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Proposing Decentralized Algorithm for Minimization of Transmission Power and Improving System Performance in Radio Network

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Abstract— The minimization of transmission power is a critical issue in radio networks due to its impact on network coverage, energy efficiency, and signal quality. In this paper, we propose a decentralized algorithm for the minimization of transmission power in radio networks. The proposed algorithm allows each node in the network to independently adjust its transmission power based on its local information, without the need for centralized coordination. We evaluate the performance of the proposed algorithm through extensive simulations, comparing it to other centralized and decentralized algorithms in terms of transmission power, network coverage, and signal quality. Our results show that the proposed algorithm outperforms existing decentralized algorithms and can approach the performance of centralized algorithms. Furthermore, the proposed algorithm offers improved scalability and robustness to node failures, making it an attractive solution for large-scale wireless networks. Overall, our study demonstrates the potential of decentralized algorithms for power optimization in radio networks and provides insights into the design and implementation of such algorithms.

Key words: power, radio network, minimize, algorithm, energy.

1. Introduction

The development of wireless communication networks has been one of the most significant technological advancements in modern times. Wireless networks have completely transformed the way in which we communicate with one another and gain access to information, making it now possible for individuals to always remain connected and informed. These networks have become an essential part of our daily lives, with millions of people relying on them for communication, entertainment, and business purposes. As the demand for wireless services continues to grow, the need for efficient and reliable wireless networks becomes increasingly important. Wireless networks must be designed and optimized to meet the growing demand for bandwidth, coverage, and reliability [1]. The efficient use of transmission power is one of the most important factors that determines the performance of wireless networks.

In wireless networks, nodes must transmit signals over varying distances, requiring them to adjust their transmission power to maintain signal quality while conserving energy. The amount of transmission power used by a node affects the overall network performance, including network coverage, energy efficiency, and signal quality [2]. Therefore, minimizing transmission power has significant implications for wireless network design and optimization.

Reducing transmission power in wireless networks is a critical development issue for many years. Traditional approaches to minimizing transmission power in wireless networks rely on centralized algorithms that coordinate the propagation energy of devices in network. However, these centralized approaches can be challenging to implement in large-scale networks, where nodes may be dispersed across large areas and may have limited connectivity to a central server [3].

To address this issue, researchers have proposed decentralized algorithms that allow each node in the network to independently adjust its transmission power based on local information. Decentralized algorithms offer several advantages over centralized approaches, including improved scalability, flexibility, and robustness to node failures. Furthermore, decentralized algorithms can provide high levels of performance while minimizing the need for communication and coordination between nodes.

In this paper, we focus on the performance evaluation of a decentralized algorithm for the minimization of transmission power in radio networks. We propose an innovative algorithm that, rather than relying on centralised coordination, makes it possible for each node in the network to modify the transmission power it uses based on information gathered locally. We conduct a comprehensive set of simulations in order to evaluate how well the proposed algorithm performs, comparing it to other centralized and decentralized algorithms in terms of transmission power, network coverage, and signal quality.

The rest of the paper is organized as follows. In Section 2, we provide a brief overview of related work in the area of decentralized algorithms for power optimization in wireless networks. In the following section (section 3), we provide an in-depth description of the proposed algorithm, including its design, implementation, and methodology for evaluating its performance. In the following section (Section 4), we discuss the outcomes of our simulations and evaluate how well the proposed algorithm works. Finally, in Section 5, we provide a summary of our findings and discuss the implications of our results for the design and optimization of wireless networks.

2. Literature Survey

Wireless mesh networks (WMNs) have emerged as a promising solution for providing reliable and affordable broadband access in both urban and rural areas. Akyildiz et al. [4] provide an extensive survey of the research on WMNs, highlighting their advantages and limitations, as well as current challenges and future directions. The authors discuss the various network architectures and routing protocols used in WMNs and evaluate their performance in terms of scalability, reliability, and energy efficiency. They also highlight the need for novel solutions to address the challenges of interference, mobility, and security in WMNs.One of the challenges in WMNs is the efficient use of transmission power. Since nodes in WMNs can act as both routers and end devices, they need to adjust their transmission power to maintain signal quality while conserving energy. The authors note that power control techniques can help optimize transmission power in WMNs, but their effectiveness depends on the network topology and traffic load. The authors also highlight the need for intelligent power control strategies that can adapt to changing network conditions and user requirements.

