Enhanced Power Aware and Quality of Service in Manet Based On Hybrid Algorithm

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ABSTRACT
MANET is Mobile Ad-Hoc Network. Mobile devices or nodes connect without a router or access point in this wireless network. Each MANET device may forward data to other devices like a router. MANETs are valuable in military operations, emergency response scenarios, outdoor events, and more since they are decentralized and self-configuring. MANETs' dynamic and ad-hoc nature makes routing, security, and resource management difficult. Routing methods and techniques have been developed to overcome these difficulties and improve MANET data transfer. This study uses approaches and algorithms to increase MANET energy efficiency and QoS. Power-Aware: This technique optimizes node energy usage within MANET QoS: Network services including data speed, latency, and packet loss are affected by MANET QoS. In real-time data or critical communications applications like video streaming, VoIP, and military networks, QoS is crucial. The research optimizes node coverage lifespan by determining energy level using Simulated Annealing. The ideal solution is found using SDS and SA algorithm. Integrated hybrid SA-SDS-based AOMDV enables MANET Quality of Services.

Keywords: MANET, AOMDV, QoS, Network.

1. INTRODUCTION

MANET stands for "Mobile Ad-hoc Network." It is a type of ad-hoc network made up of many wireless mobile nodes that can quickly set up a temporary network without the need for a central hub or control [1]. MANET is different in a number of important ways. The main ones are that it doesn't have any existing infrastructure, its nodes are autonomous, its architecture is dynamic, its devices are different, it uses multi-hop routing, it has regulated physical security, and some capacity lines have a limited bandwidth [2, 3]. Some people think that having these qualities is helpful when there isn't a stable or well-defined system [4]. Because MANET has unique features, it can be used in business, schooling, and the military [5, 6]. Another thing that makes MANETs unique is that they are all connected to the internet. This means that they don't have to work on their own and can be built into a lot of different gadgets. People can use MANET services even when they are not linked to the real network in this way. Still, if you want to use this technology to send a data file, you need to make sure there is a secure route from the source node to the destination node. This is done to meet the quality-of-service guidelines, which cover things like delay, speed, and energy use [5].

MANETs are self-organizing networks made up of movable hubs that can talk to each other over long distances. These hubs can talk to each other without the help of base stations, tubes, or any other type of group or foundation. In a MANET, the hub not only acts as a host, but also as a switch that lets items move from one host to another [6,7]. It gives applications that don't have one a stronger base. Some examples of these uses are in mines [10], saving lives in times of trouble [9], and military work [8]. In these applications, it's important for a certain group of hubs to be able to talk to each other and work together.

It is possible for the layout of the MANET to change quickly and easily because hubs can move around. There are three main types of quality of service needs that can be broken down into different applications: data loss, delay, and speed [11, 12]. Making sure the standard of the service is guaranteed from start to finish needs QoS direction.
The Internet steering is gradually split into two areas: steering within an area and steering between areas. These two parts make up the Internet steering as a whole. Standards for guiding need to take quality of service into account in both of its parts in order to get the quality-of-service product finished. There are several possible answers to the question of how to guide settlements within an area [13]. Even so, some work is done to avoid quality-of-service information that is linked to the problem of between space directions. The next step is to look into the parts and improvements that will make it possible for quality of service data to be shared and used at the entomb space level. As shown in [14], Cisco systems have given us a few rules for choosing routing protocols. Some of these rules are about the number of jumps and the different ways to tell when someone is leaving. You can use MANETs even in an emergency, like when you are fighting fires, being a police officer, helping doctors and nurses in hospitals, doing search and rescue, and so on. On top of that, it can be used in mobile network uses, like military activities and messaging. In the field of education, MANETs can be used in many places, such as universities and college settings, virtual classes, and ad hoc messaging for meetings and talks [12].
MANET can work as a stand-alone method, or it can connect to the internet and join a number of different devices. Another benefit is that it lets other people use their services. Changes in the network's structure could happen at random and at times that are hard to predict. This happens because MANET nodes can move around easily in ad hoc networks that run at different speeds. The nodes that make up a MANET construct their networks by setting up dynamic routes between themselves while moving around in any way they choose. A MANET is made up of movable nodes that don't have a lot of computer processing units (CPUs), memory, or low-power storage. Anyone or anything that has the money and the right tools can use the radio transmission route. Because of this, it is not possible to control who can use the channel.

