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Impact of Radio Propagation Models on the Performance of Routing Protocols in MANET

Minu Kumari, Manisha Jangra

ECE Department, Guru Jambheshwar University of Science and Technology, Hisar, India

Abstract: ***A mobile Ad Hoc network (MANET) is a network which consist number of nodes that can openly and dynamically self-organize into random and temporary network topology. They allow people and devices to communicate with each other without any pre-existing network. Every mobile node is moving freely with different speed in random direction. So there is no guaranteed path from one node to another node. In previous years, a lot of new routing protocol has been developed in order to increase the performance of Ad Hoc network. In this paper, we investigate the effect of two non-fading propagation models, two ray ground model and free space model, on the performance of the ad hoc routing protocol such as Ad-hoc On Demand Distance Vector (AODV), Dynamic Source Routing (DSR) and Location-aided routing (LAR1) in term of packet delivery ratio, loss packet percentage, average end to end delay, average throughput, and routing overhead.***

Keywords: MANET, AODV, DSR, LAR1, GloMoSim

1. Introduction

Mobile Ad-hoc network is a wireless network of mobile nodes communicating with multi-hop routing and established a short network. In this type of networks, communication between two nodes that are place at distant, requires relaying of messages by some intermediate nodes with act as a router node. Routing protocol have been classified in three classes namely table-driven (reactive), on-demand-driven (proactive) and hybrid [1].

Routing protocols are responsible for establishing, communication and maintaining the route between source and destination. Either it may be single hop or multi hop transmission. Signal strength is greatly affected by mobility of nodes. Effectiveness of a routing protocol is judged by its ability to choose better link to poor link.

The signal strength may gradually decrease due to many factors such as transmitter power, distance between transmitter & receiver, and wireless channel limitations. Signal propagating through a wireless channel is affected by many problems such as path loss, multipath fading and shadowing etc. These entire factors which affect the signal strength are related to environment [2].

This paper shows the effect of Radio Propagation models (free space, two ray) on the Performance of routing protocols (AODV, DSR, and LAR1) of mobile Ad-hoc network (MANET). GloMoSim simulator is used for network simulation to measure parameters like PDR, Average delay, Average throughput, LPP, Routing overhead using different routing protocols and radio propagation models. Thus comparative analysis of the effect of propagation models on performance of routing protocols can be done.

This paper is organized as follow: Summary of related work is discussed in section II. Routing protocols are explained in section III. In section IV the radio propagation models are given. Section V tells about the Simulation tool and modeling parameters. Result analysis is given in section VI. The conclusion of the work is given in section VII.

2. Related Work

In [3] performance of some of the well known ad hoc protocols was studied under different propagation models. The analysis of the propagation model shows that it had a deep impact on the performance of ad hoc routing protocols.

In [4] author compares the performance of two on-demands routing protocols DSR & AODV for MANET. A detailed simulation model is delineating into [4] the study of inter-layer interactions and their performance result compare with two layer (MAC and physical). They also show that DSR and AODV routing protocol share a similar on-demand behavior, the difference between two routing protocols lie in their mechanics. The performance differences are checked by changing the following parameter network load, node mobility and network size. Based on the observations, they find that performance of AODV is better than DSR.

In [5] studied the behavior of a wireless ad- hoc sensor network for different radio models. By means of simulations, they analyze the performance of three protocols: AODV, DSR, and DSDV considering two radio models Two Ray Ground and Shadowing. They study the perceived good put at the sink node and compare the performance of three protocols for different scenarios. The simulation results show that the fact of shadowing phenomena, by damaging the continuity of the network, reduces the average distance among nodes and at the same time increase the interference level and the latency of packet transmission. They found that the packet delivery ratio of AODV and DSR routing protocols are more stable than DSDV protocol.

In [6] analyze the effect of propagation model for both fading and non-fading and mobility on the performance of the ad-hoc (MANET) routing protocol such as AODV, DYMO and DSR finally give results gathered from simulation using NS2. The result shows that node velocity

strongly not only influences routing protocol but also physical characteristic of wireless network.