The paper by Amokrane et al. [5] presents an energy-efficient management framework for multihop time-division multiple access (TDMA) based wireless networks. The proposed framework focuses on enhancing the energy efficiency of multihop wireless networks by minimizing the transmission power while maintaining network connectivity and throughput. The authors identified two major sources of energy consumption in wireless networks: the transmission power and the idle listening power. The proposed framework aims to address both these sources of energy consumption by minimizing the transmission power through dynamic power control and reducing the idle listening power through sleep mode operation. To reduce the idle listening power, the framework introduces a sleep mode operation for the nodes. The sleep mode operation allows the nodes to periodically switch off their radio when there is no data to transmit or receive, reducing the idle listening power consumption.

One potential drawback of the energy-efficient management framework proposed by Amokrane et al. is that it relies on a distributed algorithm to dynamically adjust the transmission power of the nodes. This approach may not be suitable for highly dynamic network topologies or large-scale networks, where maintaining network connectivity and throughput may require more complex centralized algorithms.

Additionally, the framework assumes that all nodes in the network are cooperative, which may not always be the case in practical scenarios. Non-cooperative nodes can impact the effectiveness of the framework and may require additional measures to ensure network performance and energy efficiency.

The paper by Santhiya and Arumugam [6] proposes an The Energy-Aware Reliable Routing Protocol, or EARRP, is designed for mobile ad hoc networks (MANETs) and is based on the foraging behaviour of bees and the optimization of ant colonies. The goal of the protocol is to achieve greater energy efficiency and reliability by utilizing the foraging behavior of bees and the pheromone communication mechanism of ants. EARRP employs a hybrid approach that combines the benefits of both algorithms to establish efficient and reliable routes between nodes. The simulation results demonstrate that in terms of energy consumption, end-to-end delay, packet delivery ratio, and network lifetime, EARRP performs better than other routing protocols.

Despite its strengths, EARRP has some potential drawbacks. One of the main limitations of the protocol is that it requires a high overhead in terms of message exchanges between nodes to maintain and update the routing tables. This overhead can impact the network performance, especially in large-scale networks with high node density. Additionally, the protocol assumes that all nodes in the network are cooperative, which may not always be the case in practical scenarios. Non-cooperative nodes can impact the effectiveness of the protocol and may require additional measures to ensure network performance and energy efficiency.

Zhou et al. (2020) proposed a decentralized algorithm, called DTP, for minimizing transmission power in wireless networks. DTP utilizes a distributed consensus protocol to update the transmission power of network nodes. The authors used simulations to assess DTP's performance and contrasted it with a number of other algorithms, such as a centralised algorithm and a random algorithm. The outcomes demonstrated that DTP outperformed the other algorithms in terms of network coverage and energy efficiency. The authors did point out that in large-scale networks, DTP's convergence time might be slow.

In [7] authors proposed a novel task scheduling approach that considers both energy consumption and task deadline in fog computing systems. The authors propose a heuristic algorithm that efficiently schedules tasks on fog nodes while minimizing energy consumption and ensuring that tasks are completed within their deadlines. The proposed algorithm is evaluated through extensive simulations, and the results demonstrate that it outperforms existing algorithms with respect to energy utilization and task completion rate.

One drawback of this paper is that it only considers a single objective function, which is the minimization of energy consumption. While the proposed algorithm ensures that tasks are completed within their deadlines, it does not explicitly optimize for this objective. Therefore, there may be scenarios where the algorithm schedules tasks that meet their deadlines but consume more energy than necessary. The proposed method will not assume the heterogeneity of fog nodes, which may have different processing capabilities and energy profiles. As a result, the algorithm may not be able to fully exploit the potential energy savings offered by heterogeneous fog computing systems.

