1$ and Nd and it is maintained until the adjacent nodes $(Nd-1, Nd)$ move out of each other's communication range under the assumption of no energy problem in both nodes $Nd-1$ and Nd. The connection lifetime βCo to represent the estimated lifetime of the connection Co, and it only depends on their relative mobility and distance of nodes $Nd-1$ and Nd at a given time [1]. The term βNo denotes the estimated battery lifetime of node Nd. Then, the lifetime of the link Li is expressed as the minimum value of $(\beta Co, \beta Nd-1, \beta Nd)$. The ρ in equation (1) represents the number of nodes in the range. $\beta Li = \rho \min(\beta Co, \beta Nd-1, \beta Nd)$ (1)

3.3 Route Lifetime Prediction

The minimum value of the lifetime of both nodes and connections involved in route is expressed as the lifetime of route R. Assume that Ω represent the total range of node [7]. The assumed $\Omega=2\Pi/t$, which represents the range with time to predict the route lifetime. Lifetime of Route R is implied in equation (2) $\beta R= \Omega \min (\beta Nd, \beta Co)$ (2)

3.4 Shrink mechanism in Dynamic Source Routing

The proposed DSRO technique is based on shrinking methods. Shrinking is the process of eliminating least lifetime nodes that cross the same routing path from source to destination [10]. The objective of the shrink mechanism is to reduce the route length by dropping the least lifetime node from the route, creating a short-cut with the adjacent neighboring node in the desired route. Shrink mechanism has several advantages such as (i) By decreasing hop count, delay is gradually reduced (ii) By reducing link breakage, data lose is also considerably reduced. (iii) The overall energy consumed for packet transmission is reduced. The Shrink mechanism is initiated with each transmission of data packet [12]. The shrink mechanism is send along with the data packet. The shrink mechanism travels along with the data packet calculating Shrink-α. It is active until the source node is connected for the data flow with destination. The goal shrink mechanism is to reduce the hop count to reduce from 2 hops connection to 1 hop connection by eliminating minimum or redundant node in the path. Fig. 1 Shrink mechanism for preventing link breakage In shrink mechanism, the nodes exchange their route table information when they come in the same range of each other. Once two nodes come across the same route they are acknowledged as companion nodes [2]. Shrinking is the process of eliminating least lifetime nodes that cross the same routing path from source to destination. The shrink routine handles the long path where some nodes come closer to bridge each other, allowing for a possible short-cut calculated from equation (3).$\alpha = \beta Li > \min(\beta Co, \beta Nd)$ (3)

3.5 Residual energy of nodes

Whenever a packet is transmitted from source to destination, certain amount of energy is loosed by the nodes from their initial battery power. Due to this, the energy of a single node gets decreased. The remaining energy is calculated as residual energy after a node completes its transmission. The residual energy calculated are stored in the route cache and used for the future purpose. This calculated residual energy can reduce the future energy consumption for predicting node lifetime. To estimate the energy drain rate, evaluate the difference of initial energy and remaining energy of the node [5]. The R_β represents the residual energy, which is calculated from initial energy and expended energy in equation (4).

$$R_\beta=([I_\beta^{(\beta Nd)}]-[\beta Nd]$$

3.6 DSRO Algorithm

Algorithm 1
Start
Input ⟵ $\beta Co, \beta Nd-1, \beta Nd$
output ⟵ βLi, βR, α= *shrink*
Step-1 Configure network setup and invoke DSR.
Step-2 Define S and D nodes, check availability in Route Cache.
Step-3 If { R= Avail then continue}
Else { initialize RREQ from S to D}
Step-4 Flood RREQ from S to all neighboring nodes.
Step-5 If { D addr = Nd_n addr then RREP to S}
Else { Repeat flooding}

Step-6 *RREP with appended route addr from S to D.*
Step-7 *Calculate* $\beta Li = \rho \min(\beta Co, \beta Nd, \beta Nd\text{-}1)$.
Step-8 *Calculate* $\beta R = \Omega \min(\beta Nd, \beta Co)$.
step-9 *Max(βLi) nodes path are choosen.*
Step-10 *Send data packet along with shrink mechanism.*
Step-11 *If {* $\alpha = \beta Li > \min(\beta Co, \beta Nd)$ *} do shrink*
Else continue the data flow.
Step-12 *Calculate* $R\beta = ([\, I_{\beta}^{(\beta Nd)}] - [\beta Nd])$.
Stop

