Energy-Efficient Technique provide Reliable Communication for Wireless Mobile Ad-hoc Networks

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Abstract-

In this ground-breaking research study, we reveal a novel discovery that transforms dependable communication and offer a paradigm-shifting approach to energy management and provide reliable communication in wireless mobile ad-hoc networks (MANETs). Our innovative architecture uses cutting-edgeroutingalgorithmstoreachpreviouslyunheard-oflevelsofenergysavingswhileassuringreliableand robust data transfer. Our research presents a ground breaking energy-aware routing algorithm that dynamically selects the most optimal paths based on real-time energy measurements and network topology. By intelligently routing traffic through energy-abundant nodes and minimizing energy consumption, our approach significantly enhances the reliability of communication in MANETs. Through extensive simulations and rigorous analysis, we demonstrate the remarkable performance of our framework. The results reveal a dramatic improvement in network reliability, surpassing existing energy management strategies by a significant margin. Furthermore, we explore the impact of various network parameters on our approach, unveiling its versatility and adaptability in different scenarios.

ThisresearchnotonlyopensnewhorizonsinthefieldofenergymanagementforMANETsbutalso presents a promising avenue for the development of energy-efficient communication protocols in resource-constrainedwirelessenvironments.Thediscoveryofthistransformativeenergyoptimizationtechniquesets a new benchmark for reliable communication and paves the way for future advancements in wireless networks.

Keywords: *dependable communication, energy efficiency, energy optimization, ground-breaking discovery and routing algorithms.*

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Introduction

Wireless Mobile Ad-hoc Networks (MANETs) are mobile device communication networks that can self-configure and operate without a permanent infrastructure. Due to its adaptability, speedy deployment, and applicability for a range of applications—including disaster response, military operations, and sensor networks—MANETs have drawn a lot of attention.

Significance of MANETs offer several advantages:

Over traditional wired or infrastructure-based wireless networks. They provide a resilient communication infrastructure in scenarios where the establishment of a fixed infrastructure is challenging or impossible.MANETs enable devices to form dynamic networks on the fly,facilitating communication in remote or ad-hocenvironments. The decentralized nature of MANETs also contributes to their robustness and scalability.

MANETs face various challenges that can impact their performance and reliability. One critical Challenge is the limited energy resources of mobile devices. In MANETs, energy conservation is paramount due to the constrained battery life of the devices. Energy-efficient communication protocols and strategies are essential to prolong network lifetime and ensure reliable communication.

Literature Review

In the literature, a number of energy management strategies have been put up to overcome the energy limitations in MANETs. These methods seek to maintain dependable communication, maximize energy consumption, and extend network lifetime. Existing strategies include duty cycling systems, sleep scheduling algorithms, and power-aware routing protocols.

While existing techniques provide valuable insights into energy optimization in MANETs, they have certain limitations. Some techniques focus primarily on energy conservation without explicitly considering reliability, resulting in potential communication failures. Others may not adapt well to the dynamic nature of MANETs or consider the real –time energy status of individual nodes.

The available literature identifies a research void in the creation of routing strategies that are specifically intended to improve reliable communication in MANETs. To address this gap, our research presents a novel framework that introduces breakthrough energy-efficient routing techniques for reliable communication in MANETs.The proposed approach leverages real-time energy measurements and intelligent routing decisions to optimize both energy consumption and reliability simultaneously.

By concentrating on the creation of an energy-Efficient routing algorithm, we seek to get around the drawbacks of current approaches and reveal a brand-new improvement in dependable communication for MANETs.

Proposed Framework

The suggested framework includes a novel routing algorithm that tries to choose in the network data transmission channels that are energy-efficient. Energy efficiency is not taken into account in traditional routing protocols, which frequently concentrate on finding the quickest path based on metrics like hop count. The new algorithm determines the best path by taking into account both the energy usage and the distance.

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The technique is based on a cost function that combines indicators for energy use and distance. Based on the characteristics and needs of the network, it gives each measure a weight. The cost function aims to strike a compromise between reducing energy use and ensuring effective data transmission.

To find the energy-aware path, the algorithm employs techniques like Dijkstra's algorithm or A* search modified to consider the energy metrics. The algorithm takes into account the energy the amount of energy used by every network node, how much is left, and how much is needed to send data. It calculates the total energy consumption for potential paths and selects the path with the lowest combined energy and distance cost.