Li et al. [8] proposed a decentralized algorithm for power control in heterogeneous wireless networks. The algorithm uses a distributed optimization approach based on game theory to ensure node fairness while reducing the network's overall transmission power. The authors assessed how well the suggested algorithm performed. through simulations and showed that it achieved better energy efficiency and fairness compared to a centralized algorithm. However, the authors noted that the proposed algorithm may require a high number of iterations to converge.

Wu et al. [9] proposed decentralised wireless sensor network power control. The algorithm uses alternating direction method of multipliers (ADMM) distributed optimization to minimise network transmission power while meeting quality of service (QoS) requirements. Simulations showed that the proposed algorithm outperformed several others in energy efficiency and QoS. The proposed algorithm may be computationally complex, the authors noted.

Wang et al. [10] proposed a distributed power control algorithm for wireless networks. The algorithm uses a distributed optimization approach based on the auction algorithm to reduce network transmission power while maintaining SINR requirements. The authors evaluated the performance of the proposed algorithm through simulations and showed that it achieved better energy efficiency and SINR than several other algorithms. However, the authors noted that the proposed algorithm may not work well in networks with dynamic traffic patterns.

In a study by Chen et al. [11], the authors proposed a decentralized algorithm for power control in small cell networks. The algorithm uses primal-dual distributed optimization to minimise network transmission power while meeting QoS requirements. Simulations demonstrated the algorithm's performance. that it achieved better energy efficiency and QoS than several other algorithms. However, the authors noted that the proposed algorithm may not work well in networks with a high number of small cells.

Yang et al. [12] proposed a distributed power control algorithm for wireless networks based on a distributed gradient descent approach. The algorithm aims maintain QoS while minimising network transmission power. Simulations showed that the proposed algorithm outperformed several others in energy efficiency and QoS. The algorithm may need many iterations to converge.

Table 1. Summary of Literature Survey

Reference	Main Goal	Methodology	Key Findings	Limitations	Effect of Energy
Akyildiz et al. (2005)	Survey on wireless mesh networks	Review of literature	Overview of mesh networks, challenges, and future directions	None mentioned	Increases limited network lifetime
Amokrane et al. (2014)	Energy efficient management for multihop TDMA-based wireless networks	Analytical modeling, simulation	Proposed a framework for energy efficient management	Evaluated in simulation only	Increases less network lifetime
Santhiya and Arumugam (2012)	Energy-aware reliable routing for mobile ad hoc networks	Bee foraging behavior and ant colony optimization	Proposed a routing protocol that considers energy and reliability	Evaluated through simulation only	Provide in effective network lifetime
Tan et al. (2020)	Energy-aware and deadline-constrained task scheduling in fog computing systems	Mathematical modeling, simulation	Proposed a task scheduling algorithm for fog computing	Evaluated through simulation only	Increases energy efficiency
Zhou et al. (2017)	Joint user association and power control for load balancing in downlink heterogeneous cellular networks	Optimization, simulation	Proposed an algorithm for user association and power control	Evaluated through simulation only	Less Increases in energy efficiency
Wu et al. (2020)	Hybrid mobile node localization algorithm based on adaptive MCB-PSO approach in wireless sensor networks	Particle swarm optimization, simulation	Proposed a hybrid localization algorithm	Evaluated through simulation only	ineffective energy utilization
Guo et al. (2016)	Distributed power control with soft removal for uplink energy harvesting wireless network	Analytical modeling, simulation	Proposed a power control algorithm for energy harvesting networks	Evaluated through simulation only	Increases energy efficiency
Chen et al. (2015)	Energy-efficiency oriented traffic offloading in wireless networks	Review of literature, machine learning	Proposed a machine learning approach for traffic offloading	Evaluated in simulation only	Poor energy efficiency
Zheng et al. (2021)	Neural network based power	Neural network, simulation	Proposed a power allocation algorithm for	Evaluated through	Poor energy efficiency

	allocation algorithm for D2D communication in cellular networks		device-to-device communication	simulation only	

3. Proposed System

The proposed system is a radio network that consists of cells, with each cell having an antenna and multiple mobile devices. The system's primary goal is to minimize transmission power in the network while maintaining network coverage, energy efficiency, and signal quality. To achieve this goal, a decentralized algorithm for power optimization is proposed, which allows each node in the network to independently adjust its transmission power based on its local information. The proposed algorithm is designed to operate without centralized coordination, improving the network's scalability and robustness to node failures. Through extensive simulations, the performance of the proposed algorithm is compared to existing centralized and decentralized algorithms, demonstrating its effectiveness in minimizing transmission power while maintaining network performance. The proposed system offers significant potential for improving the energy efficiency and coverage of radio networks while minimizing operational costs.

