Impact of Packet size and Node Mobility Pause time on Average End to End delay & Jitter in MANET's

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***Abstract*— Mobile ad-hoc network (MANET) is a kind of self-configuring infrastructure less network of mobile devices connected by Wireless and each node or mobile device is independent to move in any desired direction and thus link goes on changing from one node to another. In MANET's, routing is considered as one of the most difficult and challenging task and due to that reason ,most of the studies have focused on comparing protocols with each other under varying network conditions. But to the best of our knowledge no one has studied effect of different factors on network performance indicators like throughput, Jitter and so on, as how much influence a particular factor or group of factors is having on network performance indicators itself. Thus, in this paper effect of three key factors i.e. routing protocol, packet size and Node Mobility Pause time will be evaluated on the key network performance metrics i.e. Average Delay and Average Jitter, as these parameters are most crucial for network performance and directly affects the buffering requirements for all video devices and downstream network. Also excess value of Delay and jitter can lead to many problems ranging from lip-synchronization problem to the loss of packets because of buffer overflow or underflow.**

Keywords*— *Mobile-Adhoc networks; wireless networks; MANET;IEEE 802.11;DYMO;AODV; Impact of Packet size; Factorial Design ; Routing protocols

I. INTRODUCTION

Mobile Ad Hoc Network (MANET) is that kind of temporary network in which two or more than two devices/nodes communicate with each other and exchange information without the help of any centralized administrator due to wireless communication and networking capabilities of the nodes and thus is a kind of dynamic network. Mobile computing has shown tremendous growth and improvements over the past few years due to many advantages like portability,ease of use, mobile and so on .Besides, with the more frequent use of laptops and IEEE 802.11 devices worldwide, Mobile Ad Hoc Network (MANET) has become a popular research area [1].

Each node in MANET can act as both source as well as sink or simply as router. There are various applications of MANET's like it can be deployed in case of battle field's , natural calamities , shopping malls and so on. Two main routing approaches in MANET's are proactive approach and reactive approach. Reactive approach is that approach in which connection between source and destination is established only when needed by a particular application while as in pro-active approach, connection is established all the time and routing table information is exchanged constantly so that latest information regarding availability of routes is there. In Proactive approach, there is overhead associated with bandwidth and energy consumption. In reactive approach, there may occur some delay due to initial route discovery process. Besides, the number of nodes present within the network and node mobility are other factors which may affect the performance of network apart from choice of routing protocol. Thus, it is essential to know, how much effect of node mobility is there on the network performance as high mobility may lead to frequent link breakages which will lead to packet drops and delays in establishment of new routes [2].

In this paper, the impact of routing protocol, packet size and node mobility pause time is evaluated and analysed on two key network performance indicators i.e. Average End to End delay and Average Jitter. Two reactive protocols i.e. AODV and DYMO [6] [7] have been taken for evaluation purposes.

The rest of this paper is constructed as: Part II: literature review is given. Part III present a methodology followed. Part IV illustrates a simulation and performance evaluation. Part V shows the simulation results and discussions.

II. RELATED WORK

Research related to MANET's has been going on in different directions like some researches are focusing on comparison of routing protocols, specifically between proactive and reactive protocols, some focus on analysing impact of different factors like mobility models , node mobility pause time , number of nodes on network and so on.

Thriveni, H. B., Kumar, G. M., & Sharma, R. (2013, April) recently studied and analysed the impact of variations in node velocity and node density combined with the choice of routing protocol, on network performance and two protocols i.e. Destination-Sequenced Distance Vector (DSDV) and Dynamic Source Routing (DSR) were considered for study. The network performance indicators taken were Packet Delivery Ratio (PDR), End-to- End Delay and Throughput. Similarly M.Geetha(2010) compared two key protocols - AODV and DSDV and finally concluded that AODV is better than DSDV [10]. Similarly In one of the research paper by Manickaml(2011), the authors compared three protocols – DSR, AODV and DSDV for the following parameters – packet delivery ratio, throughput and delay and have used NS-2 simulator under varying network conditions [11]. R.Kumar(2012) in one of the paper analyzed proactive and reactive protocols using NS-2 under three network performance metrics i.e. packet delivery ratio (or) fraction,

throughput and drops of packets or packet loss ratio [12]. Paulus, Rajeev, et al(2013) in their paper analysed performance of three routing protocols DSR, OLSR and ZRP based on variation of packet transmission time and pause time and concluded which protocol is better [3]. Still studies are going on in analysing performance of routing protocols. And all the above mentioned papers are also confined within that scope. In one of the recent paper by Ghani Ur Rehman(2014),the authors have compared the performance of two widely known ad-hoc routing protocols, AODV and DSR, in terms of packet delivery ratio, average end-to-end delay and routing overhead by changing the mobility and have used NS2 2.29 for simulation [4].

