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A Survey of Routing Protocols in Mobile Ad Hoc Network

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Abstract -Mobile Ad hoc Network (MANET) is characterized by mobile hosts, dynamic topology, multi-hop wireless connectivity and infra-structure less ad hoc environment. On demand routing protocols for ad hoc networks discover and maintain routes on a reactive, "as-needed" basis. The nodes in the MANET are typically powered by batteries which have limited energy reservoir. Sometimes it becomes very difficult to recharge or replace the battery of nodes; in such situation energy conservations are essential. Also nodes move away without giving any notice to its cooperative nodes, causing changes in network topology and thus, these changes may significantly degrade the performance of a routing protocol. Hence the energy consumption and lifetime of the node and link becomes an important issue in MANET. This paper evaluates the performance of various adhoc routing protocols such as DSDV, AODV, DSR, TORA and AOMDV in terms of energy efficiency and showed that AOMDV is better in comparison with all the above protocols. The simulation is carried out using network simulator NS-2.35 under Linux platform. The performance metrics used for evaluation are packet delivery ratio, latency, throughput, energy consumption, overhead and packet received.

Key words- AOMDV, RREQ, RREP, TORA, MANET, DSDV, DSR

I. Introduction

MANET is a wireless infrastructure less network having mobile nodes. Communication between these nodes can be achieved using multi hop wireless links. Each node will act as a router and forward data packets to other nodes. Mobile adhoc networks are operating without any centralized base station. It uses multi hop relaying. Since the nodes are independent to move in any direction, there may be frequent link breakage. The advantage of MANET is its instant deployment.

Various protocols have been developed for adhoc networks such as TORA(Temporally Ordered Routing Algorithm), DSDV (Destination-Sequenced Distance Vector), DSR (Dynamic Source Routing),AODV(Ad-Hoc On Demand Routing), AOMDV (Ad hoc On-demand Multipath Distance Vector Routing). These protocols offer varying degrees of efficiency. This paper aims to find out an energy efficient routing protocol. It also aims to limit power consumption of mobile nodes in the network in order to prolong the network life time. The main objective of this paper is to analyze AOMDV protocol for ways it could be improved. This can be done by measuring energy with respect to network size and taking into consideration the remaining battery power[1].

II. ROUTING PROTOCOLS IN MANET

Routing Protocol is used to find valid routes between communicating nodes. They do not use any access points to connect to other nodes[1]. It must be able to handle high mobility of the nodes. Routing protocols can be mainly classified into 3 categories

- -Centralized versus Distributed
- -Static versus Adaptive
- -Reactive versus Proactive
- - Hybrid Routing

In centralized algorithms, all route choices are made by a central node, while in distributed algorithms, the computation of routes is shared among the network nodes. In static algorithms, the route used by source destination pairs is fixed regardless of traffic condition. It can only change in response to a node or link failure. This type of algorithm cannot achieve high throughput under a broad variety of traffic input patterns. In adaptive routing, the routes used to route between source-destination pairs may change in response to congestion.

A. Proactive (Table-Driven) Routing Protocols

In this family of protocols, nodes maintain one or more routing tables about nodes in the network. These routing protocols update the routing table information either periodically or in response to change in the network topology. The advantage of these protocols is that a source node does not need route-discovery procedures to find a route to a destination node. On the other hand the drawback of these protocols is that maintaining a consistent and up-to-date

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routing table requires substantial messaging overhead, which consumes bandwidth and power, and decreases throughput, especially in the case of a large number of high node mobility. There are various types of Table Driven Protocols: Destination Sequenced Distance Vector routing (DSDV), Wireless routing protocol (WRP), Fish eye State Routing protocol (FSR), Optimized Link State Routing protocol (OLSR), Cluster Gateway Switch Routing protocol (CGSR), Topology Dissemination Based on Reverse Path Forwarding (TBRPF).