2. RELATED WORK

A number of academics have come up with different fake and heuristic quality of service route methods for MANETs [15, 16]. When working on mobile wireless networks, especially MANETs, it is very important to think about how much power is being used. If the nodes use less energy, their batteries will last longer. One study suggests a delay-constrained multicast routing method that uses less energy. This method is source-based, which means it looks at both how much energy is used and how long it takes from beginning to end when choosing routes. Using this method, the crossing and mutation operations are then applied right away to the trees. This makes the coding operations easier because the coding decoding process is skipped. Because of this, the writing tasks are made easier. For the multicast tree, running the heuristic mutation process makes the total power consumption ratio go up.
Someone named Chaudhari et al. [17] talked about a CA-based asset expectation system called CA-RPM. These systems make guesses about the assets that workers use through the asset forecast office, which is made up of one fixed expert, one psychology expert, and two flexible experts. In order to make sure that resources are used efficiently to support ongoing voice and video communications, managers accurately predict the traffic, flexibility, centre space, vigour, and transfer capacity. This is necessary for allocating resources well. The static operator is in charge of collecting neighbourhood measures, and the flexible experts are in charge of collecting and sending information about network traffic across MANET. CA makes experts that are both fixed and flexible as part of the asset planning process. When they are first set up, wavelet neural networks (WNNs) with an organized time layout can predict traffic and portability. People think that the expected flexibility and flow will be used for extra room, energy, and thinking about data transfer. Two different models were used by Gonzalez et al. [18] to study the flexible video spilling over portable specifically chosen system. The movie was sent using methods that made sure the data transfer rate was always the same and that all the necessary steps were taken. These are two devices that work together to help with the analysis of traffic accidents. The leading agreement that is reached through conversation between layers and is used to look at and improve the system's supporting resources. In order to evaluate the flexible piece rate proposition in a multi-jump scenario, research has been focused on and the remote cards have been described in terms of how much energy they use while taking into account the actual hub's throughput during normal information transmission.
Standards for routing that guarantee quality of service look for routes with enough resources to meet the flow's quality-of-service needs. It is the job of the Quality of Service routing algorithm to find the way that uses the fewest resources [19]. [20] talks about some important planning factors for helping with quality of service routing, as well as previous work that dealt with the issue of choosing a route when quality-of-service restrictions were in place. A system for mobile ad hoc networks that includes self-healing and

routing algorithms that find the best routes has been suggested in [21]. A new evolved multi-purpose fast process called the multi-objective evolved Algorithm (MOEAQ) process was suggested by the researchers in one of their studies as a way to find the best quality of service route. When compared to the basic method, this process produced better convergence results along with a higher level of uncertainty. This method is thought to be better than a well-known genetic algorithm (GA)-based program that is often used to solve problems with search and optimization [23]. People have also said that the QoS route problem is like a number of smart technologies [24]. One of these smart methods is called "swarm intelligence," and it is a new method that is based on how different animals act when they swarm [22]. It's important to note that the cellular model supports natural growth based on a person's point of view. This could explain a possible answer to a problem involving search, learning, or optimization.

We looked at past research, and the main thing this study adds is the idea of a new combination algorithm that combines the Stochastic Diffusion Search (SDS) and Simulated Annealing (SA) methods. With this brand-new method, the route selection in MANET is made better, which leads to an increase in the number of packets carried and the node's lifetime. This method works the same way as QoS-based methods for figuring out the average delay from start to finish. Ad-hoc On-demand Multipath Distance Vector (AOMDV) routing protocol has been added to the mixed method that has been shown to make its quality of service even better. With its reliable, handy, efficient, and easily adjustable design, the hybrid method that was created shows a good ability to study and use the search space of the MANET environment.

3. RESEARCH METHODOLOGY

The study technique includes MANET simulation and research devices. Simulating an event involves using software and hardware to minimize its limiting behavior. Academic and industrial sectors must analyze and understand theoretical models at the conceptual level. Network research focuses on enhancing efficiency, adaptability, security, and elasticity for various kinds [25,26]. Simulation is crucial to MANET for several reasons. MANET is complicated. To evaluate their model, researchers may utilize the simulator to simulate many situations with varying nodes, which would be costly in real life. Network Simulator 2 (NS-2) is used in networking research to assess proposed work's network performance. This work presents a hybrid SA-SDS technique that improves MANET QoS. This work implements MANET using NS-2.33. This study process is shown in Fig. 1. It involves MANET hybrid algorithm creation and assessment. The suggested approach is evaluated using various performance indicators and compared to the integration of AOMDV routing protocol.

