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An upgraded IoT based Mobile Ad- hoc Network enactment founded on optimized Signal Strength Based Routing algorithm

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Abstract

It is a wireless network with mobile nodes that function independently and communicate with one another with radio waves. When a node gets a packet, they evaluate all of the possible routes before selecting the optimal one. In this way, the capabilities of routing are incorporated into each node of the network. Researchers used ant colonies to find the best path between two sites. The Simple Ant Routing Protocol has improved with the assistant of Internet of Things (IoT). Energy Aware Simple Ant Routing Algorithm (EASARA), a new protocol, considers each node's energy usage. The change improved routing overhead and packet delivery ratio. It also improved communication. EASARA performed better with more hosts. Traffic congestion statistics followed. One parameter estimated host power reserve and connection congestion. Energy-congestion conscious protocol is basic routing algorithm is ECSARA (Energy-congestion based Simple Ant Routing Algorithm). The protocol improves with more hosts. It sends packets faster. Hence, transmission data transfer increased. Energy savings extended the route's lifespan. Signal strength predicted connection failures. This metric chooses a new route. Signal-to-Anchor-Receiver-Attendance based Simple Ant Routing Algorithm is SS-SARA. All host monitors detected strong signals. Communication uses substitute pathways when signal strength goes below a threshold. The protocol improved packet delivery and throughput on congested networks, according to experiments.

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1. Introduction

How effectively the routing protocol operates is a critical factor in determining how productive the network will be. The following qualities should be included in an effective MANET routing protocol. In order for the MANET routing protocols to operate well, it is ideal for them to possess certain features.

i) Distributed control: With a MANET, there is no centralized control, therefore all of the network's nodes [1] perform the task of routing collaboratively. Because of this fact, the protocols that are utilized in MANET have to feature distributed control.

ii) Loop Free: Data packets that are sent along channels that contain loops will simply continue to circulate without being consumed by any nodes. This reduces the efficiency of the network. A flawless protocol would identify a path devoid of any loops that led directly from the origin to the destination.

iii) Adapt to the conditions: the routing protocol for the MANET should enthusiastically support any modifications to the network's structure [2]. They are required to make efficient use of resources such as bandwidth and power.

iv) Safety: The establishment of a MANET calls for the participation of all hosts that are currently linked to the network.

In most cases, attacks may easily be launched against these networks at both the network and link layers. As a result, MANET protocols ought to be able to withstand a wide variety of attacks on networks [3]. In a MANET environment that is always shifting, finding the optimal path to take might be challenging. Many obstacles make efficient routing operations impossible. These are only some of the issues that should be taken into consideration while developing routing protocols for MANETs. Communication in a MANET takes place over a wireless media. The wireless medium is susceptible to distortions, particularly when electromagnetic interference or unfavorable weather conditions are present. In addition, the performance of the link and the availability of the bandwidth are both irregular [4]. All of these factors have an effect on how successfully the MANET can communicate with one another. Batteries, which are incapable of retaining electricity for a significant amount of time, are used to power hosts in a MANET. Because of this, hosts that are part of MANET have shorter lifespans. Because of their small size, they have a restricted capacity for both storage and processing power [5]. In a MANET, the nodes move around rapidly and cause sudden changes to the network's topology. In addition to this, their unpredictable movement will result in broken connections between the nodes in the immediate area. The effect of this is the failure of the path. Noise, fading, and interference are just some of the problems that can affect wireless media [6]. Wireless networks typically have a lesser link capacity than their cable counterparts do. All of these factors reduce the amount of accessible bandwidth while also putting a cap on the highest possible transmission rate. Utilizing mobile gadgets carries extra danger. They are more likely to be victims of actual theft and are more regularly subjected to attacks on their networks. Attacks such as spoofing, eavesdropping, and denial of service can be launched against mobile networks [7].

Because of the hosts' irregular movement, the network's anatomy is subject to rapid transformations when playing MANET. In a setting as dynamic as this one, traditional protocols such as shortest-path and link-state protocols become irrelevant and unnecessary. There are now several different protocols being developed to address this issue [8]. These treatments have been classified based on four criteria.

1) The procedure for keeping the routing information up to date,

2) The application of temporal information,

3) The topology that is used for the routing, and

4) The variety of resources that are used.

There are no hard and fast rules that govern the categorization of protocols; hence, a single protocol may be categorized under several different headings [9].