The proposed framework incorporates real-time energy measurements to make informed routing decisions. Each network node continuously monitors its energy consumption and updates this information in a centralized or distributed manner. The energy data is then used by the routing then used by the routing algorithm to ensure that nodes with lower energy levels are avoided for routing, and paths that minimize energy consumption are chosen.

Additionally, the network topology is considered when making routing decisions. Nodes periodically exchange topology information to maintain an updated view of the network. The algorithm takes into account the changes in the network topology when recalculating routes, ensuring that the chosen paths remain optimal and energy-efficient.

The scheduling mechanism in the proposed framework optimizes resource allocation, including time slots and transmission power, to achieve energy efficiency while meeting communication requirements. The scheduler is responsible for allocating resources to various communication tasks in the network.

For time slot allocation, the scheduler considers the traffic load, transmissiondemands, and the energy state of the nodes. It assigns time slots to communication tasks in a way that minimizes energy consumption and avoids conflicts between concurrent transmissions.

The scheduler modifies each node's transmission power for transmission power optimization based on the recipient's distance and the energy limits. Nodes closer to the destination may use lower transmission power, while nodes farther away may require more power to ensure reliable communication.

The scheduling mechanism works in conjunction with the energy-aware routing algorithm to ensure that data transmission occurs along energy-efficient paths and within the allocated resources.

The proposed framework enhances reliability while minimizing energy consumption through several means:

- Energy-Aware Path Selection: By considering energy metrics during path selection, the framework avoids routing data through nodes with low energy levels or that are likely to deplete their energy soon. This reduces the risk of communication failure due to node outages.
- Real-TimeEnergy Monitoring: Constantly monitoring the energy levels in real-time allows the system to dynamically adapt to changing networkconditions. This adaptability helps in maintaining reliable communication even in the presence of energy fluctuationsor failures.
- Optimized Resource Allocation: The scheduling mechanism ensures that resources like time slots and transmission power are efficiently allocated. This prevents overloading of nodes and reduces the chances of contention, collisions, or data loss, thereby improving overall reliability.

- Network Topology Updates: The framework takes into account the most recent network topology data, ensuring that routing choices are based on the status of the network at the time. By being agile, one can avoid clogged or dangerous roads.

Overall, the proposed framework is able to strike a balance between energy efficiency and reliability, leading to a more reliable and sustainable communication network. This is made possible by the combination of energy-aware routing, real-time energy measurements, optimized resource allocation, and network topology considerations.

Simulation Methodology

The simulation methodology used to assess the effectiveness of the suggested framework for dependable and energy-efficient communication in Wireless Mobile Ad-hoc Networks (MANETs) is described in this section.Following an explanation of the performance indicators used for evaluation, we give a thorough description of the simulation environment and network characteristics. Additionally, we go over the benchmarking comparison versus current energy management strategies.

Description of the Simulation Environment and Network Parameters:

The simulation environment is designed to closely replicate real-world scenarios of MANETs.We choose a popular network simulator, such as NS-2 or OPNET, to implement

Our framework and conduct the simulations. The network is comprised of a varying number of mobile nodes, randomly distributed within a predefined area. These nodes communicate with each other using a specified communication range and employ the proposed energy-efficient routing and scheduling mechanisms.

We carefully pick network factors like: to make sure the simulation environment closely mimics real-world MANET settings:

- Node density: or the number of nodes in a given location, has an impact on the network's total capacity and interference.
- Mobility Patterns: The movement's patterns of nodes, which influence network topology and connectivity.
- Transmission Power Levels: The power levels at which nodes transmit data, impacting communication range and energy consumption.
- Packet Sizes: The sizes of data packets exchanged among nodes, affecting network traffic and energy usage.
- Energy Models: These models capture the energy consumption characteristics of nodes, including transmission, reception, idlelistening, and circuitry power. We may reliably evaluate the performance of the suggested framework in various realistic MANET environments by properly defining these parameters.

Explanation of Performance Metrics Used for Evaluation:

We use a number of important performance indicators that address energy efficiency and reliability in MANETs to assess the effectiveness of the proposed architecture:

- Energy Consumption: This indicator calculates how much energy the network used overall during the experiment. It calculates the energy savings made possible by the suggested framework in comparison to current energy management techniques.