3. Routing Protocol in MANET

3.1 AODV

AODV is an On-Demand Distance Vector routing protocol for Ad Hoc networks. In AODV the communication between all nodes made at the time of data transmission. It is a combination of two vectors, demand vector and distance vector [7]. It has two main functions route discovery and route maintenance. At first it discovers the route and then maintains the path. It finds the path by sending route requests RREQ to each and every neighboring node in the network and then route maintenance occur. Every RREQ contains source identity, destination identity, source sequence number, destination sequence no number, etc.

3.2 DSR

In DSR routing protocol complete addresses is send at a time by each node, from source to the destination. It means that the protocol not give very effective result in large networks area, as the amount of overhead carried in the each packet will continue going to increase as the network diameter increases. DSR routing protocol has many advantages over other routing protocols [8]. Advantage of DSR is first nodes of the propagating area can store multiple routes in their route cache, this show that the origin node can check its route cache for a present route before maintaining route discovery, when a valid route is found there is no need for route discovery. This form good network with low mobility, because the routes stored in the route cache will be valid for a longer period of time. Another advantage of DSR that, it does not need any periodic beaconing, so that nodes of DSR for conserving there power enters into the sleep mode.

3.3 LAR1

LAR1 (Location aided routing protocol) is a reactive and location based routing protocol, which is mostly used in wireless ad hoc network (MANET). It has mainly three packets by which it transfer data from one node to another and maintain connection, they are - route request, route reply and route error packets. The source assumes a circular area [15] (expected zone) in which the destination is expected to be found at the same time. The position and the size of the circle are calculated based on the location knowledge of the previous destination, the time instant associated with the previous location record and the average speed of the destination. The request zone is the smallest rectangular region and this region must be includes the other expected zone and the source. Much work has been done by changing the shape and size of the request zone in order to enhance performance.

4. Propagation Model

Propagation models are used in simulators to analyze the strength of received signal indicator of each packet received by each 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 received signal strength. Those signal passes through wireless channel has many propagation effect i.e reflection, diffraction and scattering which occur due to certain obstacles like trees, large buildings, and environment. During transmission of signal, path between the transmitter and receiver may be single line-of-sight path or disturbed path. The propagation mechanism i.e reflection, diffraction and scattering have a special effect in mobile communication system [9]. Reflection due to the change in direction of a wave front at an interface between two different medium so that the wave front returns into the medium from which it generate. Common examples include the reflection of light, sound and water waves. During reflection, wave is partially refracted. Diffraction occurs only when radio path is hit with a barrier and its wave is spreads over. Scattering occurs only when the propagation medium has smaller wavelength than the signal, results change in their direction. Path loss and fading are the two main characteristics of wireless channel [2]. The propagation models are categorized as fading and non-fading model. Two non-fading models are free space model and two ray ground model. These models are discussed in the following subsections.

4.1 Free Space Model

Free space propagation model based on the assumption that clear line of sight path exist between source and destination. All other object causing reflection, refraction or scattering are assumed to be absent [6]. The effect of the curvature of earth surface is also assumed to be zero in particular area. Signal power received at the receiver node is given by equation 1.

$$P_r(\mathrm{d}) = \frac{P_t G_t G_r \lambda^2}{(4\pi)^2 d^2 \mathrm{L}} \quad (1)$$

Where P_t is the signal power transmitted, G_t and G_r are gain of transmitting and receiving antenna respectively, L is loss factor of system (L>1), λ is wave length and d is the distance between transmitter & receiver.

Antenna size is much smaller than Distances (d) between transmitter, and the far field of the electromagnetic wave dominates all other components.

4.2 Two Ray Ground Model

A single line-of-sight path between two mobile nodes is rarely the only means of proportion. The two-ray ground is a reflection model which considers as sum of both the direct path and a ground reflection path. [6] This model gives more accurate result in long distance transmission than the free space model. The received power at distance d is predicted by

$$P_r(\mathrm{d}) = \frac{P_t G_t G_r h_t^2 h_r^2}{d^4 L} \quad (2)$$

P_t is transmitted signal, G_t and G_r gain of transmitting and receiving antenna, h_t and h_r height of transmitting and receiving antenna, d is distance between transmitter and receiver, L is loss.

