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Performance Analysis of Enhanced DSDV Protocol for Efficient Routing In Wireless Ad Hoc Networks

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Abstract–*An ad hoc wireless network is a collection of mobile nodes establishing an instant network without any fixed topology. Furthermore, each node acts as both router and host concurrently, and can travel out or link up in the network freely. In such a network, designing of routing protocol is a significant and important issue and therefore, new challenges are there in ad hoc routing protocols scheme. Hence traditional routing algorithms are unsuitable for betterment of ad hoc networks. Recent research emphases on the different types of routing protocols for enhancement and compared these protocols with existing metrics of network. Since network energy is an important parameter to improve the network lifetime. In this paper, presents the multicost parameters based DSDV (MPB-DSDV) routing protocol to enhance the energy efficient of ad hoc networks. The modification adapted in DSDV makes it a more suitable routing protocol and simulate the result of the help of the performance metrics like End to End Delay, Packet Delivery Ratio, Routing Overhead and Throughput of wireless ad hoc networks. The proposed multicost parameters based DSDV algorithm can lead to energy consumption, improving the network performance than regular DSDV routing protocol.*

Keywords *–Ad hoc networks, DSDV protocol, Energy, Multicost, MPB-DSDV, Network performance.*

I. INTRODUCTION

Wireless ad hoc network consists of multiple mobile nodes that retain network connectivity through wireless radio wave communications. It has no permanent networking infrastructure. Nodes in an ad hoc networks use other nodes as intermediate relays to retransmit packets to their destinations within the limited range. Since nodes are typically battery operated, energy conservation is an important issue. Moreover, because of the broadcast nature of the wireless medium, routing is the key role to communicate them with each other by using some effective routing algorithms. The routing [1] is performing of information exchange across the network from a source to a destination. It is also represented as the procedure of selecting a path over which the packets are sent. The routing procedure usually directs forwarding based on routing tables, which conserve a record of the routes to several network destinations. However, one middle node within the network is faced during the transfer of information. Mainly, two actions are included in this perception: governing optimal routing paths and transmitting the packets through a network. The transmitting of packets across the network is named as packet switching and the path investigation could be very complicated.

Routing protocols to operate several metrics as a standard magnitude to determine the best path for routing the packets to its destination that could be stated as hops, which are handled by the routing algorithm to establish the optimal path for the packet transmitting to its destination. The method of path investigation is that, routing algorithms detect and maintain routing tables, which include the total route information in the packet. The information of route differs from one routing algorithm to another. The routing tables are packed with entries in the routing table are IP address prefix and the next hop.

Routing is generally categorized into static routing and dynamic routing. Static routing represents to the routing plan being maintained statically or manually, in the router. Static routing maintains a routing table normally entered by a network's administrator. Dynamic routing refers to the routing scheme that is being absorbed by an interior or exterior routing protocol. This dynamic routing mainly depends upon the state of the network the routing table is adopted by the liveliness of the destination. In infrastructure networks, within coverage, a base station can achieve all portable nodes without routing via broadcast in common wireless networks. Whereas in the ad hoc networks, a node have capable of retransmit thedata to other nodes in networks boundary. This produces other problems along with the problems of dynamic topology, which is uncertain changes in connectivity. Asymmetric links,Routing Overhead, Interference, and Dynamic Topology are few problems in routing with Mobile Ad hoc Networks. The categories of routing protocol (fig.1) in the wireless ad hoc network can be organized in many ways [2], but most of these methodological are done based on routing strategy and network structure. The routing protocols can be characterized as flat routing, hierarchical routing and geographic position supported routing while depending upon the network structure. Along with the routing approach routing protocols can be further classified as Table-driven and source initiated.

The categories of routing protocol are presented below. In the ad hoc networks, designing of routing protocol is an important issue and therefore, new challenges are there in routing protocols scheme. All above stated routing algorithm has separate features of merits and demerits in the network performance. Hence the traditional routing algorithms are needed to improve the betterment of network's lifetime. Research field emphases on the various types of routing protocols for enhance the network performance. Meanwhile, network energy is an important parameter to improve the network lifetime.