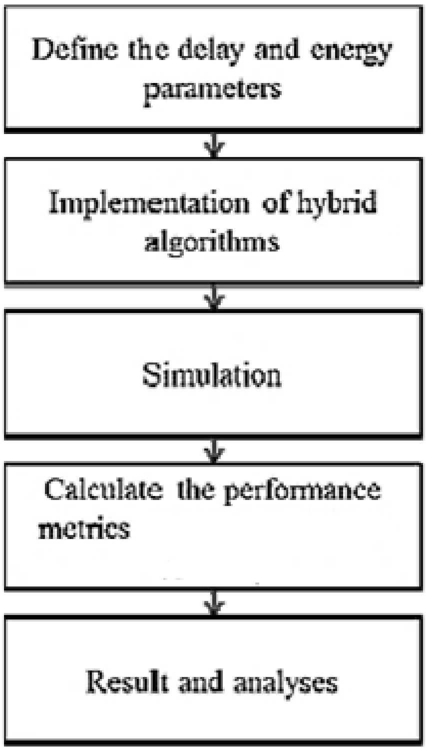

Fig 1. Methodology of the Research work flow

Calculating QoS parameters and selecting a route that satisfies QoS application criteria is the objective of QoS-aware routing protocols. Choosing or optimizing a routing protocol has a significant impact on the quality of service in an ad hoc network. Good solutions have been found using metaheuristic algorithms. Potential MANET choices included SDS and SA. In order to provide MANET QoS, the article also presented a multi-path routing network that combines Simulated Annealing (SA) with Stochastic Diffusion Search (SDS). The use of multipath routing enhanced performance, load balancing, and dependability. The problem of the Minimum Dominating Set is resolved by the SA. When applied to other algorithms, this SDS heuristic yields a straightforward algorithm that, in comparison, exhibits high exploration and quick convergence. Algorithms for SA avoid local optimal trapping while increasing agent variability.

3.1 SA Algorithm

The SA is a great example of a modern metaheuristic algorithm. It was created in 1983 by Vecchi, Gelatt, and Kirkpatrick. This idea came from the way metals are annealed when they are heated and the Metropolis methods used in Monte Carlo runs. The primary objective of this SA algorithm was like dropping balls that bounce around in an environment. After bouncing, these balls settle at local minima due to energy loss. Balls may lose energy slowly but finally reach their minimum position if allowed to bounce enough times.It may employ many balls or one to trace its journey. The optimization procedure should begin with a higher-energy estimate. With significantly less energy, it will randomly migrate to different spots. The solution will improve if the altered state has even less energy and a better goal or a lower minimization and objective function value. If the answer does not improve, it may be chosen with the following probability, according to the equation:

$$p = \exp\left[-\frac{\delta E}{kT}\right]$$

In this Boltzmann-type probability distribution, T stands for the temperature of the system and k for the Boltzmann constant, which is 1. In optimization, the goal function, f(x), is often linked to G E's energy difference. The piecewise trajectory of simulated annealing is the Markov chain in the new state, which is based on its current state or solution and has a chance p of changing. Randomness does the diversification, which comes up with new ideas, and probability decides whether something is accepted. If T is too low, any possibility E >0 is rarely seen as p->0, which limits the number of these choices. If T is high, the system will be energetic and accept more changes. Both intensification and diversity are usually controlled by temperature T. Cooling schedule is used to change T.

3.2 SDS SA Algorithm

For the purpose of the specific trial solution, the SA-MDS will function in accordance with the conventional SA by selecting trial solutions from inside the neighborhood. Using an objective function which was recently developed in line with the equation that is displayed below, an evaluation of the level of quality of both of these approaches is carried out. This evaluation is carried out in order to accomplish the task. An additional point to consider is that the selection for the upcoming iteration solution is made from two different potential options.

$$f(x) = \frac{n}{|V|} + \frac{1}{|V|\,\gamma_x(G)}$$

The solution x in this case has G nodes, and the letter n in this case indicates the quantity of nodes that are part of that solution. Two parts make up the goal function in the vast majority of instances. The true amount of x's dominance on the G parameter is represented by the first component, n/|V|. Assuming x is the dominating set, this component will take on the value of 1. At the same time, the second portion, represented by the formula 1/|V|x(G), will separate out a variety of solutions with values similar to the first part's. The real number of nodes in each solution will form the basis of this differentiation.

1. *Initialization. Choose the cooling schedule parameters :*
initial temperature T_{max}, *final temperature* T_{min},
cooling ratio $\lambda \in (0, 1)$, *and the epoch length* M.
Set $T := T_{max}$, *and generate an initial solution* x^0.
Set $x^{best} := x^0$, *and* $k := 0$.
2. *Evaluation. Evaluate the objective function at* x^k *by using eq.2.*
3. *Main Loop. Repeat the following Steps 3.1 – 3.4* M *times.*
3.1. *Set* $y = x^k$.
3.2. *Node-Reduction. If* $f(x^k) \geq 1$, *then go to Step*
3.2.1. *Otherwise, go to Step 3.3.*
3.2.1. *Randomly select a component* y_i *with value 1 as*
in Step 3 of the Procedure 1, set $y_i = 0$.
3.2.2. *If* $\Delta f(x) = f(y) - f(x^k) > 0$, *set* $x^{k+1} := y$,
update x^{best}, *set* $k := k+1$, *and go to step 4.*
3.2.3. *The trial solution y is accepted with the probability*

