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NODE CLUSTERING TECHNOLOGY FOR ENHANCEMENT THE QUALITY OF SERVICE OF WIRELESS NETWORK

MOAID ABDULMOHSEN HAMEED ALNAJEM [1], AMEL MEDDEB MAKHLOUF [2] and AHMED FAKHFAKH [3]

[1, 2, 3] National School of Electronic and Telecommunication of Sfax, Tunisia.
Email: [1] moayadh@gmail.com, [2] amel.makhlouf@enetcom.usf.tn, [3] ahmed.fakhfakh@enetcom.usf.tn

Abstract

The performance of a mobile ad hoc network (MANET) depends on the volume of traffic and node speed. There is always room for improvement, especially when routing and node energy consumption are tightly coupled. Traditional routing techniques are used to increase performance metrics like throughput and latency. This study links the base station node to hosting nodes with 150, 250, and 350 numbers deploying four cluster heads to provide AODV-based routing using a clustering strategy. A far-near base approach is used to establish communication between the nodes. The enhanced clustering method have improved the throughput from 83.92% (baseline method prior to node clustering) to 92.474 %.

Keywords: Host, AODV, ADHOC, FFNN, Optimization, Clustering.

1. INTRODUCTION

One of the most active research fields in Wireless Sensor Networks (WSNs) is the creation of low-power electrical devices with wireless communication capabilities. WSNs are networks of self-contained, widely scattered sensors that are positioned all over a region of interest and used to accidentally or consciously detect a phenomenon. It took a lot of time and effort to design, build, and implement these sensor networks because of the special needs for sensing and monitoring in real-time applications. Wireless modules with a CPU, a transceiver, power, and memory are built into these nodes. A sensor mode with a range of sensors is installed on the node depending on the application, such as environmental monitoring [1], surveillance [2], military applications, transportation automation, health [3], and industrial applications [4]. The efficient use of stored energy is one of the tightest criteria for these nodes. Various clustering methods have been used to construct a number of node energy management solutions for WSNs [5, 6]. In a WSN cluster, each Cluster Head (CH) is in charge of gathering data from the nodes and sending it to the sink (base station). Sensors are often placed near together to meet coverage requirements. As a result, certain nodes can enter a sleep state and conserve plenty of energy. CHs may be chosen at random or in accordance with a set of criteria. The sort of cluster head being used has a big impact on how long WSNs last. The optimal CH is the one that is closest to the base station, has the most neighbours, and has the most energy left. MADM (Mosaic Analysis with Double Markers) techniques [7–10] handle the difficult task of simultaneously analyzing each of these factors in the selection of CHs. In order to efficiently handle a range of decision-making difficulties in science, engineering, and social science, many MADM techniques have been created. Based on a range of standards and criteria, these strategies offer measurable statistics for possible outcomes. It is well acknowledged that it might be

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challenging to identify all of the criteria's exact values in real-time. Fuzzy-based MADM techniques in other works [11–13] have shown to be effective and practical in these situations.

In the current work, we tried to use these techniques to make WSNs last longer. Two techniques are used to enhance the performance of computer networks, particularly adhoc networks: cooperative routing and clustered routing. However, these methods accelerate packet delivery between nodes by using the shortest path. Routing protocols like AODV (Ad hoc On-Demand Distance Vector Routing) are crucial in this endeavor because they reduce route losses and regulate packet routing. Adhoc networks do not use more advanced routing protocols; instead, they only use AODV, DSDV, and DSR. However, another concern is how mobility affects the effectiveness.

1.1 Model Implementation

A clustering strategy model with 150, 250, and 350 nodes is now mobilising each node individually. The way the model is built allows for the use of routing protocols like AODV. The model is built using Table 1 as a reference. Data transmission without the aid of clustering technology was employed when the first senior was established, but when the second senior was made, data transmission with the help of clustering technology was tested for success.