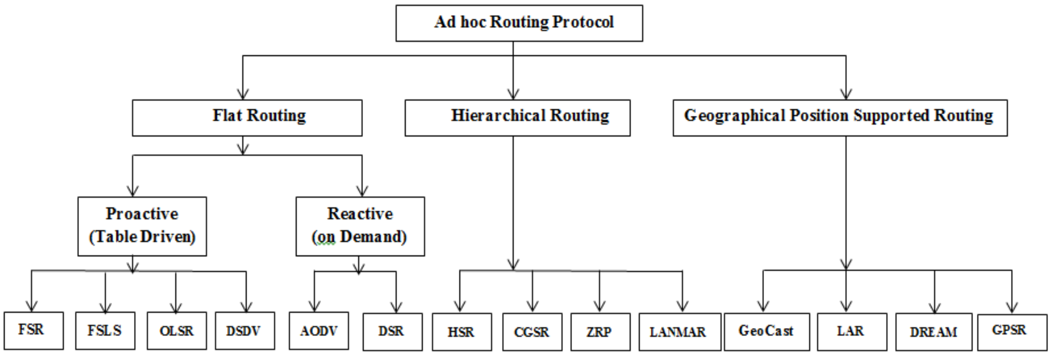

Figure.1 Ad hoc Routing Protocols

FSR – Fish Eye State Routing ; FSLS – Fuzzy Sighted Link state; OLSR – Optimized Link State Routing; DSDV – Destination Sequenced Distance Vector; AODV – Ad hoc On Demand Distance Vector; DSR – Dynamic Source Routing ; HSR – Hierarchical State Routing ; CGSR – Cluster Gateway Switch Routing; ZRP – Zone Routing Protocol; LANMAR – Landmark Ad hoc Routing; GeoCast – Geographic Addressing and Routing; LAR – Location Aided Routing Protocol; DREAM – Distance Routing Effect Algorithm for Mobility; GPSR – Greedy Perimeter Stateless Routing.

This paper focuses and analyzes through network simulation (NS2) which compares the performance metrics like End to End Delay, Packet Delivery Ratio, Routing Overhead and Throughput with respect to energy constrained of both regular DSDV and modified DSDV (MPB-DSDV). The cost parameters of Hop count (h), total interference (I), node link delay (d), residual energy of a node (R) and the node transmission power (T) are the cost parameters assigned for link and path of the ad hoc networks. The new descriptions of a node in the network the link and path cost parameters which are suitable for implement routing algorithms for the network. These parameters are combined in different optimization function with respect to DSDV routing algorithm and MAX/MIN Energy-Half-Interference-Half Hop multicost algorithm for selecting the optimal path. The simulation result shows that the MPB-DSDV performs well in significant metrics of wireless network performance.

II. RELATED WORKS

The algorithms of routing protocol are suitable for adopt and can be modified for enhancement of network performance. The various authors are proposed on DSDV protocol for modification on it and cost parameter's implementation in ad hoc, which are mentioned below, Wang Kai [3] et al., proposed the MDSDV in the network simulator-2 (NS2) comparing with previous DSDV and the ad hoc on-demand distance vector (AODV) routing. The simulation results show that the proposed MDSDV can preferably fit the specific characteristics of WMNs, and it is the relative best choice for WMNs, which consist of a large number of nodes and need high packet delivery rate, low end-to-end delay and insensitive routing overhead.

Tao Wan [4] et al. stated that a mobile ad hoc network was formed by a group of mobile wireless nodes, each of which functions as a router and agrees to forward packets for others. Many routing protocols have been proposed for MANETs. However, most assume that nodes are trustworthy and cooperative. Thus, they are vulnerable to a variety of attacks. Tao Wan proposed a secure routing protocol based on DSDV, namely S-DSDV, in which, a well-behaved node can successfully detect a malicious routing update with any sequence number fraud, and any distance fraud provided no two nodes are in collusion. Tao Wan et al., compare security properties and efficiency of S-DSDV with super SEAD. Efficiency analyzed that S-DSDV generates high network overhead. However, which can be reduced by configurable parameters. Tao Wan believed that the S-DSDV overhead is justified by the enhanced security.

Khaleel Ur Rahman Khan [5] et al., proposed an extended version DSDV (eDSDV) Protocol for Ad Hoc networks. eDSDV overcomes the problem of stale routes, and thereby improves the performance of regular DSDV. Simulator and performance comparison has been made with regular DSDV. The performance metrics considered are packet-delivery ratio, end-end delay, dropped packets, routing overhead, route length. It has been found after analysis that the performance of eDSDV is superior to regular DSDV under different simulation scenarios. The proposed protocol is an extension of DSDV in terms of two-hop route-requests packets and dynamic buffer management algorithm, which is used to avoid discarding of packets in case when the buffer associated with the destinations, becomes full.

