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Effect of Rician Fading Channel on Performance of MANET

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ABSTRACT

A Mobile ad hoc network is a self configuring infrastructure less network of mobile devices. It consists of set of independent mobile nodes. The performance of ad hoc network depends on various parameters i.e. average delay, throughput, jitter and pdr. To evaluate the performance of wireless networks with rician fading model Network Simulator Qualnet6.1 has been used for different speed of nodes. This paper proposed the effect of speed of nodes on key network performance matrices i.e. average delay, throughput, jitter, and PDR as these parameters play very important role in the performance analysis & design of the mobile Ad-hoc network over the multipath fading environment for network performance of MANET.

***Index Terms**: MANET, Fading Channel, Rician Fading, speed of nodes.*

I. INTRODUCTION

Mobile Ad-hoc Networks (MANETs) consist of a collection of wireless mobile devices dynamically forming a temporary network without the use of any existing infrastructure or centralized administration .In such a network, each node acts as a host or may act as a router .One of the major issues in Mobile Ad-hoc Networks is dynamic topology due to the mobility of the nodes

Recent advances in wireless technology have enhanced the feasibility and functionality of wireless mobile ad hoc networks (MANETs). MANETs are networks in which multiple nodes, each possessing a wireless transceiver, form a network among themselves via peer-to-peer communication. In particular, there is no central controller (i.e., there is no entity equivalent to a base station in a cellular network). An ad hoc network can be used to both exchange information between the constituent nodes and to allow communication with remote sites that would be otherwise unreachable.

In static wireless networks, a uniform distribution is usually adopted to model the node distribution in order to study network capacity and connectivity properties .However the presence of mobility which is an inherent feature of many wireless networks requires a more realistic and non uniform model for the spatial distribution of the mobile nodes. Several such mobility models have been adopted in the literature to model the distribution of mobile receiving terminals in order to study the impact of mobility on the performance of the wireless network. one such model that is commonly used in ad-hoc networks is the random waypoint.

II. PROPAGATION MODEL

Propagation models are used in simulators to predict the received signal strength indicator of each packet received by a node. The characteristics of propagation model may change randomly from location to location and time to time. Every wireless channel can be defined as a function of distance, frequency, time, space and

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received signal strength. The signal passes through wireless channel has several propagation effect like reflection, diffraction and scattering which occurs may be due to certain obstruction. During transmission there may be single line of sight path or obstructed path between transmitter and receiver. The propagation mechanism like reflection, diffraction and scattering has a great impact in mobile communication system. Reflection occurs by a propagating wave when it falls on the object with lower dimension than object. During reflection wave may be partially refracted. When radio path is obstructed with a barrier and its wave is spreads over then diffraction is arise. Scattering occurs if the propagation medium has smaller wavelength and changes the direction of wave. Path loss and fading is the two main characteristics of wireless channel. The propagation models are categorized as fading and non-fading model. Fading is the important part of design of wireless communication. Fading is the signal fluctuation over a propagation media. Fading in mobile radio channel depends on channel properties and transmitted signal. The signal strength measurement of fading propagation model relied on the movement of user or node. Based on the signal parameter like bandwidth and path loss the signal may have different types of fading

In the other hand non-fading model cover its radio wave over a growing area with the increase of distance. The fading may be large scale where signal deviation occurs due to motion over large area or small scale fading due to small changes in the position. Normally large scale fading provide method for computing path loss as a function of distance which is affected by building, forest and mountains. In small scale fading there is sudden change in the amplitude and phase over a short distance. Non-fading model includes free space and two ray ground models. It is necessary to understand clearly the distribution received signal strength to get the concept of channel in wireless network. Shadowing is most frequently used distribution for large scale and rayleigh and nakagami is used as small scale fading model.

III. FADING

Fading in wireless means variation of the attenuation of a signal with various variables which is affecting a signal over a particular propagation media. It may vary with frequency, position and time. Fading may be either due to multipath propagation or due to shadowing from obstacles. Fading is characterized in two types namely slow fading and fast fading. Fast fading is due to multipath propagation of transmitted signals. As multiple paths most of the times add either constructively or destructively at the receiver side which leads to variation in power level. If there is direct line of sight path between sender and receiver then it follows Rician[3] distribution . Later in this paper comparison of performance of Rician[3] fading channel and without fading channel is discussed using qualnet 6.1.