This method is applied to the classification of routing protocols the majority of the time. It differentiates between the protocols based on the way that is utilized to obtain and maintain the route. The protocols that fall into this category make decisions about new courses by considering both the state of the links and the information they gathered on their previous journey. The routing protocols that fall under this category can be further subdivided into three distinct sorts according to the times at which the routes are discovered and updated. The Proactive routing systems, which are also referred to as "table-driven" protocols, maintain a list of routing information [10]. In order to carry out their functions, they continually discover new channels towards all hosts in the network while also maintaining the pathways that go to all other hosts. Because of the pre-established paths, quick delivery of packets is possible without the necessity of discovering new paths. They unfortunately send out route revisions on a regular basis in order to keep the routes up to date. Routing information is generally flooded across the network via proactive protocols, which results in a rise for traffic and a reduction for bandwidth that can be used for the actual transfer of data. When nodes relocate, the links between them can become severed [11].

It is only when there is unmistakable proof that it is necessary that the reactive routing protocol will look for a path to take. When a host needs to interact with another host, it consults its routing table to figure out how to actually communicate with the other host. The path that had been established in the past will be utilized if it is still present in the given location. Nevertheless, in the situation where there is no route that has been known in the past, it is possible that a new way will be found. There is a direct correlation between this and the fact that route discovery is only carried out when it is necessary. They are also known as an on-demand routing system because they possess on-demand routing capabilities. Request messages are sent around the neighborhood until they arrive at their ultimate destination [12]. This process continues for the length of the phase that is devoted to discovering routes, which is referred to as route discovery. It is possible that a packet will be transmitted to the succeeding intermediate node in the case that this requirement is not satisfied. Using a combination of reactive and proactive routing algorithms, the Hybrid Routing Protocols are designed to provide their users with improved service. The protocol is sometimes referred to as a hybrid routing protocol because it possesses this characteristic. When a collection of nodes is located within a topographical region or within a region that has already been constructed, it is usual practice to consider those nodes to be a component of a routing zone. This is because routing zones are used to transport data between nodes. Communication that is proactive takes place within the routing zone when hybrid routing systems are being utilized, whereas communication that is reactive takes place between routing zones [13].

In the next paragraphs, the outline that will be followed by the rest of the paper will be offered. In part 2, we will provide a quick overview of the work that is relevant, and in section 3, we will provide a description of the methodology, in addition to the theoretical underpinnings of the methodologies that will be utilized. In the following section, "Results and Analysis," both the outcomes of the simulation and an interpretation of those outcomes are offered. In the final part of the chapter, under "major findings," we will present a synopsis of the findings that were determined to be the most important.

2. Existing Work Done

Ant HocNet is the name given to an upgraded version of the ARA protocol that has been developed by a group of researchers. This technique deviates from the standard maintenance procedure in a number of ways. In this scenario, the sender host will routinely and frequently send proactive FANT (PFANT) to its close neighbor in order to evaluate the link quality. In order to discover new pathways, PFANTS are dispersed at a more leisurely pace. A cantered protocol known as HOPNET serves as an alternative method. [14] It does this by segmenting the surrounding area into a number of separate segments based on the wireless radius. While connecting with people in different places, the proactive technique is utilized inside, while the responsive method is utilized externally. When AODV and ACO are brought together, MRAA is produced. In this implementation, the ACO algorithm is employed to generate inter-node paths, while the AODV algorithm is utilized during the path search operation. Even though it stores and maintains the standby path, the protocol continues to function normally, although having significantly less time and overhead. I-ACO makes use of two different strategies in order to maintain a high level of pheromone in the host. These processes are referred to as the transition probability and the directional probability [15]. Despite the fact that the protocol requires a larger control above and usages more resources than other protocols, it enhances packet delivery and decreases delay. a protocol that is built on reactive regions and is named POSANT. As it searches for a way out, FANT continues to move through each location. The protocol suffers because of its inability to maintain host location information. The difficulty in allocating regions stems from the fact that the purpose changes so frequently [16].

Nodes in a MANET have the ability to play any of the three roles available to them: source, destination, or intermediary. In each of these instances, they have the ability to transmit, receive, and forward packets. Power is required for both sending and receiving data packets. Hosts with less computing power will quickly lose their ability to function, and if these hosts are connected to a route, the route will fail as a result. The reduction of energy consumption in ant colony routing is the objective of this effort (ACR). The newly developed protocol will reduce the delay by taking into account the signal strength while switching between different possible channels, as well as by moving packets over pathways that are less congested and experiencing fewer bottlenecks [17].