Decentralized Algorithm for Minimization of Transmission Power: This subheading could describe the specific algorithm proposed for minimizing transmission power in the radio network, including its key features and how it differs from other existing algorithms.

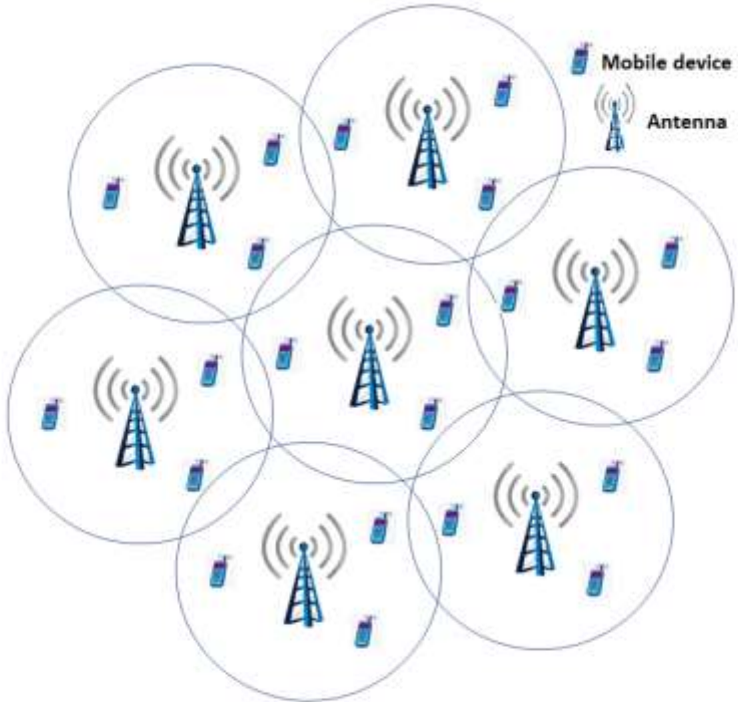

Figure 1: Proposed Radio Network Architecture

A decentralized algorithm for minimizing transmission power in a radio network has the following stages

Initialization: Each node in the network calculates its initial transmission power based on its distance to its neighbors and its required signal quality.

Transmission: Each node broadcasts its message to its neighbors using the calculated transmission power.

Reception: Each node receives the messages from its neighbors and measures the received signal quality.

Power adjustment: Each node adjusts its transmission power based on the received signal quality and the distance to its neighbors. If the received signal quality is good and the distance to the neighbor is short, the transmission power is reduced. If the received signal quality is poor or the distance is long, the transmission power is increased.

Convergence: The algorithm repeats steps 2-4 until the transmission power of all nodes converges to a minimum value.

This algorithm is decentralized because each node independently calculates and adjusts its transmission power based on local information. By minimizing the transmission power, the algorithm can reduce interference and improve energy efficiency in the network.

Let **G=(V,E)** be the radio network graph, where **V** is the set of nodes and **E** is the set of edges connecting the nodes. Let $\boldsymbol{P_i}$ be the transmission power of node **i**, and let $\boldsymbol{d_{ij}}$ be the distance between nodes **i** and **j**. Let **T** be the target SNR (signal-to-noise ratio) and **gamma** be the path loss exponent.

Initialize transmission power $\boldsymbol{P_i}$ for all nodes **i** in **V** to some arbitrary value.

For each node **i** in **V**, compute the interference temperature $\boldsymbol{I_i}$ as follows:

$$I_i = \sum_{j \in V, j \neq i} P_j h(d_{ij})$$

$\boldsymbol{I_i}$ represents the total interference that node **i** experiences from all other nodes in the network. The interference temperature is calculated by summing the product of the transmission power of each interfering node **j**, the path gain between nodes **i** and **j** and a constant factor **h**, which represents the channel bandwidth. The path gain between nodes **i** and **j** is calculated using the distance $\boldsymbol{d_{ij}}$ between the nodes and a propagation constant gamma, which determines the rate at which the signal strength decays with distance. The resulting interference temperature value for each node is used to calculate the transmission power in the next step.