From the above mentioned studies, we can conclude that although routing protocols has been compared from each other with respect to performance but how much important routing protocol is for a specific Network performance indicator or how much important the other factors are like packet size, mobility model and so on is really a research challenge and has not been studied.

III. METHODOLOGY

In this research, the first step is to analyze two protocols which are AODV and DYMO under varying network conditions which are already mentioned in section IV. Once simulation results are obtained, then those results are analyzed using a mathematical technique known as Factorial Design.

A factorial design is that technique which can consist of two or more than two factors but with discrete values or levels at each level which are 1 and -1 in this research. This technique allows us to analyze effect/interactions of each factor or combination of different factors for any particular variable which is Average Jitter and Average Delay in our case [8] [9] and the equation for calculating the effect is:

$$SST = q^2A + q^2B + q^2C + q^2AB + q^2AC + q^2BC + q^2ABC \quad (1)$$

Where SST denotes Sum of Square Total (SST) [15]

$$\text{Effects} = \text{Qi Factors}/SST \quad (2)$$

In our case ,since we are taking effect of three factors i.e. routing protocol ,packet size and Node Mobility pause time , we are using 2^K factor design technique, where k denote the factors and each factor has two levels 1 and -1 and 2 denotes the number of levels [15].

IV. SIMULATION SETUP

Qualnet 5.1 simulator is used to analyse DYMO and AODV protocol [5]. In analysis UDP (User Datagram Protocol) connection is used and over it CBR (Constant bit rate) is applied between source and destination. The 100 nodes are placed uniformly initially. The random waypoint mobility model with the maximum speed of 30 m/s is used in a rectangular field. Multiple CBR application is applied over 13 different source nodes and destination nodes respectively. All the above parameters are applied under DSSS rate of 2Mbps with respective packet sizes of 256 Bytes and 512 Bytes. The simulation parameters are shown in Table I.

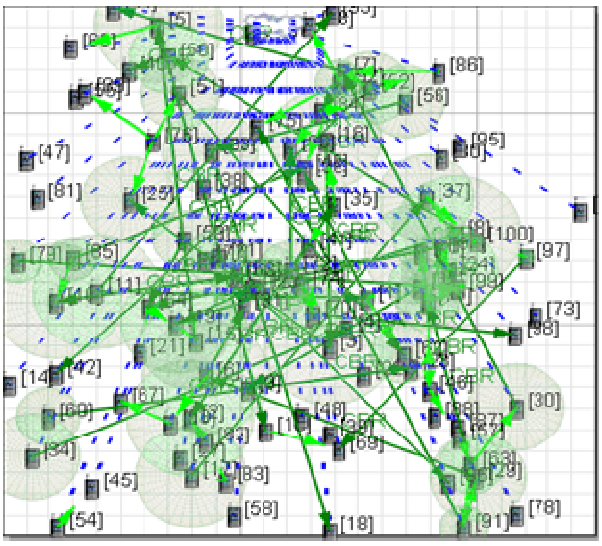
TABLE I. SIMULATION PARAMETERS

Simulation parameters	
No. Of nodes	100
Speed of nodes	30 m/s
Sender	13 nodes(4,53,57,98,100,7,3,49,10,93,1,66,9)
Receiver	13 nodes(5,91,94,59,60,95,27,97,100,54,33,31,92)
Mobility model for movement	Random waypoint
Area	1500 * 1500 m
Protocols used	DYMO,AODV
DSSS Rate	2 mbps
Packet size	256 ,512 bytes
Number of packets	2,4,5,10,15,20,25
Simulated time	300 seconds
Path loss model	Two ray Model
Physical layer Radio type	IEEE 802.11b
MAC protocol	IEEE 802.11
Antenna Model	Omni-Directional
Node Mobility Pause Time	30 seconds , 60 seconds

4.1 Performance Metrics

1. *Average End to End Delay:* It is that parameter which gives us the overall delay in time the packets suffer while moving from source to destination across the network and is summation of all types of delays which includes processing delay, queuing delays, propagation delays, and end system processing delays. The packets which get delayed more than the required threshold value are effectively lost. Delay is very important and crucial network performance indicator

2. *Average Jitter:* Jitter is very important and crucial network performance indicator as it directly affects the buffering requirements for all video devices and downstream network. Higher value of jitter can lead to many problems ranging from lip-sync errors to the loss of packets because of buffer overflow or underflow .Jitter is the variation/fluctuation of end to end delay between the two packets .Packet arrival time is expected to be very low while calculation of jitter parameter. For better performance, the delay between packets must be low than the required threshold value



a.