Swarm intelligence is the foundation of the Ant Colony Optimization strategy, which takes advantage of the natural intelligence of foraging ants to determine the optimal path forward. Ants that travel in the forward direction begin their journey at the sender node and make their way towards the destination [18]. During the course of the traverse, the advancing ant will stop at each intermediate node to gather important information [19-20]. Once they have accomplished their mission, the advance ants are exterminated, and the reverse ants are produced. The backward ant utilizes the knowledge gained from the forward journey as it modifies the pheromone concentration it produces at each intermediate host. With the transmission of FANT in a reactive fashion, the ARA protocol is able to circumvent the issue of extreme control overhead in circulation [21]. This protocol makes the assumption that the traffic is evenly distributed, which prevents it from considerably reducing the overhead. The SARA utilizes a distinct technique. In addition to this, it disperses FANTs to nodes in the surrounding area while simultaneously enabling a chosen host to redistribute the FANT once more. Here is an example of a neighbor broadcast that is under control. In addition, the protocol takes into account the possibility that there will be an unevenness in communiqué and employs super FANT in order to redress the pheromone imbalance that has developed close to the link [22].

After selecting a node that has a lot of power to be the cluster head, it sets up many connections between the cluster head and the sinks. It decides on a communication route taking into account power levels and other relevant criteria [23]. It has been found that the protocol minimizes the amount of power that is used and maintains the path's availability for a longer period. Nevertheless, the protocol does not efficiently address pheromone depletion or connection failures that are motion-based. E- AOMDV creates a number of different paths between the communication nodes, taking into account both the hop count and the power efficiency [24-25].

3. The Objective of the Research Work

- Enhance routing efficiency in wireless networks with mobile nodes by integrating IoT and advanced protocols, such as EASARA and ECSARA, to improve packet delivery ratios and reduce routing overhead.
- Develop protocols that minimize energy consumption, thus extending the lifespan of the network and improving overall performance by considering each node's energy usage and optimizing signal strength monitoring.
- Evaluate the impact of enhanced routing protocols on network performance metrics like throughput, packet delivery, and congestion management, ensuring robust communication even with increasing numbers of hosts.

4. The Projected Work

Measurement of residual energy is given by the difference between initial energy (E0) and energy consumed up to the present time (Ec):

$$E_c = E_i - E_{co} \qquad (1)$$

Packet transmission (Et), reception (Er), and eavesdropping (Eo) all drain a node's energy supply. The sum of these energies is what we call "energy consumption," and it comes from

$$E_{co} = E_t + E_r + E_o \qquad (2)$$

Buffer occupancy size is a useful indicator of network congestion. If the queues at each node are identical in length, the node with the largest occupied buffer value is considered the more crowded. By periodically exchanging residual energy and buffer size information with the HELLO packet, hosts can assess the remaining power and congestion levels of their adjacent neighbor. A node using these parameters, according to the equation, can estimate energy Congestion