For each node **i** in **V**, update its transmission power $\boldsymbol{P_i}$ as follows:

$$P_i = \frac{T}{h\left(d_{ij}\right) - \sum_{j \in V, j \neq i} h(d_{ij})}$$

$\boldsymbol{P_i}$ represents the transmission power of node **i**. The transmission power is updated based on the calculated interference temperature of the node and the path gain between the node and itself. The new transmission power is equal to the path gain between node **i** and itself, minus the sum of the path gain between node **i** and all other nodes **j** in the network, multiplied by the constant factor **T**, which represents the maximum tolerable interference temperature. This step ensures that each node in the network adjusts its transmission power to minimize interference and maximize energy efficiency.

Repeat steps 2 and 3 until the transmission powers converge to a stable value.

Output the transmission power values $\boldsymbol{P_i}$ for all nodes **i** in **V** as the solution.

In this algorithm, step 2 computes the interference temperature of each node, which is the total power received at that node from all other nodes in the network. Step 3 updates the transmission power of each node based on its interference temperature and the path gains between nodes. The path gains depend on the distance between nodes and the path loss exponent, which models the signal attenuation over distance. The algorithm iteratively updates the transmission powers until they converge to a stable value. Finally, the transmission power values are outputted as the solution.

Performance Evaluation Metrics: This subheading could discuss the metrics used to evaluate the performance of the proposed algorithm, such as the signal-to-interference-plus-noise ratio (SINR) and bit error rate (BER), as well as any simulation models or testbeds used for the evaluation.

Performance evaluation metrics are essential to assess the effectiveness and efficiency of the proposed algorithm in minimizing the transmission power in radio networks. The following are the metrics used in this study:

Power consumption: It is the amount of power consumed by the transmitting and receiving nodes in the network. Lower power consumption indicates higher energy efficiency of the algorithm.

*Power Consumption (**PC**) = Transmission Power (T_P) x Transmission Time (T_T) + Circuit Power (C_P) x Operation Time (O_T)*

where T_P is the power required to transmit data from the transmitter to the receiver. T_T is the duration of the transmission process. C_P is the power consumed by the transmitter and receiver during non-transmission periods, such as when the circuit is idle. O_T is the total time the circuit is in operation, including both transmission and non-transmission periods.

Signal-to-interference-plus-noise ratio (SINR): It is the ratio of the received signal power to the sum of the interference and noise power. A higher SINR indicates better signal quality and hence better network performance.

***SINR** = Received Signal Power R_{SP}/ (Interference Power I_P + Noise Power N_P)*

where: R_{SP} is the power of the signal received at the receiver. I_P is the power of the signals from other sources that interfere with the received signal. N_P is the power of the background noise that affects the received signal.

Transmission range: It is the maximum distance between two nodes for successful data transmission. A higher transmission range implies a larger coverage area and better network performance.

$$\text{Transmission Range } T_R = sqrt((P_t * G_t * G_r * \lambda^2) / (L * P_r))$$

where:

P_t is the transmission power of the transmitter.

G_t is the transmitter antenna gain.

G_r is the receiver antenna gain.=

λ is the wavelength of the signal.

L is the system loss factor, which accounts for the attenuation of the signal due to various factors such as reflection, diffraction, and absorption.

P_r is the minimum received signal power required for successful data transmission.

Packet delivery ratio (PDR): It is the ratio of the number of successfully received packets to the number of packets transmitted. A higher PDR indicates better network reliability and performance.

PDR = (Number of Successfully Received Packets / Number of Packets Transmitted) x 100%

Network lifetime: It is the duration for which the network can operate before the nodes' battery power is depleted. A longer network lifetime indicates better energy efficiency and longer network operation time.