Charles E.Perkins [6] et al., projected an ad-hoc network is the cooperative engagement of a collection of Mobile Hosts without the required intervention of any centralized Access Point. Charles E., Perkins presented an innovative design for the operation of such ad-hoc networks. The basic idea behind the design is to operate each Mobile Host as a specialized router, which periodically advertises its view of the interconnection topology with other Mobile Hosts within the network. This amounts to a new sort of routing protocol. Charles E.Perkins have investigated modifications to the basic Bellman-Ford routing mechanisms, as specified by RIP, to make it suitable for a dynamic and self-starting network mechanism as is required by users wishing to utilize ad hoc networks. Charles E.Perkins modifications address some of the previous objections to the use of Bellman-Ford, related to the poor looping properties of such algorithms in the face of broken links and the resulting time dependent nature of the interconnection topology describing the links between the Mobile Hosts.

Anand [7] et al., expressed the nodes are relied on batteries or exhaustive energy sources for power and drop out within an ad hoc network, since energy sources have a limited lifetime. As the power availability is one of the most important constraints upon the operation of the ad hoc network. Anand presented performance evaluation and verification for energy-efficient DSDV (EEDSDV) routing protocol for MANET and simulate the result from the help of the performance matrices like End to End Delay and Packet Delivery Ratio. The EEDSDV uses variant transmission energy approach to overcome the problem of more energy consumption for transmission and receiving messages in DSDV

Nikos Karagiorgas [8] et al., studied the combination of multicost routing and adjustable transmission power in wireless ad hoc networks, to obtain dynamic energy and interference efficient routes to optimize network performance. In multi-cost routing, a vector of cost parameters is assigned to each network link, from which the cost vectors of candidate paths are calculated. Only at the end, these parameters are combined in various optimization functions, corresponding to be different routing algorithms, for selecting the optimal path. The multicost routing problem is a generalization of the multi-constrained problem, where no constraints exist, and is also significantly more powerful than single cost routing. Since energy is an important limitation of wireless communications, the cost parameters considered are the number of hops, the interference caused, the residual energy and the transmission power of the nodes on the path; other parameters could also be included, as desired. Nikos Karagiorgas assume that nodes can use power control to adjust their transmission power to the desired level. The experiments conducted show that the combination of multicost routing, and adjustable transmission power can lead to reduced interference and energy consumption, improving network performance and lifetime.

III. DESTINATION SEQUENCED DISTANCE VECTOR (DSDV)

DSDV is one of the proactive routing protocols available for Ad Hoc networks. It was developed by C. Perkins in 1994. DSDV is modified from Bellman-Ford algorithm. In DSDV [5] each routing table will comprise all available destinations, associated with next hop. A sequence number and associated metric are created by a destination node. The routing tables are renewed in the topology after exchange between nodes. All the nodes can broadcast to its neighbor's entries in their table. This swap of entries can be done by dumping the whole routing table, or by presenting an incremental update, which means exchanging just newly updated routes. Nodes which obtain this data can then renew their tables if they received a better route, or a latest one.Updates are implemented regularly, and are immediately scheduled if a new event is found in the topology. If there are repeated changes in topology, complete table exchange will be favored whereas in a fixed topology, incremental updates will produce less traffic. The route selection is done on the metric and sequence number standards. The sequence number is a time signal sent by the destination node. It permits the table to update process, as if similar routes are known, the one with the best sequence number is kept and used, while the other is abolished and, which is considered as the stale entries.

Assume with two topologies illustrated in fig 2 and fig 3. At time t=0, the network is structured as shown in fig 2 and supposed to this time, the network is stable. And therefore, all the nodes have an exact routing table for each destination. Later, node A is supposed to moving with time t+1, the network topology is as indicated like in the fig 3. In this phase, the below mentioned events are found and actions are taken (Link with node). Node A and node B link is broken; the route entry has deleted, and also updates are sent to node C and G nodes. A new link is found at node H and F; the new entry is inserted in their routing table, and updates are sent to neighbors G and E. The two new links are found by node A; the routing table is revised, and full dump is forwarded to node H and F.

