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Efficient Optimization of Adaptive Transmission Range in Manets to Maximize the Packet Delivery Ratio

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Mobile Ad-hoc Network (MANET) is a self-systematized network, hasn't fixed infrastructure and centralized administration system. Due to the frequent changes in network topology, MANET nodes are free to change locations anywhere they like.

Novelty statement: Typically, mobile devices in MANET are configured identically to have same transmission ranges, homogeneously. Previous research proves the optimum homogeneous transmission range that maximizes Packet Delivery Ratio (PDR). Mostly, it has been shown inversely proportional to the node density, and transmission range itself along with its PDR is not being studied. This study aims to show that instead of using an optimum homogenous transmission range for all mobile nodes, a non-homogenous scheme, where optimum transmission range for each node is computed separately.

Material and Method: In order to validate the study, simulations were performed on the network simulator NS3 with node ranges of 25, 50, and 100 over an area of 500 m2. Destination Sequences Distance Vector (DSDV) Protocol was selected to perform simulations in which each scenario was executed for 300 seconds (5 minutes).

Result and Discussion: The evaluation of results show that the maximum PDR can be achieved by computing a separate transmission range for each node as compared to the homogenous transmission ranges.

Concluding Remarks: In the end, it can be concluded that adaptive transmission ranges are optimally effective as compared to homogenous transmission range.

Keywords: MANETs, Packet Delivery Ratio, Adaptive Transmission Range, Efficient Optimization.

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Introduction:

With the innovation of technology, communication devices have drastically transformed into an information society, moreover wired devices have been replaced with wireless systems like laptop, mobile phone, Bluetooth etc. Like, wireless based medium which consists of a centralized system, the wireless network too has various nodes integrated with a centralized system to communicate [1]. A movable based node was connected on a short-term network, which is an effective way to communicate devices with each other without any need for a centralized arrangement like a base station or an access point which is known as Mobile Ad-hoc Network (MANET) [2].

With the passage of time the importance of MANET due to their better performance and less complexity grew in demand, whose best example is Wireless Ad hoc Network (WANET) [3]. MANET is well-known because of its infrastructure less quality, quick deployment, moveable nodes, budgeted and self-organized scenarios [4][5] The key features in the growth of wireless communication are Ad hoc networks [6]. Ad-hoc networks are having multi-hop and dynamic topologies which are composed of bandwidth-constrained wireless links [7]. The purpose of mobile ad-hoc networking is to increase mobility into the realm of mobile, wireless domains & where a set of nodes by combined routers [8]. In MANET each device is free to move separately in any direction and will therefore frequently alter its connections to other devices.

MANET has a routable networking environment on top of an ad hoc Link Layer network. MANETs are peer-to-peer, self-forming, self-healing networks. MANETs typically communicate laptop development at radio frequencies (30MHz-5GHz) and 802.11/Wi-Fi since the mid-1990s. MANETs interact frequently at radio frequencies (3MHz - 5GHz). The growth of tablets and 802.11/Wi-Fi remote organization has made MANETs a well-known study topic [9] A View of MANETs has been shown by [10] in Figure 1, which shows how it works.

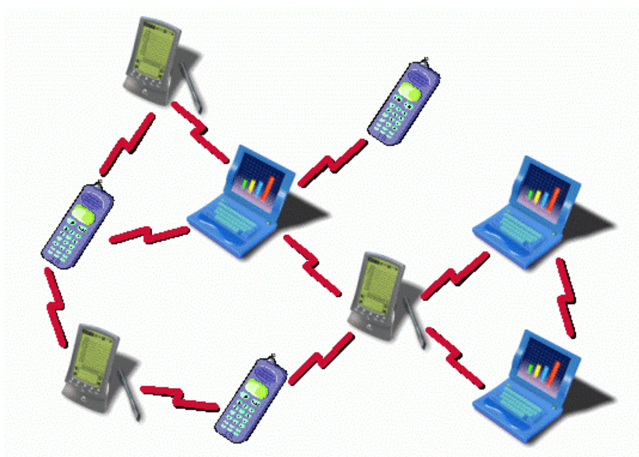


Figure 1. A view of MANET, how it is designed and work [10].

The mobile devices in a MANET were configured identically to have same transmission ranges, homogeneously, and minimum uniform transmission range were computed for an ad-hoc remote arrange where each router employed the identical transmission control by also keeping an ID of networks used with other router [11]. The homogenous transmission range system has a drawback where ideal packet size and interval time is to be identical. Moreover, it leads to nodes disconnected from a network and with too low transmission ranges it can lead to packet losses. Consequently, on a too high transmission range it can lead to starvation of nodes. By applying a better-optimized technique of non-homogenous transmission ranges for each node can prevent their packets, maximize the PDR and enhances the performance of the network. This research attempts to improve the performance of MANET by enhancing PDR: the proportion of total packets delivered to the total packets transmitted across the network from source node to destination node.

Novelty statement:

Mobile devices in MANET are often homogeneously equipped with identical transmission ranges. The most homogenous transmission range for maximizing Packet Delivery Ratio has been demonstrated by prior studies. It has often been demonstrated to be inversely related to node density, and neither the transmission range nor its PDR are being researched. This study attempts to demonstrate that a non-homogeneous system, where the optimal transmission range for each node is computed independently, is preferable to employing an optimal homogenous transmission range for all mobile nodes.