$$p = \exp\left(\frac{\Delta f}{f}\right), \qquad (3)$$

where $\Delta f(x) = f(y) - f(x^k) \leq 0$.
3.2.4. *If* y *is accepted, then set* $x^{k+1} := y$. *Otherwise,*
set $x^{k+1} := x^k$.
3.2.5. *Set* $k := k + 1$, *and go to Step 4.*
3.3. *Node-Addition.*
3.3.1. *Randomly select a component* y_i *with value 0 as*
in Step 4 of the Procedure 1, set $y_i = 1$.
3.3.2. *If* $f(y) > f(x^k)$, *set* $x^{k+1} := y$, *update* x^{best},
set $k := k+1$, *and go to Step 4.*
3.4. *Node Swapping. If* $f(y) < f(x^k)$, *then set* $z = x^k$.
3.4.1. *Randomly replace a component* z_i *with value 1*
with a component z_j *with value 0 as in Step 5 of the*
Procedure 1, i.e., $z_i = 0, z_j = 1$.
3.4.2. *If* $f(y) > f(x^k)$, *set* $x^{k+1} := z$, *update* x^{best},
set $k := k+1$, *and go to Step 4.*
3.4.3. *Accept* z *with the probability similar to p which is*
given by Eq. 3.
3.4.4. *If* z *is accepted, then set* $x^{k+1} := z$. *Otherwise,*
set $x^{k+1} := x^k$. *Set* $k := k + 1$, *in both cases.*
4. *Epoch Length Condition. If the epoch length* M *is*
attained, then go to Step 5. Otherwise, go to Step 3.
5. *Stopping Condition. If* $T > T_{min}$, *then set* $T := \lambda$
T *and go to Step 3. Otherwise, terminate.*

It's likely that the SA-MDS will stick to the SA and its main organization. This means that there is a starting answer, which is shown by the symbol x0 and is chosen at random from its search space. For every iteration k, a trial solution y is made nearby the present iterate solution, which is x_k. It is common for this sample answer to be made. After all of these creation steps, this annealing acceptance method is used to decide whether to accept or reject the trial answer y that is made. For all of those production methods, this technique has been used.

3.3 QoS Based AOMDV

The AOMDV protocol is nothing more than an extension of the AODV protocol, which is used for the purpose of calculating various loop-free and link disjoint pathways. It is important in tracing paths for the node or the destination to retain the hop count as reported by a destination since all future hops have a sequence number that is comparable to the one that was used in the first transmission. Each duplicate route advertising that is received by a node has the ability to designate at least one additional alternative path that is used in the destination. The acceptance of alternative routes to the target is the means by which loop freedom is established. Because there are several hops counts that are utilized and broadcast for this kind of sequence number, in the event that any route for an advertisement has a number in its

sequence that is higher, the following hop list and hop count that is announced for that route may be re-initiated.
Therefore, AOMDV is used to discover node-disjoint or link-disjoint routes, which are routes that replicate the RREQs that are disallowed from the network infrastructure. These RREQs will continue to reach their destination by way of a neighbor who is distinct and also describes the route that is disjointed between the nodes. The route will be established in order to duplicate the RREQs, and this will be accomplished by arriving at their distinct neighbors. The objective of this is to achieve the goal of disjointing various routes of connection. RREPs have a tendency to take a number of different reverse pathways, some of which are of a link-disjoint nature, while others are of a node-disjoint one. These pathways, which are a component of the RREP, will have the ability to intersect intermediate nodes, and each of these intermediate nodes will take a further reverse path form a source in order to guarantee that this connection is not connected to any other nodes. The most significant benefit of the AOMDV was that it enabled intermediate nodes to respond to all RREQs at the moment of destination selection. Furthermore, it also responded to multiple RREQs, which resulted in longer overheads. This was the fundamental advantage of the structure.By boosting the balance of its route and by conserving power, QoS-AOMDV is possible to enhance the AOMDV. This is accomplished via the use of power conservation. In order to maximize the effectiveness of the network as a whole, this particular design was built on a cross-layer architecture. All of the destination nodes are not going to immediately replay to the RREQ while the route selection procedure is being carried out. With this in mind, the RREP is carried out according to a criteria that is based on the overall cost. During the course of transmission, information will be sent over a number of different channels in sequential order. This will ensure that the energy is balanced along with the traffic loads that are present in a number of different pathways. Additionally, in comparison to the AOMDV, the QoS-AOMDV has a lower end-to-end latency and a better throughput.

3.4 Hybrid Algorithm

In contrast to some algorithms that are based on natural phenomena, the SDS has a stronger mathematical foundation that explains the algorithm and how it works. This is done by looking into how resources are distributed, how quickly they converge to a global optimal, how long it takes to solve linearly, the basic convergence criteria, and how stable the solution is. The biggest problem with the SDS was that the search areas were badly messed up by noise and the activity spreading out because of disruption. It's possible that these changes will lower the average number of idle agents in a random search. This will make it take longer for those agents to reach their steady state.
Some people have used a SA algorithm to make the agents more diverse and to keep them from getting stuck in the local minimum. An N x N number matrix with edges between edges i and j is what a mixed SA-SDS method needs to work. It will then be possible to use the P x N number matrix called an agent. The real number of bots used in this method will be equal to its P value. There will be one agent's view of each city and its neighbors in each row of this grid. Each row in this table shows a possible answer to the Travelling Salesman Problem (TSP). It is thought that each row here is a cycle vector. In the first step of a mixed program, bots will be set up. To do this, a random number will be used to set up each. One unique restriction was that the number had to be in the range [0, N-1], and it couldn't be used again in the same row.
After that, the SA will be used to get another good answer from each of these agents. With this in mind, an energy function E was looked at, where f (S_i) shows the real length of the route within agent S_i. After the $\Delta f = f(S_{new}) - f(S_{old}) = \Delta E$has been set, it will represent the difference in energy among an agent in the swarm and its neighbor. In the next step, the neighbor will be created by using a straightforward and arbitrary swap motion that was performed between these two sides. Either the neighbor's offer is accepted or turned down, or the tour of an agent is updated. This depends on the following formula, which is related to the calculation and how it is used.