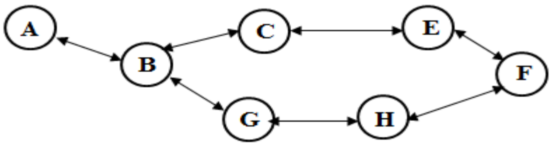

Figure.2Ad hoc topology with time t=0

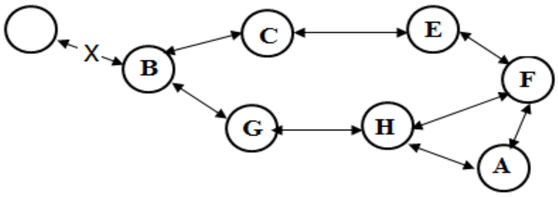

Figure.3Ad hoc topology with node moving time t+1 of node A

3.1 Merits and Demerits of DSDV

The main advantages of DSDV are fairly apt for establishing ad hoc networks with the certain number of mobile nodes, and it is ensured for loop-free path. The demerits of DSDV have regular update of its routing tables, which uses up energy and a small value of bandwidth even when the network is inactive.

IV. MULTICOST PARAMETER BASED DSDV (MPB-DSDV) ROUTING PROTOCOL

Since network energy [9] is an important parameter to improve the network lifetime. The demerits of updating the energy by DSDV may overcome with the implementation of multicost parameter's concept in DSDV. The cost parameters of Hop count (h), total interference (I), node link delay (d), residual energy of a node (R) and the node transmission power (T) are the cost parameters assigned for link and path of the ad hoc networks. The performance metrics, end to end Delay, Packet Delivery Ratio, Routing Overhead and Throughput with respect to energy constrained were compared with regular DSDV and modified DSDV (MPB-DSDV). The new descriptions of link and path cost parameters that are suitable for implementing better routing algorithms.

4.1 Multicost Routing Parameters

In multicost routing [8], a vector of cost parameters [10] is consigned to each link and the cost vector of a path. It is well-defined based on the cost vectors of the links that combined it by applying, component wise. And uses a monotonic associative operator ʘ, apply for all the cost vector parameter. Path cost vector is constructed of links in the network are included with the associative operator used for entire cost vector components. Furthermore, by condition applied to them (to maximize or minimize) for choose the optimum path.In the detail specification, the link cost vector parameter of Link *l* is represent by $V(P) = (V_{1l}, V_{2l}, \ldots, V_{kl})$ and the cost vector of the path *P* in represent by $V(P) = (V_1, V_2, \ldots, V_k)$contains of links l = 1, 2… l. The optimization function *f* (V) has to be minimized so as to choose the optimum path. The path cost vector $V(P) = (V_1, V_2, \ldots, V_k)$ contains of links *l = 1, 2… l* is derived from link cost vector $V(P) = (V_{1l}, V_{2l}, \ldots, V_{kl})$ that comprise it along with representing of component-wise a monotonic associative operator ʘ to all the cost vector parameter(Equ.1).

$$V_m = \Theta_{l-1}^{L} V_{ml} \qquad \ldots (1)$$

where, $V_m = \sum_{l=1}^{L} V_{ml}, V_{ml} \geq 0$ If additive and m^{th} parameter of the cost vector

4.2 Cost parameters for ad hoc networks

In the projected multicost parameters [11] for ad hoc network consists of the following five parameters.

- The number of hops h in a path (Equ.2):

$$h = \sum_{l=1}^{j} h_l \qquad \dots (2)$$

Where h_l= 1 for all links l, the associative operator Θ used here for addition.