B. Reactive (On-Demand) Routing Protocols

For protocols in this category there is an initialization of a route discovery mechanism by the source node to find the route to the destination node when the source node has data packets to send. When a route is found, the route maintenance is initiated to maintain this route until it is no longer required or the destination is not reachable. The advantage of these protocols is that overhead messaging is reduced. One of the drawbacks of these protocols is the delay in discovering a new route. The different types of reactive routing protocols are: Dynamic Source Routing (DSR), Ad-hoc On-Demand Distance Vector routing (AODV), Adhoc On-demand Multipath Distance Vector Routing Algorithm (AOMDV) and Temporally Ordered Routing Algorithm (TORA).

C. Hybrid Routing Protocols

Both of the proactive and reactive routing methods have some advantages and shortcomings. In hybrid routing a combination of proactive and reactive routing methods are used which are better than the both used in isolation. It includes the advantages of both protocols. As an example facilitate the reactive routing protocol such as AODV with some proactive features by refreshing routes of active destinations which would definitely reduce the delay and overhead so refresh interval can improve the performance of the network and node. These protocols can incorporate the facility of other protocols without compromising with its own advantages. Examples of hybrid protocols are Zone Routing Protocol, Hazy Sighted Link State[3].

D. ENERGY EFFICIENT ROUTING PROTOCOLS

A. Energy consumption model

Wireless network interface can be in one of the following four states: Transmit, Receive, Idle or Sleep. Each state represents a different level of energy consumption[2].

- Transmit: node is transmitting a frame with transmission power Ptx ;
- Receive: node is receiving a frame with reception power Prx.

That energy is consumed even if the frame is discarded by the node (because it was intended for another destination, or it was not correctly decoded);

- Idle (listening): even when no messages are being transmitted over the medium, the nodes stay idle and keep listening the medium with P idle ;
- Sleep: when the radio is turned off and the node is not capable of detecting signals. No communication is possible. The node uses P sleep that is largely smaller than any other power. The typical values of consumption for a wireless interface (measured for a Lucent Silver Wavelan PC Card) are reported.

Transmit P tx = 1.3W
Receive P rx = 0.9W
Idle P idle = 0.74W
Sleep P sleep = 0.047W

The energy dissipated in transmitting (Etx) or receiving (Erx) one packet can be calculated as:

Etx =Ptx X Duration
Erx =Prx X Duration (1)

Where Duration denotes the transmission duration of the packet. When a transmitter transmits a packet to the next hop, because of the shared nature of wireless medium, all its neighbours receive this packet even it is intended to only one of them. Moreover, each node situated between transmitter range and interference range receives this packet but it cannot decode it. These two problems generate loss of energy.

Energy is a limiting factor in case of Ad-hoc networks. Energy efficient routing protocols are the only solution to above situation. Most of the work of making protocols energy efficient has been done on “on demand routing protocols” because these protocols are more energy efficient rather than proactive protocols. Energy efficiency can also be achieved by sensible flooding at the route discovery process in reactive protocols. And energy efficiency can also be achieved by using efficient metric for route selection such as cost function, node energy, battery level etc. Here energy efficiency doesn’t mean only the less power consumption here it means increasing the time duration in which any network maintains certain performance level. We can achieve the state of energy efficient routing by increasing the network lifetime and performance.

B. **METHODOLOGY**

In the existing system, different routing protocols in MANETs are compared by many researchers. They compared EE-OLSR with OLSR. Some implemented overhead reduction and efficient energy management for DSR in MANET. Some compared the performance of DSR and DSDV based on the node termination rate as well as the overall throughput

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of the network. Some researchers compared AODV and DSR in terms of pause time and no. of nodes. These works provide detailed performance analysis on adhoc routing protocols but energy performance was not addressed. It does not reflect the topological change. In the proposed system, various routing protocols such as AODV, DSR, DSDV,TORA and AOMDV are compared with respect to more metrics.

IV. PERFORMANCE METRICS

A. Simulation Parameters

The simulators measured the following noteworthy statistical performance metrics:

1. Packet delivery ratio

It is the ratio of the data packets delivered to the destinations to those generated by the sources.

2. Energy consumption

This is the ratio of the average energy consumed in each node to total energy.

3. End to end delay

This is the ratio of the interval between the first and second packet to total packet delivery.

4. Throughput

The throughput metric measures how well the network can constantly provide data to the sink. Throughput is the number of packets arriving at the sink per ms.