4 Performance Evaluation

The proposed DSRO technique is implemented in NS2.34. The proposed work was compared with EDNR in different performance metrics. The simulation network consists of 100 nodes that are randomly deployed in a 1000m× 1500m. The simulation time is 1000 seconds [13]. The nodes move randomly in the deployed area at the speed between 4m/s to 24m/s in the adapted mobility model. After moving to a target position, there is a pause time before the node starts a new movement. When pause time is set to 0, there is a movement in the nodes, and when the pause time and the simulation time are equal, the nodes are in rest. The table 1 briefs the simulation parameters in DSRO technique. The performance evaluation says that DSRO technique works better than the existing EDNR and the energy consumed by the node are reduced by shrink mechanism and the node lifetime calculation. The energy model represents the initial energy as 100 J. the transmit energy and the receive energy are 0.4 w and 0.3 w. The proposed DSRO technique performs better with respect to energy efficiency and preventing link breakage. The simulation results are shown in graphs which tell about the comparison of proposed DSRO technique with existing EDNR method.

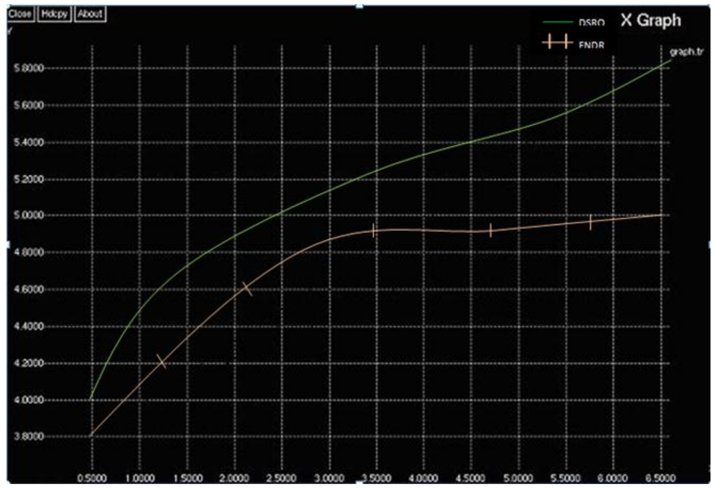
Table 1
Simulation Parameter

Parameter	values
Simulation time	1000 s
Topology size	1000m x 1500m
No. of nodes	100
MAC type	MAC 802.11
Radio propagation model	Two ray ground
Radio propagation range	250 m
Pause time	0s
Max speed	4m/s – 24m/s
Energy model	Energy model
Initial energy	100 J
Transmit energy	0.4 w
Receive energy	0.3 w
Idle energy	0 w
Traffic type	CBR
CBR rate	512 byte x 6/s
Max no. of connection	50

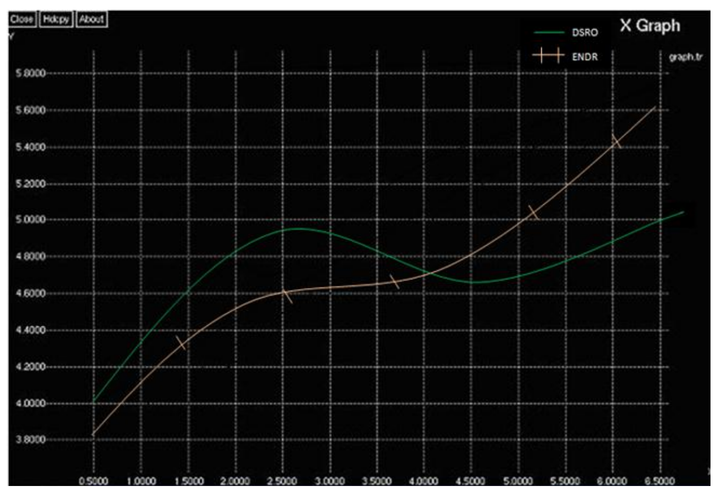
4.1 Simulation Assumption

To evaluate the performance of the DSRO, the performance of DSRO is compared with EDNR in terms of network throughput, Energy consumption, end to end delay and packet delivery ratio. In DSR routing protocol, the shortest path is selected between source node and destination node without considering the lifetime of the node and the lifetime of the link. The DSRO technique attempts to find a route with maximum node and link lifetime using the proposed algorithm. The Shrink mechanism reduces the route length by dropping the minimum lifetime nodes from the path and connects to the neighbors creating short-cut. Generally speaking, the EDNR mechanism performs better in a low-mobility scenario, whereas the DSRO technique seems to be more suitable for a high-mobility scenario.