- The total interference I_1 and I_∞ both are usually desirable (Equ.3).

$$I_1 = \sum_{l=1}^{j} I_l \ (or) \ I_\infty = max_{l=1,\dots,j} I_l \qquad \dots (3)$$

- The minimum residual energy R of a path(Equ.4):

$$R = min_{l=1,\dots,j} R_{l.} \qquad \dots (4)$$

- The minimum T_1 or the maximum T_∞ of the transmission powers acquired from the nodes on a path (Equ.5):

$$T_1 = \sum_{l=1}^{j} T_l \ \ (or) \ T_\infty = max_{l=1,\dots,j} T_{l.} \qquad \dots (5)$$

The above cost parameters are constituted with optimal path(P) with respect to MAX/MIN Energy-Half-Interference-Half Hop algorithm [8] mentioned below in Equ.6.

$$min_P \frac{\sqrt{h(P).T_\infty(P)} \cdot \sqrt{I_\infty(P)}}{R(P)} \qquad \dots (6)$$

Since node link delayd_l is used to calculate the network performance in ad hoc network and it may considered as performance metrics. To increase the throughput andpacket delivery ratio of the network, minimum nodelink delayleadsbetterpacket delivery of transmission. Hence$d_l$could be considered asan additional cost parameterto enhance the packet delivery ratio in the network. Furthermore the $d_l$can be expressed asbelow in Equ.7

- The node link delaysd_l or equivalently, its length d_t(Scalar) where d_l = 1 for all links *l*:

$$d = \sum_{l=1}^{j} d_l \qquad \dots (7)$$

All thesefive cost parameters $h_l, I_l, R_l, T_l, d_l$are constituted with optimal path*(P)* in DSDV with respect to MAX/MIN Energy-Half-Interference-Half Hop algorithm and can be modified as mentioned below in Equ.8.

$$min_P \frac{\sqrt{h(P).T_\infty(P)} \cdot \sqrt{I_\infty(P)}}{R(P).d(P)} \qquad \dots (8)$$

All these cost parameters are combinedin the optimization functions, corresponding to MAX/MIN Energy-Half-Interference-Half Hop algorithm. The capability of mobile transmission nodes to adjust transmission power [10] themselves which outcomes shows difficulties andcompromises onmulti constrained [12] QoS routing. The proposed MPB-DSDV mainly tends to solve the capability adjustable transmission power by the nodes can lead to increase the energy consumption and improving the network performance.

V. RESULTS AND DISCUSSION

5.1 Simulation

Simulation [13] has a dynamic role in the enhancement and examining of ad hoc networking protocols. Though, the simulation of large networks is still a tough task that consumes a lot of processing power, memory, and time. The modifications were made in the implementation of DSDV written for NS2 with necessary simulation parameters (Table.1). A 50 nodes network in a terrain size of 500m x 500m was used. The mobility model used was random waypoint in a square/rectangular field. In random waypoint, each node leads its journey from its present location to a random location within the field. The speed is randomly chosen to be between 1-20 M/sec. The pause time is set to 5 seconds and to set the simulation time is 900 seconds.

Table.1 Simulation Parameters for node mobility

Parameter	Value
Number of Packet(Traffic)Sources	2-5
Terrain Area	500x500 m
Transmission(radio) range	250 m
Traffic Type	Constant Bit Rate (CBR)
No of nodes	50
Packet size	512 Bytes
Standard packet sending rate	5 packets/sec[20Kbps]
Standard Ad Hoc host speed	20 m/s (Max)
Mobility Model	Random waypoint
Pause Time	5 sec
Simulation Time	900 sec
DSDV periodic route update interval	10 sec
No. of times the MPB-DSDV ROUTE REQUEST may be resent	2
Time duration before sending a new ROUTE REQUEST	1 sec

5.2 End To End Delay

The End-to End delay metric is calculated by a packet from the time it was transmitted by a source node at the time it was received at the destination node. In the graphs, Multicost Parameters Based DSDV is marked as MPB-DSDV. The MPB-DSDV shows better performance than DSDV protocol for varying number of nodes, particularly between 15 and 30 nodes. Due to using the transitory routes in the MPB-DSDV the packet latency obviously is certain to decrease. In Fig 4 indicated on the graph though, with the increase at the mobility rate and the number of nodes, the delay is destined to increase.

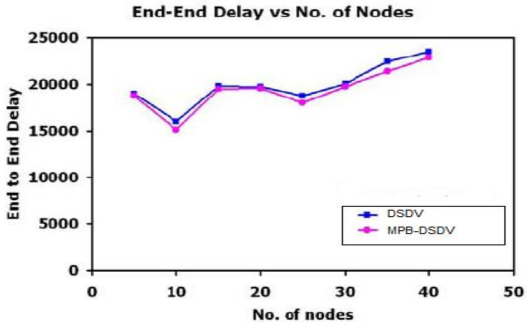

Figure.4 shows the End-End delay for the two protocols as a function of the number of nodes

5.3 Packet Delivery Ratio

Packet delivery ratio metric is calculated by Application layer dividing the number of packets received by the destination through the number of packets originated. The graph shows that the better performance of MPB-DSDV than the regular DSDV in both the states. It may also be detected that the packet delivery ratio of DSDV falls to nearly 75% for 50 nodes and mobility speed of 20 m/s. However for MPB-DSDV, it is more than 90% for the same state shows in Fig 5.

