EFFECT OF RADIO-WAVE PROPAGATION MODEL FOR NETWORK PERFORMANCE USING AODV ROUTING PROTOCOL FOR IL-VANET

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Abstract

Vehicular Ad Hoc Network (VANET) is a sub class of mobile ad hoc networks. VANET is most advanced technology for intelligent transportation system providing wireless connectivity among vehicles according to IEEE 802.11p standard for end to end communication. In VANET, routing protocols have a significant role in terms of the performance because they determine the way of sending and receiving packets between mobile nodes. In this paper, we have examined and analyzed the performance of Ad-Hoc On-demand Distance Vector (AODV) routing protocol on the basis of radio-wave propagation model with constant bit rate (CBR) data traffic over various node speed and number of nodes. Network performance is analyzed by measuring Packet Delivered Ratio (PDR), Average Throughput and Average end to end delay. The objective of this study is to find out the radio-wave propagation model for wireless communication which gives best network performance with AODV routing protocol on in fracture less Vehicular Ad-Hoc Network (IL-VANET). Based on the validated results, shadowing radio-wave propagation model serves the best.

Keywords – *AODV; Average end to end delay; Packet delivered ratio; Radio-wave propagation models; Routing protocol; Self-organized network; IL-VANET; Throughput; VANET.*

I: INTODUCTION

Vehicular ad hoc network is a special form of MANET which is a vehicle to vehicle & vehicle roadside wireless communication network. We have concentrated on an autonomous & self-organizing wireless communication network, where nodes in VANET involve themselves as servers and/or clients for exchanging & sharing information independent of a road side unit (RSU), termed as infrastructure less VANET (IL-VANET).

The ad hoc on-demand distance vector routing protocol (AODV) joins mechanism of DSR (Dynamic Source Routing protocol) and DSDV (Destination-Sequenced Distance-Vector Routing). The periodic beacon, hop-by-hop routing and sequence numbers of DSDV (Destination sequence distance vector) which based on Bellman –ford algorithm and pure on –demand mechanism of route discovery and route maintenance from DSR are combined, which is not scalable for the long distance. AODV routing consists of three phases:route discovery, data transmission and route maintenance. Route discovery phase starts when a node wants to transmit data and has no route to destination. Now, AODV call route discovery process. In this phase, source node broadcasts a Route Request Packet (RREQ) to its neighbor. Nodes that receive RREQ packets divide into three categories: the receiver nodes the destination of route, the node that has a route to destination or none of both. In the two first, receiver uncast a Route Reply (RREP) packet to the route that received Route Request (RREQ) packet. The route that RREP packet traverses, selected as one of the main routes for source that has been sent RREQ packet [2].

Route maintenance phase maintain the nodes survey the link status of their next hop neighbors in active routes. The route detecting a link break sends a ROUTE ERROR message to each of its upstream neighbors to invalidate this route and these propagate the ROUTE ERROR to their neighbors. This continues until the source node is reached. Each node periodically transmits a HELLO message to detect the link breakage. The failure of reception of three consecutive HELLO messages from a neighbor is handles as link error [3].

II. Radio wave propagation mode

The radio propagation models implemented in ns are used to predict the received signal power of each packet. At the physical layer of each wireless node, there is a receiving threshold. When a packet is received, if its signal power is below the receiving threshold, it is marked as error and dropped by the MAC layer. Up to now there are three propagation models in ns, which are the free space model, two-ray ground reflection model and the shadowing model.

1.1 Free space model

This is a large scale model. The received power is only dependent on the transmitted power Pt, the antenna's gains (Gs and Gr) and on the distance between the sender and the receiver. It accounts mainly for the fact that a radio wave which moves away from the sender has to cover a larger area. So the received power decreases with the square of the distance [4].

1.2 Two ray ground model

The Two Ray Ground model is also a large scale model. It is assumed that the received energy is the sum of the direct line of sight path and the path including one reflection on the ground between the sender and the receiver. A limitation in ns2 is that sender and receiver have to be on the same height [4].

1.3 Shadowing

The shadowing model of ns2 realizes the log-normal shadowing model. It is assumed that the average received signal power decreases logarithmically with distance. A Gaussian random variable is added to this path loss to account for environmental influences at the sender and the receiver [4].

III. Related Work

Radio channels are much more complicated to analyze than wired channels. Their characteristics may change rapidly and randomly. There are large differences between simple paths with line of sight (LOS) and those which have obstacles like buildings or elevations between the sender and the receiver [5].

Shadowing-pattern model is near from realistic propagation behavior. VANET simulations must integrate this type of propagation model [6].