IV. RICIAN FADING

Rician fading is a stochastic model for radio propagation anomaly caused by partial cancellation of a radio signal by itself — the signal arrives at the receiver by several different paths (hence exhibiting multipath interference), and at least one of the paths is changing (lengthening or shortening). Rician fading occurs when one of the paths, typically a line of sight signal, is much stronger than the others. In Rician fading, the amplitude gain is characterized by a Rician distribution.

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V. PERFORMANCE METRICS

Some of the important performance metrics can be evaluated

i. Throughput: The average rate of data successfully received at the destination from the source is throughput[1]. It is usually measured in bits per sec (bit/s or bps), and sometimes in data packets per second.

Throughput = total packet received / total packet sent.

ii. Average end to end delay:

The difference in the calculation while transmitting, packets send time and received time is average end to end delay. This delay is generally due to route discovery, re-transmission delay and queuing propagation.

$D = (TR - TS)$

iii. Jitter**:**

Jitter is defined as a variation in the delay of received packets.

iv. PDR:

Packet delivery ratio is defined as the ratio of data packets received by the destinations to the packets those generated by the sources.

VI. SIMULATION SETUP AND ENVIRONMENT

The simulation model was developed in the scalable and portable simulator qualnet6.1 with the features supporting different speed of nodes. For the simulation setup we took 50 mobile nodes randomly placed in a terrain size of 1500mx1500m (fig.1).The access point is put at the centre. The mobility model and the energy model used are random waypoint and mica z respectively. The battery model and propagation model used is linear and Rician model respectively . For the traffic generation, the traffic source used is CBR (constant bit rate) in which 512 bytes of data at data rate of 2mbps is sent over the network. There are 5 CBR connections are done. The design scenario of 50 nodes randomly placed in the defined terrain.

The simulation parameters are summarized below in Table 1.

Table 1 SIMULATION PARAMETERS

Parameters	**Values**
Simulator	Qualnet6.1
Terrain Size	1500mx1500m
No. of nodes	50
Network protocol	IPV4
Data size	512 Bytes
Data rates	2mbps
Mobility model	None
Propagation model	Rician fading model , fast Rayleigh, none
Channel frequency	2.4Ghz
Traffic source	CBR
Speed of nodes	5,10,15,20(mps)

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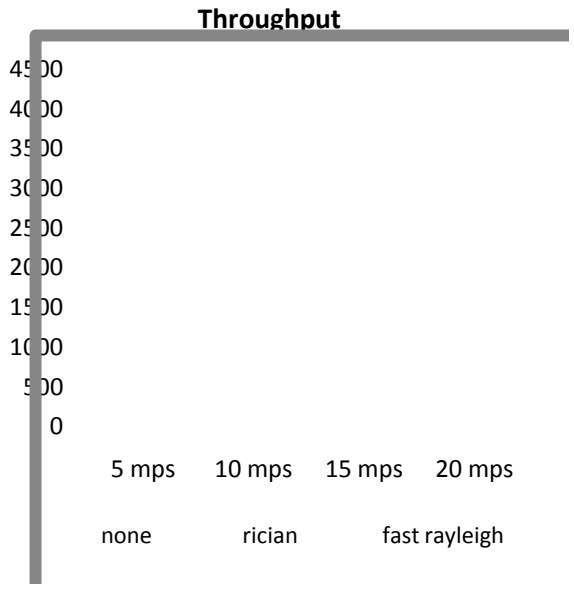
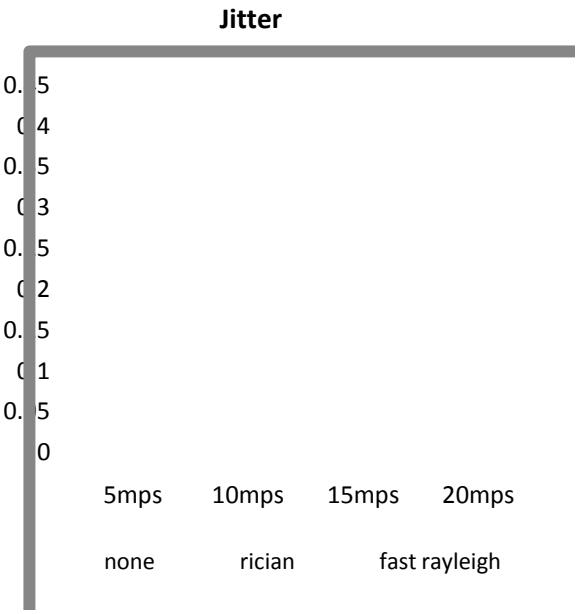
Simulation time	300 sec
Routing protocol	AODV

V. SIMULATION RESULTS

In this paper three scenarios are simulated . In the first scenario, all 50 nodes are equipped with none fading model. In the second scenario, all the nodes are equipped with Rician[3] fading. In the third scenario, all the 50 nodes are equipped with fast Rayleigh fading and the AODV routing protocol is used.

