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Impact of Key Factors on Average Jitter in MANET

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***Abstract*— MANET or mobile Adhoc network is that network which is infrastructure less and does not need any centralized support. In this network, mobile nodes are equipped with CSMA/CA (carrier sense multiple access with collision avoidance) transceivers and communicate with each other via radio. This network is a kind of temporary network and is best suited for emergency purposes. 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 DSSS rate will be evaluated on one of the key network performance metric i.e. Average Jitter, as this parameter is most crucial for network performance as it directly affects the buffering requirements for all video devices and downstream network. Also excess value of 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;CBR; MAC; IEEE 802.11; DYMO;AODV; DSSS rate, Factorial Design ;Jitter; Routing protocols.

I. INTRODUCTION

MANET is a multi-hop Adhoc network which consists of set of independent mobile nodes and do not require any infrastructure for communication purposes. Since MANET does not require any infrastructure and do not require any extra costs ,this type of network is best suited for temporary purposes like in case of military emergency , rescue scenario, shopping mall scenario ,educational trip scenario and so on. It is type of multi hop network due to the reason that mobile modes have limited transmission range, thus has to relay on other intermediate nodes. Thus, in MANET each node acts as router too [1].Routing is considered one of the most difficult task in MANET due to changing network topology and it is really difficult to select a particular protocol. Although, there are many approaches for routing but all approaches differ based on particular environment.

One of the key contribution in wireless LAN standard was the addition of 802.11b at the physical layer level which supported two new speeds of 5.5 Mbps and 11 Mbps in addition to 1 Mbps and 2 Mbps. Direct sequence spread spectrum (DSSS) which is also known as direct sequence code division multiple access (DS-CDMA), is one of two approaches which is used to spread spectrum modulation for digital signal transmission over the airwaves. In other words, we can say DSSS is a transmission technology which combines user data signal with a bit sequence of higher data rate, also known as chipping code. And According to 802.11b standard, there are four kind of these data rates: 1 Mbps, 2 Mbps, 5.5 Mbps and 11 Mbps transmission [13] [14]. The main benefits which DSSS Rate technology provides are:

- It provides resistance to jamming.
- Reduced background noise.
- Use/sharing of single channel among multiple users.
- Relative timing determination between transmitter and receiver.

Dymo or Dynamic Manet on demand source routing protocol is one of the most popular reactive, on-demand routing protocol [7].This protocol is basically modification of AODV protocol and was standardized by International Engineering task force in its sixth revision [7].Although, this protocol is modification of AODV, that modification is not in terms of adding some new features or extension of AODV, rather the things were made simplified in this protocol with same mode of basic operation. This protocol like all other reactive protocols also have two modes of operation: route discovery and route maintenance. The procedure of working is same as that of other reactive protocols i.e. the node which wants to send packet discovers the route on demand and route request message (RREQ) is broadcasted throughout the network and once the route is selected and packet reaches its destination, the route reply is received back from the destination to source along with the path which packet traversed while reaching to the destination. Thus, in this paper, performance analysis of DYMO and AODV routing protocol based on varying DSSS rate [5] and packet size is done and after simulation results, the impact of some key factors like DSSS rate, routing protocol and packet size on Average jitter will be evaluated.

II. BACKGROUND

Currently, there has been research going on in comparison of routing protocols, specifically between proactive and reactive protocols.

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In one of the paper by M.Geetha(2010), the author has compared two key protocols - AODV and DSDV and finally concluded that AODV is better than DSDV [17]. Similarly In one of the research paper by Manickaml(2011), the authors have 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 [18]. 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 [19]. Still studies are going on in analyzing performance of routing protocols. And all the above mentioned papers are also confined within that scope. In one of the latest papers 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 [20].

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 is DSSS rate or many other important factors 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 will be 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 in our case [15] [16] 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]

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

In our case ,since we are taking effect of three factors i.e. routing protocol ,packet size and DSSS rate , 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 analyze DYMO and AODV protocol. 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 mps is used in a rectangular field. Multiple CBR application is applied over 13 different source nodes and destinations nodes respectively. All the above parameters are applied under varying DSSS rates of 2Mbps and 5.5Mbps 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 /5.5 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

A. *Performance Metric*

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.

V. RESULTS AND DISCUSSION

The performance of DYMO and AODV is analyzed with varying mobility speed, traffic load, Packet size and DSSS rate using Qualnet 5.0.2. The snapshot of broadcasting, nodes mobility and transmission of data is shown in Figure 1. The simulation results are shown in Figures from 2 to 5 under respective DSSS rates of 2 and 5.5 Mbps with two different packet sizes.