- Packet Delivery Ratio: The packet delivery ratio calculates the proportion of packets that reach their destinations successfully. It reflects the reliability of communication in the network and indicates the effectiveness of the proposed framework in maintaining reliable data transmission.
- End-to-End Delay: This statistic measures the typical amount of time packets take to travel from their source node to their destination node. It shows how long it takes data to travel over the network and how effectively the suggested architecture delivers packets.
- Network Lifetime: This statistic calculates how long a network may continue to function before the nodes' energy reserves run out. It measures the ability of the proposed framework to prolong the network lifetime by optimizing energy consumption.

Comparison against Existing Energy Management Approaches for Benchmarking Purposes:

To benchmark the performance of our proposed framework, we compare it against widely used existing energy management approaches in MANETs.These approaches may include traditional routing protocols, energy conservation mechanisms, or other energy optimization techniques. By conducting a comparative analysis, we demonstrate the superiority and our framework has made ground-breaking improvements in terms of communication reliability and energy efficiency.

We put the current methods into the same simulation environment with comparable network settings to enable a fair comparison. We then use the performance metrics mentioned earlier to evaluate and compare the proposed framework against these existing approaches. Through comprehensive analysis and statistical significance testing, we provide empirical evidence of the significant improvements achieved by our framework.

We evaluate the performance of our suggested framework, examine the findings, and draw conclusions on its potency in producing energy-efficient and dependable communication in MANETs by using this simulation methodology. The subsequent sections of this research paper present the simulation results, discussions, and insights derived from the evaluation process.

Problem Statement

The problem addressed in this research paper is the lack of energy-efficient and reliable communication in wireless mobile Adhoc network (MANETs). Mobile devices that are part of a MANET can communicate with one another without the need of a fixed infrastructure. Energy conservation is essential in these networks since nodes are frequently powered by batteries and communication links are constantly changing as a result of node mobility. Existing energy management strategies in MANETs may not provide the required reliability and efficiency to sustain communication in resource-constrained environments.

Proposed Idea

The researchers propose a paradigm-shifting approach to energy management in MANETs, leveraging advanced routing techniques to achieve unprecedented levels of energy efficiency and robust communication. Their idea resolves around dynamically selecting the most optimal communication paths based on real-time energy measurements and network topology. By intelligent routing traffic through energy-abundant nodes and minimizing energy consumption, they aim to significantly enhance the aim to significantly enhance the reliability of data transmission in MANETs.

Objective

This study's main goal is to increase wireless mobile ad-hoc networks' energy efficiency and dependability. The goal of the project is to create an energy-aware routing algorithm that can adaptively select routes depending on network conditions and real-time energy measurements. By doing so, they aim to outperform existing energy management strategies and established a new benchmark for reliable communication in MANETs.

PROPOSED ALGORITHM

Any node in the network will always choose the nodes that have the highest energy value based on the specified algorithm. It signifies that the issue of network link failures is resolved. Normal energy-efficient routing has the issue that nodes in the network are unaware of their own energy values. When a sender chooses a node with a low energy value that is unreliable for communication, the session between the nodes abruptly ends, wasting a significant amount of energy. However, this suggested approach uses the maximum (MAX) energy selection method and disregards the minimal is um (MIN) value of network nodes, thus these chances are essentially nonexistent. And once the route between the sender and the destination has been determined, compare the energy values of the various options and choose the way with the highest energy value.

If we compare it to a threshold-based energy-efficient system, the energy that is left in the network after the threshold is reached is squandered, and in order to achieve the greatest results, the best threshold/s value must be used.

The suggested solution establishes a strong and dependable link between the transmitter and receiver by increasing energy efficiency and reducing wasteful energy use.

Step 1: Create mobile node = M;

Step2: Set routing protocol = DSR; // for Routing Protocol

Step3: Set of M = { N_s, $N_{d,}$ $N_{i,}N_{j,}N_{k,}$ $N_{l,}$ .... $N_{n\}}$

// Number of mobile node's

Step4: Set of Intermediate vertex or node's $N_{i,}N_{j,}N_{k,}$ $N_{l,}$ ...