5. Number of Packets dropped:

This is the number of data packets that are not successfully sent to the destination during the transmission. In this study the time versus the number of packets dropped have been calculated.

B. Simulation Environment

Ns-2 simulator was used in our simulations. The following parameters given in the table 1 are use for the simulation.

Table 1 Simulation Environment

Simulation Time	100s
Topology Size	1000m x 1500m
Number of Nodes	50
MAC Type	MAC 802.11
Radio Propagation Model	Two Ray Model
Radio Propagation Range	250m
Pause Time	0s
Max Speed	4m/sec-24m/sec
Initial Energy	100J
Transmit Power	0.4W
Receive Power	0.3W
Traffic Type	CBR
CBR Rate	512 bytes x 6 per second
Number of Connections	50

V. RESULTS AND DISCUSIONS

A. Results of Simulation

Figure 1 shows the Comparison of Energy consumption versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes. It shows that the energy consumption of networks using AOMDV is minimum compared to TORA, AODV, DSR and DSDV. TORA is consuming the maximum energy. AODV is consuming lesser energy than TORA, DSR and DSDV.

Figure 2 shows the comparison of Packet lost versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes. Packet loss is minimum using AODV compared to DSR and DSDV. It shows that the packet lost is minimum for AODV and AOMDV when compared to the other three protocols.

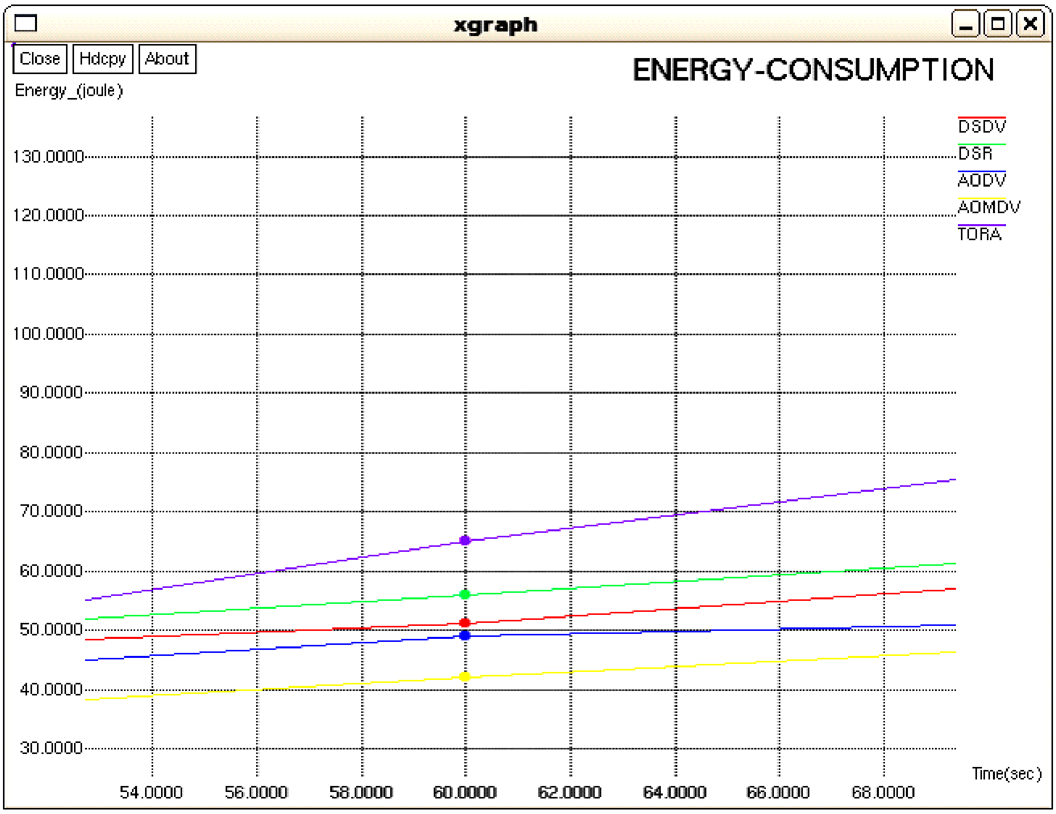

Fig 1. Comparison of Energy consumption versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes

Figure 3 shows the comparison of Packet delivery ratio versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes. It shows that the packet delivery ratio of the networks using AOMDV is better compared to than AODV, TORA, DSR and DSDV. TORA has a poor packet delivery ratio than all the other protocols.