$$P\begin{cases} \exp\left[\dfrac{-\Delta f}{t_k}\right] & if\ \Delta f > 0 \\ 1 & if\ \Delta f \le 0 \end{cases}$$

Once all of the agents have been able to locate the most advantageous neighbor tour via the use of the SA approach, the agent that is deemed to be the most advantageous will be selected from among its agent matrix. Following this, the crossing operation will be applied to both the $S_i^{bestNeighbor}$ and the $S^{globalbestNeighbor}$ in order to bring each and every agent Si that is included inside the agent matrix up to date. Lastly, the equation that is used to calculate temperature T is as follows:

$T = \alpha^i T_0 + T_\lambda$

As was said earlier, the most important difference between an algorithms that was provided by Fang was the frequency that was identified in the application of the SA algorithm for the goal of enhancing the degree of variety. This was the most significant distinction.For the SA, it solely used the first agent query that was conducted. Instead, a hybrid SA-SDS algorithm employs a SA algorithm in conjunction with the cycles of the SDS algorithms. This is in contrast to the traditional SA algorithm. Additionally, in order to accomplish the goals of this algorithm, a simple sorting method was developed for the edges that when the Si agent would be updated. That technique was applied. The edges that were thought to be in the same order as those in an array are the ones that are being discussed here. In order to put the edges from agent Si in this order, the Bubble sort method was used. First, the edges that are nearest to the chosen edge were put first, and then the edges that are farthest away from the chosen edge were put last. Both the amount of time required for execution and the quality of the solution, which is achieved via the use of a hybrid SA-SDS algorithm, have been made significant improvements in this context. These improvements are connected to the difference.

4. RESULTS AND DISCUSSION

Adjusting the range of motion of nodes is a method that may be used to evaluate how effective the methodology that was recommended is. The simulation was carried out on a network area that was three thousand square meters in size, and the Constant Bit Rate was used as the source of traffic. In this scenario, the introduction energy level of each node is 100, and the broadcast range is 250.The simulation parameters are shown in Table1, which may be found here.

Table 1. Simulation Parameters

Parameter	**Value**	**Unit**
Network size	3000	*m2*
No. of nodes	125	*Node*
Simulation time	50	*Second*
Mobility	5, 10, 15, 20, 25	*m/s*
Traffic type	CBR	
Packet size	64	*Byte*
Pause time	30	*Second*
Transmit power	1.4	*Joule*
Reception power	1.0	*Joule*
Idle power	0.05	*Joule*

Table 1 shows that the movement changes from 5 to 10, 15, 20, and 25. There is a 30-second pause, and the exercise lasts for 50 seconds. These numbers and factors were picked based on what is known at this time. In this case, we change the number of nodes from 125 to 500. The network is created to show how well the mixed algorithm works with the AOMDV routing protocol and energy cost. As soon as the suggested algorithm's test is over, performance analysis is done using the evaluation measures. Average packet loss, average end-to-end delay, jitter, and control packet overhead were some of the things that were used to measure how well the network worked.

Table 2. Average Packet Loss (%) of proposed algorithm

Number of Nodes	**QoS-AOMDV**	**SA-SDS**	**Hybrid SA-SDS**
100	12.6	11.8	10.94
200	13.44	12.35	11.65
300	16.43	15.89	14.21
400	16.74	15.34	15
500	19.54	18.23	17.12

