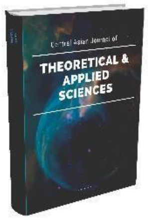

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AD-HOC Better Costing Dynamic Routing Protocol for Enhancement of Network Lifetime

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Abstract: *Mobile ad hoc networks are generally infrastructure-less networks that are self-organizing temporary networks. They do not have a centralized controller. They are applied in diverse sensing and mobility applications. Routing in such networks requires a lot of considerations. Energy efficiency is a challenge in MANETs. This is because since nodes are in motion, they require energy. Energy efficiency in the network is increased by reducing power consumption. This is the primary idea behind this paper. The objective is to enhance the network's lifetime by avoiding the nodes from moving out of the network. We hence propose a novel routing protocol, Ad hoc Better Costing Dynamic (ABCD) protocol, which focuses not just on the residual battery power of the node but also on the energy required to forward the packets through the route. While choosing the path, according to the Mini-max formulation, the path which has the maximum energy among the lowest hop energy is given high preference. The purpose is to avoid using the path with the lowest energy, leading to link breakage. This paper evaluates three routing protocols, Ad hoc On-demand Distance Vector (AODV) routing protocol, Dynamic Source Routing (DSR) protocol and Ad hoc Better Costing Dynamic (ABCD) routing protocol and finds the ABCD protocol to perform better.*

Keywords: *MANETs, residual battery power, AODV, DSR.*

I. INTRODUCTION

Networks are bunches of terminals that speak with one another. It is a progression of focuses or hubs interconnected using correspondence ways [1]-[5]. One organization can interconnect with different organizations and can contain sub-organizations. The broadest geography or general designs of organizations incorporate the transport, star, token ring and cross-section geographies [6]. The organization might be wired or remote. Wireless networks are of two types: infrastructure networks and infrastructure fewer networks [7]. In the former, the communication among the nodes is established and maintained through centric controllers. The latter is referred to as a wireless ad hoc network [8]-[13]. In an ad hoc network, the terminals communicate by each additional in a multihop manner, not including the help of fixed infrastructure. MANETs are groups of mobile nodes that are free to move over a specific space [14]. The mobile devices form a network independent of any centralized administration. Hence, each node acts as an independent router [15]. The topology is highly dynamic. The transmission range of any particular mobile node cannot possibly reach all other nodes in the network. For this reason, the transmission is done in a multi-hop manner [16]-[22]. A typical layout of MANET is shown in figure 1.

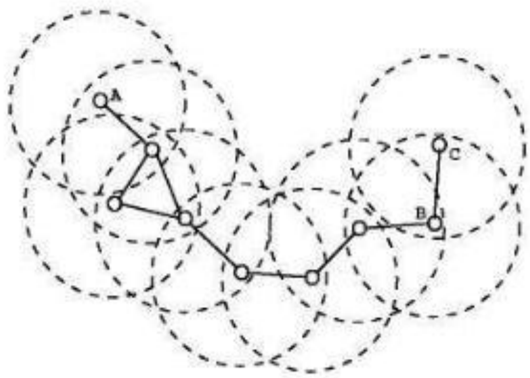

Fig. 1. MANET Example

In MANETs, directing and asset the board are done dispersed. That is, all hubs direction to empower correspondences among themselves [23]-[29]. This requires every hub to be more insightful so it can work both as an organization have for communicating and getting information and as an organization switch for sending bundles for different hubs [30]-[33]. The cell phones are battery worked. When the battery empties, the hub might move out of the organization. Accordingly, expanding the battery life has formed into a significant goal [34]. A large portion of the scientists has begun to foster power-mindful, effective steering conventions for MANETs. MANET hubs are furnished with remote transmitters and recipients utilizing receiving wires which might be Omni-directional (broadcast), profoundly directional (highlight point), perhaps steerable, or some mix thereof [35]-[41]. The specially appointed geography might change with time as the hubs move or change their transmission and gathering boundaries. Every versatile hub in a MANETs plays out the steering capacity for layout correspondence among other portable hubs [42]-[49]. This infers that the "termination" or even a couple of the hubs for certain, reasons like power depletion could cause separation of the administrations in the whole MANET [50]. Thus, they experience the ill effects of the restricted energy level issue. On the off chance that a hub moves out of the radio scope of the further hub, the connection interfacing them isn't working. This ought not to occur [51]-[55].