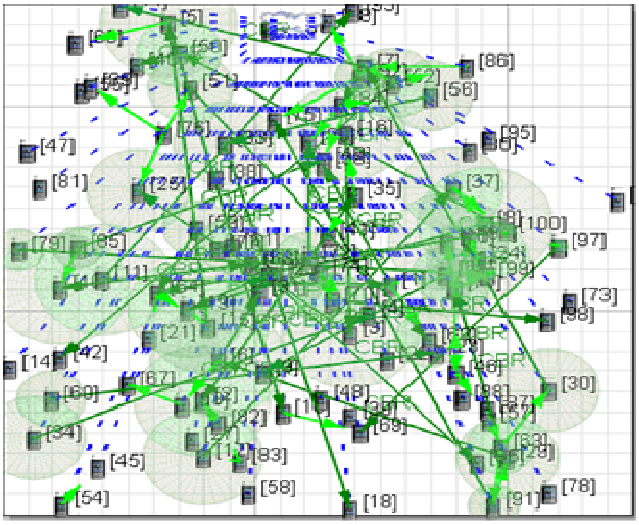

Fig. 1. Animated view

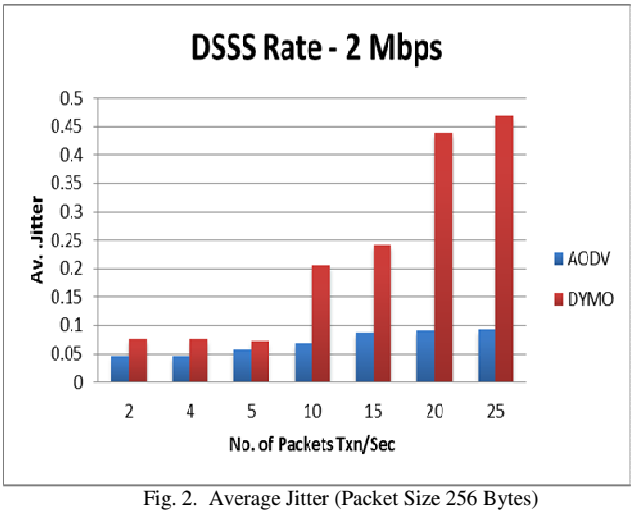

Fig. 2. Average Jitter (Packet Size 256 Bytes)

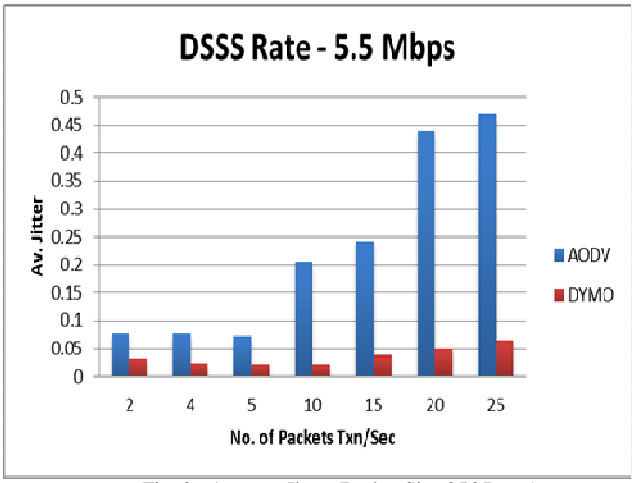

Fig. 3. Average Jitter (Packet Size 256 Bytes)

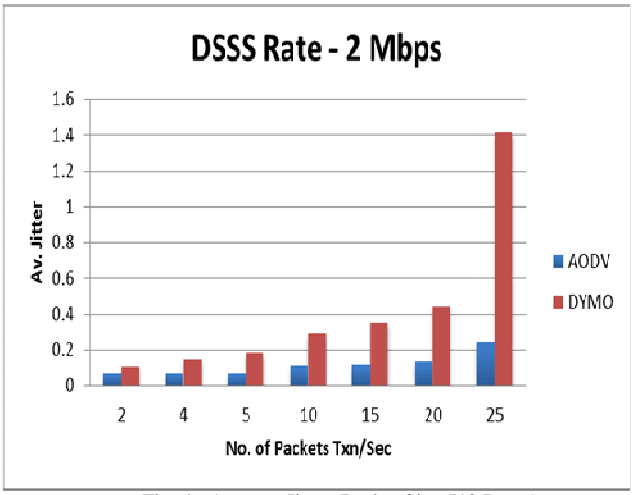

Fig. 4. Average Jitter (Packet Size 512 Bytes)