5. Simulation Model

To show the impact of propagation model in performance of Ad hoc routing protocol, the simulation has been done using GlmoSim simulator.(GloMoSim) stands for Global Mobile Information System Simulator. It is network protocol simulation software that simulates wireless and wired network systems. GloMoSim is designed using the event simulation capability provided by Parsec, a parallel programming language. Simulation parameters are show in table 1.

Table 1: Simulation Parameter

Time	600s
Area	(1000,1000)
Node placement	Random
Mobility model	Random-way point
MAC	IEEE 802.11
Seed	1

We measure the performance of AODV, DSR and LAR1 routing protocols with various merits that is packet delivery ratio, Loss packet percentage, Average end to end delay, Average throughput, routing overhead by using AWK file.

5.1 Environment

To study the effect of propagation model on routing protocol and to realize the difference, we use notion of radio range. We use random way point (RWP) mobility pattern [10] to define movement of mobile node. We use traffic (APP. Conf.) between the source and destination pair. Every source is associated with CBR traffic generator. Each source sends packets of 512 bytes at a different rate of 1 packet per second.

5.1.1 Radio Range

Transmission range of a node refers to the average maximum distance in usual operating conditions between two nodes. We can change the radio range by varying the transmitter power (RADIO-TX-POWER) [16] or the receiver power (RADIO-RXTHRESHOLD), it is somehow advisable to change the transmitter power, because the receiver power depends of the radio environment while we can control the transmitter power. We considered 100, 200,300,400,500,600,700 meters as radio ranges.

5.2 Simulation Metrices

5.2.1 Packet Delivery Ratio:

It is the ratio between actual data packet received by the receiver to the data packet send by the source [14].

$$\frac{total\ \ Received\ \ packet\ \ at\ recevier}{total\ \ number\ \ of\ packet\ \ sent} \times 100 \qquad (3)$$

5.2.2 Average Delay

This determines the average delay in transmission of packet. These calculations rely on physical properties of link and delay. This includes queuing at interface, retransmission at the MAC, propagation, transfer through channel and delay in buffering at route discovery process [14].

$$\frac{\sum_{i=0}^{n} Time\ \ packet\ \ received\ -time\ \ packet\ \ sent}{Total\ \ number\ \ of\ packet\ \ received} \qquad (4)$$

5.2.3 Loss Packet Percentage:

Packet Loss is the difference between the number of data packets sent and the number of data packets received [14].

$$LPP = Data\ sent - Data\ received \qquad (5)$$

5.2.4 Average Throughput

Average throughput can be defined as the ratio of total amount of data reaches a destination from the source. The time it takes by the destination to receive the last message is called as average throughput. It is expressed in bytes or bits per second (byte/sec or bit/sec). It express as

$$\frac{Number\ \ of\ delivered\ \ packets\ *packet\ \ size\ *8}{total\ \ duration\ \ of\ simulation} \qquad (6)$$

5.2.5 Routing Overhead

It determines the number of control packet transmitted per actual data packet received at receiver.

6. Result and Analysis

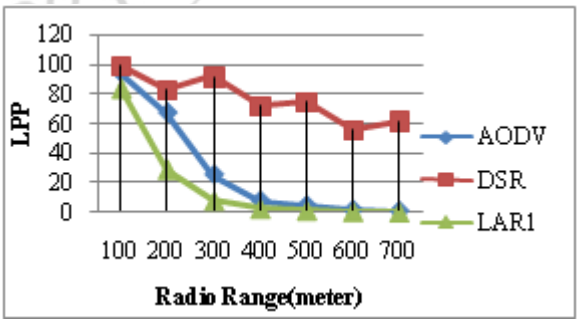
In this section, the results obtained from the number of experiments with various scenarios to show the desired true characteristic in ad hoc network. In scenario1, we vary Radio range in order to explore the effect of propagation model on routing protocol.