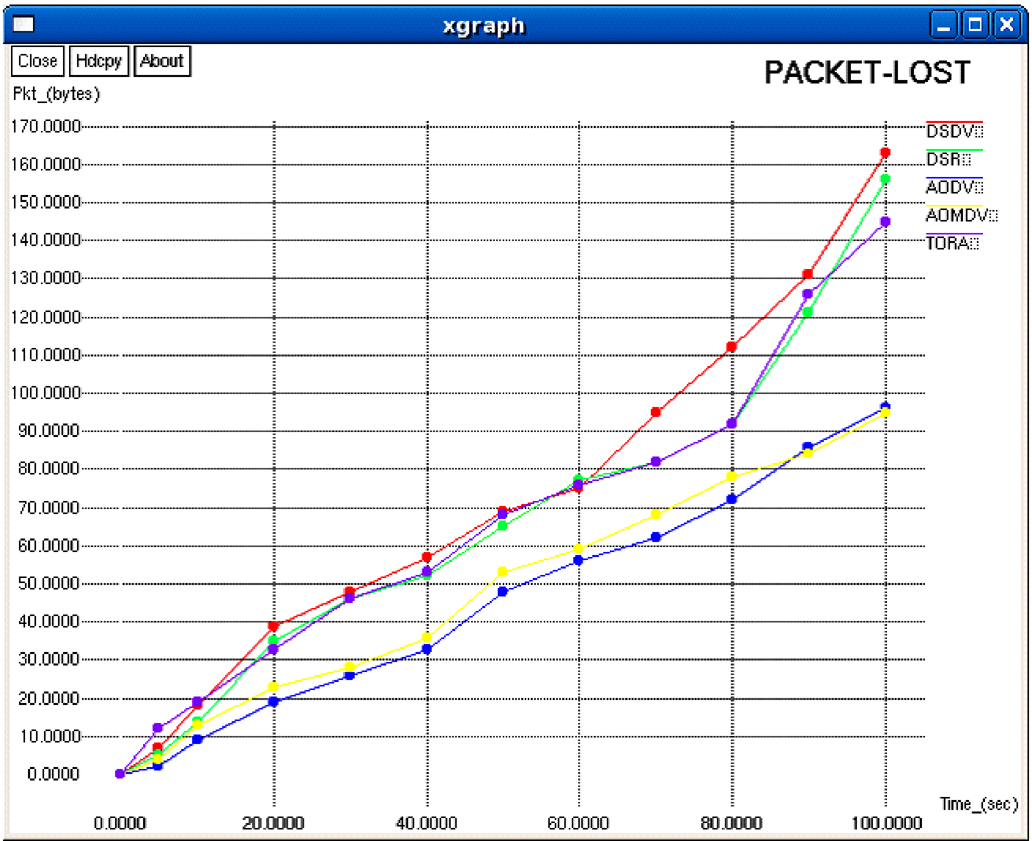

Fig 2. Comparison of Packet lost versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes

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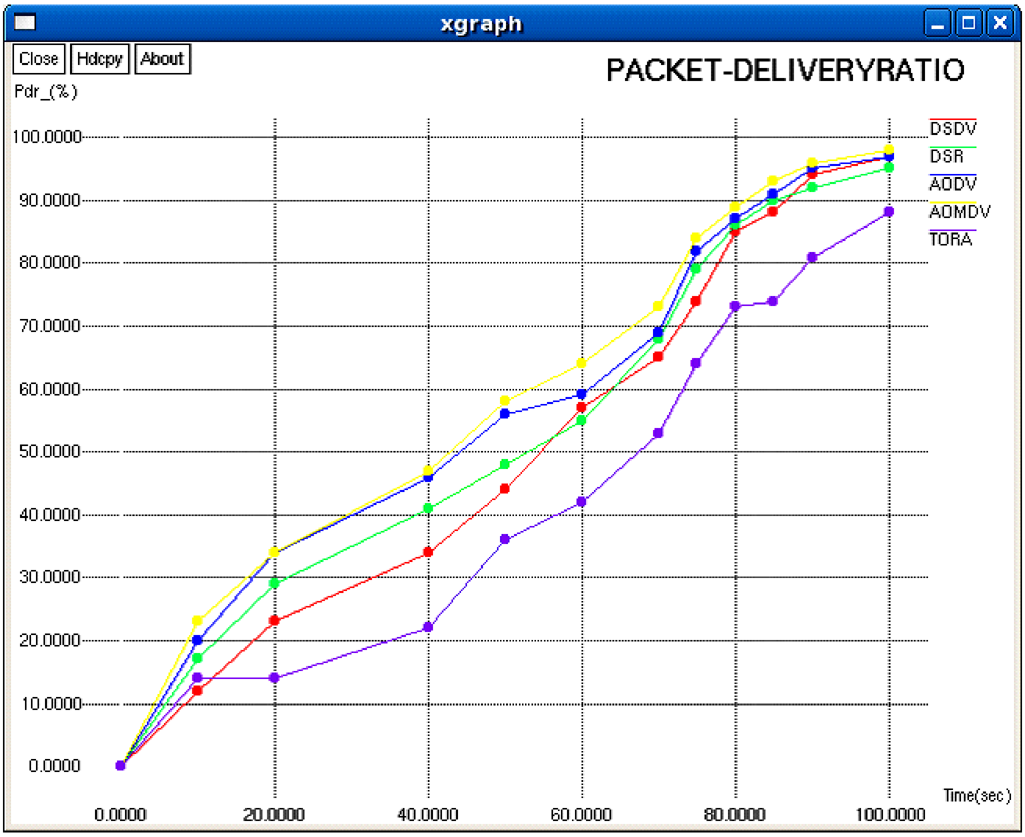

Fig 3. Comparison of Packet delivery ratio versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes

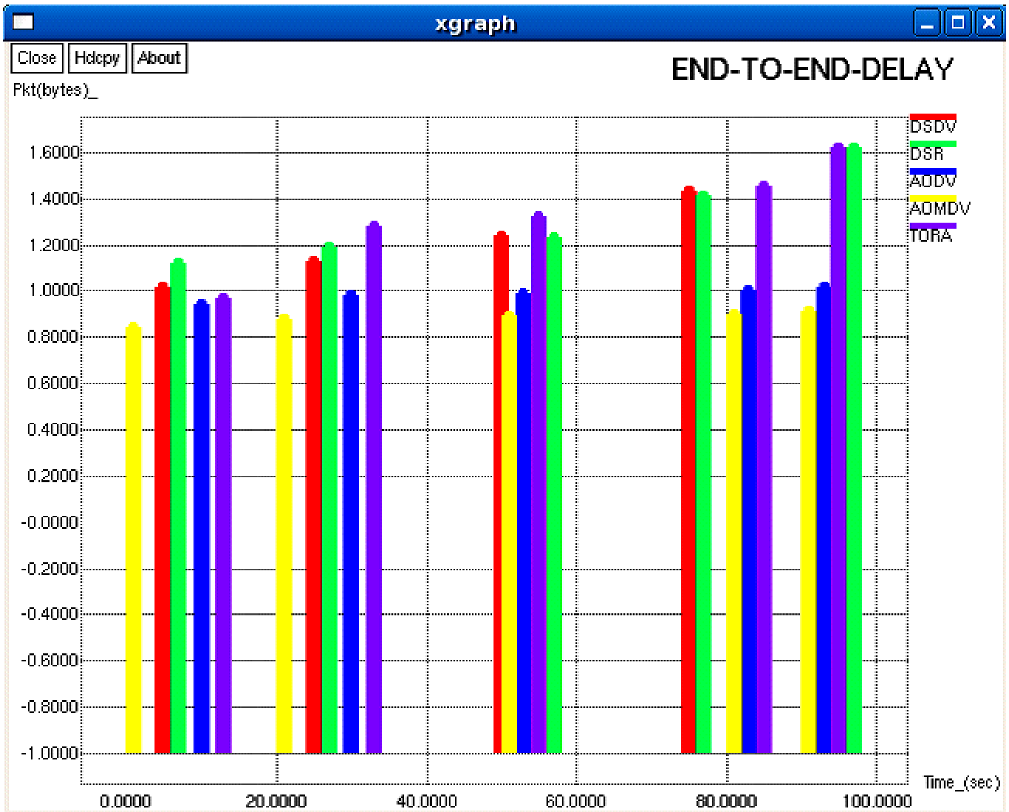

Fig 4. Comparison of End to end delay versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes