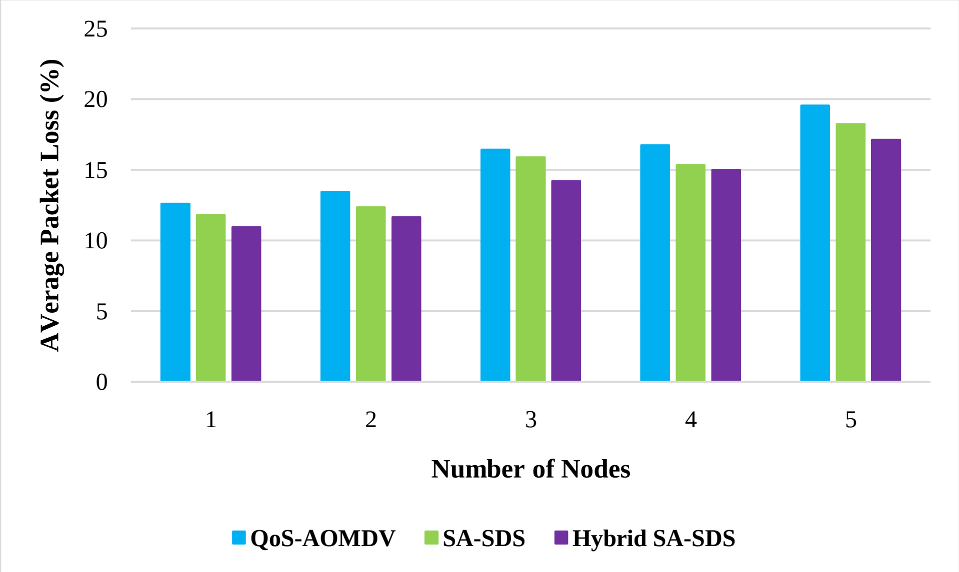

Figure 2. Average Packet Loss (%) of proposed algorithm

Table 3. End-to end delay (ms) of hybrid SA-SDS algorithm

Number of Nodes	QoS-AOMDV	SA-SDS	Hybrid SA-SDS
100	22.6	20.89	19.78
200	28.76	23.89	20.43
300	36.54	32.76	30.12
400	39.23	35.32	32.45
500	43.76	40.76	38.65

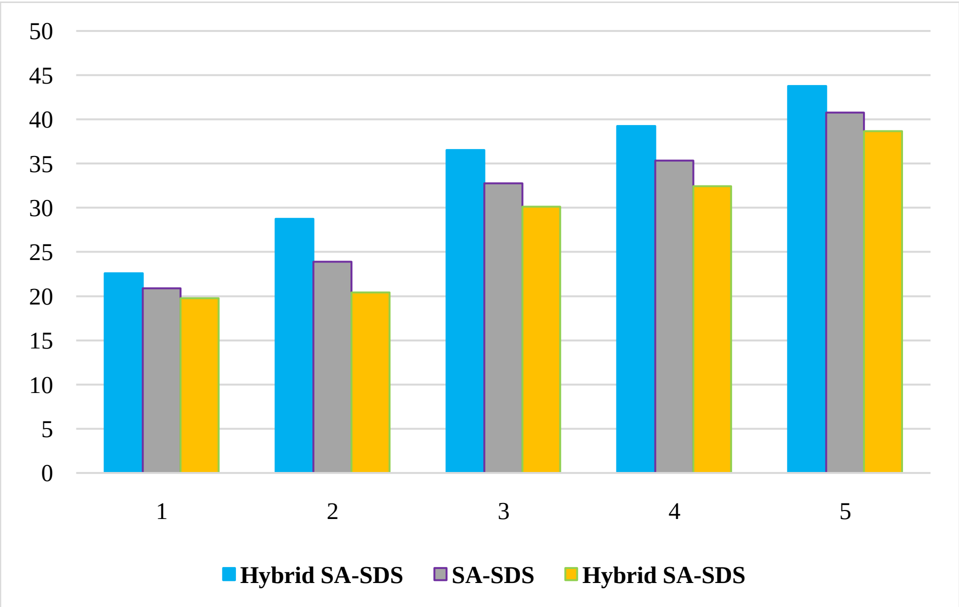

Figure 3. End-to end delay (ms) of hybrid SA-SDS algorithm

Table 4. Jitter (ms) of proposed algorithm

Number of Nodes	QoS-AOMDV	SA-SDS	Hybrid SA-SDS
100	0.00014	0.00013	0.00009
200	0.0001	0.00009	0.00017
300	0.00001	0.00001	0.00028
400	0.00025	0.00022	0.00028
500	0.00007	0.00007	0.00003