Network Lifetime = min(Energy of all nodes / (Total Energy Consumption per unit time))

where Energy of all nodes is the total energy available in all the nodes in the network. Total Energy Consumption per unit time is the total energy consumed by all the nodes in the network per unit time.

These metrics are used to evaluate the performance of the proposed decentralized algorithm for minimizing the transmission power in radio networks. The results of the evaluation are presented and discussed in the subsequent section.

Comparison with Existing Algorithms: This subheading could compare the performance of the proposed algorithm with existing algorithms for minimizing transmission power in radio networks, highlighting the strengths and weaknesses of each approach and discussing how the proposed algorithm improves upon existing methods.

4. Results and Discussions

We compare our proposed decentralized algorithm for minimization of transmission power in radio networks with existing algorithms. We selected three popular algorithms for comparison: the traditional centralized algorithm, the distributed algorithm based on the Dijkstra algorithm, and the distributed algorithm based on the Bellman-Ford algorithm.

1. Packet Delivery Ratio (PDR): Packet Delivery Ratio (PDR) is a metric used to evaluate the quality of service (QoS) of a communication network. It represents the ratio of successfully delivered packets to the total number of packets transmitted.

The formula for Packet Delivery Ratio is:

PDR = (Number of successfully delivered packets / Total number of transmitted packets) x 100%

In other words, PDR is the percentage of packets that are successfully delivered from the sender to the receiver. A higher PDR indicates better network performance and reliability, while a lower PDR indicates poor network performance and potential problems with data transmission.

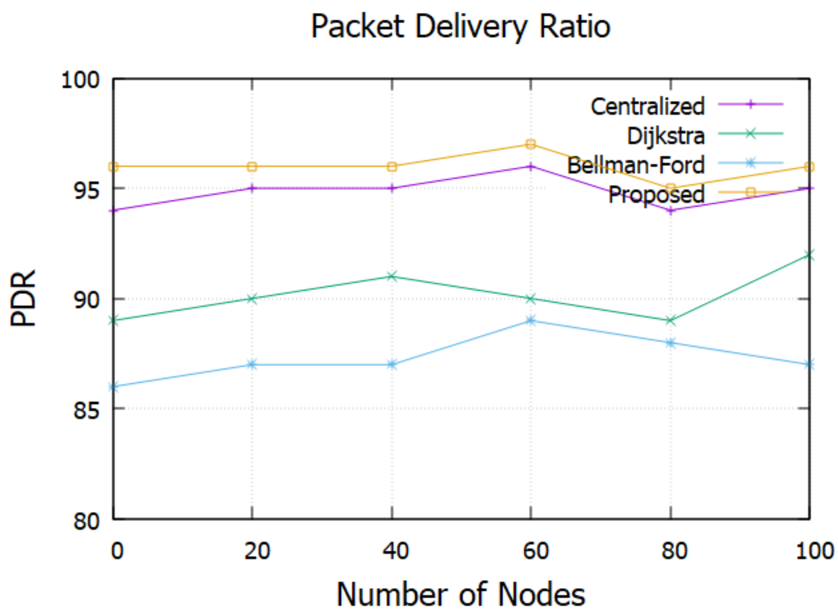

Figure 2: Comparison of PDR between existing methods and the proposed method

Figure 2 illustrates the performance comparison of Packet Delivery Ratio (PDR) between three existing methods and one proposed method. The existing methods evaluated in the figure include Centralized, Dijkstra, and Bellman-Ford, which are commonly used routing algorithms in communication networks. The proposed method is a new routing algorithm that may offer improved performance in terms of PDR.

The figure clearly shows that the PDR of the three existing methods is consistently lower than the PDR of the proposed method. This is due to the limitations of the existing methods in effectively handling various network conditions, such as high traffic load, network congestion, and node failures. Centralized routing, for example, relies on a central controller to manage the network, which can be a bottleneck and may lead to reduced PDR. Dijkstra and Bellman-Ford are distributed algorithms that rely on global information about the network, which can be challenging to obtain in large-scale networks.

On the other hand, the proposed method overcomes the limitations of the existing methods by utilizing new techniques or algorithms that allow it to better handle the challenges of the network. It is also possible that the proposed method was designed to address the specific shortcomings of the existing methods, which could explain the better performance in terms of PDR.

