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PERFORMANCE EVALUATION OF MULTIPLE RATE MOBILE AD-HOC NETWORKS USING RAYLEIGH FADING

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ABSTRACT

An effort has been made to illustrate the performance of the Rayleigh fading channel models by using Qual net simulator in terms of Throughput and PDR. A scenario has developed here for the Rayleigh fading channels, with various parameter. The parameters such as data rate and speed of nodes play very important role in the performance analysis and design of the mobile ad-hoc network over the multipath fading environment. The impact of fading on network throughput and packet delivery ratio is explored in this paper. Results show the performance evaluation of ad-hoc network without fading environment and with Rayleigh fading in different scenarios.

Index Terms: MANET, Fading Channel, Rayleigh Fading, data Rate, speed of nodes

I. INTRODUCTION

Ad hoc wireless network is an infrastructure-less networks where each node is a mobile router, equipped with a wireless transceiver. Recently, there is a growing interest in ad hoc networks and its applications**.**

It is an autonomous system of mobile nodes which share a single wireless channel to communicate with each other. In wireless ad hoc networks, especially in mobile environments, channel conditions are time-varying. For a given node pair, the link quality may be too poor to transmit any data even at the lowest data rate or may be so good that a high data rate can be achieved.

Node mobility is responsible for network topology and propagation model for calculating signal strength at receiver. In wireless network MANET suffers a huge loss in performance due to obstacle between transmission and variation in signal strength at receiver. Variation in signal strength is due to the different type of fading.

It is well known that the instantaneous received signal power in a wireless communication system is a random variable which, in a Rayleigh fading channel, follows an exponential distribution.

Many routing protocols are proposed based on which include the effect of fading and path loss. So it is important to find the effect of fading and node velocity for accurate estimation and analysis of performance of routing protocols in MANET.

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Multi-path fading models e.g., the Rayleigh and Fast Rayleigh models have been frequently employed to characterize wireless channels.

In this paper we consider a more realistic wireless channel model. In particular, we consider one of the most well-known wireless channel models, the Rayleigh fading channel model. The Rayleigh fading model is used to describe channels which have a number of multipath signal components caused by reflections from objects in the signal environment such as trees, hills and buildings. These components, then, destructively or constructively interfere, to varying degrees, at different locations in the transmission environment. In such a signal environment, even if a given pair of nodes are within possible transmission range of each other, signal fidelity cannot be guaranteed. The nature of the Rayleigh fading signal is determined by the signal environment and the positions of the communicating nodes.

II. MOBILE RADIO PROPAGATION

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 no line of sight path between sender and receiver then it follows Rayleigh distribution. Later in this paper comparison of performance of Rayleigh fading channel and without fading channel is discussed using qual net 6.1.

III. RAYLEIGH FADING MODEL

The Rayleigh fading model comes about, primarily, due to the presence of multipath signals. By multipath we mean that the transmitted signal reaches the receiver via a number of different paths (multiple paths) due to reflections from obstacles in the signaling environment such as trees, people and buildings. Because these paths have different lengths, they have different phases upon reaching their destination. Therefore, destructively or constructively interfere causing stronger or weaker signals at different receiver locations. Where the signal strength is weak, the signal is referred to as being faded. The well-known Rayleigh fading model assumes no (dominant) direct path. Understanding this type of fading induced by mobility is essential to deal with random networks because nodes are mobile in many applications.

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IV. 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. 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. The sending side transmits packets in a continuous stream and spaces them evenly apart. Because of network congestion, improper queuing, or configuration errors, the delay between packets can vary instead of remaining constant.

iv. PDR:

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

V. SIMULATION SETUP AND ENVIRONMENT

The simulation model was developed in the scalable and portable simulator qualnet6.1 with the features supporting different data rate and different speed of nodes. For the simulation setup 50 mobile nodes are randomly placed in a terrain size of 1500mx1500m .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 Rayleigh 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, 5.5mbps and 11Mbps rate 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

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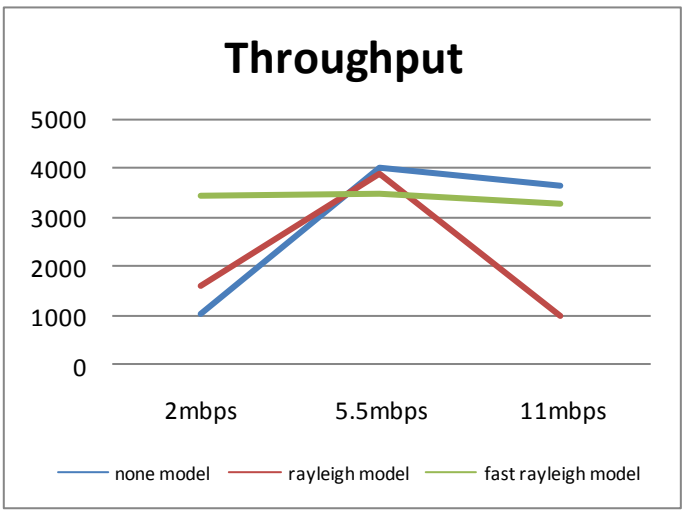
Network protocol	IPV4
Data size	512 Bytes
Data rates	2,5.5,11(mbps)
Mobility model	None
Propagation model	Rayleigh ,fast Rayleigh ,none
Channel frequency	2.4Ghz
Traffic source	CBR
Simulaton time	300 sec
Routig protocol	Bellman Ford

VI. 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 Rayleigh fading. In the third scenario, all the 50 nodes are equipped with fast Rayleigh fading and the bellman ford 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 data rate and different speed of nodes.