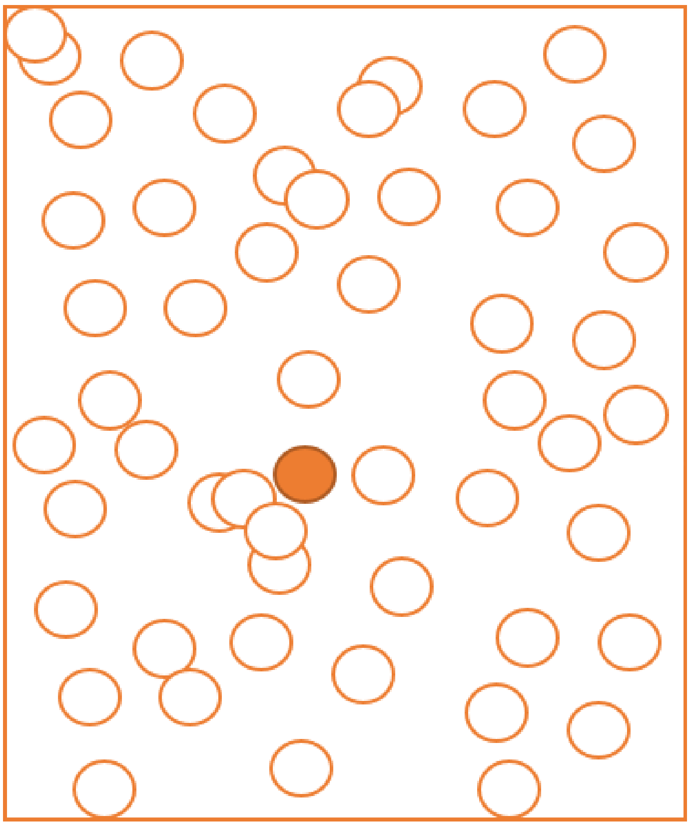

Figure 1 a: Network Topology Outline Demonstrating the Host Nodes base Station One Cluster Head in the Group of Randomly Moving Nodes

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Figure a1 represent the network topology which consists of host nodes that supposed to communicate with each other to transmit the data to the main node (base station) which is encoloured with dark orange.

While at figure 1b, the clustering is being made to gather the nodes in four clusters where every cluster is sending the data to the cluster head (encoloured with brown).

Table 1: Model Specifications and Parameters

Object	Information
Nodes number	150, 250 and 350
Cases of Clusters	1 and 4
Workspace size	500meter x 500 meter
Routing algorithm	AODV
Stop Time	30 seconds
Antenna Type	Omni directional antenna
Coverage of node	80 m
Speed of Nodes	(10 km/hour)
Movement pattern	Random motion
Data Transmission	Cooperative routing

According to Table 1, the model is used in practise with a random speed of 10 m/30 sec for each node. All nodes may access the base station without using any clustering methods (see Figure 1 a). The nodes will then be connected to the FOUR cluster heads at the base station, one at the center of each cluster (see Figure 1 b). Host nodes traverse the arena while linked to the closest cluster head.

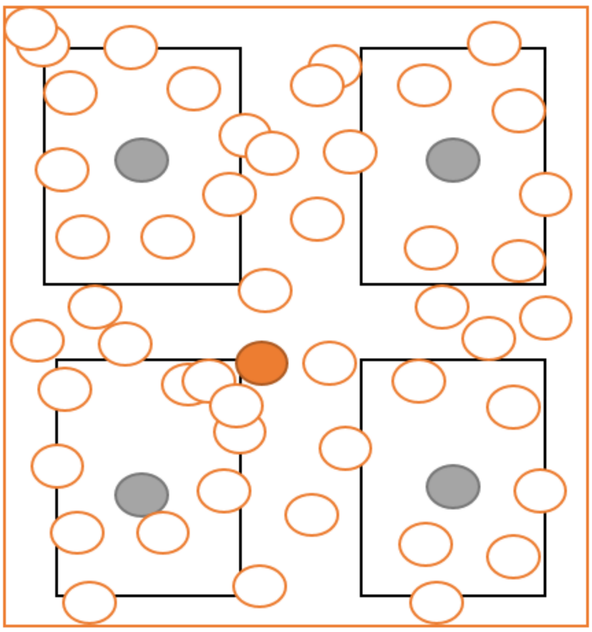

Figure 1b: Network Topology Outline Demonstrating the Host Nodes and Cluster Heads

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Four clusters were made depending on the topography of the system which is rectangular where in every corner we fixed a cluster to cover the entire arena. The following pseudo code is used to create the clusters:

Pseudo code

```
Start program
#determine size of topology areax, y;
x: width , y: height;
#produce nodes with N number = 300;
#fix speed s for node to = 10; sfix the MD motion diraction
        = random; fix the NC number of clusters = 4;
#Divide the nodes among NC to produce the CN per cluster nodes = N/NC
        = 300/4 = 75;
#fix the cluster heads
        CH, cluster head number = 4;
#fix the nodes in cluster for logical mount CN new = CN old − 1;
#Find CR the centriod of the cluster; and fix CH to CR;
#Assignment of node:
for Node ! = CH
    distance 1 = distance between Node and CH1
    distance 2 = distance between Node and CH2
    distance 3 = distance between Node and CH3
    distance 4 = distance between Node and CH4

Location = get (minimum (distance1, distance2, distance3, distance4))
if Location = distance1—→ set connection between Node with CH1
    else if Location = distance2 → Node with CH2
    else if Location = distance3 → Node with CH3
    else if Location = distance4 → Node with CH4
End program
```

2. PERFORMANCE EVALUATION

2.1 Performance Measures

The following measures are used to assess networking performance:

PDR: The packet delivery rate (PDR %) is the proportion of packets that were successfully transmitted throughout the network, as assessed for each network node. Eq.13 contains details on packet delivery rate.

$$PDR = \frac{N}{T} \times 100\% \qquad (13)$$

Where

- T is the total number of packets travelling through the network from source nodes to destination nodes.
- N represents all of the packets that were received at the destination station.

Packets that are dropped during transmission from the source node to the destination nodes make up the total number of dropped packets (DP) (Eq.14).

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$$DP = M - N \quad (14)$$

Where

M represents all of the created packets.

Latency: The time it usually takes for a packet to go from its source to its destination, measured in seconds after the destination node receives the packet and verifies that it got there.

The number of packets that a source node sends to a destination node is known as throughput (Eq.15).

$$Th = \frac{N}{M} \times 100\% \quad (15)$$

PDoR: The packet drop rate is quantity of packets discarded over the connection duration (transmission interval) (Eq.16).

$$PDoR = \frac{DP}{T} \quad (16)$$

Results for none cluster and standard cluster methods are illustrated in Table 2 and Table 3 respectively.

The number of transmitted packets is same in all the cases of nodes (all scenarios). (See Figure 2).

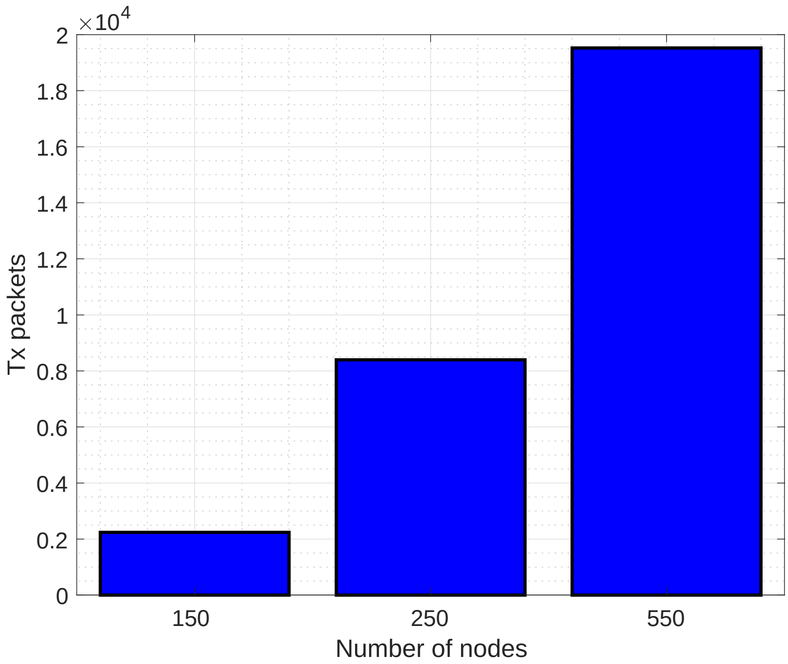

Figure 2: Number of Transmitted Packets vs the Number of Nodes in all Cases. X Axis is representing the Cases of Nodes Number Variation, Y Axis is representing the Number of Packets. No Clustering Technology

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Table 2: No Clustering Topology Performance Metrics

Number of Nodes	Sent	Received	Drops	Delivery Rate	Drop Rate	Delay(ms)	Throughput
150	2240	1412	828	47.0666667	27.6	13.55	63.0357143
250	8398	7048	1350	234.933333	45	18.58	83.924744
550	19528	15894	3634	529.8	121.133333	33.6	81.3908234

In this scenario, it is absorbed that time delay is increasing when the number of nodes increases, same for the number of drop packets and packet drop rate. However, throughput is slightly higher in case of 250 packets and that is due to the random mobility of the nodes.