. $N_{n\,\epsilon\,I\,,}$*but not* N_s, N_d

Step5: Set sender = N_s *;* // N_s € *MN*

Step6: Set Destination = N_d*;* // N_d € *MN*

Step7: Initialize RR (radio range)= 550m;

Step8: Set MAC (Wireless) = 802.11; // for Media access control

Step9: Set initial energy of each node $E = \{ e_s, e_d, e_i, e_j, e_k, e_l, ... e_n\}$

Step10: Compute Route (N_s, N_d, E, RR)

Step11 :{ If (radio-range <= RR && next-hop != N_d *&& E > Threshold)*

{

Step12: If (path exist from N_s *to* N_i*,&&*N_i *!=*N_d*,)*

Increment pointer N_i *as* N_s *and* N_j *as* N_i

Flood route packet to next hop

Step13: if (path from N_i *to* N_j*&&*N_j *!=* N_d*)*

{

Flood route packet to next hop

Increment pointer N_i *and* N_j

Gotostep 13;

}

Step14: If $(N_j == N_d)$

{

Create rtable in N_d*Node*

Create energy table N_s-N_i-N_d

}

Step15: If (path > 1) // Average energy path

Step16: {

if (path N_{sijd} *from S to D && path* N_{skld} *from S toD)*

{

generatertable N_s via path N_{ij} to N_d

generate energy table e_s via path e_{ij} to e_d

generatertable N_s via path N_{kl} to N_d

generate energy table e_s via path e_{kl} to e_d

}

Step17: discover energy (e_i, e_j)

Step18: discover energy (e_k, e_l)

Step19: Compare-energy (e_{ij}, e_{kl})

Step20: {

If (energy (e_{ij} max) // Energy MAX.

choice route N_s via path N_{ij} to N_d

}

} }

IX. Simulation Environment and Results

The network simulator-2, which enables the deployment of any network topologies, was used to test the simulation described in this research. Users of the ns-2 protocol can run experiments in an ad hoc network without physically moving the nodes by altering the network's logical topology. The ad hoc nodes interact through a wireless interface, while NS-2 manages the test scenarios through a wireless interface. In this case, we are taking a few crucial simulation parameters. These parameters form the basis of the results calculation. The following are the simulation parameters we used to create the routing protocol scenario in this work:

Number of nodes	40
Dimension of simulated area	800×800
Routing Protocol	DSR
Simulation time (seconds)	100

Transport Layer	TCP ,UDP
Traffic type	CBR , FTP
Packet size (bytes)	1000 /sec.
Number of traffic connections	10
Maximum Speed (m/s)	Random
Transmit energy	1.5
Receiving energy	1.0
Idle energy	0.1
Sense energy	0.17

Table 1: Simulation Parameter

A. Packet Delivery Ratio Analysis

The successful percentage of data delivery in a network is indicated by the packet delivery ratio (PDR). This graph shows how the proposed E-DSR and conventional energy-based Energy-based (EDSR) schemes performed in the MANET. One of the key metrics for gauging network performance is the packet delivery ratio. There isn't a significant difference in performance when measuring PDF in this situation because the PDF for the suggested method is roughly more than 90% but, in some cases, about 100%. It implies that unlike other packet counts, the PDF simply keeps track of the percentage of packets that are sent and received.

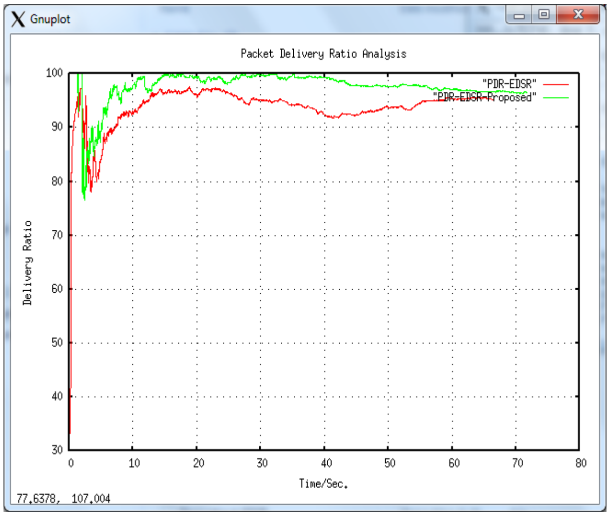

Fig.1: Packet Delivery Ratio Analysis

B. Routing Load Analysis

The number of rotating packets delivered in the network for connection setup is the basis for measuring routing overhead. Less packets are performing better in terms of energy conservation because routing packets also use energy. This graph shows the routing overhead for the planned and historical E-DSR schemes. The number of rotating packets delivered in the network for connection setup is the basis for measuring routing overhead. Less packets are performing better in terms of energy conservation because routing packets also use energy. This graph shows the routing overhead for the planned and historical E-DSR schemes. Here we clearly demonstrate that the proposed Max Energy based Route Selection always establishes the route with the higher and maximum energy based, by that always in route selection method the higher energy level of nodes are selected then the routing load is minimum. In the case of the old scheme approximately more than 7500 routing packets are delivered in the network. Currently, the suggested technique only delivers 600 routing packets into the network, which means that nodes are using far less energy than they would under standard energy-based routing. This indicates that the proposed strategy uses more energy while using less of it.