$$E_{ci} = 0.4 \text{ x } E_{ri} + 0.6 \text{ x}(1/R_{sizei}) \qquad (3)$$

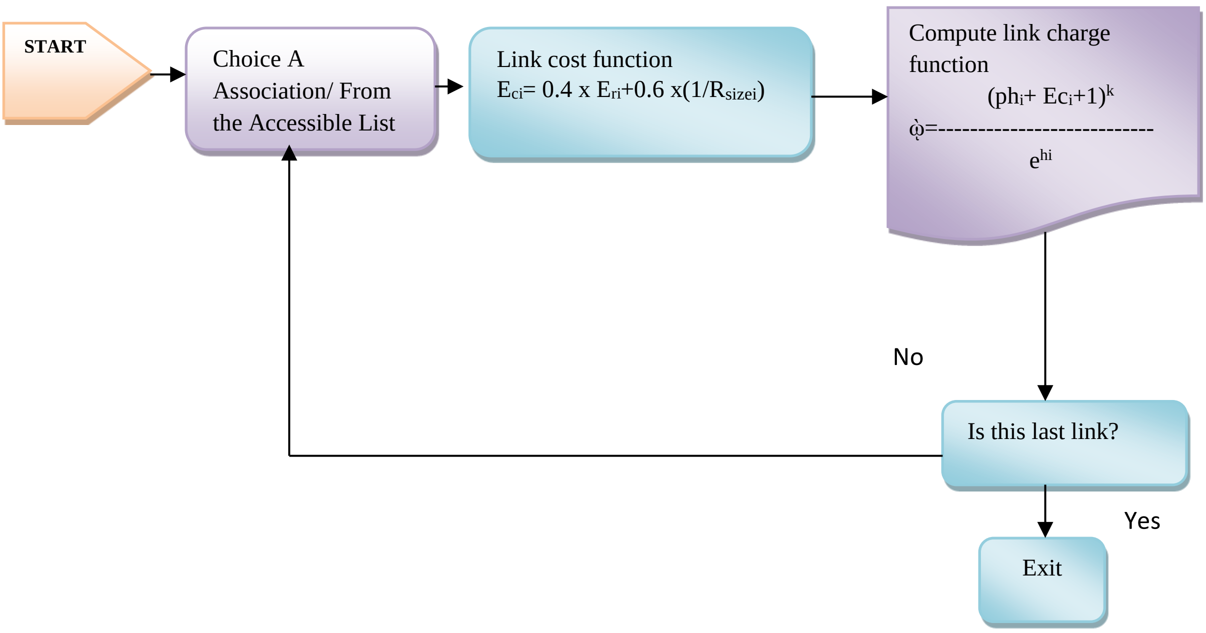

Figure 1. Calculating energy cramming metric.

Here, kis is the convergence factor, and h is the number of hops. Energy and Congestion Aware Simple Ant Routing Algorithm is the name of the protocol (ECSARA). The diagram illustrates this process stage.

Link failures are commonplace when nodes in a MANET are randomly relocated. Because of this, network efficiency is reduced. When a link fails, it must be repaired or rebuilt, and this requires establishing a new path. These two choices are expensive since they slow down communication and need additional control packets. A node's ability to monitor a connection and take corrective action prior to a link failure improves the network's overall performance. The incoming signal's strength (SS) can be utilized to foretell when a connection will fail. It is possible to compute the signal strength at a node I between two other nodes at a distance x.

$$SS_x = \frac{G_r * G_t * S_t}{4\pi * x/\lambda^2} \quad (4)$$

The abbreviations Gt and Gr stand for antenna gain transmission and reception, respectively. The radio frequency's wavelength is denoted by here. The St Parameter has been set to match the sending station's maximum output. The typical node distance, assuming the antenna covers a radius of R, is 0.9054R. The link's threshold signal strength can be calculated by plugging this number into Eq. 9. The equation for this is:

$$TSS_i = \frac{G_r * G_t * S_t}{4\pi * 0.905R/\lambda^2} \quad (5)$$

It is possible to calculate Gr and R if the host is known. The wavelength is also unchanging. The default values for Gr and Gt are 1.0.Because of their erratic behavior, the hosts are far separated. As a result, communication breaks down. When the distance between the nodes increases, the strength of the signal weakens; when the signal strength drops below a certain threshold, the connection is maintained.

With a small number of hosts, route restoration may not be successful, forcing the origin to start the discovery process over again. This procedure increases the routing load and introduces additional control packets into the environment.

5. Result and Discussion

Analyses are carried out on the throughput in addition to the packet delivery rate (PDR) for a number of different nodes, both in the presence and absence of outliers. Following this, comparisons are conducted with the method that is currently being utilized. According to the findings of the investigation, it has been established that the throughput of the network will increase in proportion to the number of nodes that are present in the network. The reason for this is that the maximum number of nodes are currently taking part in the activities that are being carried out by the network. The reason for this is that the maximum number of nodes that are now engaging in the activity is currently present. Assuming that there are no outliers, the throughput of the network scenario that has been given is within the threshold limits. However, if there are any outliers present, the throughput will fall below the lower worthy threshold limit. End-to-end (E2E) delay has a variety of benefits, two of which being decreased power consumption and increased reliability. However, these benefits pale in comparison to the other advantages.

The effectiveness of the suggested routing protocols is compared with that of the existing routing protocols. All of these evaluation parameters are determined for the routing protocols that have been discussed above.

Table 1: Comparison of the suggested method to the current model using a variety of input parameters.