Realistic radio-wave propagation must be developed considering dynamic behavior of the radio waves along with multipath effect due to obstacles. Shadowing somewhat proves in the said direction. But as per the latest development a new concept for radio propagation must be developed [7].

The propagation model used in a VANET simulation has large influence on the results. It impacts which nodes are able to communicate and the probability of correct reception. As a result, it can influence the speed at which messages propagate through the network, directly influencing end-to-end delay in a multi-hop scenario. The probability distribution of correct reception also influences the overhead with respect to collisions and medium utilization [8].

IV. Simulation results

The Packet Delivery Ratio, Average End to End Delay, and Average Throughput for each of free space, two ray ground and shadowing model have been measured. Different node speed in the range from 1m/s to 40 m/s under CBR traffic connections is used to evaluate the performance of the said radio-wave propagation models.

We have used different number of nodes and varying speed as a constrain parameter for measuring network performance. The speed ranges from 1 m/s to 40 m/s and number of node ranges from 5 to 40 to examine the performance of the protocols. Based on the node speed and number of nodes we received different results for our measured parameters; Packet Delivery Ratio, Average End to End Delay, and Average Throughput.

4.1 Packet deliver ratio

Packet delivered ratio is the ratio of data packet successfully received to the total number of data packets transmitted. Results with CBR data traffics for fixed and mobile nodes are simulated with various node mobility speed and number of nodes.

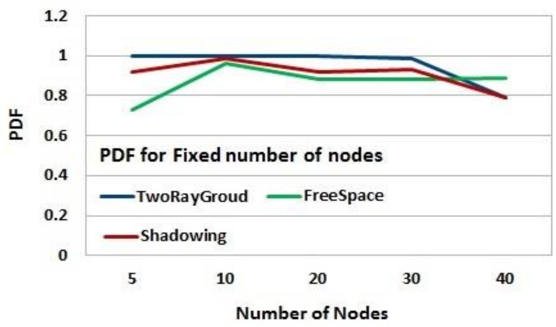

Figure 1: Packet deliver ratio vs. fixed nodes

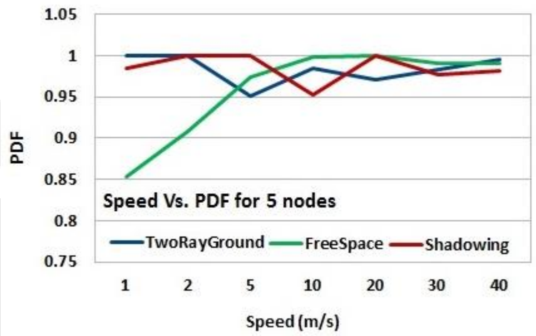

Figure 2: packet deliver ratio vs. speed for 5 nodes

Fig. 1 shows the graph of packet delivered ratio (PDF) vs. immobile nodes. PDF for two ray ground model is constant except for 40 nodes. On the other end it drastically varies for the other two models.

Fig. 2 shows the graph of PDF vs. speed for network formed by 5 nodes. None of the model shows the consistent behavior. Similarly, fig. 3, 4, 5 and 6 shows the graph for PDF vs. speed for 10, 20, 30 and 40 nodes respectively. The average result shows consistent PDF is achieved with shadowing propagation model.