6.1 Scenario

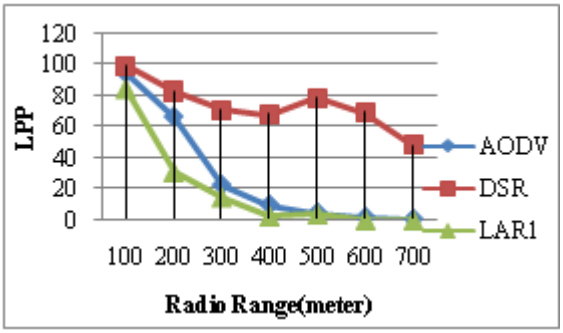
In this section we vary the radio range to investigate the effect of propagation model on routing protocol in MANET. Radio range is the distance between the source and destination.

6.1.1 Loss packet percentage

From fig1, LPP of DSR is more as compare to AODV and LAR1 in free space model. LAR1 has minimum LPP. It means maximum packets are loss in DSR protocol and less packet loss in LAR1. In two ray ground model LPP of DSR is more as compare to AODV and LAR1. But in case of two ray ground model loss packet percentage of DSR, AODV and LAR1 is less compare to free space mode.



Free space model

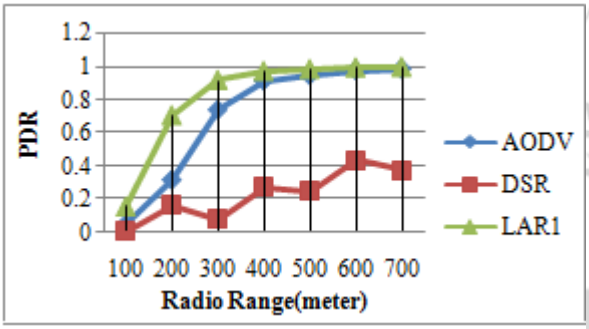


Two ray ground model

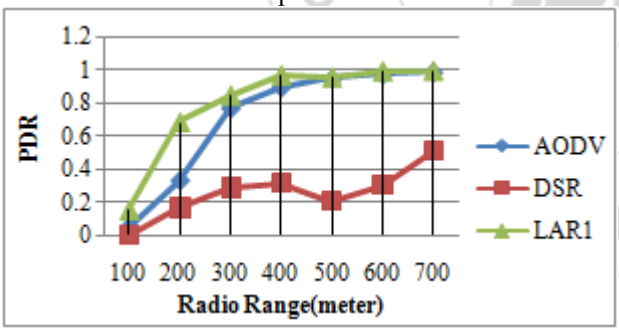
Figure 1: LPP vs Radio Range

6.1.2 Packet delivery ratio

From fig 2, Packet delivery ratio of LAR1 is better as compare to AODV and DSR in free space model. DSR has minimum LDR. It means maximum packets are delivered in LAR1 protocol and less packet deliver in DSR. In two ray ground model PDR of LAR1 is better as compare to AODV and DSR. In case of two ray ground model delivery of packet of DSR, AODV is better compare to free space model. But in case of LAR1 it delivers more packets in free space model.