Node Count	Throughput (Kbps)			End to End Delay (ms)		
	SARA	ECSARA	SSSARA	SARA	ECSARA	SSSARA
10	190.02	189.25	189.34	236.42	236.35	236.28
30	226	226.14	226.64	245.48	245.63	246.17
50	249.12	256.71	263.17	220.43	221.59	221.65
70	260.28	265.73	265.97	237.28	237.49	237.67
90	252.41	266.27	266.59	215.83	216.28	216.97

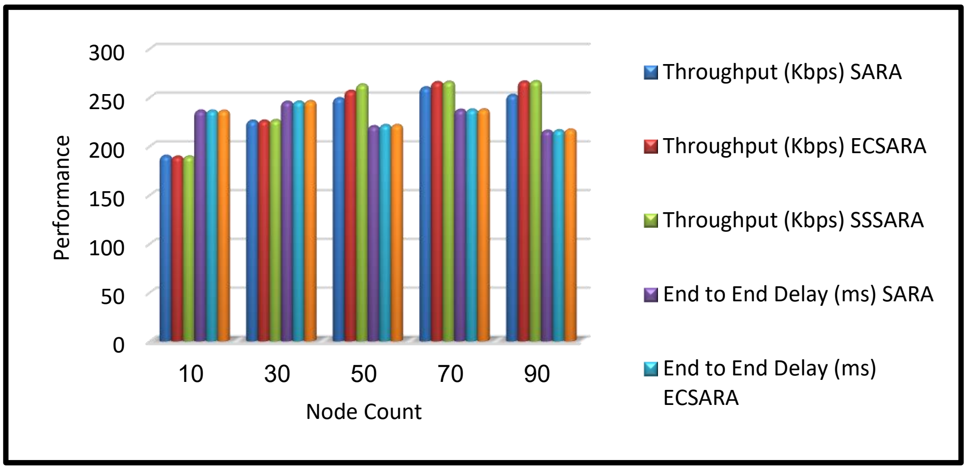

Figure 2. Capacity and End-to-End Throughput Put off evaluating competing approaches.

Table 2: Comparison of the suggested approach and the current model with various settings taken into account.

Node Count	Packet Delivery Ratio (%)			Energy Consumed (J)		
	SARA	ECSARA	SSSARA	SARA	ECSARA	SSSARA
10	99.24	99.35	99.21	7.89	7.63	7.52
30	98.89	99.21	98.34	15.27	14.82	14.46
50	99.48	99.62	99.65	24.43	24.03	23.86
70	99.67	99.76	99.82	34.58	34.16	34.08
90	99.73	99.89	99.85	43.52	42.19	42.16

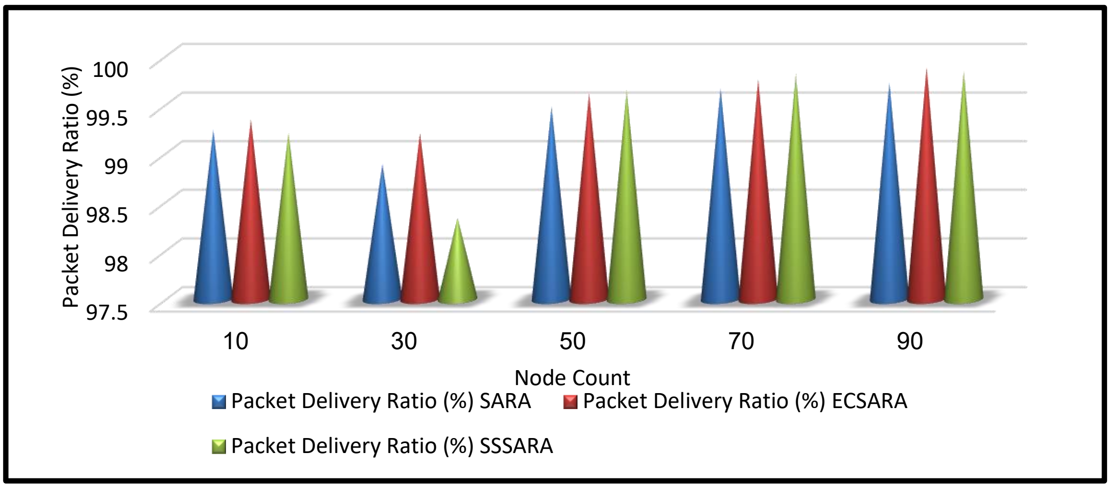

Figure 3. Analysis of the Proposed Method's Packet Delivery Ratio.

This can be concluded from Table 2 and 3. Energy consumption is predicted to be lower with ECSARA thanks to simulation. This is because ECSARA prioritizes nodes with higher energy levels during packet transmission. As a result, packets travel around the network at a rate that is roughly proportional to the energy consumption of each node.

