Impact of Random, Uniform node placement and Grid environment on the Performance of Routing Protocols in MANET

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Abstract:-An ad-hoc network is frequently represented as a group of mobile platforms or nodes where each node can move freely and randomly without the benefit of any fixed infrastructure except for the nodes themselves. They are often autonomous, self-configuring, and adaptive. Each node in an ad hoc network is in charge of routing information between its neighbors, thus imparting to and holding connectivity of the network. MANET has to face many challenges in various aspects; one of the future challenges is terrain size and node placement. Here, performance of two popular protocols in MANET i.e. AODV and DSDV is evaluated under three different node placements namely Random, Uniform and Grid using GLOMOSIM simulator. The performance analysis is based on different values of Radio Range in network and different network metrics such as Packet Delivery Ratio (PDR) and Average Delay.

Keywords: *MANET, AODV, DSDV, Placement Environments, GLOMOSIM.*

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1. Introduction

In contrast to infrastructured wireless networks, where each user directly communicates with an access point or base station, a mobile ad-hoc network, does not rely on a fixed infrastructure for its operation. A mobile ad-hoc network (MANET) is a self-configuring network of mobile routers connected by wireless links - the union of which forms a random topology. The routers are free to move stochastically and organize themselves at random; thus, the networks' wireless topology may change speedily and unpredictably. Such a network may operate in a standalone fashion, or may be connected to the larger Internet. A central challenge in the design of mobile ad hoc networks is the evolution of routing protocols that can efficiently detect the transmission paths between two communicating nodes. The ad hoc networks are very flexible and eligible for several types of applications due to its feature like they allow the constitution of impermanent communication without any pre-installed infrastructure.

2. Protocol Description

In On-Demand driven routing, when a source node needs to send data packets to some destination then it checks for route availability. If no route exists, it executes a route discovery procedure to find a path to the destination. Hence, route discovery becomes on- demand. Therefore the on-demand routing techniques are also called reactive routing. The route discovery typically contains the network-wide flooding of a request message. Once a route has been established, it is preserved by some form of route maintenance procedure until either the destination becomes inaccessible or until the route is no longer desired. On the other hand, the proactive routing protocols attempt to maintain consistent, up-to-date routing info from each node to every other node in the network. These protocols require each node to maintain one or more tables to keep routing information, and they respond to changes in network topology by propagating updates across the network in order to maintain a invariable network view. The proactive protocols are not worthy for larger networks, as they need to maintain node entries for each and every node in the routing table of every node. This causes more overhead in the routing table resulting to consumption of more bandwidth.

2.1 Destination-Sequenced Distance-Vector (DSDV)

DSDV is evolved on the basis of Bellman–Ford routing algorithm with some modifications. In this routing protocol, each mobile node in the network stores a routing table. The list of all available destinations and the number of hops to each is contained by each routing table. Each table entry is tagged with a sequence number, which is originated by the destination node. Periodic transmissions of updates of the routing tables help maintaining the topology information of the network. If there is any new important change for the routing information, the updates are transmitted immediately. So, the routing info updates might either be occasional or event driven. DSDV protocol requires each mobile node in the network to publicize its own routing table to its current neighbors. The advertisement is done either by broadcasting or by multicasting. By promoting the routing tables, the neighboring nodes can know about any change that has happened in the network due to the motions of nodes. The routing updates could be sent in two ways: one is called a full dump and second is incremental. In full dump, the entire routing table is sent to the neighbors, where in incremental update, only the entries that require changes are sent.

2.2 Ad Hoc On-Demand Distance Vector Routing (AODV)

AODV is basically a betterment of DSDV. But, AODV is a reactive routing protocol instead of proactive. It minimizes the number of broadcasts by producing routes based on demand, which is not in case of DSDV. A route request (RREQ) packet is broadcasted, whenever a source node wants to send a packet to a destination. The neighboring nodes in turn forward the packet to their neighbors and the process continues until the packet reaches the destination.

During the process of transmitting the route request, intermediate nodes store the address of the neighbor from which the first copy of the broadcast packet is received. This address is stored in their routing tables, which helps for establishing a reverse path. The packets are discarded, if additional copies of the same RREQ are later received. The reply is sent using the reverse path. For route up keeping, when a source node moves, it can reinitiate a route discovery process. If any intermediate node relocates itself within a particular route, the neighbor of the drifted node can detect the link failure and notify its upstream neighbor. This process continues until the failure notification reaches the source node. On the basis of obtained information, the source might decide to re-initiate the route discovery phase.

3. Node Placement

3.1 Uniform Node Placement

This placement is based on the number of nodes in the simulation the physical terrain is divided into a number of cells, a node is placed randomly. This yields a topology that is random, but with a somewhat uniform density of nodes.

3.2 Random Node Placement

Nodes are placed randomly within the physical terrain.

3.3 Grid Node Placement

Node placement starts at (0, 0) and the nodes are placed in a grid format with each node a grid-unit away from its neighbor. Grid-unit must be specified numerically, with the unit in meters or degrees, depending on the value of coordinate-system.