Because of its novel foundation less trademark contrasted with different sorts of remote organizations, A MANET can be extremely helpful for some applications where no framework exists [56]-[61]. Send off correspondence among a gathering of officers in a combat zone is a genuine model. A decent foundation in hostile areas or antagonistic territories may not be imaginable [62]. In such conditions, MANETs can give the necessary correspondence. Likewise, applications in this space require a protected correspondence as snooping or other security dangers can think twice about network and compromise the wellbeing of faculty associated with these tactical tasks [63]-[65]. Secure multicast may likewise be required. For instance, the head of a gathering of troopers might need to request to every one of the officers or a bunch of chosen faculty [66]. Thus, steering conventions in such applications need secure correspondence support for multicast directing [67]-[72].

One more region where MANETs can be sent is cooperative and disseminated processing [73]. The prerequisite for an impermanent correspondence network among a gathering in a meeting, meeting or study hall requires the arrangement of a portable impromptu organization [74]-[76]. For instance, accept a gathering of scientists who need to share their exploration results or show materials during a meeting or an instructor circulating talk notes for the class. In such cases, developing a portable impromptu organization with vital help for multicast steering can fill the need [77]-[81]. Albeit these circulated document sharing applications may not need the degree of safety expected in a tactical climate, security viewpoints, for example, information trustworthiness and information insurance against unapproved access, are as yet required [82-89]. For example, search and save crisis tasks can likewise acquire extraordinary advantages from MANETs [90]. In circumstances where the foundation-based correspondence offices are obliterated during wars, militant psychological exercises or as an outcome of cataclysmic events, such as typhoons or quakes, a moment arrangement of portable specially appointed organizations would be a decent answer for planning salvage exercises [91]-[97].

II. GENERAL CHARACTERISTICS OF AD HOC NETWORKS

Mobility

The way that hubs can be quickly repositioned or potentially moved is a trait of impromptu organizations [98]-[101]. Quickly activity in regions with no framework infers that the clients should investigate a region and maybe structure groups/swarms that thus coordinate among themselves to make the team or a mission [102]-[135]. We can have arbitrary individual portability as our base versatility design [136-167]. The portability can have significant contact with the choice of a steering plan and can accordingly impact execution [168].

Multi Hopping

A numerous jump network is an organization where the way from source to objective navigates a few different hubs [169-176]. Specially appointed networks regularly display numerous bounces for blockage control, range reuse, and energy insurance [177-188].

Self-Organization

The impromptu organization should independently decide its setup boundaries, including tending to, directing, grouping, position order, power control, and so forth [189-199].

Energy Consumption

Most specially appointed hubs have restricted power supply and no capacity to produce their power. Energy qualified convention configuration is basic for the life span of the organization.

Scalability

The impromptu organization can develop to a few thousand hubs in certain applications. Progressive development, Mobile IP or nearby handoff methods weaken the issue, yet huge scope is one of the most basic difficulties in the specially appointed plan.

Security

The difficulties of remote security are notable - the capacity of the gatecrashers to snoop and stick/parody the channel. Specially appointed networks are more vulnerable to assaults than the framework matching part. Both aloof and dynamic assaults are conceivable.

III. RELATED WORKS

Certain chips away at steering in a remote, specially appointed network bargain the issue of finding and keeping up with the advanced course to the objective during portability. A simple implementable calculation is introduced to ensure genuinely strong availability and restricted hub range. For the most part, the briefest way calculation is utilized for solid availability.

Proactive Routing Protocols (Table Driven Proactive)

In this convention, every one of the hubs consistently looks for steering data inside an organization; each hub keeps at least one table addressing the whole geography of the organization. These tables are refreshed routinely, so when a course is needed, the course is known. To send any data to another hub, the way is perceived. Consequently, idleness is low. However, when there is a ton of hub development, then, at that point, the expense of keeping up with all geography data is extremely high. Proactive steering conventions constantly attempt to keep up with modern directing data on each hub in the organization. This enjoys the benefit that association times are quick because steering in succession is now accessible when the main parcel is sent. A downside of proactive conventions is that they constantly use assets to impart steering data, even after no traffic.

Reactive Routing Protocols (On-Demand Reactive)

Directing data is gathered when required, and course reason relies upon sending course inquiries all through the organization. That is, at whatever point there is a need of away from any source to objective, then, at that point, a kind of inquiry answer discourse accomplishes the work. Subsequently, the inertness is high. However, no excess control messages are required.