Fig. 1. Animated View

V. RESULTS AND DISCUSSION

The performance of DYMO and AODV is analyzed with varying mobility speed of nodes (30 seconds and 60 seconds), traffic load and Packet size using Qualnet 5.0.2. The snapshot of broadcasting, nodes mobility and transmission of data is shown in Fig 1. The numerical results are shown in Tables from III to VIII under respective Node Mobility Pause time of 30 and 60 Seconds with two different packet sizes.

From the simulation data, results were calculated for each scenario and same were evaluated using using 2^3 factorial design technique.

TABLE II. TOTAL NO. OF FACTORS

Symbol	**Throughput**	**Levels**	
		-1	1
A	Routing Protocol	DYMO	AODV
B	Node Mobility Pause Time	30 Seconds	60 Seconds
C	Packet Size	256 Bytes	512 Bytes

TABLE III. AVERAGE VALUES FROM SIMULATION RESULTS FOR AVERAGE JITTER

	B(-1)		B(1)	
	Node Mobility Pause time	(30 seconds)	Node Mobility Pause time	(60 seconds)
Column1	Column2	Column3	Column4	Column5
A	C		C	
	Packet Size	Packet Size	Packet Size	Packet Size
Routing Protocol	-1	1	-1	1
	256 Bytes	512 Bytes	256 Bytes	512 Bytes
AODV(1)	0.46877285	0.30268182	0.113275246	0.16350305
DYMO(-1)	0.07644283	0.72510437	0.246584969	1.19966123

TABLE IV. AVERAGE VALUES FROM SIMULATION RESULTS FOR AVERAGE DELAY

	B(-1)		B(1)	
	Node Mobility Pause time	(30 seconds)	Node Mobility Pause time	(60 seconds)
Column1	Column2	Column3	Column4	Column5
A	C		C	
	Packet Size	Packet Size	Packet Size	Packet Size
Routing Protocol	-1	1	-1	1
	256 Bytes	512 Bytes	256 Bytes	512 Bytes
AODV(1)	0.09480063	2.184058	2.676182	2.41654231
DYMO(-1)	8.20045823	10.9265577	8.239914308	5.39349538

TABLE V. FACTORIAL DESIGN FOR AVERAGE DELAY

I	A	B	C	Y	AB	AC	BC	ABC
1	-1	-1	-1	8.20045823	1	1	1	-1
1	1	-1	-1	0.094800631	-1	-1	1	1
1	-1	1	-1	8.239914308	-1	1	-1	1
1	1	1	-1	2.676182	1	-1	-1	-1
1	-1	-1	1	10.92655769	1	-1	-1	1
1	1	-1	1	2.184058	-1	1	-1	-1
1	-1	1	1	5.393495385	-1	-1	1	-1
1	1	1	1	2.416542308	1	1	1	1
Total	-25.388843	-2.6797406	1.709298	40.13200855	8.30747191	1.94993714	-7.921415446	3.22362132
Total/8	**-3.1736053**	**-0.3349676**	**0.213662**	**5.016501069**	**1.03843399**	**0.24374214**	**-0.990176931**	**0.40295267**

TABLE VI. FACTORIAL DESIGN FOR AVERAGE JITTER

I	A	B	C	Y	AB	AC	BC	ABC
1	-1	-1	-1	0.076442831	1	1	1	-1
1	1	-1	-1	0.468772846	-1	-1	1	1
1	-1	1	-1	0.246584969	-1	1	-1	1
1	1	1	-1	0.113275246	1	-1	-1	-1
1	-1	-1	1	0.725104369	1	-1	-1	1
1	1	-1	1	0.302681823	-1	1	-1	-1
1	-1	1	1	1.199661231	-1	-1	1	-1
1	1	1	1	0.163503054	1	1	1	1
Total	-1.1995604	0.15002263	1.485875	3.296026369	-1.1393754	-1.717601	0.520733554	-0.0880959
Total/8	**-0.1499451**	**0.01875283**	**0.185734**	**0.412003296**	**-0.1424219**	**-0.2147001**	**0.065091694**	**-0.011012**