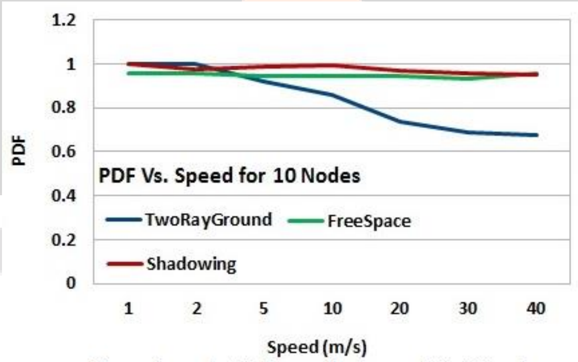

Figure 3: packet deliver ratio vs. speed for 10 nodes

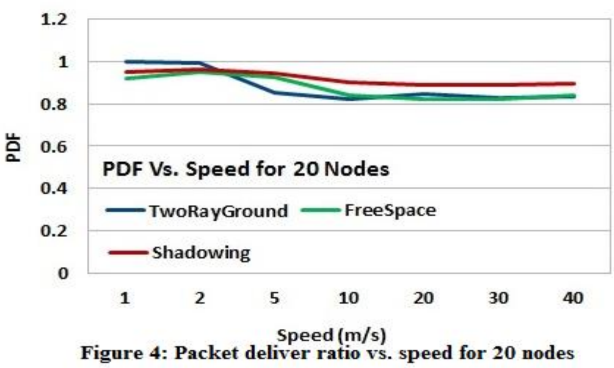

Figure 4: Packet deliver ratio vs. speed for 20 nodes

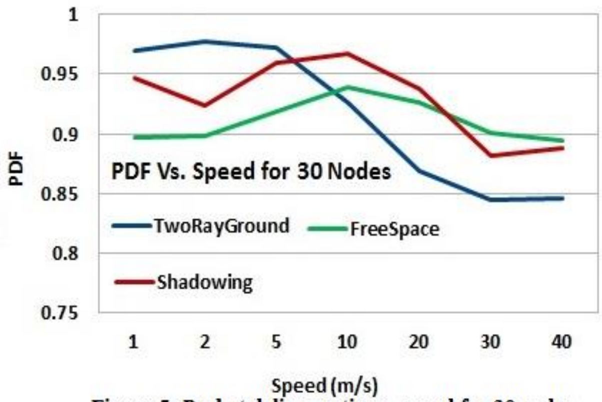

Figure 5: Packet deliver ratio vs. speed for 30 nodes

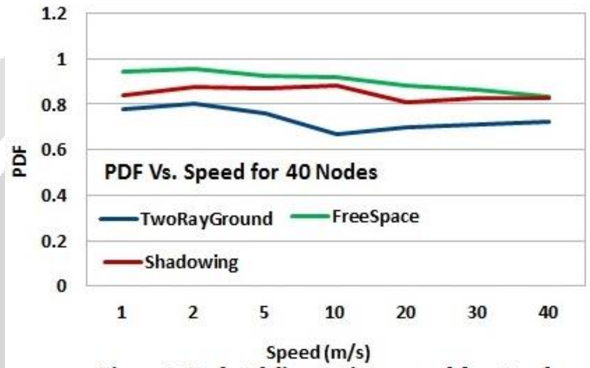

Figure 6: Packet deliver ratio vs. speed for 40 nodes

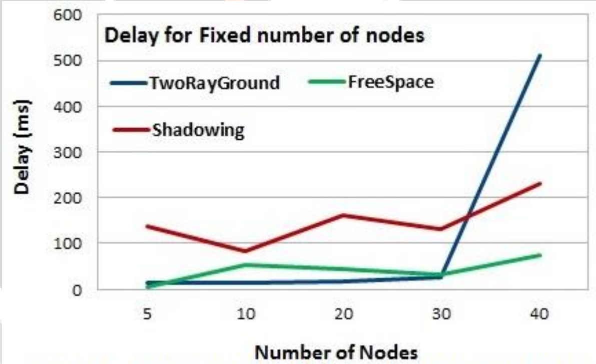

Figure 7: Average end to end delay vs. fixed number of nodes

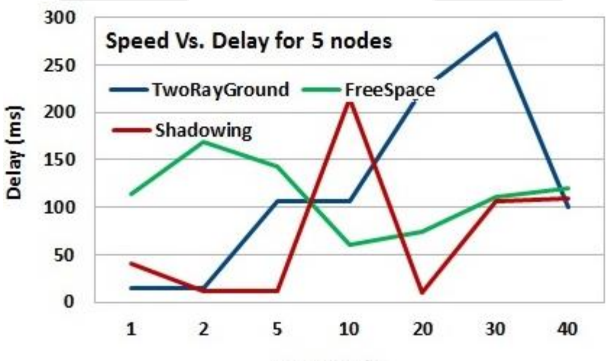

Figure 8: Average end to end delay vs. speed for 5 nodes

4.2 Average end to end delay

End to end delay is the time required for the data packet to reach destination from source node. Results with CBR data traffics for fixed and mobile nodes are simulated with various node mobility speed and number of nodes.

Fig. 7 shows the graph for average end to end delay (AEED) vs. immobile nodes. AEED for two ray ground model is lowest with that for free space and shadowing model varying between 10ms to 150ms.

Fig. 8 shows average end to end delay vs. speed for network formed by 5 nodes. None of the model shows the consistent behavior. Similarly, fig. 9, 10, 11 and 12 shows the graph for AEED vs. speed for 10, 20, 30 and 40 nodes respectively. The average result shows consistent AEED is achieved with two ray ground propagation model. In case of 10 and 40 nodes the delay values are much higher.