AD-HOC On-Demand Distance Vector Routing (AODV)

AODV has a place with Distance Vector Routing Protocols (DV) class. Specially appointed On-Demand Distance Vector (AODV) is a receptive steering convention, which starts a course revelation process just when it has information parcels to communicate. It has no course way towards the objective hub, or at least, course disclosure in AODV is called on-request. AODV is made out of the accompanying three components:

- ƒ Route Discovery process
- ƒ Route message generation
- ƒ Route maintenance

Route Discovery

A source hub sends a transmission message to its nearby hubs, assuming no course is available for the ideal objective containing source address, source series number, objective location, objective succession number, communicate ID, and jump count. Two pointers, for instance, head pointer and reverse pointer, are used during course revelation. Forward pointers keep the way of the mediator hubs while messages are being sent to the objective hub. At long last, when the course demand message arrives at the objective hub, it then, at that point, sends a unicast answer correspondence to the source through the moderate hubs and the regressive pointer monitor the hubs. The significant part of AODV that separates it since DSR is the objective series number utilized to adjust the cutting-edge way to the objective.

Route Maintenance

Three kinds of messages traded between the source and objective: course blunder correspondence, hi message, and break message. Course mistake message guarantees that this message will be communicated to every one of the hubs since when a hub notices a bombed interface, it will communicate this message to its upstream hubs towards the source hub. Hi, message guarantees the forward and reverse pointers from the end. The broken message ensures the cancellation of a connection when there is no accomplishment for a specific measure of time between the source and the objective hub.

Advantages

- It is an efficient calculation for versatile specially appointed networks; additionally, it is adaptable.
- It invests in some opportunity for meeting and is a circle free convention.
- Messaging straightforwardness to report the connection disappointment is less contrasted with DSR.

Disadvantage

The fundamental weakness is that it needs a colossal data transfer capacity to keep up with the intermittent welcome message.

Dynamic Source Routing (DSR)

The DSR is perhaps the perfect illustration of an on-request steering convention that depends on the idea of source directing. It is planned especially for use in multihop impromptu organizations of portable hubs. It permits the organization to be completely self-coordinating and self-arranging and not bother with any current foundation or organization. DSR is made out of the two systems

- ƒ Route Discovery
- ƒ Route Maintenance

Route Discovery

It is an on-request directing convention, and it looks into the steering in correspondence of a parcel. In the underlying stage, the communication hub searches its course reserve to see whether an appropriate objective exists. Provided that this is true, then, at that point, the hub begins sending to the objective hub and course disclosure methodology end here. On the off chance that there is no objective location, the hub broadcasts the course request parcel to arrive at the reason. Whenever the objective hubs get this parcel, it returns the educational way to the premise hub.

Route Maintenance

It is a course of broadcasting a message from a hub to any remaining hubs that illuminate the organization or hub crash in an organization. It gives an early finding of hub or connection crash since remote organizations use the bounce to jump recognize.

Advantages

- Aware of the presence of elective ways that assist with observing another way in the event of a hub or connection separate.
- It tries not to defeat the circle.
- Less security upward expense as it an on-request directing convention.

Disadvantages

- The long course obtaining hangs tight for the course revelation, which may not be reasonable in the circumstances like the war zone.
- It doesn't fit for various hubs where speed might endure.
- It delivered colossal informing slides during active times.

IV. DESIGN AND IMPLEMENTATION

As specified earlier, energy conservation utilizing reducing power consumption is accomplished. This requires the calculation of energy. This paper calculates the residual energy of a node and the energy spent to forward a packet over a specific link. The energy consumption for a packet is calculated by equation (1)

$$E_C = \sum_{i=1}^{k} T(n_i, n_{i+1}) \quad (1)$$

There n_k are nodes along the path through which the source reaches the destination. T denotes the transmission energy of the corresponding node to its next hop. The paths with minimum E_C are chosen. The maximum among these is used for transmission purposes.

Route Discovery and Maintenance in Proposed Algorithm

ABCD scheme makes routing decisions considering various performance-related metrics. The ABCD protocol is only based on performance and not on the underlying ad hoc routing protocol. Hence this can be applied to any basic ad hoc routing protocols. For those networks that aim of enhancing their lifetime, this scheme is particularly useful. This paper deals with two routing objectives: minimum total broadcast energy and total operational lifetime of the network. The lifetime is preserved by the fact that the node used as an intermediate, again and again, is avoided to be used further. As a node is used more, there are wide chances for it to get depleted soon. This would eventually lead to a decrease in the lifetime of the network. The issue is overcome by choosing an alternate path when a node possesses less energy or battery power. Consider a network with topology as shown in figure 2.