Objectives:

The main goal of this research is to develop scenarios with both homogeneous and non-homogenous optimal transmission ranges for characteristics that fluctuate. Furthermore, this research also aims to recreate the scenario in the Network Simulator 3 (NS3) and compare the results to determine whether PDR method is more effective.

Literature Review:

The existing literature basically consists of mostly homogenous transmission ranges and their effects on the energy factor and while using some energy routing protocols. Some of the literature is devoted to the adaptive transmission ranges which is limited for the calculation of the exact intervals of message hello in MANETs.

Hajek [12] proposed that the start of each transmission should be dynamic & adjustable. To reach an adjoining node oriented towards the intended destination node, the routing strategy implemented was adjustment of nodes transmission. When applied to the low-cost, resource-constrained nodes that are being investigated, this technique has one obvious disadvantage. This routing approach necessitated that the transmitting node be aware of the proposed destination node's direction. The adaptive transmission range technique, on the other hand, resulted in each node having an optimal number of close to three (3) neighbour's, according to the mathematical modelling done in this study.

Ansari [13] provided the simulation study for an adaptive power system for transmitting the node packets to the other nodes through ATP-AODV routing protocols in MANET using several power techniques such as constant power, common power or higher power. The findings of the performance analysis showed that using the ATP-AODV protocol saved a large amount of energy, which can extend the network's lifetime. The research was extremely useful in demonstrating the superiority of the ATP-AODV protocol over the AODV protocol in terms of energy utilization. It was proposed that ATP-AODV be updated to boost the issue of ATP-latency AODV's per data packet by selecting a route across less congested network areas.

Energy optimization of nodes was often taken as the metric norm during the routing process, according to [14]. This allows nodes to complete route selection quickly and efficiently, ensuring data transmission reliability. The enhanced scheme balanced the network's energy consumption that has significant advantages in terms of packet delivery ratio and throughput, and extended the network's lifespan, according to simulation findings.

Nagpal [15] conducted the study about the impact of MANET's flexible transmission spectrum on energy savings. The performance analysis was based on both routing protocols; Minimum Total Power Routing (MTPR) and Minimum Hop Routing (MHR). Based on the outcomes and analysis, MHR energy consumption was higher than MTPR as it took a route that attempted to decrease the amount of nodes to reach its endpoint. Whereas in the event of

MTPR, it selected a route that tried to decrease the complete power consumption from source to endpoint. The comparison inquiry handed over shows that the adjustable transmission extension has the option of reducing control of use or productive vitality of mobile hoc advertising systems. The findings of this study provide a strong reason for the use of adjustable transmission running in the forthcoming mobile advertising hoc arrangement and acknowledge the adjustable transmission extension is more suitable to the needs of flexible advertising hoc organization, their gadgets and applications.

Park [16] conducted the study about mobile ad-hoc networks (MANETs), for maintaining the link connectivity and to detect the neighbour nodes they use hello messages. In a usual MANET routing scheme, there is a fixed interval for broadcasting hello messages. However, a fixed hello interval creates a lengthy delay in neighbourhood detection (too long hello intervals) or more bandwidth waste due to unnecessary overhead protocol (too brief hello intervals) can trigger a fixed message hello interval. This article investigated the effect of node velocity and transmission range on hello intervals in terms of network throughput. Through the main objective of this paper was to perform some simulations for a mobile ad-hoc network using AODV routing protocol, which showed that determining the maximization of network throughput as a function of node speed and transmission range. In this document, the scientists Park used the transmission variety to determine the set interval of hello texts that creates some delays in neighbour detection only.

Porto and Stojanovic [17] proposed the technique to increase the energy efficiency by optimizing the transmission power of the nodes. The optimal power was the minimal power that still guaranteed connectivity between each node and the sink. Simulation results showed that this transmission power also results in throughput maximization was being studied.

In some of the studies accomplished by various authors, the outcome of the study had shown that if the transmission range is not aligned, the packet can hold the medium of all transmissions for a very longer period which can lead to the decrease of the overall network. The influence of the transmission range was analysed by the average setting time - the time at which all nodes in the network finish, this theory being studied for the optimal transmission radius for flooding in large scale networks [18]

The scope of this research was not to change the protocols itself but changing the various scenarios of both homogenous and non-homogenous and achieve and compare the results for both homogenous and non-homogenous ranges and the nodes have also given static ranges thus it has no mobility. The study is also important to conduct because previously authors had studied about transmission range, in which the range was being adaptive for only routing protocols, and only in terms of energy, while some studies have discussed transmission range for keeping the nodes alive and some studies have transmission ranges either used short transmission range or long transmission range for clustering, that reduce the density of MANETs. Optimization of the mentioned transmission ranges also validated in this research which maximizes the network PDR.

Methodology:

Firstly, for the comparison of various scenarios of both homogenous and non-homogenous ranges, Network Simulator 3 (NS3) [19][20] was used to achieve the maximum achievable PDR by changing the transmission range of all the nodes homogeneously. Afterwards, maximum achievable PDR was attained by changing the transmission ranges of each node adaptively depending upon its local node density. The adaptive transmission ranges were calculated by generating nodes in a geographical area considering normal distribution and then the distance between the nodes through the basic distance formula was calculated based on their node density. The generation of adaptive transmission ranges, which comprised of sorting of the distances between the nodes, resulted a different transmission range for each node considering at least 2 nodes in a neighbour. In the end comparative analysis between the adaptive and homogeneous ad-hoc networks was conducted in NS3 simulator. The work flow of study is demonstrated in Figure 2.