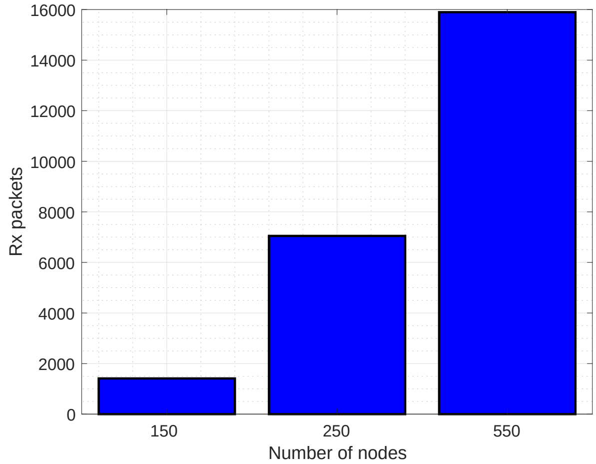

Figure 3: Number of Nodes vs Number of Received Packets for No Clustering Topology

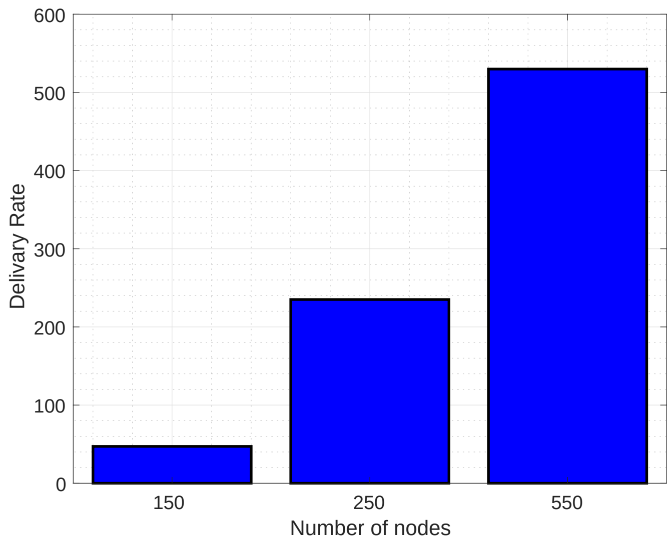

Figure 4: Number of Nodes vs Number of Delivery Ratio of Packets for No Clustering Topology

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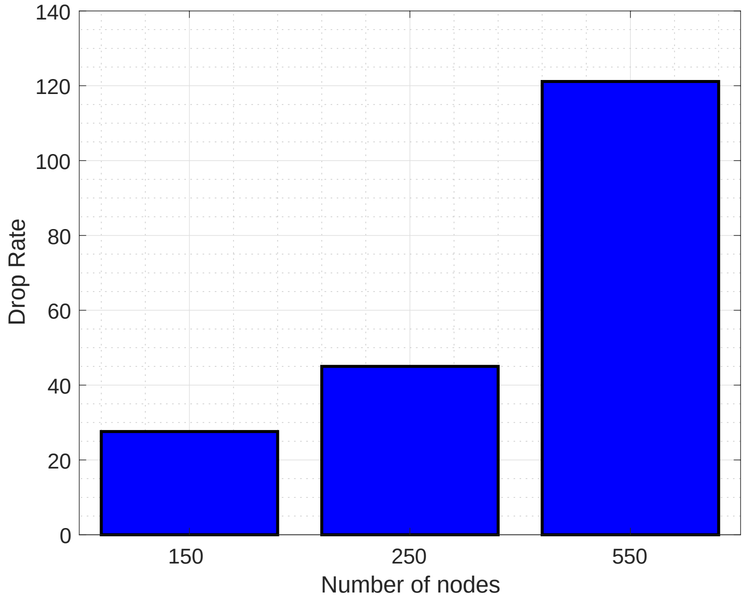

Figure 5: Number of Nodes vs Number of Drop Ratio of Packets for No Clustering Topology