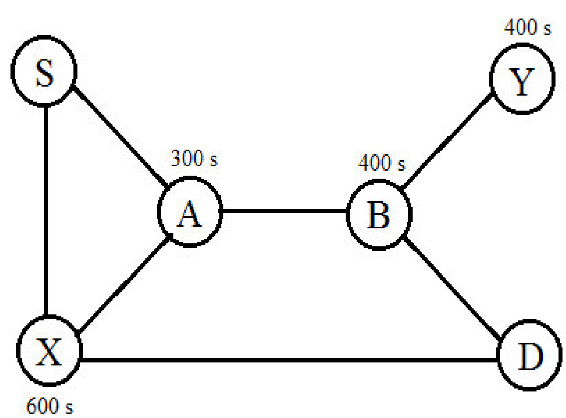

Fig. 2. Route discovery and maintenance process in ABCD

If a packet is to be delivered from source 'S' to destination 'D', owing to the shortest path, an optimized route, SABD, is chosen. Also, if 'X' is the source and the destination is 'Y', 'A' and 'B' are the intermediate nodes. This scenario would deplete the energy of the nodes 'A' and 'B'. In using these nodes, again and again, it is obvious that these nodes tend to run out of battery and eventually move out of the network. The network lifetime is affected. To overcome this issue and enhance the network's lifetime, the source node tends to determine the energy of the next-hop node. If the energy is below the threshold energy level, the source node will reroute the packets via some other path. Hence, if the source is 'S' and the destination is 'D', until the nodes 'A' and 'B' can manage the traversal, the path is SABD is used. As the energy of the intermediate nodes starts to drop below the threshold energy, the path SXD is chosen to avoid the nodes from moving out of the network. When the intermediate nodes are charged up, and the energy of the nodes rise, the path SABD is given priority and can again be used.

V. SIMULATION PARAMETERS

The traffic sources are CBR (persistent piece rate). The source-objective sets are expanded arbitrarily over the organization. The versatility model purposes 'arbitrary waypoint model' in a rectangular document of 1000m x 1000m with 100 hubs. Every hub begins its excursion from an irregular spot to a haphazardly picked objective during the recreation. When the objective is reached, the hub takes a rest episode of time in second, and one more irregular objective is picked after that quietness time. This cycle rehashes all through the recreation, causing nonstop changes in the geography of the first organization. Different organization situations for various hubs and respite times are created.

Packet Delivery Ratio

At the last objective, the proportion between how many bundles began from the CBR sources and the number of parcels got by the CBR sink. It depicts the disappointment rate seen by the convention.

$$\text{Packet delivery ratio} = \sum \text{Number of packets receive} / \sum \text{Number of packets send}$$

Throughput

It is characterized as the complete number of bundles got by the objective. It is a proportion of support of a steering convention. There are two portrayals of throughput: how much information moves throughout the timeframe expressed in kilobits each second (Kbps). The other is the parcel conveyance rate acquired from a proportion of the number of information bundles sent and the number of information parcels got.

$$\text{Throughput} = \text{Data packets sent} / \text{Number of packets received}$$

Average End-To-End Delay

The normal measure of time taken by a bundle to go from the source to the objective. This incorporates all potential deferrals brought about by buffering during course recognition idleness, lining at the point of interaction line, retransmission on delays at MAC, and spread and move times

$$\text{End-to-end delay} = \sum (\text{arrive time} - \text{send time}) / \sum \text{Number of connections}$$

Energy Consumption

Energy utilization of a hub is fundamental because of the transmission and the gathering of information or controlling bundles. To quantify this measure of energy consumed during the transmission interaction (noted txEnergy), we should duplicate the transmission power (txPower) when expected to send a bundle:

$$txEnergy = txPower * (\text{packet size}/\text{bandwidth})$$

And for a received packet:

$$rxEnergy = rxPower * (\text{packetsize}/\text{bandwidth})$$

VI. SIMULATION AND RESULT DISCUSSION

Broad reenactments were led utilizing NS-2.35. The duplicated network comprises 50 to 100 hubs at irregular dispersed in a 1000x1000m region toward the beginning of the reproduction. The device sendest was utilized to create a versatility situation, where hubs are moving at a uniform speed of 10 m/s and a steady delay season of 10s. Table 1 shows the reproduction boundaries set for the convention evaluation. These were produced utilizing the instrument ABCD.tcl, with the accompanying boundaries.