Free space model

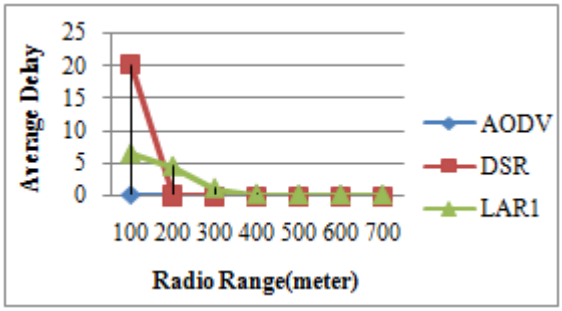


Two ray ground model

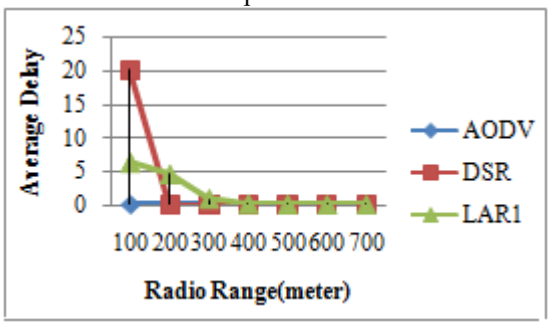
Figure 2: PDR vs radio range

6.1.3 Average Delay

From fig 3, Average delay of LAR1 is more as compare to AODV and DSR in free space model. DSR has minimum average delay. It means that maximum average delay in LAR1 protocol and less average delay in DSR. So DSR is best because it has minimum delay. In two ray ground model average delay of LAR1 is more as compare to AODV and DSR. In case of two ray ground model average delay of DSR, AODV is less compare to free space model. But in case of LAR1 average delay is more in free space model.



Free space model

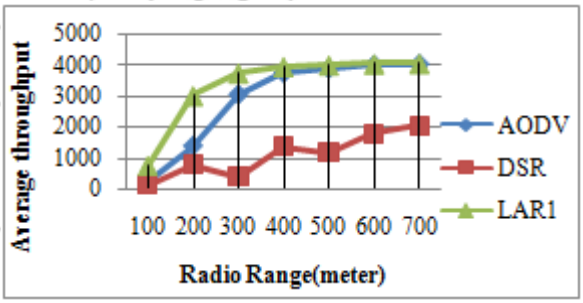


Two ray model

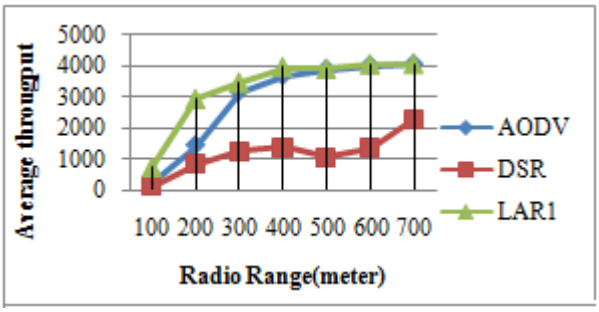
Figure 3: Average delay vs Radio range

6.1.4 Average throughput

From fig 4, Average throughput of LAR1 is better as compare to AODV and DSR in free space model. DSR has minimum average throughput. It means that maximum average throughput in LAR1 protocol and less average throughput in DSR. So LAR1 is best because it has maximum throughput. In two ray ground model average throughput of LAR1 is more as compare to AODV and DSR. In case of two ray ground model average throughput of DSR, AODV is better compare to free space model. But in case of LAR1 average throughput is better in free space model.



Free space model

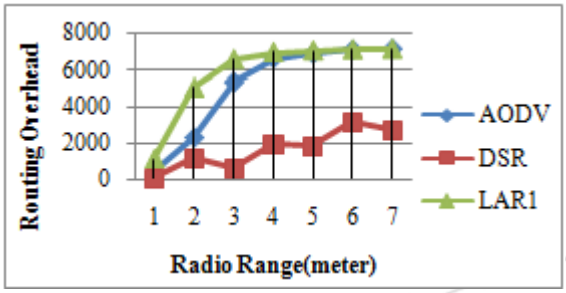


Two ray ground model

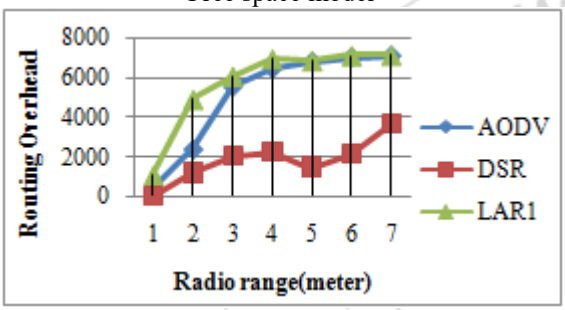
Figure 4: Average throughput vs Radio range

6.1.5 Routing Overhead

From fig 5, Routing overhead of LAR1 is more as compare to AODV and DSR in free space model. DSR has minimum routing overhead. It means that maximum routing overhead in LAR1 protocol and less routing overhead in DSR. In two ray ground model routing overhead of LAR1 is more as compare to AODV and DSR. In case of two ray ground model routing overhead of DSR, AODV is worst compare to free space model. But in case of LAR1 routing overhead is better in free space model.