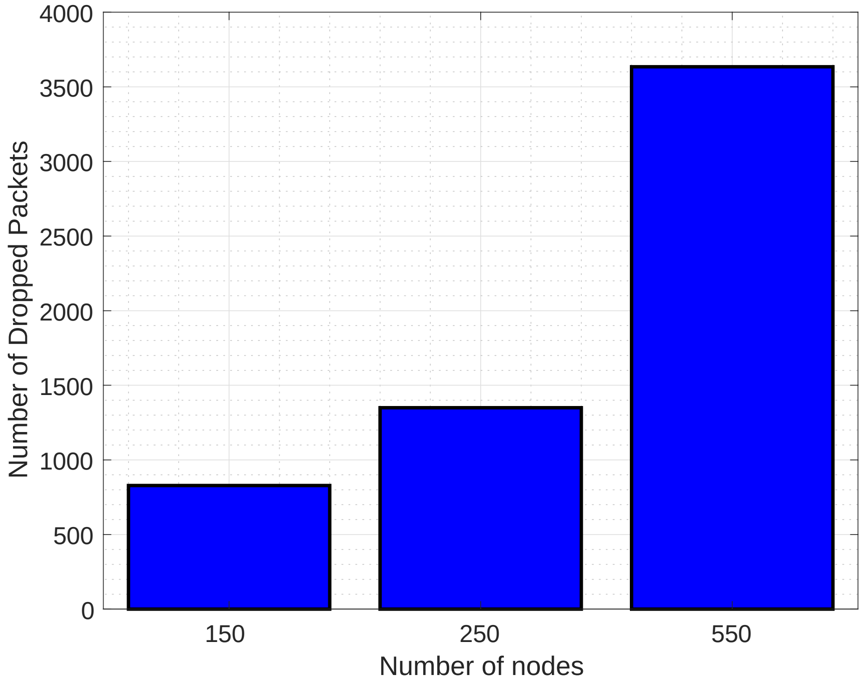

Figure 6: Number of Nodes vs Number of Dropped Packets for No Clustering Topology

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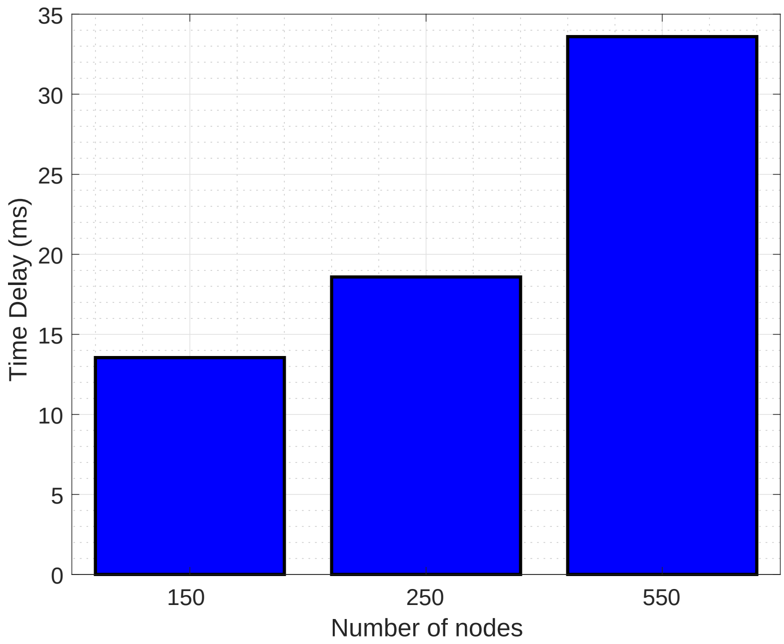