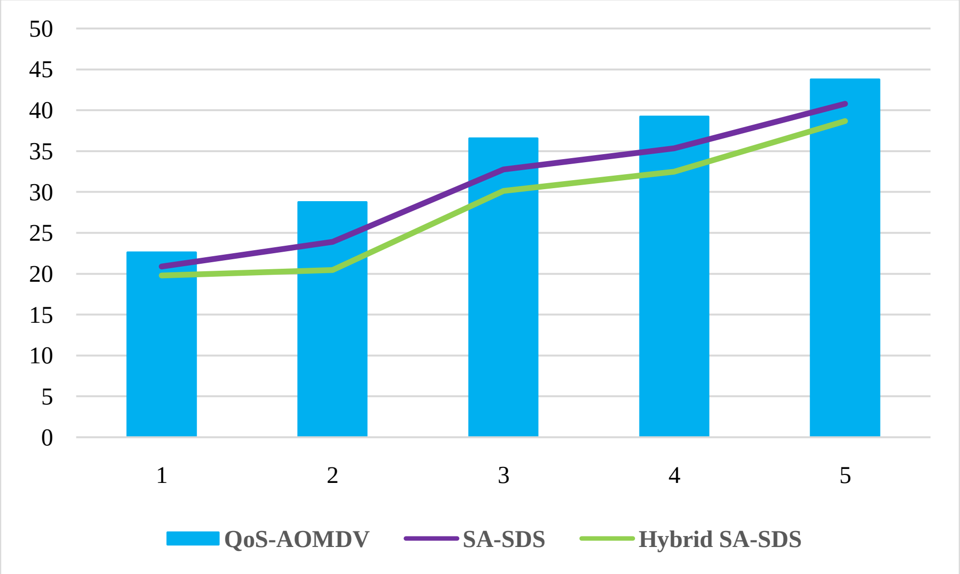

Figure 4. Jitter (ms) of proposed algorithm

Table 5. Control Packet Overhead of hybrid SA-SDS algorithm

Number of Nodes	QoS-AOMDV	SA-SDS	Hybrid SA-SDS
100	5	4	5
200	6	5	6
300	9	8	5
400	8	7	7
500	11	10	6

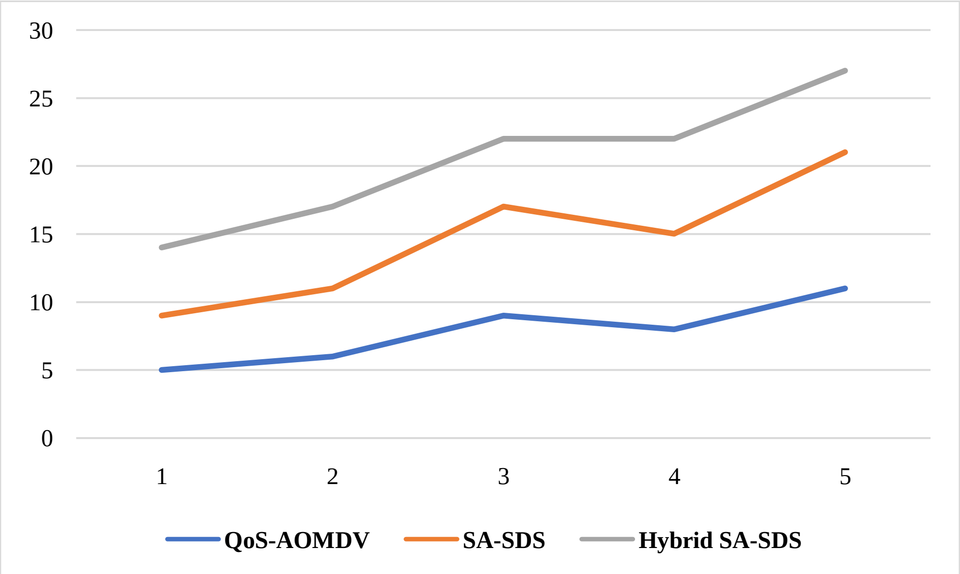

Figure 5. Control Packet Overhead of hybrid SA-SDS algorithm

5. CONCLUSION

MANET is made up of nodes that can talk to one another without any extra hardware. It is used for many different things, like business, technology, the military, and more. To make sure that the data provided meets the QoS standards, an optimized way must be set up from the sender to the target nodes. The Quality of Service (QoS) guarantees services like the rate at which users' packets are delivered, as well as delay, jitter, delay, and capacity. The QoS problem is NP-complete when more of these QoS conditions are taken into account. When multipath routing methods are used, they usually have to figure out how to spread the traffic load to each path. Given data from real-time traffic, it was possible to come up with a very effective and straightforward metaheuristic method. SA is a popular combinatorial optimization metaheuristic. As a global search based on several agents, the SDS can determine how simple agents interact. Just a few decades ago, the SA-SDS hybrid algorithm solved a multipath routing issue and a typical TSP. The key distinction between the algorithms was how frequently the SA algorithm increased variety. This occurs only in the initial SA user search. However, the SA-SDS algorithm combines SA and SDS phases. Also, because a simple sort method is used, the moving of the agents can be done more quickly. When compared to the CDS-SA, the findings showed that the combination SA-SDS worked better.

REFERENCES

[1] Conti M, Giordano S. Mobile ad hoc networking: milestones, challenges, and new research directions. IEEE Communications Magazine, 2014, 52(1):85-96.

[2] Basagni S, Conti M, Giordano S, Stojmenovic I. Mobile Ad Hoc networking: the cutting-edge directions: John Wiley & Sons; 2013.

[3] Karthikeyan P, Amudhavel J, Infanta E, Deepika P, Saranya M, Nandhini C, editors. Impact on Self-Organization in Mobile Adhoc Networks: A Comprehensive Review. Proceedings of the 2015 International Conference on Advanced Research in Computer Science Engineering & Technology (ICARCSET 2015); 2015: ACM.