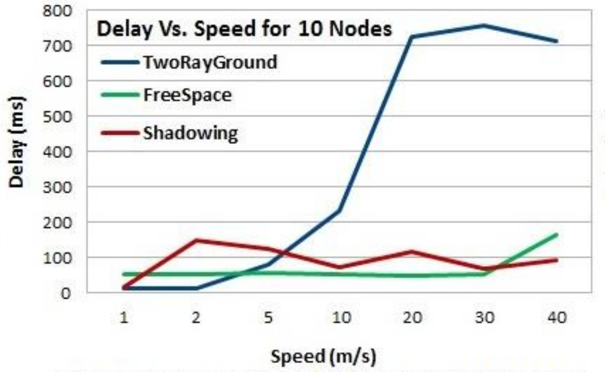

Figure 9: Average end to end delay vs. speed for 10 nodes

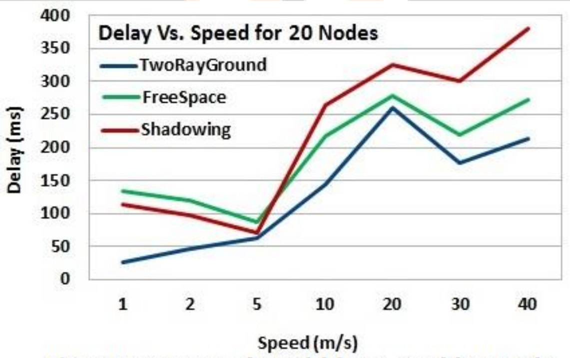

Figure 10: Average end to end delay vs. speed for 10 nodes

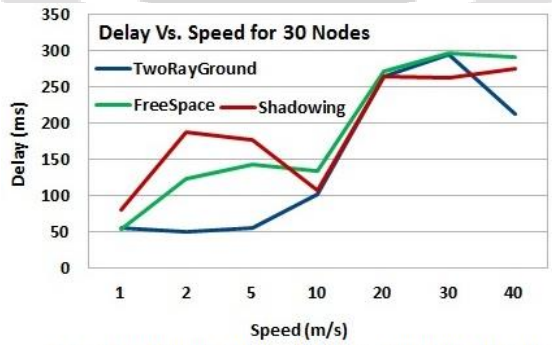

Figure 11: Average end to end delay vs. speed for 30 nodes

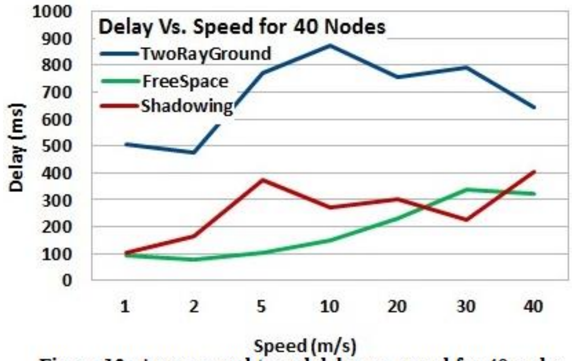

Figure 12: Average end to end delay vs. speed for 40 nodes

4.3 Average Throughput

The controlling parameter for judging the network performance is throughput. Throughput defines the maximum transmission of simultaneous data through network. Fig. 13 shows the graph for average throughput vs. immobile nodes. Highest average value for the throughput is observed for two ray ground model.

Fig. 14 shows the graph for average throughput vs. speed for network comprising of 5 nodes. It is observed that none of model has an acceptable measurement. Even though two ray ground model shows least variation with speed as compared to other two models.

Fig. 15, 16, 17 and 18 shows the graph for average throughput vs. speed of 10, 20, 30 and 40 nodes respectively. The average of the result shows that acceptable measurements can be obtained with shadowing model although the values for the same have more deviation with 5 and 30 nodes. Average throughput for 40 nodes supports free space model.