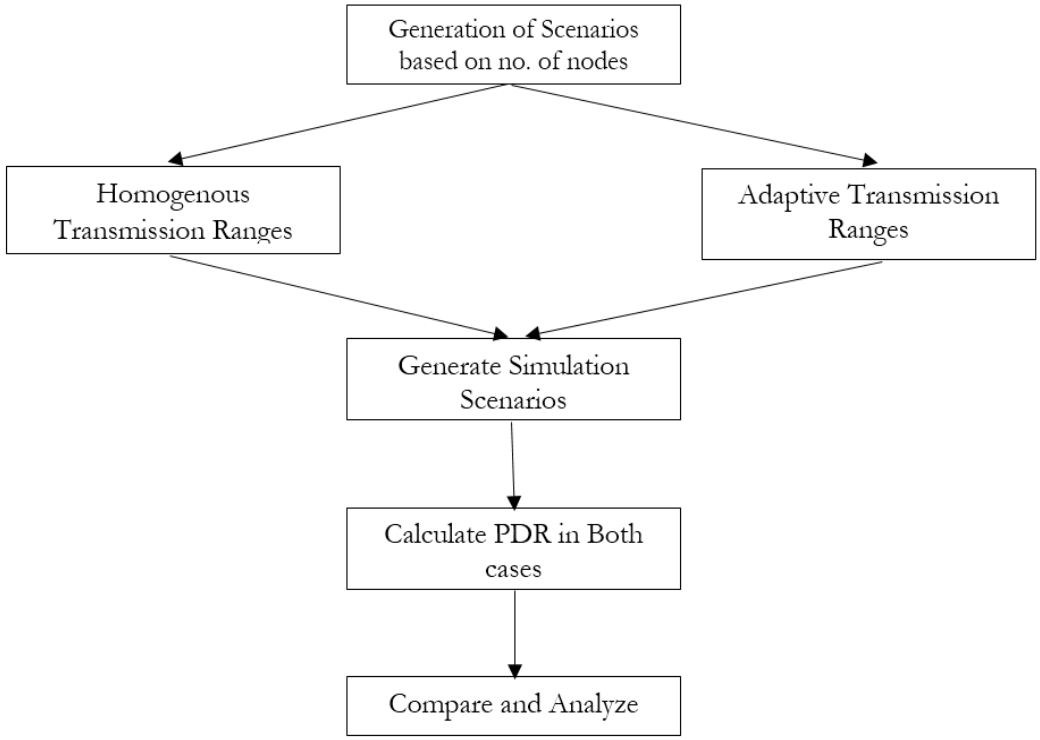


Figure 2: Study work Flow.

Simulation Parameters:

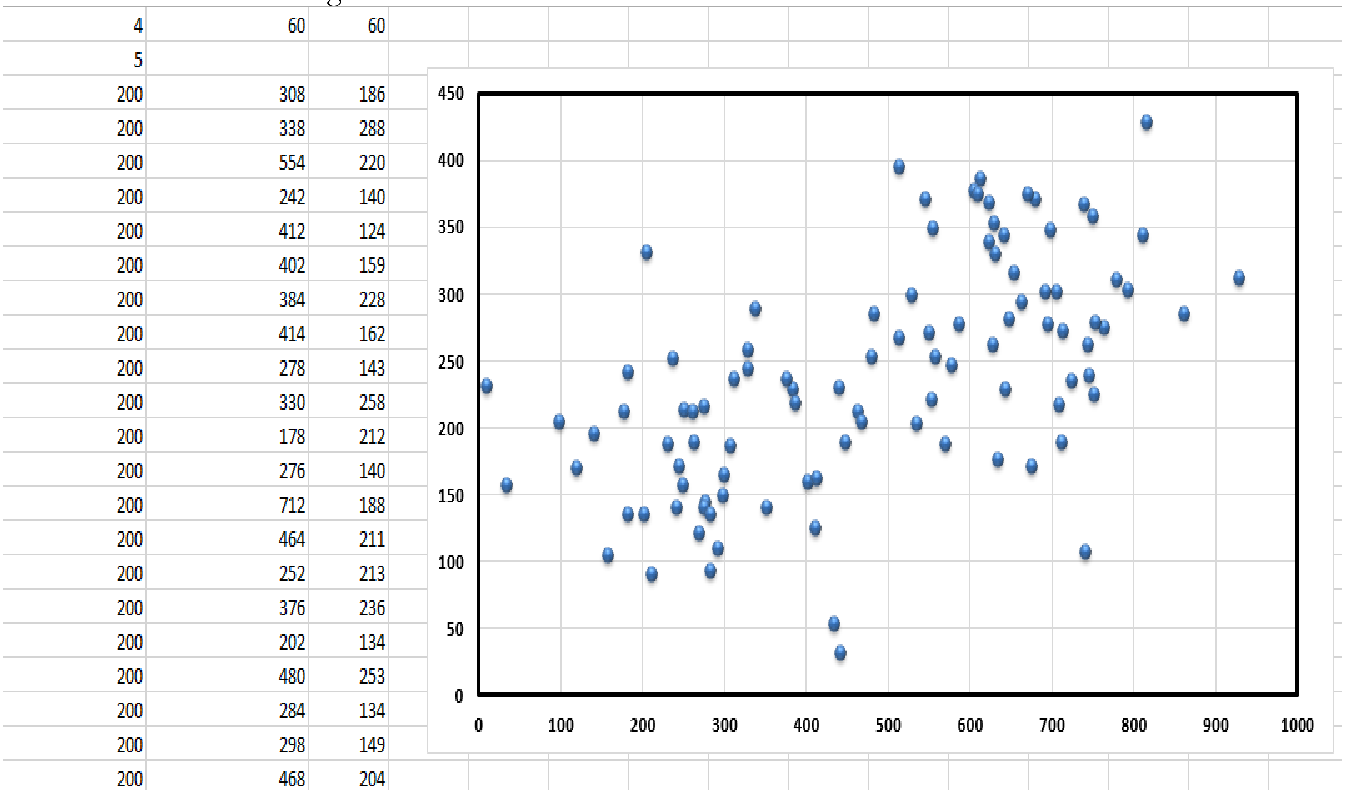
Different parameters were used to comprehensively simulate MANET scenario with Homogenous transmission ranges and Non-homogenous Transmission ranges. These parameters describe the characteristics and behaviour of ad hoc network. The following simulation scenario consists of 25, 50, and 100 mobile nodes with different areas of about 250 x 250, 250 x 500 and 500 x 500. Platform of Ubuntu 16 and protocol type was DSDV which is a hop-by-hop vector routing protocol requiring each node to periodically broadcast routing updates. The buffer size is set to 50 packets while simulation duration was set to 300 seconds (5 minutes) for all the scenarios. Different values of Transmission range for each scenario in homogenous were used in this study. The traffic generation type used was CBR. All of the mentioned Parameters are reflected in Table 1.