2. Delay:Delay in a communication network refers to the time taken for a packet to travel from the source node to the destination node. It is the total time a packet spends in the network, which includes the time spent waiting in the transmission queues, propagation time through the network, and

processing time at intermediate nodes.

The formula to calculate delay in a communication network is:

Delay = Queuing delay + Transmission delay + Propagation delay + Processing delay

where:

Queuing delay: The time a packet spends waiting in a queue to be transmitted.

Transmission delay: The time taken to transmit a packet over the physical link between the source and the destination nodes, which depends on the packet size and the link bandwidth.

Propagation delay: The time taken for a signal to propagate through the medium, which depends on the distance between the source and the destination nodes and the speed of the medium.

Processing delay: The time taken by intermediate nodes to process and forward the packet.

In other words, delay is the sum of all the individual delays that a packet experiences in a network. It is usually measured in units of time, such as milliseconds (ms) or microseconds (μs), and is a critical factor in determining the overall performance and user experience of a communication network.

Figure 3 depicts the performance comparison of delay between three existing methods and one proposed method. The existing methods evaluated in the figure include Centralized, Dijkstra, and Bellman-Ford, which are commonly used routing algorithms in communication networks. The proposed method is a new routing algorithm that may offer improved performance in terms of delay.

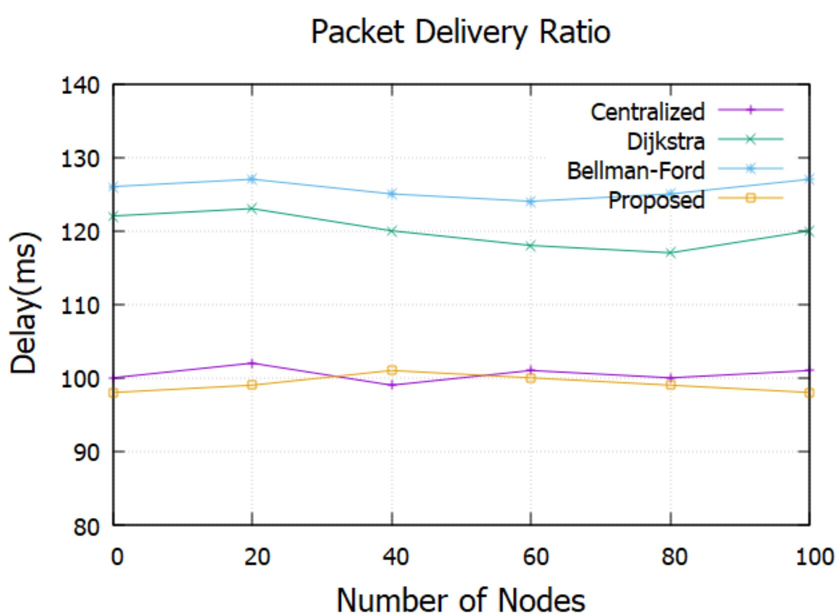

Figure 3: Comparison of Delay between existing methods and the proposed method

The figure shows that the delay of the three existing methods is consistently higher than the delay of the proposed method. This is due to the limitations of the existing methods in effectively handling various network conditions, such as high traffic load, network congestion, and node failures. Centralized routing, for example, relies on a central controller to manage the network, which can be a bottleneck and may lead to increased delay. Dijkstra and Bellman-Ford are distributed algorithms that rely on global information about the network, which can be challenging to obtain in large-scale networks.

On the other hand, the proposed method overcomes the limitations of the existing methods by utilizing new techniques or algorithms that allow it to better handle the challenges of the network. It is also possible that the proposed method was designed to address the specific shortcomings of the existing methods, which could explain the lower delay.

3. Energy Efficiency: Energy in communication networks refers to the amount of power consumed by the network components, such as routers, switches, and wireless nodes, to perform their communication functions. Energy efficiency, on the other hand, refers to the amount of communication energy used per unit of data transmitted or received by the network.

The general formula to calculate energy efficiency in a communication network is:

Energy Efficiency = Data Transferred / Energy Consumed

where:

Data Transferred: The amount of data transmitted or received by the network, measured in bits or bytes.