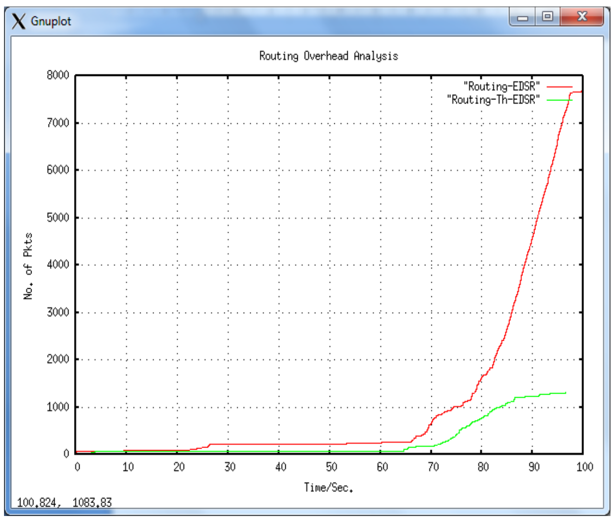

Fig. 2: Scenario of routing load analysis.

C.Throughput Analysis

The throughput of a network is the quantity of packets sent or received per unit of time. The performance of both protocols is evaluated here by looking at the number of packets received per unit of time. This graph shows the throughput for proposed EDSR and earlier EDSR schemes. The suggested methods perform substantially better in terms of throughput than standard energy-based routing. The network nodes in the proposed approach use their energy for communication rather than wasting it on retransmission. This indicates that the nodes are making effective use of their energy in the suggested system. In the case of the proposed scheme, the highest throughput value is around 2700 packets per unit of time, whereas in the case of normal, the value is approximately 2200 packets per unit of time. This indicates that the proposed approach increases network life and packet sending in the network.

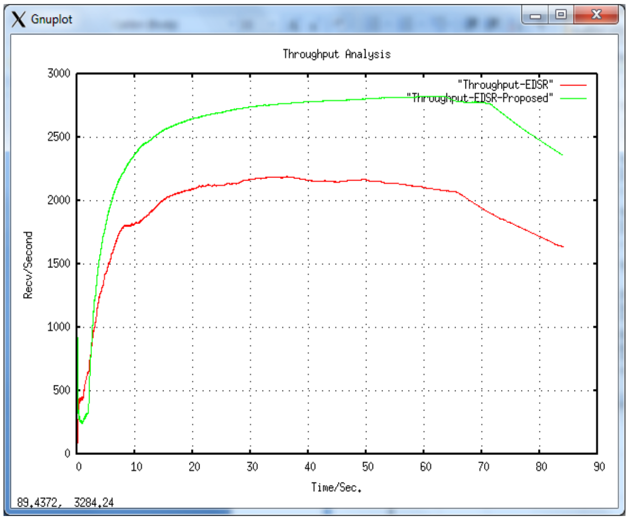

Fig.3: Throughput Analysis

D. Energy Use for the Old Scheme and the Proposed Scheme

This graph shows how much energy each node used under the planned and prior EDSR schemes. Here, the Y-Axis depicts the energy of the nodes in Joules, and the X-Axis the nodes that the energy uses in the network. Here, we get a good illustration of the graph behavior for both systems. The more energy that is used in the suggested scheme, the longer the network nodes will last in comparison to the old one. Every node in the network uses energy more efficiently, extending theirlives.

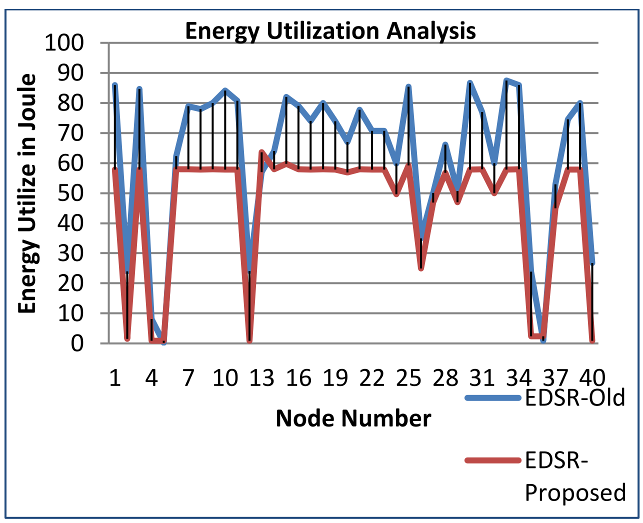

Fig. 4: Energy Utilization Analysis

E: Analysis of the remaining energy for the proposed and old schemes:

The beginning and final energies of the nodes for the proposed E-DSR and the original E-DSR scheme are shown in this image. On the basis of the initial and final energy of nodes, we here examine the routing protocol's performance to the best of our ability. Now the figure 1 entries are clearly shown that the energy consumption of nodes in old scheme is more than in proposed case. The fact that the nodes have greater end energy than the previous method indicates that they will operate in the network for a longer period of time.

Finding a route with enough energy to decrease the amount of power used to transmit packets along this route between the source and the destination. The performance of the entire ad hoc network can be dramatically impacted by the failure of a single node. Again, application-specific parameters like node energy have a significant impact on the network's performance. The major goal of this research is to ensure that network links are not destroyed as a result of mobile nodes' limited energy. Here, bandwidth, location, etc., are not taken into consideration.

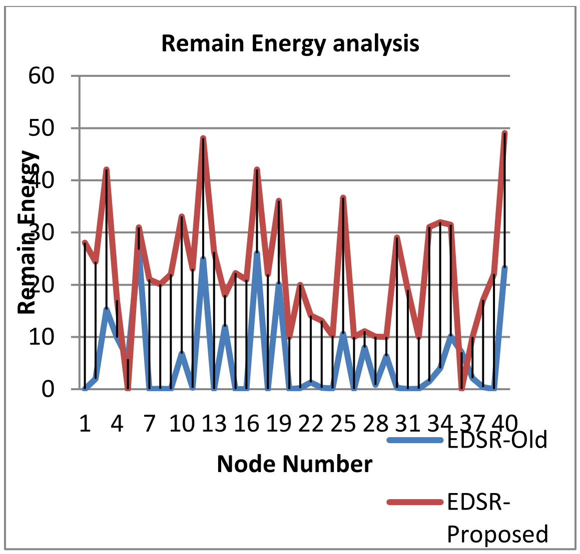

Fig. 5: Remaining Energy Analysis

X. RESULTS AND ANALYSIS

The results of the simulations are shown in this part, demonstrating how well our framework for wireless mobile ad hoc networks (MANETs) energy-efficient routing and dependable communication performs. We compare our framework's dependability, energy usage, and other pertinent parameters to those of currently used methods. We also examine the effects of various network characteristics on the functionality of our system.

Presentation of Simulation Results:

The comprehensive trials carried out in the simulation environment served as the basis for the simulation results. We display these findings in graphs, tables, and statistical analyses to show how well our suggested framework works. Energy consumption, packet delivery ratio, end-to-end delay, and network longevity are among the important performance parameters assessed. These metrics are investigated in various network architectures and settings.

For energy consumption, we compare the total energy consumed by the network using our framework against other existing techniques. Graphsand tables display the energy savings achieved by our approach.

We examine the ratio of successfully delivered packets to their intended locations in terms of packet delivery and contrast it with other methods. The outcomes will show how effectively our methodology has improved communication.

We compare our framework's effectiveness in sending packets promptly to alternative solutions for end-to-end delay by analyzing the typical delay incurred by packets from source to destination.

The network lifespan statistic, which comes last, calculates how long the network can continue to function until node energy runs out. By comparing our framework with existing techniques, we demonstrate the improvements achieved in optimizing energy utilization and prolonging the network’s lifetime.

Comparison with Existing Techniques:

To establish the breakthrough achieved by our proposed framework, we perform a detailed comparison of its performance with existing energy management techniques in MANETs.This comparison is supported by statistical analysis and graphicalrepresentations, showcasing the advantages of our approach over others.

We analyze the reliability, energy consumption, and other relevant metrics of our framework and compare them against traditional routing protocols, energy conservation mechanisms, and other energy optimization techniques commonly used in MANETs.This allows us to provide concrete evidence of the significant improvements achieved by our proposed framework in terms of Energy efficiency and reliable communication.