Table 1. Simulation Parameters

Parameters	Values
Simulator	Network Simulator 3
Platform	Ubuntu 16
No of Nodes	25, 50, 100
Area (sq. meter) per node	250 x 250, 250 x 500, 500 x 500
Data Traffic Model	CBR / UDP
Packet size	512 bytes
Buffer/Queue Size	50 packets
Simulation Time	300 sec
Protocol Type	DSDV

Mac Protocol	802.11b
Mobility model	No Mobility in the model

The generation of the nodes were achieved which is shown in Figure 3. The distance between the nodes is represented in Figure 4 and the adaptive transmission ranges for the nodes are shown in Figure 5.



4	60	60
5		
200	308	186
200	338	288
200	554	220
200	242	140
200	412	124
200	402	159
200	384	228
200	414	162
200	278	143
200	330	258
200	178	212
200	276	140
200	712	188
200	464	211
200	252	213
200	376	236
200	202	134
200	480	253
200	284	134
200	298	149
200	468	204

Figure 3. Shows the generation of nodes.

=SQRT((D$2-$C4)*(D$2-$C4)+(D$1-$B4)*(D$1-$B4))

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
1				308	338	554	242	412	402	384	414	278	330	178	276	712
2				186	288	220	140	124	159	228	162	143	258	212	140	188
3	1	308	186	0.0	106.3	248.3	80.4	121.1	97.8	86.8	108.7	52.4	75.3	132.6	56.0	404.0
4	2	338	288	106.3	0.0	226.5	176.4	179.9	144.0	75.6	147.1	156.9	31.0	177.1	160.5	387.1
5	3	554	220	248.3	226.5	0.0	322.1	171.4	163.8	170.2	151.5	286.5	227.2	376.1	289.3	161.2
6	4	242	140	80.4	176.4	322.1	0.0	170.8	161.1	167.1	173.4	36.1	147.2	96.3	34.0	472.4
7	5	412	124	121.1	179.9	171.4	170.8	0.0	36.4	107.7	38.1	135.3	157.1	250.0	136.9	306.8
8	6	402	159	97.8	144.0	163.8	161.1	36.4	0.0	71.3	12.4	125.0	122.4	230.2	127.4	311.4
9	7	384	228	86.8	75.6	170.2	167.1	107.7	71.3	0.0	72.5	135.9	61.8	206.6	139.3	330.4
10	8	414	162	108.7	147.1	151.5	173.4	38.1	12.4	72.5	0.0	137.3	127.6	241.2	139.7	299.1
11	9	278	143	52.4	156.9	286.5	36.1	135.3	125.0	135.9	137.3	0.0	126.2	121.5	3.6	436.3
12	10	330	258	75.3	31.0	227.2	147.2	157.1	122.4	61.8	127.6	126.2	0.0	158.8	129.8	388.4
13	11	178	212	132.6	177.1	376.1	96.3	250.0	230.2	206.6	241.2	121.5	158.8	0.0	121.6	534.5
14	12	276	140	56.0	160.5	289.3	34.0	136.9	127.4	139.3	139.7	3.6	129.8	121.6	0.0	438.6
15	13	712	188	404.0	387.1	161.2	472.4	306.8	311.4	330.4	299.1	436.3	388.4	534.5	438.6	0.0
16	14	464	211	158.0	147.7	90.4	233.1	101.4	80.9	81.8	70.0	198.0	142.0	286.0	201.0	249.1
17	15	252	213	62.2	114.1	302.1	73.7	183.1	159.4	132.8	169.8	74.7	90.0	74.0	76.8	460.7
18	16	376	236	84.4	64.4	178.7	164.8	117.6	81.3	11.3	83.2	135.1	51.0	199.4	138.6	339.4
19	17	202	134	118.1	205.5	362.4	40.4	210.2	201.6	204.8	213.8	76.5	178.2	81.6	74.2	512.9
20	18	480	253	184.6	146.2	81.0	263.5	145.8	122.1	99.2	112.4	230.0	150.1	304.8	233.2	240.9
21	19	284	134	57.3	163.2	283.4	42.4	128.4	120.6	137.2	133.0	10.8	132.3	131.6	10.0	431.4
22	20	298	149	38.3	144.6	265.7	56.7	116.7	104.5	116.8	116.7	20.9	113.6	135.5	23.8	415.8
23	21	468	204	161.0	154.8	87.5	234.9	97.7	79.9	87.4	68.4	199.6	148.2	290.1	202.4	244.5