Figure 4 shows the comparison of end to end delay versus time for DSDV, DSR, TORA, AODV and AOMDV using 50 nodes. It shows that the end to end delay is minimum when using AOMDV compared to AODV, TORA, DSR and DSDV. TORA is having the highest end to end delay compared to all the other protocols.

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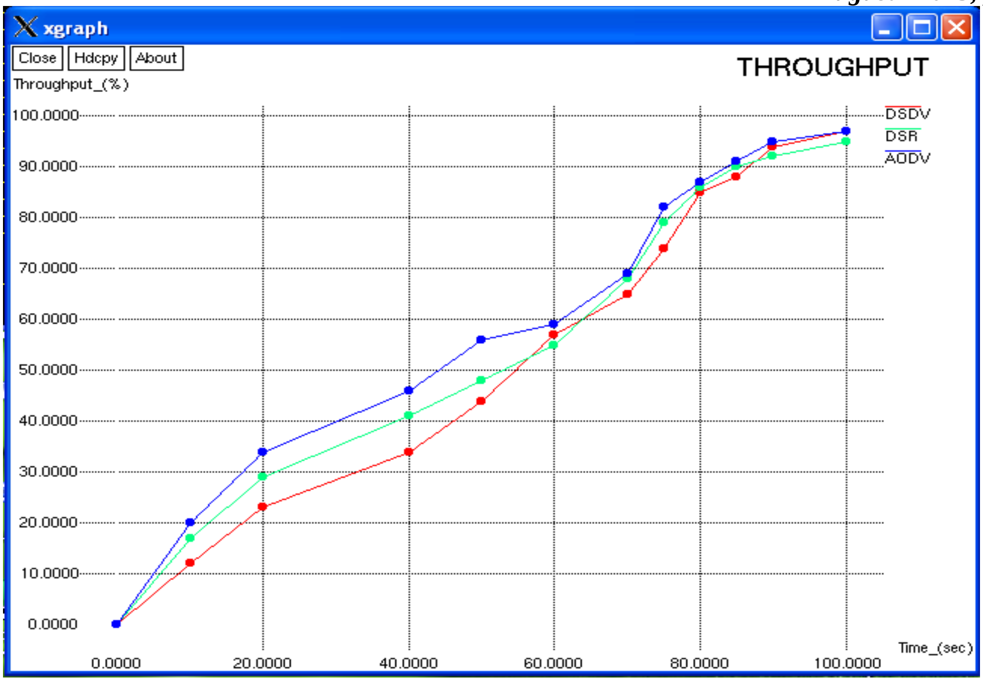

Fig 5. Comparison of throughput versus time for DSDV, DSR, and AODV using 50 nodes

The following are the observations from the above four graphs

1. The energy consumption of networks using AOMDV is minimum compared to TORA, AODV, DSR and DSDV
2. It shows that the packet lost is minimum for AODV and AOMDV when compared to the other three protocols
3. The packet delivery ratio of the networks using AOMDV is better compared to than AODV, TORA, DSR and DSDV
4. The end to end delay is minimum when using AOMDV compared to AODV, TORA, DSR and DSDV

It is concluded that AOMDV is best on demand routing protocol.

VI . Conclusion

In this paper the performance of different routing protocols such as, AOMDV, AODV, DSDV, TORA and DSR in MANET in different network environments is evaluated. AOMDV is analyzed as the best protocol compared to AODV, TORA, DSR and DSDV when energy efficiency is taken into consideration.More research is needed to combine and integrate some of the protocols presented in this paper to keep MANETs functioning for a longer duration.

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