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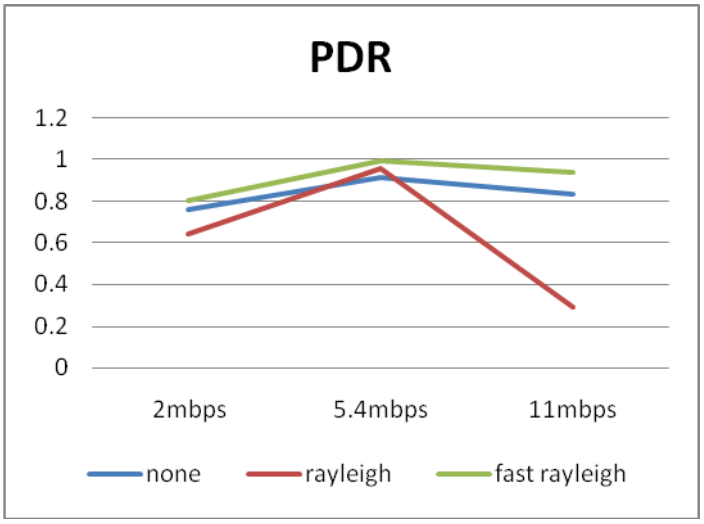

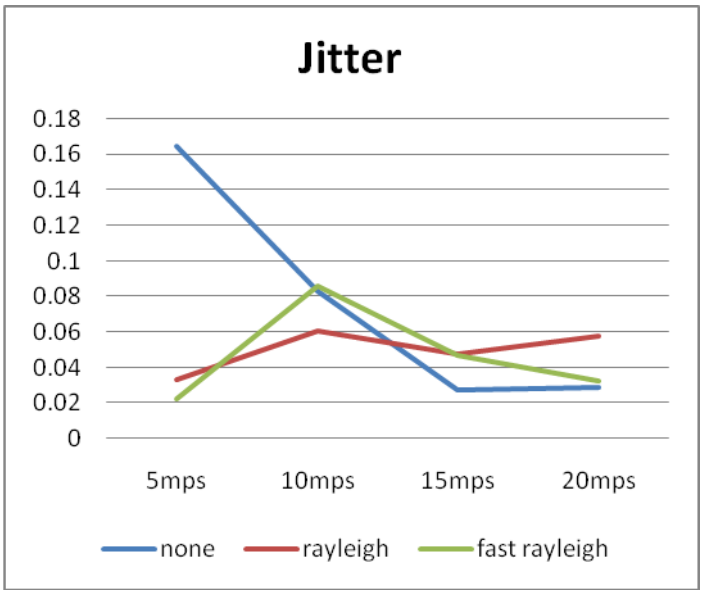

VII. RESULT ANALYSIS

If the results for the throughput is considered, it can be seen that the fast Rayleigh fading model QOS much better than the Rayleigh fading model.

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

It is also noticed that the performance of Rayleigh fading degrades while the performance of fast Rayleigh increases 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. The former results are in more benefits of packet bursting. The latter leads to the more serious problem.

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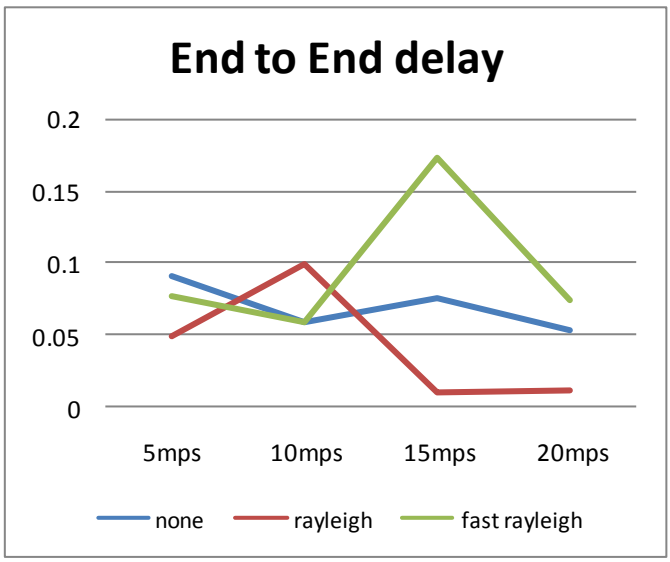

VIII. CONCLUSION

Here a more realistic channel model for ad hoc networks is considered, taking into account actual channel effects such as multipath. A Rayleigh fading model is chosen to capture the effects of the multipath. A comparison of the performance of an ad hoc network operating in a Rayleigh fading channel with the more commonly used in range channel model has shown that the end to end delay is inadequate for describing the performance of the Rayleigh fading channel model for most applications of interest. Here the throughput , jitter, delay are introduced as the more appropriate performance metrics which provide a more intuitive indication of delivery of packets in ad hoc networks operating in a Rayleigh 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. The simulation of the Rayleigh and fast Rayleigh fading channels in terms of the throughput by using Qual net simulator for different data rate is also done. It is observed from the graph that the throughput in the Rayleigh fading channel is lower than that of the fast Rayleigh fading channel. 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.

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