Figure 4. Shows the distances between the nodes.

Node	X	Y	0	1	2	3	4	5	6	7	8	9	10	11	12
1	308	186	0.0	23.4	38.3	43.2	44.1	50.2	52.4	52.8	56.0	57.3	62.0	62.2	63.7
2	338	288	0.0	31.0	44.7	58.1	64.4	75.6	86.0	95.8	106.3	106.6	107.5	114.1	117.3
3	554	220	0.0	24.8	32.2	35.4	36.7	50.2	61.7	66.4	81.0	81.6	84.6	87.5	90.4
4	242	140	0.0	17.9	31.3	34.0	34.4	36.1	40.4	42.4	48.1	53.7	56.7	58.3	58.8
5	412	124	0.0	36.4	38.1	62.1	73.4	74.3	97.0	97.7	97.7	101.4	107.7	109.6	116.7
6	402	159	0.0	12.4	36.4	53.5	54.4	60.6	71.3	79.9	80.5	80.9	81.3	97.8	102.1
7	384	228	0.0	10.8	11.3	56.0	56.3	61.8	71.3	72.4	72.5	75.5	75.6	81.8	86.8
8	414	162	0.0	12.4	38.1	42.8	61.7	65.8	68.4	70.0	72.5	72.8	83.2	108.7	110.8
9	278	143	0.0	3.6	10.8	20.9	24.4	30.4	30.9	36.1	36.8	42.5	48.1	51.4	52.4
10	330	258	0.0	14.0	28.4	31.0	51.0	61.8	69.0	70.5	75.3	82.1	90.0	92.3	95.5
11	178	212	0.0	29.3	39.8	59.5	71.6	72.2	74.0	78.1	79.4	80.4	81.6	84.0	89.0
12	276	140	0.0	3.6	10.0	20.9	23.8	30.5	33.9	34.0	34.9	43.1	48.7	50.4	56.0
13	712	188	0.0	28.1	40.2	48.5	53.8	60.5	78.9	79.1	80.6	84.0	87.3	90.4	99.3
14	464	211	0.0	8.1	28.0	30.6	44.9	70.0	72.4	75.1	75.7	76.3	80.9	81.8	90.4
15	252	213	0.0	10.0	24.1	26.8	32.8	40.5	42.4	57.0	62.2	64.3	68.6	73.7	74.0
16	376	236	0.0	11.3	21.6	46.7	51.0	64.0	64.3	64.4	81.3	83.2	84.4	86.5	91.5
17	202	134	0.0	20.0	40.4	45.1	52.8	53.3	57.5	60.9	69.4	74.2	76.5	81.6	82.0
18	480	253	0.0	31.3	36.8	44.9	46.1	50.4	67.3	72.0	72.4	75.1	78.0	81.0	98.2
19	284	134	0.0	10.0	10.8	19.8	20.5	26.2	34.0	40.5	42.0	42.4	53.0	57.3	58.5
20	298	149	0.0	15.1	20.5	20.9	23.8	38.3	40.3	40.4	48.5	52.5	54.7	56.5	56.7
21	468	204	0.0	8.1	25.6	38.2	50.4	68.0	68.4	78.0	79.9	81.2	81.6	87.4	87.5

Figure 5. Shows the adaptive transmission ranges for the nodes.

Simulation Results:

The simulation results that were carried out using Network Simulator 3 (NS-3). These simulation results were based on 25, 50 and 100 nodes with different Area (sq. meter) per node of 250 x 250, 250 x 500 and 500 x 500. The performance of these nodes on homogenous and non-homogenous were measured on the performance metrics as described below:

Packet Delivery Ratio (PDR):

The PDR is defined as the number of data packets received divided by the number of data packets sent. PDR shows the efficiency of MANET which shows the best-chosen transmission range. The PDR is assumed to be better for non-homogenous scheme comparatively to Homogenous scheme which is proved from the results of this study in which the higher PDR for Non- Homogenous transmission range is achieved.