SST for average jitter = $2^3((0.14994)^2+(0.018752)^2+(0.18573)^2+(-0.14242)^2+(-0.21470)^2+(0.06509)^2+(-0.01101))^2$
= 1.02456613 from Equation (1)

SST for average delay = $2^3((-3.17360)^2+(-0.33496)^2+(0.21366)^2+(1.03843)^2+(0.24374)^2+(-0.99017)^2+(0.40295))^2$
= 100.081618 from Equation (1)

After further calculations derived from the equation 1 and 2 ,the results were as follows for average jitter network performance indicator: the effect of Routing Protocol (R.P) 17.5 % , the effect of Node mobility pause time 0.27%, the effect of Packet Size (P.S) 26.9%, the interaction/effect of Routing Protocol and Node mobility Pause time 15.8 %, the interaction/effect of Routing protocol and Packet size 36 %, the interaction/effect of Packet Size and Node Mobility Pause time 3.3% and the interaction/effect of Packet Size ,Node Mobility Pause time ,Routing Protocol(0.094%).And for average Delay network performance indicator the results were as follows : : the effect of Routing Protocol (R.P) 80% , the effect of Node mobility pause time 0.89%, the effect of Packet Size (P.S) 0.36%, the interaction/effect of Routing Protocol and Node mobility Pause time 8.6%, the interaction/effect of Routing protocol and Packet size 0.4 %, the interaction/effect of Packet Size and Node Mobility Pause time 7.8% and the interaction/effect of Packet Size ,Node Mobility Pause time ,Routing Protocol(1.29%).

TABLE VII. RESULTS (IN TERMS OF %) FOR AV. DELAY

EFFECT OF R.P	80.5084572
EFFECT OF Node Mob	0.89689415
EFFECT OF P.S	0.36491471
EFFECT OF R.P & Nod	8.61972594
EFFECT OF R.P & PS	0.47489426
EFFECT OF P.S & Node	7.83720627
EFFECT OF P.S, DSSS,F	1.29790748

TABLE VIII. RESULTS (IN TERMS OF %) FOR AV.JITTER

EFFECT OF R.P	17.5555434
EFFECT OF Node Mob	0.27458927
EFFECT OF P.S	26.9360757
EFFECT OF R.P & Nod	15.8381214
EFFECT OF R.P & PS	35.9927137
EFFECT OF P.S & Node	3.30827147
EFFECT OF P.S, DSSS,F	0.09468503

Thus ,from the results above ,we can conclude ,the most important factor which plays most crucial role for Average Jitter network performance metric is packet size and routing protocol as effect of packet size alone is 26 % followed by routing protocol 17.5%.From these analysis , we can analyze that node mobility pause time and routing protocol together has almost 16 % effect on average jitter performance metric which means node mobility pause may depend on the type of routing protocol used and may have much more influence on network .Also , from this analysis ,we can conclude that for average delay performance metric indicator , routing protocol plays key role and have impact of 80% and together with node mobility pause time , the impact is 8 % .It is quite interesting to know that in case of Jitter, packet size has more impact and in case of Delay, routing protocol has more impact. And the reason for this is jitter is concerned with delay between two packets and packet size may influence the performance while as delay is concerned with overall delay of packets from source to destination and during the whole process routing protocol may affect the performance.

VI. CONCLUSION AND FUTURE WORK

During the analysis with the help of factorial design technique, it can be observed that while deploying MANET, the most important factor to keep Average Jitter at optimum level is to give priority to packet size followed by routing

protocol as both of these factors has significant influence/impact on Average Jitter network performance metric and for average delay, selection of routing protocol has to be made wisely. There has been researches going on in comparing protocols with each other but when we analyzed the factors, it is clear from this research, there is need to evaluate the effect of each factor on network performance indicators rather comparing protocols from each other. In case of Jitter performance metric, priority should be given to packet size first, as which packet size gives good performance under varying network conditions. After finalizing packet size, next step will be routing protocol and similarly all factors can be prioritized based on their effect on Average Jitter and following this procedure will help the deployed MANET in attaining better performance. Similarly, for average delay, routing protocols plays key role.

Future work can be attributed by evaluating the effect of these factors on some other key network performance indicators like throughput, PDR, and so on.

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