[4] Bang AO, Ramteke L. MANET: History, Challenges and Applications. International Journal of Application or Innovation in Engineering & Management (IJAIEM), 2013, 2(9):249-51.

[5] Liu F-H, Lo H-F, Juan SC, Lee W-T, Liao J-c. Energy-efficient antcolony-based routing algorithm for the MANETs. J Internet Technol. 2013; 14(1):21-30.

[6] Shashidhara, D. N., Chandrappa, D. N., &Puttamadappa, C. (2020). A novel location aware contentprefetching technique for mobile adhoc network. Procedia Computer Science, 171, 1970–1978.

[7] Zemrane, H., Baddi, Y., &Hasbi, A. (2019). Mobile adhoc networks for intelligent transportation system: Comparative analysis of the routing protocols. Procedia Computer Science, 160, 758–765.

[8] Manohar, S., Rajasekar, V., &Muthurasu, N., (2020). Energy optimization and reliable message communication in mobile adhoc networks using packet shifting. Materials today: Proceedings.

[9] Alappatt, V., &Prathap, P. J. (2020). Hybrid cryptographic algorithm based key management schemein MANET. Materials today: Proceedings.

[10] Gautam, D., &Tokekar, V. (2020). A novel approach for detecting DDoS attack in MANET. MaterialsToday: Proceedings, 29, 674–677.

[11] Karunkuzhali, D., Prasad, M., Singh, G., Kaur, A., Periasamy, J. K., &Ramprabu, G. (2020). Traffic analysis in vehicular adhoc networks using flow and network level analysis. Microprocessors andMicrosystems, p. 103450.

[12] Rajendran, N., Jawahar, P. K., &Priyadarshini, R. (2019). Cross centric intrusion detection system forsecure routing over black hole attacks in MANETs. Computer Communications, 148, 129–135.

[13] Jaron, A., Mihailovic, A., &Aghvami, A. H. (2016). Qos-aware multi-plane routing method for OSPFbased IP access networks. Computer Networks, 99, 1–14.

[14] Lv, J., Wang, X., Zhang, Q., & Huang, M. (2018). LAPGN: Accomplishing information consistencyunder OSPF in General Networks (an extension). Journal of Network and Computer Applications, 119,57–69

[15] Nivetha S, Asokan R, Senthilkumaran N. ACO-GA Hybrid MetaHeuristic (AGHM) Optimization for Multi-constrained Quality of Service Routing in MANETs. 2014.

[16] Allakany AM, Mahmoud TM, Okamura K, Girgis MR. Multiple constraints QoS multicast routing optimization algorithm based on Genetic Tabu Search Algorithm. Advances in Computer Science: an International Journal (ACSIJ). 2015

[17] Chaudhari, S., &Biradar, R. (2016). Traffic and mobility aware resource prediction using cognitive agent in mobile ad hoc networks. Journal of Network and Computer Applications, 72, 87–103.

[18] González, S., Castellanos, W., Guzmán, P., Arce, P., & Guerri, J. (2016). Simulation and experimental testbed for adaptive video streaming in ad hoc networks. Ad Hoc Networks, 52, 89–105.

[19] P. Mohapatra, L. Jian, and C. Gui, "Qos in mobile adhocnetworks," IEEE Wireless Communications Magazine, vol. 10,no. 3, pp. 44–52, 2003.

[20] B. Zhang and H. T. Mouftah, "QoS routing for wireless adhoc networks: problems,algorithms, and protocols," IEEECommunications Magazine, vol. 43, no. 10, pp. 110–117, 2005.

[21] C. Gui and P. Mohapatra, "SHORT: self-healing and optimizing routing techniques for mobile ad hoc networks," inProceedings of the 4th ACM International Symposium on MobileAd Hoc Networking & Computing (MobiHoc '03), pp. 279–290,Annapolis, Md, USA, June 2003.

[22] Abu-Ein, A., & Nader, J. (2014). An enhanced AODV routingprotocol for MANETs. International Journal of Computer ScienceIssues, (1):1694-0814.

[23] Lu T, Zhu J. Genetic algorithm for energy-efficient QoS multicast routing. Communications Letters, IEEE. 2013; 17(1):31-4.
[24] Kiani F, Amiri E, Zamani M, Khodadadi T, Manaf AA. Efficient, intelligent energy routing protocol in wireless sensor networks. International Journal of Distributed Sensor Networks. 2015; 2015:15.
[25] Amini, A., Jamil, N., Ahmad, A. R., &Zaba, M. R. (2015). Threat Modeling Approaches for Securing Cloud Computing. Journal of Applied Sciences, 15, 953-967.
[26] Amini, A., Jamil, N., Ahmad, A. R., &Sulaiman, H. (2017, April). A Fuzzy Logic Based Risk Assessment Approach for Evaluating and Prioritizing Risks in Cloud Computing Environment. In International Conference of Reliable Information and Communication Technology (pp. 650-659). Springer, Cham