Free space model



Two ray ground model

Figure 5: routing overhead vs Radio range

7. Conclusion

In this study, we have examined the impact of two non-fading propagation model on the routing protocol. Also we compared radio range propagation model performance on the basis of following metrics: packet delivery ratio, loss packet percentage, average delay, average throughput and routing overhead. We observe that performance of LAR1 routing protocol is best, and performance of DSR protocol is worst as radio range increases. In comparison of free space model and two ray ground model, two ray ground models is best in case of AODV and DSR, but in case of LAR1 free space model gives best result. Further this study will be extended to investigate the performance of LAR1 routing protocol in fading propagation model. Beside that will compare the performance of LAR1 routing protocol in fading and non-fading propagation model.

References

[1] Sixte martial, “Effect of Propagation models on Ad Hoc Networks Routing Protocols”, sensorcomm, in 2008, 145, proceeding with IEEE.
[2] Prashant kumar pattnaik, ”Impact of radio propagation model and mobility in on demand and routing protocol of manet”, JATIT vol 65 B=No.1, in july 2014.
[3] Sixte Martial Itoua, “Effect of propagation model on Ad hoc network routing protocol”. Second International Conference on Sensor Technologies and Applications, 2008. IEEE, Pp: 752-757, DOI: 10.11.09.
[4] Das, S.,R., Perkins, C.,E., & Royer, E.M., “Performance comparison of two on-demand routing protocols for ad hoc networks”, vol. Tel Aviv, Israel, 2000, IEEE INFOCOM.
[5] Tao Yang, Makoto Ikeda, “Performance behavior of AODV, DSR, and DSDV Protocol for different radio model in Ad Hoc network”. Proceeding in IEEE (2007) conference on parallel processing workshop.
[6] Sukant K.B, Prasant K.P, “Impact of radio propagation model and mobility in on-demand routing protocol in manet”. Proceeding with JATIT, in Vol 65, No.1.
[7] Kulbir K.W and Barinderpal Singh, “Performance Analysis of AODV Routing Protocol with and without Malicious Attack in Mobile Ad hoc Networks” Proceeding with International Journal of Advanced Science and Technology (2015), in Vol.82, from pp.63-70.
[8] Rachit Jain1, Laxmi Shrivastav, “Performance Comparison of AODV & DSR on the basis of Path Loss Propagation Models” Proceeding with International Journal of Advanced Science and Technology (July 2011), Vol. 32.
[9] T.S.Rappaport, “Wireless Communications: principles and Practices”, 2nd edition.(1996) Upper Saddle River, NJ: Prentice Hall PTR.
[10] T.Camp, J.Boleng, V.Davies, “A survey of mobility models for ad hoc network research”,(2002) Wireless Communication and Mobile Computing, in Vol. 2, No 5, from page 483-502.
[11] S.K.Bisoy, M.R.Panda, G.K.Pallai and D.Panda, “ Analyzing the Interaction between Mobility Model and Unipath Routing Protocols in Mobile Ad Hoc Networks”, Proceeding with International Journal of Application or Innovation in Engineering & Management, (2013), from page 449-456.
[12] H.Pucha, S.M.Das, Y.C.Hu, “The performance impact of traffic patterns on routing protocols in mobile ad hoc networks”, proceeding in Computer Journal Network (2007) , from page.3595-3616.
[13] P.Gupta, P.R.Kumar, “The capacity of wireless networks”, proceeding with IEEE Transactions on Information Theory, page 388-404, in 2000 year.
[14] Impact of Variation in Pause Time and Network Load in AODV and AOMDV Protocols.
[15] Ashish k. Maurya, Ashish kumar and dinesh singh, “RWP Mobility model based performance evaluation of OLSR and LARI routing protocol in manet” proceeding in IJCNC, Vol.3, No.6, November 2011.
[16] Effect of radio range in wireless communication.