Table 1. Simulation parameters

Number of nodes	100
Area size	1000*1000
Mobility model	Random Way Point
Traffic type	FTP
Transmit energy	1.3J
Receiver energy	1.1J
Initial energy	20J
Communication system	MAC/IEEE 802.11G
Routing protocols	AODV,DSR, ABCD

The simulation parameters applied to each of the routing protocols, namely AODV, DSR, ABCD, the xgraph generation and the analysis of protocols, are as follows. Figure 3. shows the plot between the number of nodes and packet delivery ratio.

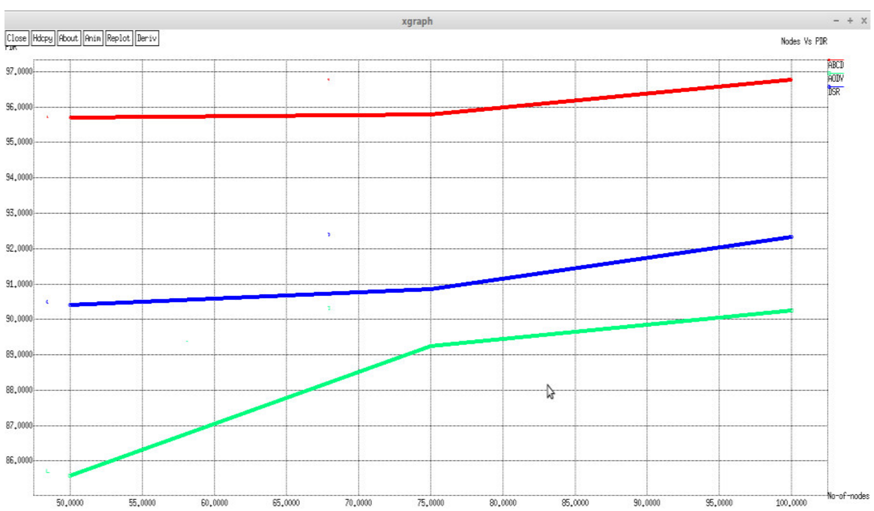

Fig.3. Packet Delivery ratio Vs number of nodes

The parcel conveyance proportion of AODV, portrayed in green tone, is low when the quantity of hubs is less and shows an increment as the organization size increments. Suppose there should arise an occurrence of DSR, portrayed in blue tone, the bundle conveyance proportion bit by bit increments as the size of the organization increments. The parcel conveyance proportion of ABCD, portrayed in red shading, shows a continuous increment beginning from an apparent worth. Nearly the ABCD convention has the most noteworthy bundle conveyance proportion than the other two for each situation of the organization size. Figure 4. shows the plot between End-to-end delay and the number of nodes.

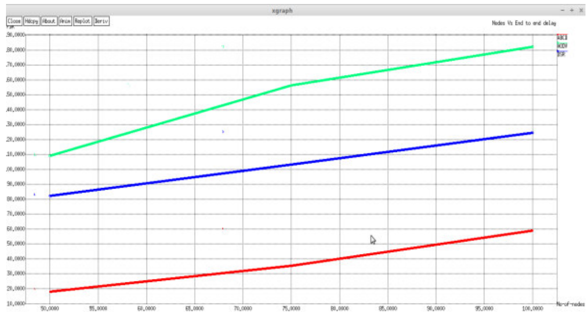

Fig. 4. End-to-end delay Vs number of nodes

The end-to-end delay of AODV, depicted in green, is quite high in all cases and increases as the network size increases. In the case of DSR, depicted in blue, the end-to-end delay steadily increases as the size of the network increases. The packet delivery ratio of ABCD, depicted in red, shows a gradual increase starting from a very low value. Comparatively, the ABCD protocol has the lowest end-to-end delay than the other two in each case of the network size. Figure 5. shows the plot between throughput and the number of nodes.