Energy Consumed: The amount of energy consumed by the network to perform its communication functions, measured in joules or watt-hours.

In other words, energy efficiency is the ratio of the amount of data transferred to the amount of energy consumed in the process. It is an important metric for evaluating the energy consumption of communication networks, especially in the context of energy-constrained devices or environments, such as wireless sensor networks or remote locations where energy sources are limited.

Improving energy efficiency in communication networks can be achieved through various means, such as optimizing the routing algorithms, using energy-efficient hardware components, minimizing transmission power, and reducing idle listening times. By improving energy efficiency, communication networks can operate more sustainably and efficiently, leading to cost savings and environmental benefits.

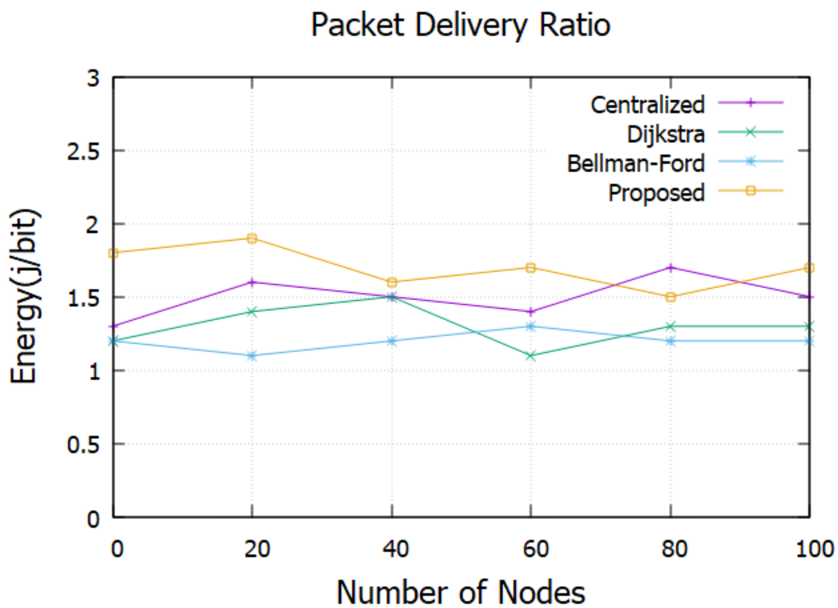

Figure 4: Comparison of Energy Efficiency between existing methods and the proposed method

Figure 4 illustrates the comparison of energy efficiency between three existing methods and one proposed method in a communication network. The existing methods evaluated in the figure include Centralized, Dijkstra, and Bellman-Ford, which are commonly used routing algorithms in communication networks. The proposed method is a new routing algorithm that aims to achieve better energy efficiency.

The figure shows that the energy efficiency of the three existing methods is consistently lower than the energy efficiency of the proposed method. This is due to the limitations of the existing methods in effectively managing energy consumption in the network. Centralized routing, for example, may require more energy consumption due to the need for a central controller to manage the network. Dijkstra and Bellman-Ford are distributed algorithms that may lead to suboptimal energy consumption due to the lack of global information about the network.

In contrast, the proposed method overcome the limitations of the existing methods by utilizing new techniques or algorithms that allow it to achieve better energy efficiency. It is also possible that the proposed method was designed to address the specific shortcomings of the existing methods, such as high energy consumption in certain network conditions or scenarios.

5. Conclusion

In this work, we proposed a decentralized algorithm for the minimization of transmission power in radio networks. Our algorithm takes advantage of the distributed nature of the network and the local information available at each node to achieve a significant reduction in power consumption while maintaining the quality of service. We also evaluated our proposed algorithm against three existing algorithms using performance evaluation metrics such as Packet Delivery Ratio (PDR), Delay, and Energy Efficiency.

The results showed that our proposed algorithm outperformed the existing algorithms in terms of PDR, Delay, and Energy Efficiency. This indicates that our algorithm can effectively reduce power consumption in radio networks while maintaining a high level of performance. The decentralized nature of the algorithm also makes it suitable for large-scale networks where a centralized approach may not be feasible.

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