There was a reduction in lag time and a stabilization of packet loss when more nodes were added to the network. These two features help ECSARA achieve its superior throughput figures. While sending data, ECSARA prioritizes lanes with less traffic.

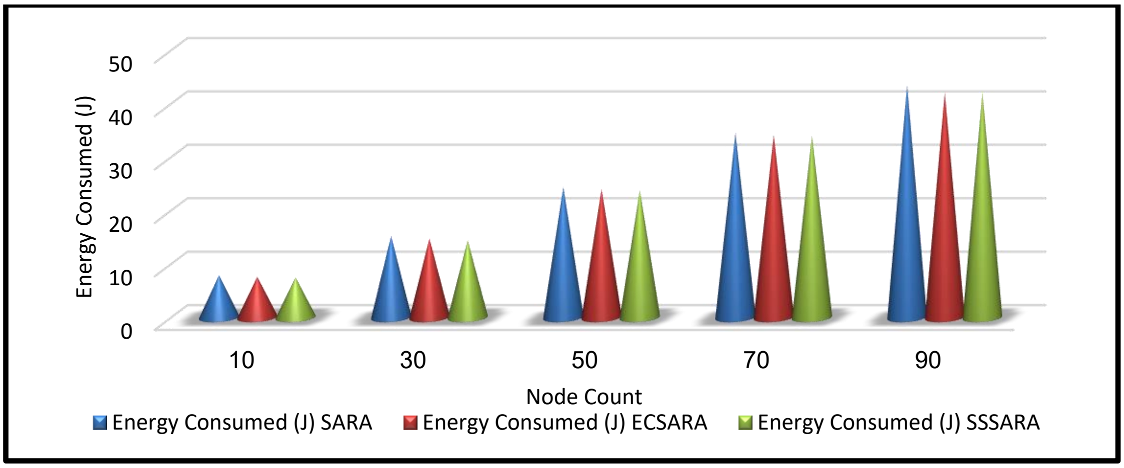

Figure 4. Analysis of the Proposed Method's Energy Use.

As a result, the packets spend less time in transit. ECSARA improves PDR even as it multiplies the number of hosts in the ecosystem. There are two main causes for this. First, having more hosts means more opportunities to use routes with less traffic. Second, the path that has been decided upon is composed of hosts that are more powerful. Hence, the trail remains for longer.

As congestion is not estimated during transmission, there is no appreciable delay between the two methods. Yet, it looks that SS-SARA has a longer turnaround time. This is because SS-SARA can predict when a connection will be lost and take measures to prevent this from happening. Congestion and packet queuing may follow, as well as the creation of extra packets. The SS-SARA throughput is shown to be greater in more dense networks. This is because SS-SARA has better packet delivery and less latency. Using simulations, we find that evaluating signal strength dramatically enhances packet delivery and network throughput. We can deduce that in a moderately crowded network, received signal strength can be used efficiently to improve packet delivery and throughput, albeit at the expense of some additional routing overhead.

6. Conclusion

Researchers zeroed in on a methodology inspired by ant colonies to determine the best path between two points. One such protocol that has undergone development is the Simple Ant Routing Protocol. Conscious of energy needs The Energy-Aware Simple Ant Routing Algorithm (EASARA) is an innovative protocol that prioritizes the conservation of energy across a network. The adjustment was shown to be effective in lowering routing overhead and raising the packet delivery ratio. Such a change also improved transmission rates in communications. When testing EASARA, it was found that the more hosts it had, the better it performed. Then, a statistic for traffic congestion was developed. It used a single parameter that incorporated estimations for both host power reserve and connection congestion. Energy and Congestion aware Simple Ant Routing Algorithm is the name of this protocol (ECSARA). As the number of hosts grows, the protocol's effectiveness improves. It is able to send out more packets in less time. Because of this, the data transfer rate of the transmission increased.

The route's lifespan was increased because to reduced energy consumption. Before a connection failure could occur, the received signal strength was used to anticipate it. This metric is now used to select an alternate route. SARA stands for Signal-to-Anchor-Receiver-Attendance, which describes (SS-SARA). All of the host monitors picked up strong signals here. Substitute paths are considered for communication when the signal strength drops below a certain threshold. The experimental results showed that even in a congested network, packet delivery and throughput were both increased thanks to the protocol.

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