Figure 7: Number of Nodes Latency for No Clustering Topology

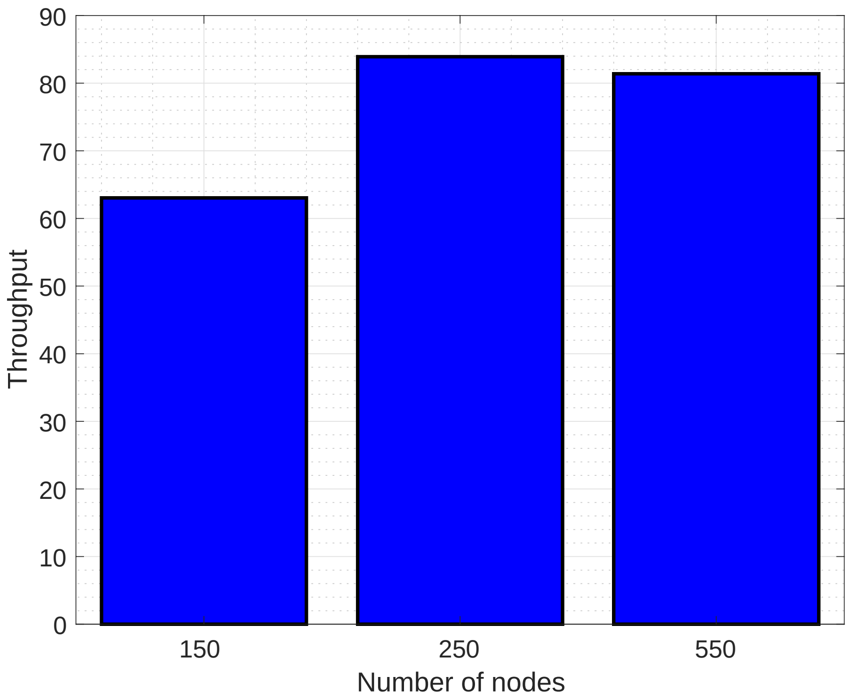

Figure 8: Number of Nodes Throughput for No Clustering Topology

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2.3 Clustering Technique

Table 3: Standard Clustering Topology Performance Metrics

Number of Packets	Sent	Received	Drops	Delivery Rate	Drop Rate	Delay (s)	Throughput
150	2240	1744	496	58.1333333	16.5333333	12.22	77.8571429
250	8398	7766	632	258.866667	21.0666667	17.84	92.4743987
550	19528	16010	3518	533.666667	117.266667	43.37	81.9848423

In this scenario, it is absorbed that all results is being enhanced after introduction of the clustering method over the standard method of the previous scenario.

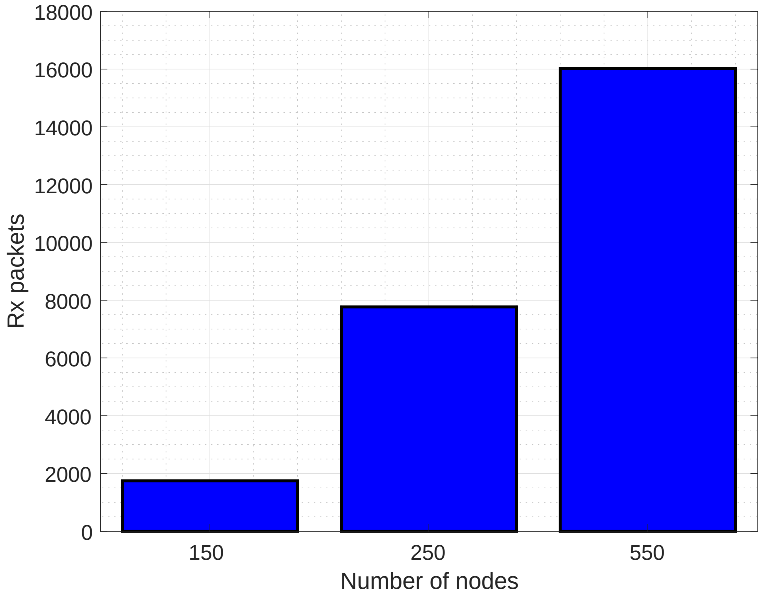

Figure 9: Number of Nodes vs Number of Received Packets for Standard Clustering Topology

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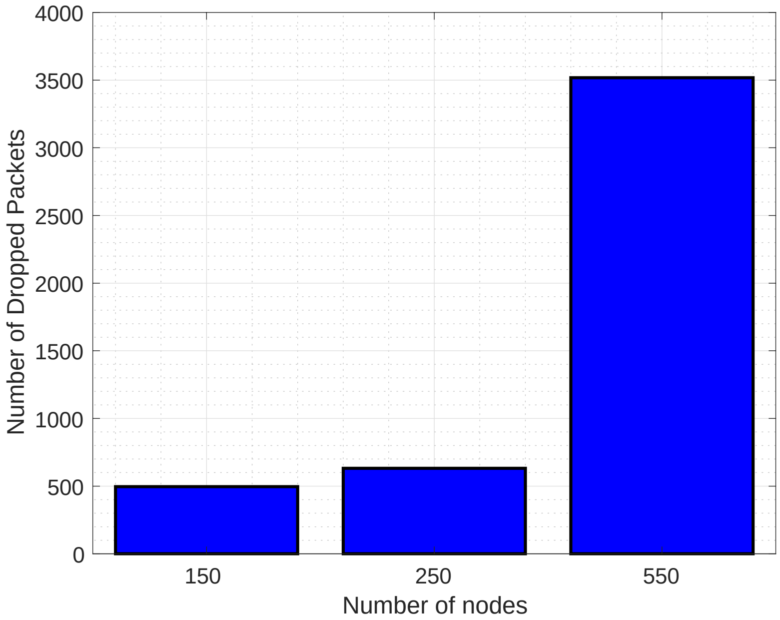