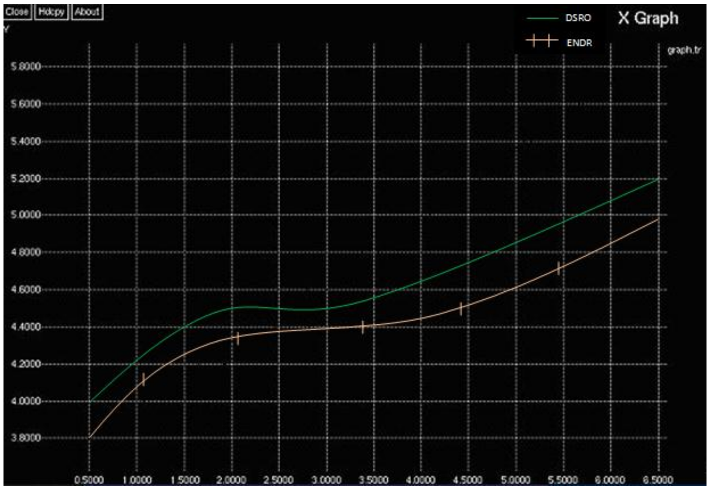
4.2 Simulation Result



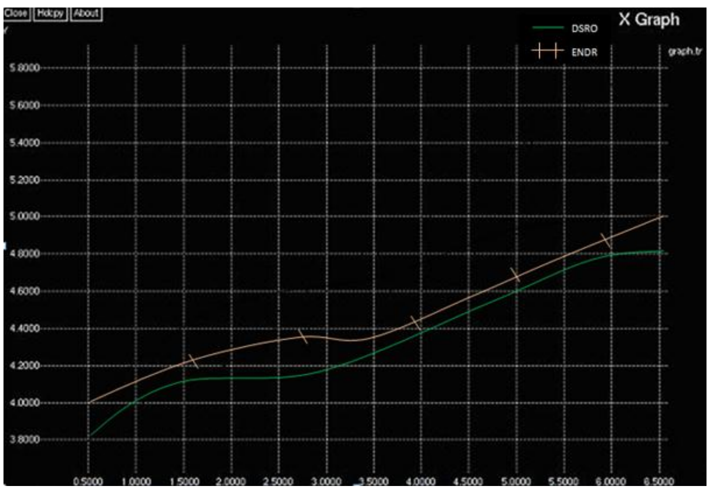
DSRO has an increase in the packet delivery ratio than EDNR.
***Fig. 2** Packet Delivery Ratio*



DSRO has decreased energy consumption than EDNR
***Fig. 3** Energy Consumption*



DSRO has an increased throughput than EDNR.
Fig. 4 *Throughput*



DSRO has a decreased Delay than EDNR
Fig. 5 *Delay*

5CONCLUSION AND FUTURE ENHANCEMENT

In this paper, by considering the node lifetime and link lifetime, the optimal path is chosen for avoiding link breakage and modified shrink mechanism is used to minimize the energy consumed for packet transmission. A novel DSRO algorithm is proposed. MANET consists of nodes that are connected through a communication link with limited battery power. Due to their mobility, MANET nodes move out of their communication range. As the result, there are link breakages between the nodes. The energy is also wasted to complete one transmission. The energy drain rate is evaluated using the residual energy calculation for future use which is stored in the route cache. By using the proposed DSRO technique the longest lifetime nodes path for persistent data forwarding is selected and shrink mechanism to eliminate the least lifetime node is dropped, creating a shortcut path with the adjacent neighboring node and also to predict the residual energy. The performance results of the proposed DSRO algorithm and EDNR are compared and it is proved that DSRO performs better than EDNR mechanism.The future work is to improve the proposed scheme in terms of both shrink mechanism and DSRO technique resulting in gain of path optimality of short-cut gained in the hop reduce to be enhanced still more in path lengthy reduction.This leads researchers to develop efficient route recovery without worrying about the path optimality.

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