Packet Delivery Ratio (PDR %) For 25 Nodes:

From the Table 2., it is clearly evident that the 25 nodes in a geographical area of 250 x 250 in non-homogenous transmission range the PDR is 98% as compared to homogenous transmission range which shows the transmission ranges are being increased gradually.
The plotted graph shown in figure 6 is between the transmission ranges and PDR which shows the results for 25 nodes.

As can be observed from the data, the adaptive transmission range provides greater PDR than the homogeneous case because of the range expansion. When considering the adaptive scenario, the maximum PDR is 98%, and with even five or six neighbouring nodes, its minimum PDR is still 78%, which is still better and more ideal than the homogenous approach. Homogenous transmission range gives the maximum PDR until 91% and after a certain range, the PDR drops to 64%.

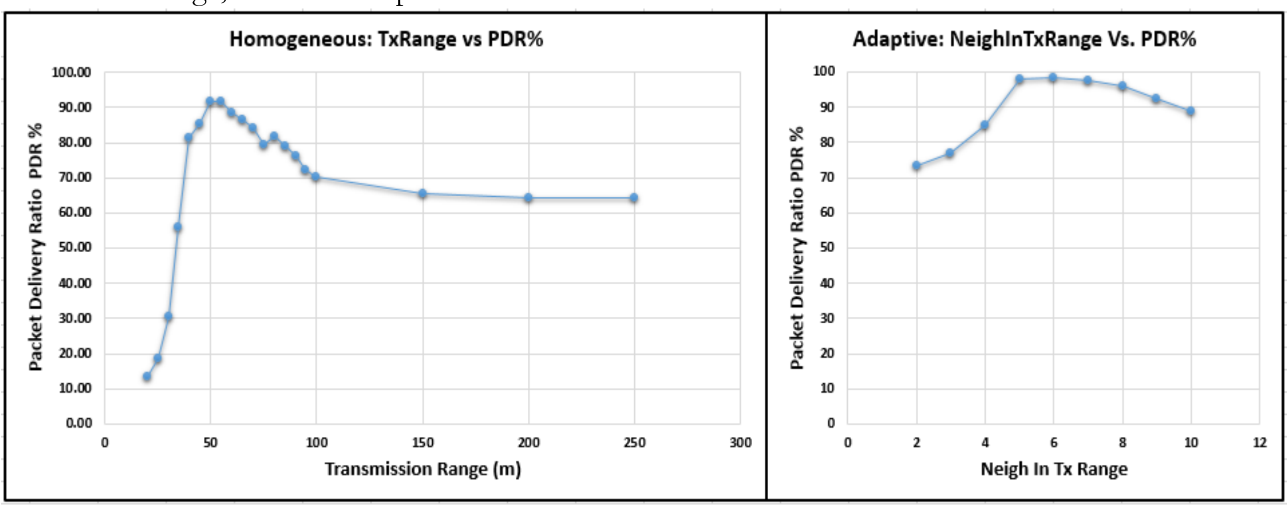


Figure 6. A graph showing PDR for 25 Nodes in 250 x 250 meters.

Table 2. Simulation results for 25 nodes.

Nodes: 25				
Area: 250 x 250				
Homogenous Transmission Range			Adaptive Transmission Range	
Transmission Range	Average Neighbor	PDR%	Neighbor In Range (at least)	PDR%
20	1.16	13.54	2	73.46
25	1.80	18.61	3	76.88
30	2.56	30.44	4	84.93
35	3.64	55.82	5	98.03

40	5.04	81.49	6	98.52
45	6.04	85.30	7	97.66
50	7.18	91.88	8	95.87
55	8.76	91.89	9	92.39
60	10.20	88.42	10	89.01
65	11.98	86.71		
70	13.64	84.03		
75	15.24	79.59		
80	17.10	81.66		
85	18.86	78.92		
90	20.88	76.41		
95	22.56	72.13		
100	24.62	70.12		
150	41.24	65.48		
200	54.20	64.33		
250	66.12	64.33		

Packet Delivery Ratio (PDR %) for 50 Nodes:

The graph in figure 7. shows the results for 50 nodes, the comparison results can be seen in the table 3.