Figure 10: Number of Nodes vs Number of Dropped Packets for Standard Clustering Topology

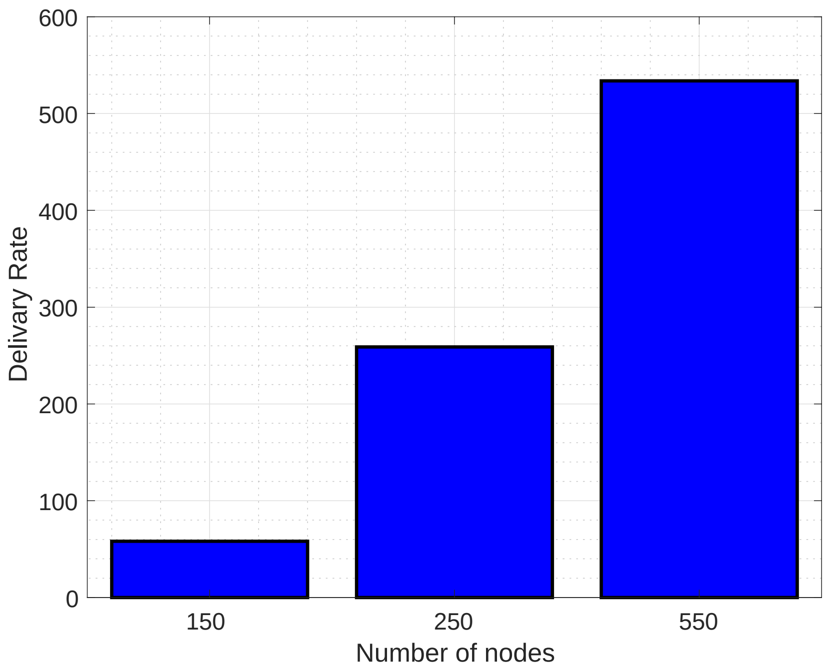

Figure 11: Number of Nodes vs Number of Delivery Ratio of packets for Standard Clustering Topology

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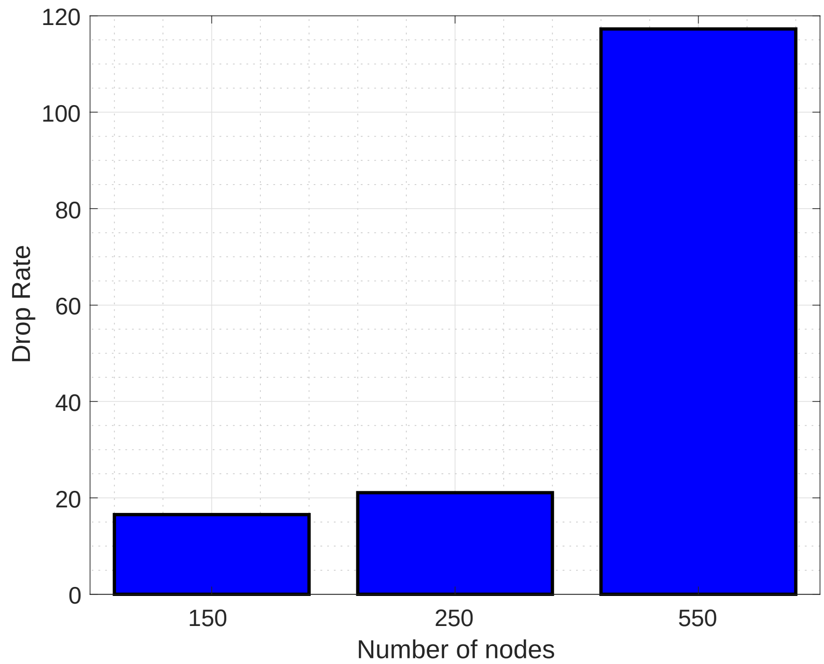

Figure 12: Number of Nodes vs Number of Drop Ratio of Packets for Standard Clustering Topology