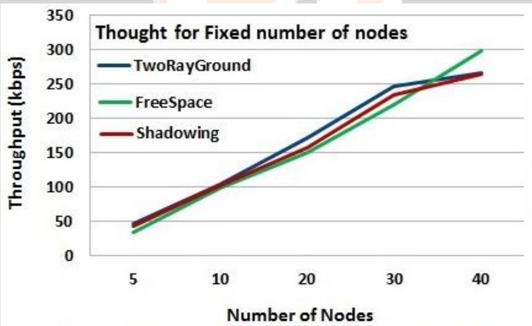

Figure 13: Average throughput vs. fixed number of nodes

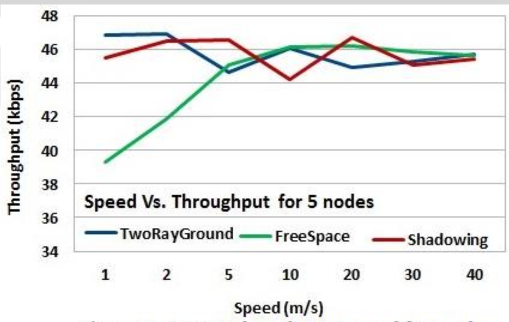

Figure 14: Average throughput vs. speed for 5 nodes

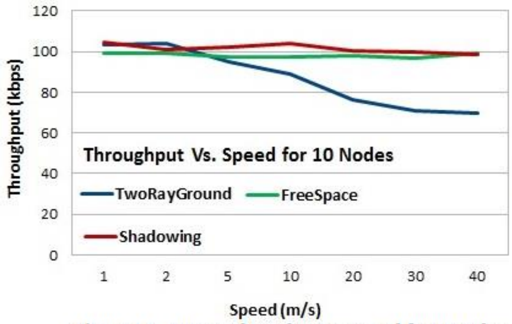

Figure 15: Average throughput vs. speed for 10 nodes

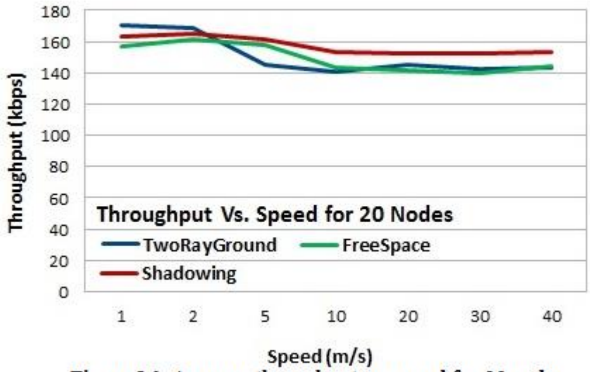

Figure 16: Average throughput vs. speed for 20 nodes

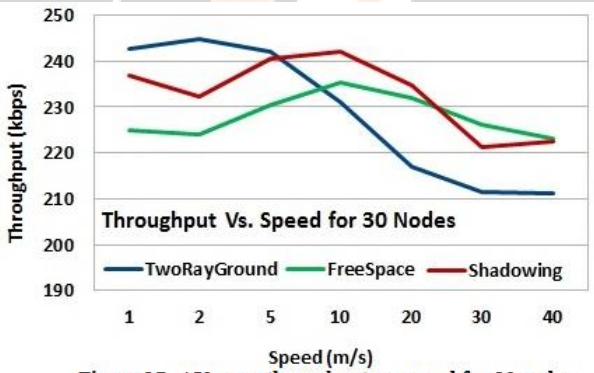

Figure 17: AVerage throughput vs. speed for 30 nodes

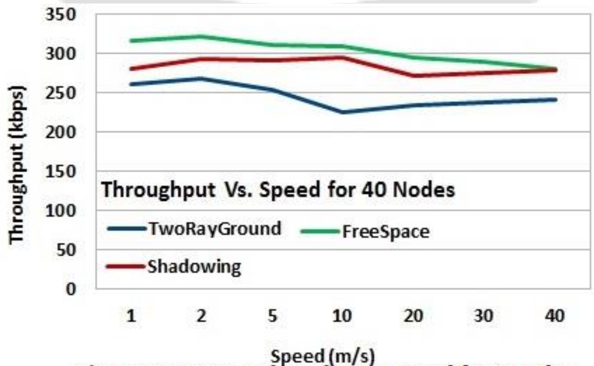

Figure 18: AVerage throughput vs. speed for 40 nodes

V: Conclusion and future scope

Under this paper we examined and analyzed AODV routing protocol over radio-wave propagation models like free space, two ray ground and shadowing. Number of nodes forming the network and the speed of mobility is considered for feting the propagation model which serves best with AODV routing protocol with IL-VANET.

As per the simulation results, packet delivered ratio is observed to be promising for shadowing model. However, as the number of node keeps on increasing free space model serves better; but under the realistic scenario it may not be always possible to have a line of sight (LOS) communication.

For average network throughput, undoubtedly shadowing model performs the best. For immobile nodes result shows good performance with two ray ground model and secondly free space model for higher node densities.

Delay plays major role in determining network performance. Simulation result shows major various in the measurements. For delay minimization AODV_BD routing protocol must be implemented, although free space model measures minimum delay followed by shadowing model.

We recommend Shadowing model for proposed IL-VANET. It would not be possible to determine best network environment which results in superior network performance unless and until all the parameters are considered at the same time with simulation. As a future scope, there is a need of all the parameters to be simulated simultaneously. Thereafter fewer requirements will arise to modifying the existing routing protocol.

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