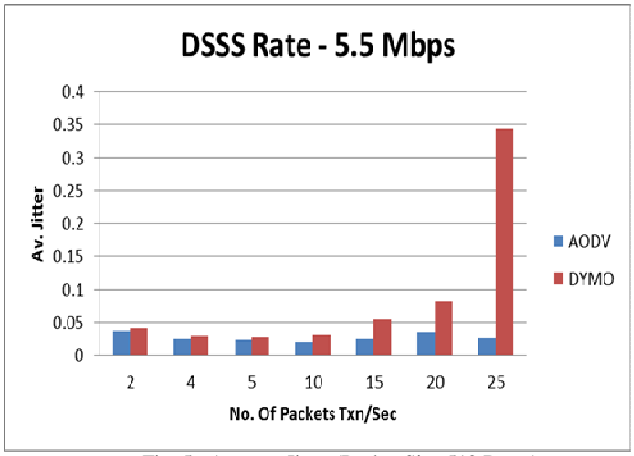

Fig. 5. Average Jitter (Packet Size 512 Bytes)

From the results shown below, we can clearly see under DSSS rate 2 Mbps, AODV showed good performance as compared to DYMO while as under 5.5Mbps DYMO showed good performance when packet size was 256 bytes .But when packet size was 512 bytes, AODV showed fine performance under both DSSS rates. Now in order to determine, which factor has more effect for Average Jitter network performance indicator ,the values from simulation results will be analyzed using 2^3 factorial design technique.

TABLE II. TOTAL NO. OF FACTORS

Symbol	Throughput	Levels	
		-1	1
A	Routing Protocol	DYMO	AODV
B	DSSS Rate	2 Mbps	5.5 Mbps
C	Packet Size	256 Bytes	512 Bytes

TABLE III. AVERAGE VALUES FROM SIMULATION RESULTS

	B(-1)		B(1)	
	DSSS Rate 2 Mbps		DSSS Rate 5.5 Mbps	
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)	0.06920058	0.11432823	0.023234836	0.02739202
DYMO(-1)	0.2252164	0.41638913	0.035612614	0.08743459

TABLE IV. FACTORIAL DESIGN

I	A	B	C	Y	AB	AC	BC	ABC
1	-1	-1	-1	0.225216399	1	1	1	-1
1	1	-1	-1	0.069200579	-1	-1	1	1
1	-1	1	-1	0.416389125	-1	1	-1	1
1	1	1	-1	0.114328227	1	-1	-1	-1
1	-1	-1	1	0.035612614	1	-1	-1	1
1	1	-1	1	0.023234836	-1	1	-1	-1
1	-1	1	1	0.087434588	-1	-1	1	-1
1	1	1	1	0.027392017	1	1	1	1
Total	-0.5304971	0.29227953	-0.65146	0.998808386	-0.1937099	0.38565637	-0.180321221	0.09838028
Total/8	-0.0663121	0.03653494	-0.08143	0.124851048	-0.0242137	0.04820705	-0.022540153	0.01229754

SST = $2^3((-0.06631)^2+(0.03653)^2+(-0.08143)^2+(-0.024213)^2+(0.0482)^2+(-0.0225)^2+(0.0122))^2$

= 0.1274629 from Equation (1)

After further calculations derived from the equation 1and 2 ,the results were as follows: the effect of Routing Protocol (R.P) 27.5 % , the effect of DSSS rate 8.37%, the effect of Packet Size (P.S) 41.61%, the interaction/effect of Routing Protocol and DSSS rate 3.67 %, the interaction/effect of Routing protocol and Packet size 14.58 %, the interaction/effect of Packet Size and DSSS rate 3.18% and the interaction/effect of Packet Size ,DSSS rate ,Routing Protocol(0.94%).

TABLE V. RESULTS (IN TERMS OF %)

EFFECT OF R.P	27.5 %
EFFECT OF DSSS RATE	8.37 %
EFFECT OF P.S	41.61 %
EFFECT OF R.P & DSSS	3.67 %
EFFECT OF R.P & PS	14.58 %
EFFECT OF P.S & DSSS	3.18 %
EFFECT OF P.S,DSSS,R.P	0.94 %

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 ,followed by routing protocol as effect of packet size alone is 41.6% followed by routing protocol 27.5% followed by DSSS rate which is 8.37 %.From these analysis , we can prioritize the factors while deploying MANET network i.e. if there is going to be video transmission in the said network then Jitter has to be low and priority should be given to packet size first followed by routing protocol.

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. 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.

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

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