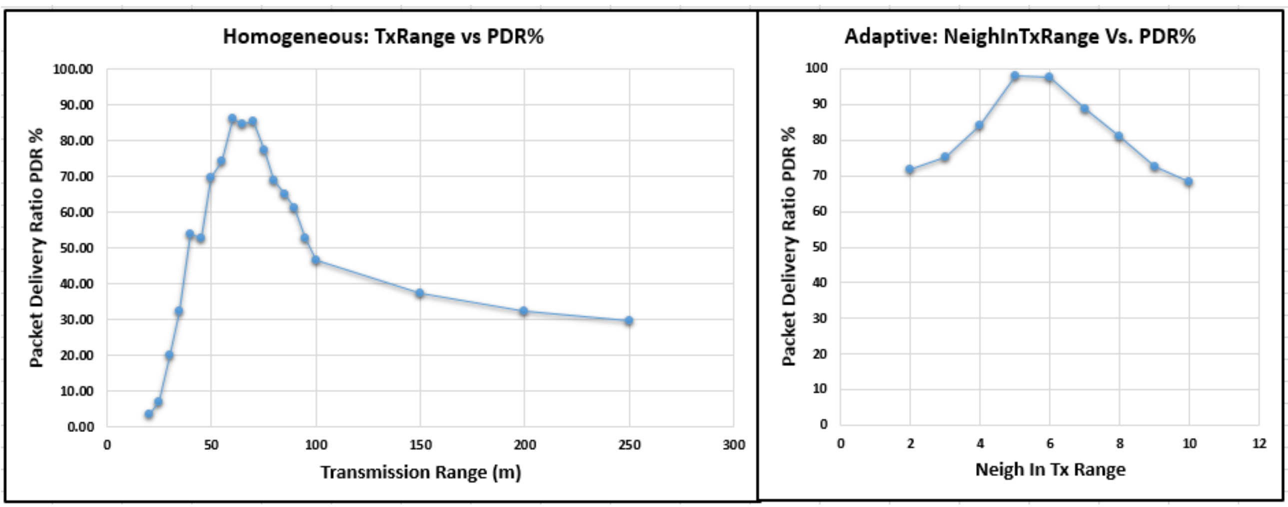


Figure 7. A graph showing PDR for 50 Nodes in 250x 500 area.

Table 3. Simulation results for 50 nodes.

Nodes: 50				
Area: 500 x 250				
Homogenous Transmission Range			**Adaptive Transmission Range**	
Transmission Range	**Average Neighbor**	**PDR%**	**Neighbor In Range (at least)**	**PDR%**
20	1.08	3.58	2	71.84
25	1.60	7.06	3	75.46
30	2.20	19.93	4	84.33
35	2.96	32.46	5	98.21
40	4.16	54.03	6	97.69
45	5.12	52.66	7	88.79
50	6.00	69.53	8	81.26
55	6.96	74.20	9	72.44

60	8.28	86.06	10	68.34
65	9.92	84.54		
70	11.00	85.43		
75	12.36	77.53		
80	13.76	68.77		
85	15.20	65.16		
90	16.84	61.09		
95	18.00	52.88		
100	18.88	46.79		
150	27.68	37.43		
200	35.36	32.41		
250	42.40	29.51		

As can be seen from the results for this scenario, the maximum PDR for a homogeneous transmission range is 86%, and continuing the same pattern of increasing the transmission range at too high a range results in a decrease in the PDR to as low as 29%. However, the results for an adaptive scenario show a maximum PDR of 98% and a minimum PDR of 68%, which is a better result.

Packet Delivery Ratio (PDR %) for 100 Nodes:

The figure 8 demonstrate the result for biggest scenario for this study which shows a clear result of higher PDR for non-homogenous transmission range. The comparison results are given in Table 4. According to the data for this particular case, the maximum PDR for homogeneous transmission range is 93%, and the PDR drops to 55% as the range is increased. Comparatively, the adaptive scenario outperforms the homogeneous scenario in terms of maximum PDR, which may reach 98% and as low as 89%.

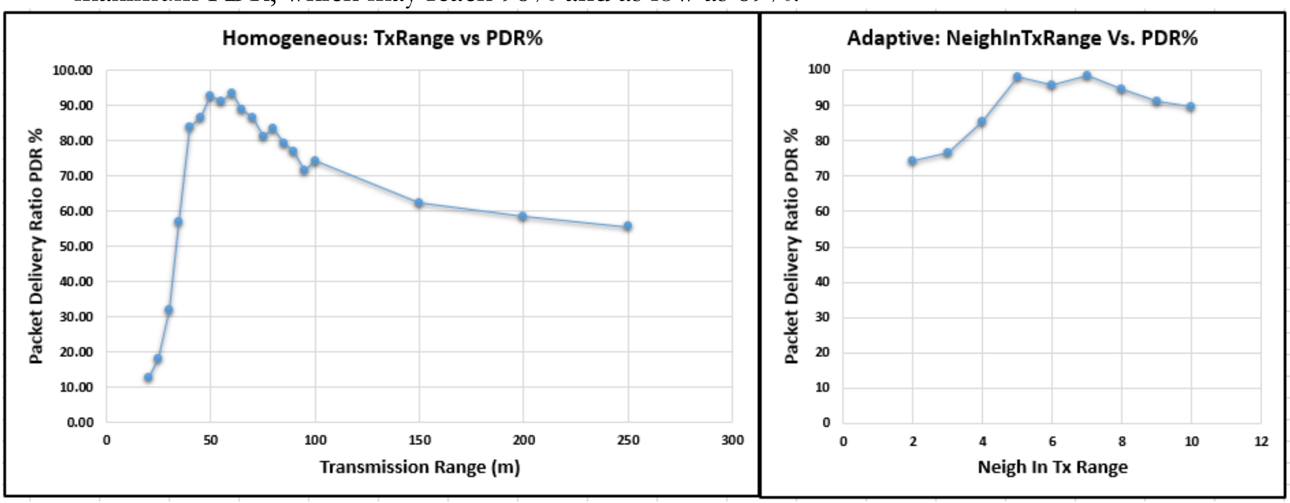


Figure 8. A graph showing results for 100 nodes in 500 x 500 area.

Table 4. Simulation results for 100 nodes.