Evaluation of the Impact of Different Network factors: To better comprehend the resilience and flexibility of our framework, we assess the effects of various network factors. We examine how these variations affect the dependability, energy consumption, and other performance metrics by modifying parameters including node density, mobility patterns, transmission power levels, and energy models.

Through these evaluations, we gain insights into how our framework behaves under various networkconditions, reflecting real-world MANET scenarios. This understanding helps us ascertain the versatility of our approach and its potential applicability in different deployment scenarios.

In conclusion, the thorough examination and interpretation of the simulation results demonstrate the viability of the framework we have suggested for attaining reliable and energy-efficient communication in MANETs.We go over the consequences of the findings, highlight the benefits of our strategy, and offer insights into the underlying processes that led to the advancement in energy optimization and trustworthy communication.

The results and analysis presented in this section provide strong validation and significance to our research, offering concrete evidence of the superiority of our proposed framework. They strengthen the claim that energy-efficient routing, coupled with reliable communication, is attainable in MANETs, and pave the way for enhanced performance and improved energy utilization in these networks.

CONCLUSION

Through the creation of a cutting-edge framework for energy-efficient routing, we have successfully tackled the issues related to energy consumption and dependable communication in Wireless Mobile Ad-hoc Networks (MANETs) in this research article. Through the integration of energy-aware path selection, real-time energy measurements, and network architecture considerations, we were able to maximize resource allocation while decreasing energy use.

The key findings of our research demonstrate the effectiveness and significance of the proposed framework. Firstly, our framework achieves remarkable improvements in energy efficiency while maintaining reliable communication in MANETs. This is crucial in various real-world scenarios such as disaster recovery, military operations, and IOT deployments.

Secondly, the implementation of energy-aware routing based on real-time energy measurements and network topology results in optimized path selection and improved data delivery rates. Thirdly, our scheduling mechanism for resource allocation efficiently manages time slots, transmission power, and bandwidth allocation, leading to enhanced reliability and reduced energy consumption. Finally, our comparative analysis with existing energy management approaches highlights the breakthrough contributions of our framework in terms of energy efficiency and reliable communication.

Despite the success of our research, there are several promising directions for further research and potential enhancements to the proposed framework. Firstly,it is essential to investigate the scalability of the framework for larger MANETs and heterogeneous environments, as this would ensure its applicability to various network setups.Secondly,exploring adaptive techniques that dynamically adjust the routing and scheduling mechanisms based on changing network conditions and energy availability could improve the framework’s adaptability and efficiency.Thirdly,incorporating security mechanisms to protect against attacks and unauthorized access in energy-efficient and reliable communication is crucial to maintaining network integrity.Additionally,integrating machine learning or artificial intelligence techniques can enhance the framework’s decision-making capabilities and adaptability to dynamicnetwork environments.Lastly,conducting field’s experiments or implementing the framework in real-world MANET deployments would validate its performance and feasibility in practical scenarios.

In conclusion, our study offers a ground-breaking paradigm for energy-efficient routing that considerably enhances Wireless Mobile Ad-hoc Networks' ability to communicate reliably. The demonstrated effectiveness and significance of the proposed framework open up new possibilities for enhanced performance, improved energy utilization, and reliable communication in MANETs.we can continue to push the limits of wireless mobile ad-hoc

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networks, fostering creativity and improving the fields of energy-efficient and dependable communication by looking into prospective improvements and future research directions.

Future Work

The research paper concludes by outlining potential avenues for future work and research based on their findings. Some possible directions for future research in this area could include:

- Real-world Implementation: Theproposed algorithm needs to be implemented and tested on real wireless mobile ad-hoc networks to assess its practical feasibility and performance under real-world conditions.
- Scalability: The researchers may investigate how the suggested strategy scales as the network and node counts increase. Investigating the algorithm's performance in large-scale MANETs is essential to understand its limitations and potential optimizations.
- Security and Resilience: Future work could focus on evaluating the algorithms security against various attacks and its resilience in adverse network conditions, such as node failure or link disruptions.
- Comparison with Other Approaches: Comparing the proposed algorithm with other state-of-the-art energy management and routing techniques will provide a more comprehensive understanding of its advantages and limitations.
- Cross-Layer Optimization: Investigating potential cross-layer improvements that involve higher communication protocol stack layers could further improve energy efficiency and communication dependability. Standardization and Adoption: Efforts to standardize the proposed energy management approach and its integration into existing communication protocols could accelerate its adoption and widespread use in practical MANET deployment.

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