The main purpose of the above simulation is to compare various QoS parameters like average Throughput, average end to end delay ,average jitter, packet delivery ratio in wireless MANET for different propagation model with different speed of nodes.





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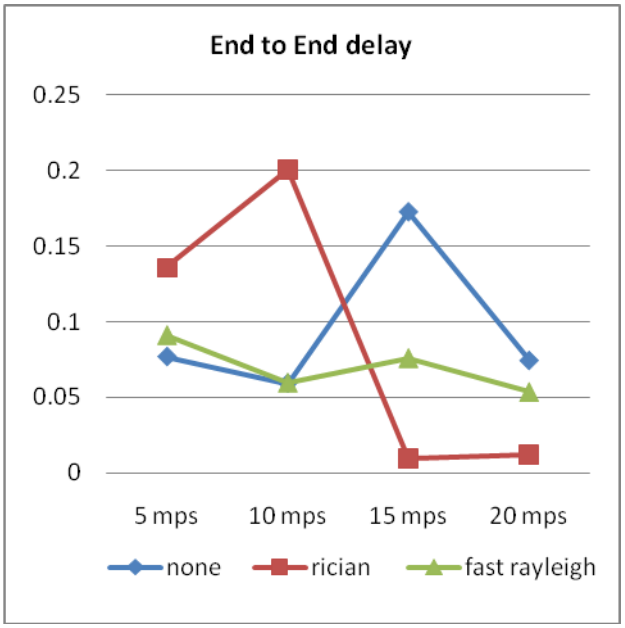

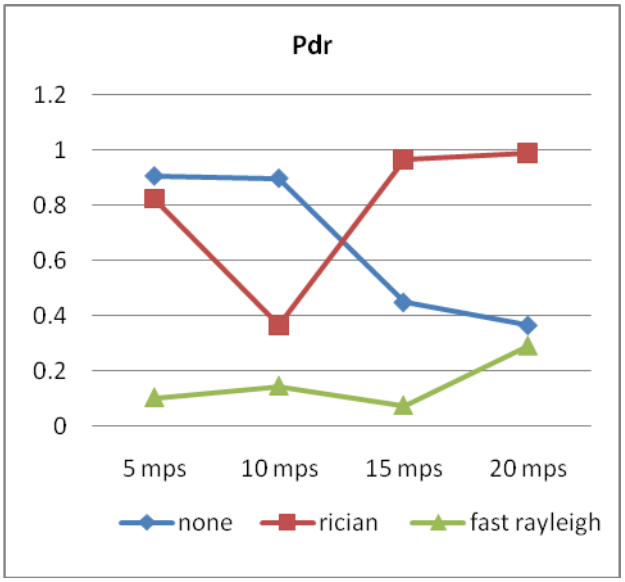

VI. RESULT ANALYSIS

In this paper by considering the results for the throughput, pdr, jitter, end to end delay it can be seen that the Rician fading model QoS much better than the fast rayleigh model.

The data packet size is set to 512 bytes in all simulations and each reported result is the average 300 second simulations.

It can also be concluded that the performance of Rician fading improves while the performance of fast rayleigh decreases when the speed of the nodes is increases. This result is due to two effects introduced by the change of the channel coherence duration: the increase of the average channel duration of good quality and the increase of that of poor quality.

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VII. CONCLUSION

In this paper considered a more realistic channel model for ad hoc networks, taking into account actual channel effects such as multipath. A comparison of the performance of an ad hoc network operating in a Rician[3] fading channel with the more commonly used in range channel model has shown that the end to end delay[1] is inadequate for describing the performance of the Rician[3] fading channel model for most applications of interest. We have introduced the throughput[1], jitter, delay as the more appropriate performance metrics which provide a more intuitive indication of delivery of packets in ad hoc networks operating in a Rician[3] fading channel environment.

From the simulation results, it is conclude that as the speed of user is increased, the amount of fading is increased in the signal envelope. Therefore, as the speed of the nodes increases, more of the signal goes below the threshold and the amount of fading increased . It is also concluded that the delay and jitter decreases as the speed of the node increases for all fading models. Dynamically changed multipath and Doppler effects are the main causes behind the degradation of the channel capacity. However, the mobile channel would like to develop an other model for fading in mobile communication system, which will be reported in future communication.

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