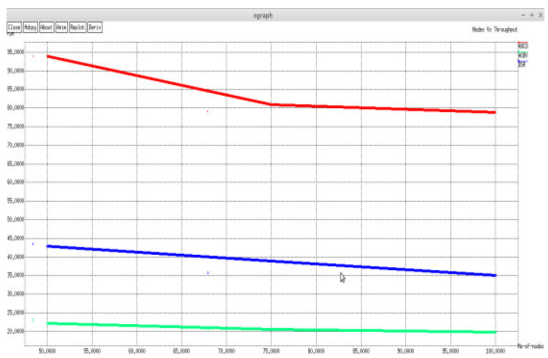

Fig. 5. Throughput Vs Number of nodes

The throughput of AODV, portrayed in green tone, is low when the quantity of hubs is less and shows a consistent increment as the organization size increments. In the event of DSR, portrayed in blue tone, the throughput progressively diminishes as the size of the organization increments. The throughput of ABCD, portrayed in red shading, shows a steady lessening beginning from an apparent worth. The ABCD convention has the most noteworthy throughput than the other two for each situation of the organization size. Figure 6. shows the plot between average energy consumption and the number of nodes.

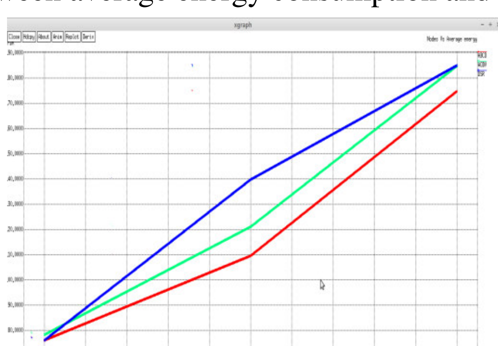

Fig. 6. Average energy consumption Vs number of nodes

The average energy consumption of AODV, depicted in green colour, is low when the number of nodes is less and shows an increase as the network size increases. In the case of DSR, depicted in blue colour, the average energy consumption increases as the size of the network increases. The average energy consumption of ABCD, depicted in red colour shows an increase starting from an appreciable value. Comparatively, the ABCD protocol has the lowest average energy consumption than the other two in each case of the network size. Figure 7. shows the plot between total energy consumption and the number of nodes.

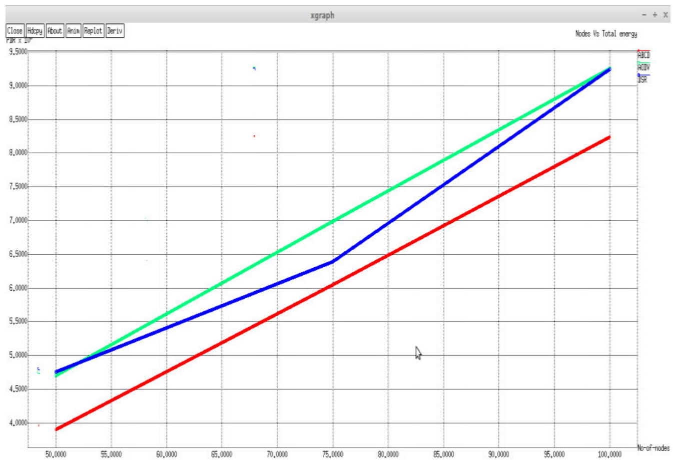

Fig. 7. Total energy consumption Vs number of nodes

The absolute energy utilization of AODV, portrayed in green tone, is low when the quantity of hubs is less and shows a consistent increment as the organization size increments. If there should be an occurrence of DSR, portrayed in blue tone, the complete energy utilization continuously increments as the size of the organization increments. The complete energy utilization of ABCD, portrayed in red shading, shows a consistent increment beginning from a considerable worth. Relatively, the ABCD convention has the most minimal all-out energy utilization than the other two for each situation of the organization size.

VII. CONCLUSION

This paper deals with the problem of network lifetime enhancement of the MANET. We presented an original solution, the Ad-hoc Better Costing Dynamic (ABCD) routing protocol, which extends the AODV routing protocol. An evaluation of the three routing protocols Viz. Adhoc On-demand Distance Vector (AODV) routing protocol, Dynamic Source Routing (DSR) protocol and Ad-hoc Better Costing Dynamic (ABCD) routing protocol the basis of certain metrics, the proposed ABCD protocol proves to perform better. Also, the study shows that although the DSR protocol works well for small-sized networks, it is inefficient as the network size increases. The AODV routing protocol is efficient enough, but it is not much preferable when it comes to energy consumption. Network lifetime being the main focus of this proposal, it is well proven that the energy consumption of ABCD protocol is less and eventually, the lifetime of the network increases.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

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