Nodes: 100				
Area: 500 x 500				
Homogenous Tx Range			**Adaptive Tx Range**	
Transmission Range	**Average Neighbor**	**PDR%**	**Neighbor In Range (at least)**	**PDR%**
20	1.16	12.58	2	74.38
25	1.80	17.99	3	76.54
30	2.56	31.83	4	85.33

35	3.64	57.11	5	98.28
40	5.04	83.80	6	95.63
45	6.04	86.44	7	98.34
50	7.18	92.72	8	94.66
55	8.76	91.34	9	91.36
60	10.20	93.56	10	89.72
65	11.98	88.75		
70	13.64	86.56		
75	15.24	81.11		
80	17.10	83.37		
85	18.86	79.35		
90	20.88	76.96		
95	22.56	71.63		
100	24.62	74.26		
150	41.24	62.54		
200	54.20	58.43		
250	66.12	55.64		

Discussion:

The simulation results of transmission ranges for nodes 25, 50 and 100 are discussed with the interpretation of the homogenous transmission rages and non-homogenous transmission ranges over these scenarios in MANETs with the help of NS3 simulator. It is well known fact that a very large transmission range for all the nodes can cause starvation of the nodes and can affect its PDR. A very small transmission range can cause multiple retransmissions of the same packets through nodes which results in packets lost and effect on the PDR. These facts are validated from the results compiled from this research work.

As seen in the results, several transmission ranges have been given to the homogenous range to obtain its PDR. In case of adaptive, different transmission range for each node, has been computed to the nodes having at least 2 neighbours in a transmission range which proves that adaptive transmission range is optimally effective as compared to homogenous transmission range.

Interpreting the Results for 25 Nodes:

As seen in the results above, the adaptive transmission range gives better PDR as compared to homogenous scenario due to range increase. Homogenous transmission range gives maximum PDR till 91% and after a certain range the PDR drops till 64%, but when we look into the adaptive scenario, it gives the maximum PDR of 98% and with even 5-6 neighbouring nodes still its minimum PDR is 78% which is still better and more optimum than the homogenous approach.

Interpreting the Results for 50 Nodes:

As seen in the results for this scenario, the results for homogenous transmission range shows the maximum PDR goes till 86% and following the same pattern of increasing the transmission range at too high range decreases the PDR as low as 29% but when looking into the adaptive scenario, the results shows maximum PDR as 98% and as low as 68% which is a better result.

Interpreting the Results for 100 Nodes:

As seen in the results for this particular scenario, the results for homogenous transmission range shows the maximum PDR which goes till 93% and when increasing the range, the PDR decreases till 55%. whereas, while looking into the adaptive scenario the maximum PDR goes till 98% and as low as 89% and gives us better results than the homogenous scenario.

Comparatively it has been seen through the various scenarios that eventually adaptive scenario gives the better PDR on the network and by following this particular approach the network can avoid having loss of the packets and out layering of the nodes which is one of the main problem in existing MANETs networks.

Observations from various scenarios have demonstrated that utilizing a short transmission range does not consistently result in optimal performance, as indicated in [21]. Additionally, it's noteworthy that most of the current routing protocols assume homogeneous network conditions where all nodes have the same capabilities and resources, where all nodes possess equivalent capabilities and resources, as highlighted by Al [22][23]. Additionally, numerous researchers altered the standard MANET scenario parameters to examine the effects described in [16] and [17]. Performance of any network is measured in terms of "packet delivery ratio (PDR)," average packet delay, and number of hops from source to destination. In this paper, different simulations were performed to compare the performance of homogeneous and non-homogeneous transmission ranges in terms of PDR, and ultimately adaptive strategy gives the better PDR on the network. Furthermore, by using an adaptive strategy, the network minimises packet loss and out laying of nodes, which is a major issue in conventional MANETs networks, and so increases overall performance.

Conclusion:

MANETs is getting popularity because of its ease of deployment and infrastructure less architecture, the existing MANETs network can make a significance role for being a game changer in the world of technology while looking into its transmission range aspect. In a typical MANET scenario, it has been assumed to have a uniform transmission range for all the nodes which results in lower results when tested in terms of PDR because of the loop holes resides in it as a too low transmission range can lead to the out layering of the left out nodes and nodes gets disconnected from the network, the other drawback for too low transmission range are the bottlenecks created by the nodes. As low transmission range leads to retransmitting of the packets and thus create several bottlenecks in the network which may lead to the packet loss. Whereas, keeping a too high transmission range can lead to the starvation of nodes as long as a node is communicating all other nodes have to wait for the communication to be done which may lead to packet loss in the network but applying a new technique of having adaptive (non-homogenous) transmission ranges for each node can prevent the network to lose their packets and increase the efficiency of the network.

There are studies conducted on different aspects of the transmission ranges and other variants on other topics for example energy effective protocols and energy consumption, power consumptions for transmission ranges but according to the surveyed articles there are very less studies conducted on the performance analysis for adaptive transmission ranges. So, to research for this study fills a gap in the literature for these variants.

According to this study, as shown in the results when homogenous transmission ranges were tested with the different transmission ranges for each scenario by varying the area per square meters and number of nodes it gives a pattern of increasing the transmission range to the point of maximum achieved PDR and then lower the results and gives a lesser PDR.

In contrast with the adaptive case where the transmission ranges for each node was being computed by the C++ indigenous tool and an approach of having at least 2 nodes in a neighbour resulted in a higher PDR for all the scenarios varying number of nodes and the area for transmission because each node had got its transmission range and while doing transmission in a less dense area can have a low transmission range, nodes having transmission in a denser area can have a larger transmission range.

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