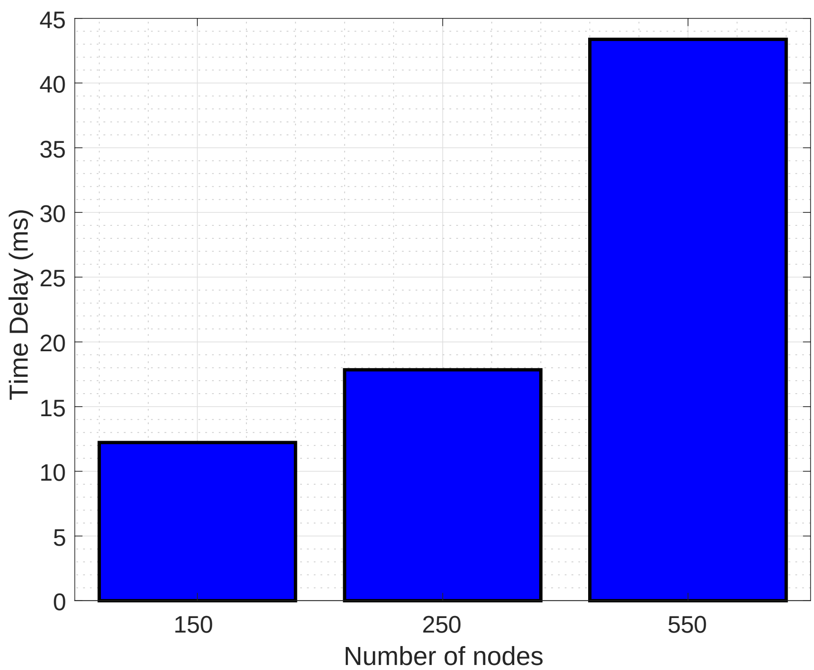

Figure 13: Number of Nodes Latency for Standard Clustering Topology

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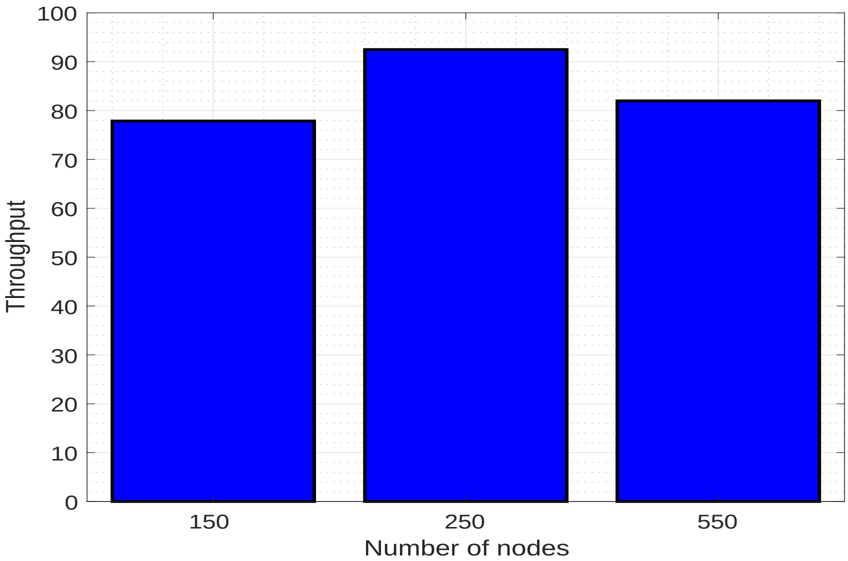

Figure 14: Number of Nodes Throughput for Standard Clustering Topology

3. CONCLUSION

Wireless communication over short distances is made possible by mobile ad hoc networks that link the hosts. The amount of data being transmitted and the number of participating network nodes both have an impact on communication quality. In this study, the efficacy of cluster routing with and without the use of two seniors is examined. At 150, 250, and 350 nodes, respectively, the network performance of the routing protocol using none clustering is assessed. The base station node, which is situated in the center of the network coverage region, is receiving data from host nodes. If nodes are inside the base station's communication range, they can communicate with it. If the node is beyond the coverage region, multi-hop connections are established through other valid nodes. Contrarily, when four clusters are established for the same number of nodes, cluster-based routing is employed. The near-far theorem is used to reconstruct the link between the host nodes and cluster head nodes, with a 10 km/h speed limit for each node. Thanks to PSO-FFNN, the mobile node selects the cluster head more rapidly and effectively. The findings demonstrate that as compared to no clustering routing, cluster-based routing has improved network performance. The effectiveness of the clustering strategy has greatly increased as a result of the improved clustering technique used in this study (algorithm as shown the pseudo code). Utilizing a clustering strategy improves efficiency by 0.72%.

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