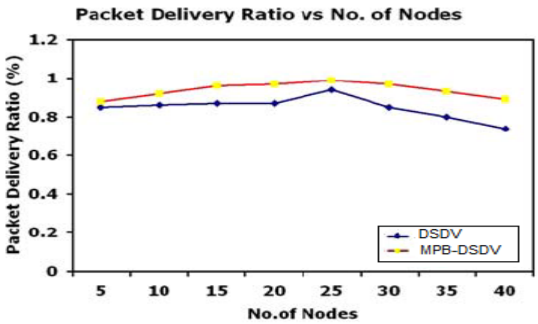

Figure.5 shows the protocols as a function of the number of nodes of Packet delivery ratio

5.4 Routing Overhead

This metric is defined as the number of control packets created per mobile node. Control packets comprise route requests, route replies and error messages. Fig. 6 shows the performance of the DSDV and MPB-DSDV protocols for routing overhead as a function as the number of nodes. The MPB-DSDV routing overhead is initiated to be somewhat higher than the regular DSDV protocol. The facts of the supplementary routing control messages are produced due to broken links in the network. The rise in the routing overhead can be a compromise with the dropped packet rate and the end-to-end delay.

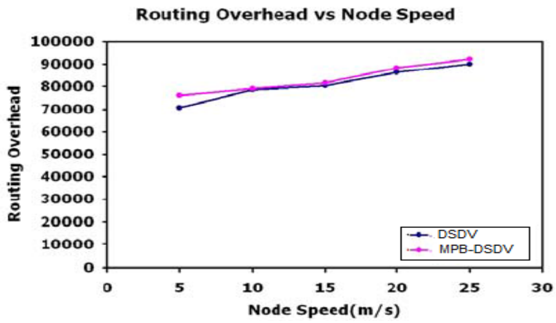

Figure.6 shows the Routing overhead for the two protocols as a function of the node speed

5.5 Throughput

The throughput metric is defined as the total amount of data a receiver receives from the sender divided by the time it takes for the receiver to get the last packet. The throughput is measured in the bits per second (bit/s or bps). The fig 7 shows that the maximum throughput in the time interval of 160 to 200 for both and throughput is increased due to node density, less traffic and free of channel. The overall performance with respect to UDP, the proposed MPB-DSDV routing shows the better outcome than regular DSDV.

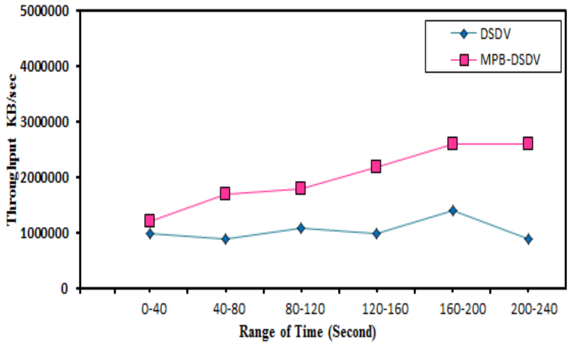

Figure.7 shows the Throughput for the two protocols as a function time range on UDP.

VI. CONCLUSION

The performance of wireless ad hoc routing protocols was examined using the NS-2 simulator on regular DSDV and Multicost Parameters Based DSDV (MPB-DSDV) protocols. Considered complete simulation results of existing metrics of end-to-end delay, packet-delivery ratio, routing overhead, and throughput over the DSDV and MPB-DSDV by varying number of nodes, node speed and range of time. The DSDV routing develops a new attribute, sequence number, to all route table entry; the data packet exchange will increase each time network topology change. However, the proposed Multicost Parameters Based DSDV protocol outclasses is better because of it has adjustable transmission power in high mobility so as to enhances the network energy and network lifetime also allowing the MAX/MIN Energy-Half-Interference-Half Hop algorithm.

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