4. Methodology

Results are evaluated on the basis of different performance metrics such as Packet Delivery Ratio and Average Delay using GlomoSim simulator. Performance of both protocols is evaluated for different Radio Ranges and for different grid units in grid environment. Global Mobile Information System Simulator (GloMoSim) is network protocol simulation software that simulates wireless and wired network systems. GloMoSim is designed using the parallel discrete event simulation capability provided by Parsec, a parallel programming language. GloMoSim currently supports protocols for a purely wireless network. It uses the Parsec compiler to compile the simulation protocols. Parsec is a C-based simulation language. GloMoSim simulates networks with up to thousand nodes.

4.1 Simulation Parameters

Parameters	Value
Simulator	GlomoSim
Protocol Studied	AODV and DSDV
Simulation Time	300s
Terrain Dimension	1800, 1800
No. of Nodes	100
Node Placement	Uniform, Random and Grid
Node Mobility Model	Random Waypoint
Node Speed	20
Pause Time	20s
Radio Range	50,100,150,200,250,300,000,000
Traffic Type	CBR
Traffic Pair	12
Propagation Model	Free Space
Grid Unit	10,20,30,40,50,60,70,80,90,100

4.2 Performance Metrics

A. Packet Delivery Ratio (PDR)

Packet delivery ratio is an important metric as it describes the loss rate that will be seen by the transport protocols, which run on top of the network layer. Thus packet delivery ratio in turn reflects the maximum throughput that the network can support. It is defined in as the ratio between the number of packets originated by the application layer CBR sources and the number of packets received by the CBR sink at the final destination.

B. Average Delay

The average delay of a data packet is the time interval when a data packet generated from Constant Bit Rate source completely received to the application layer of the destination.

5. Simulation Results and Discussion

5.1 Scenario for Radio Range

Performance of protocols evaluated for different radio ranges. Final conclusion is made by comparing the result of PDR and Average Delay for all radio ranges namely

(50,100,150,200,250,300,350,400) in three different node placements.

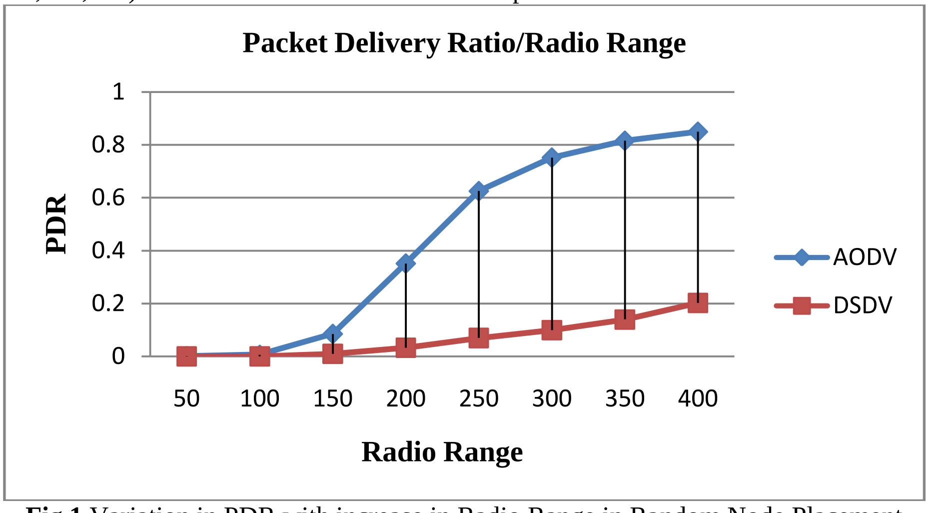

Fig.1 Variation in PDR with increase in Radio Range in Random Node Placement

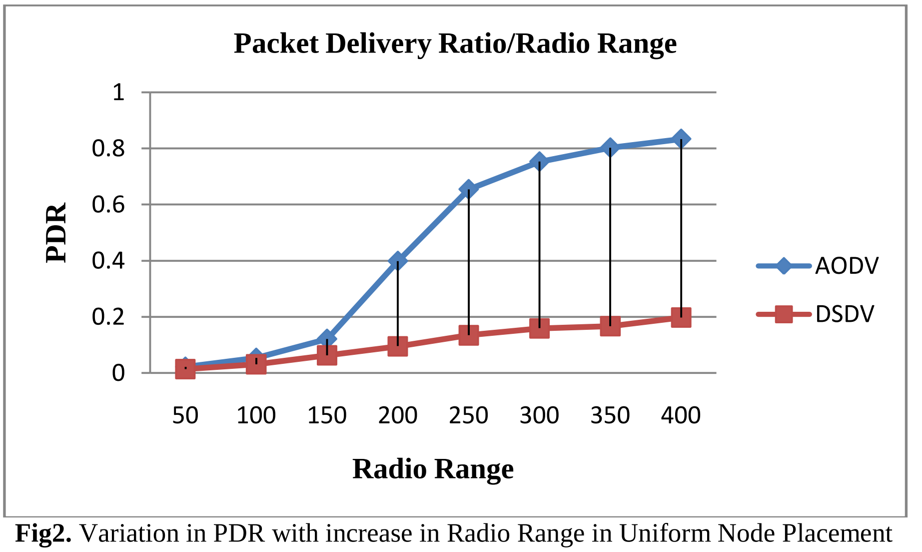

Fig2. Variation in PDR with increase in Radio Range in Uniform Node Placement

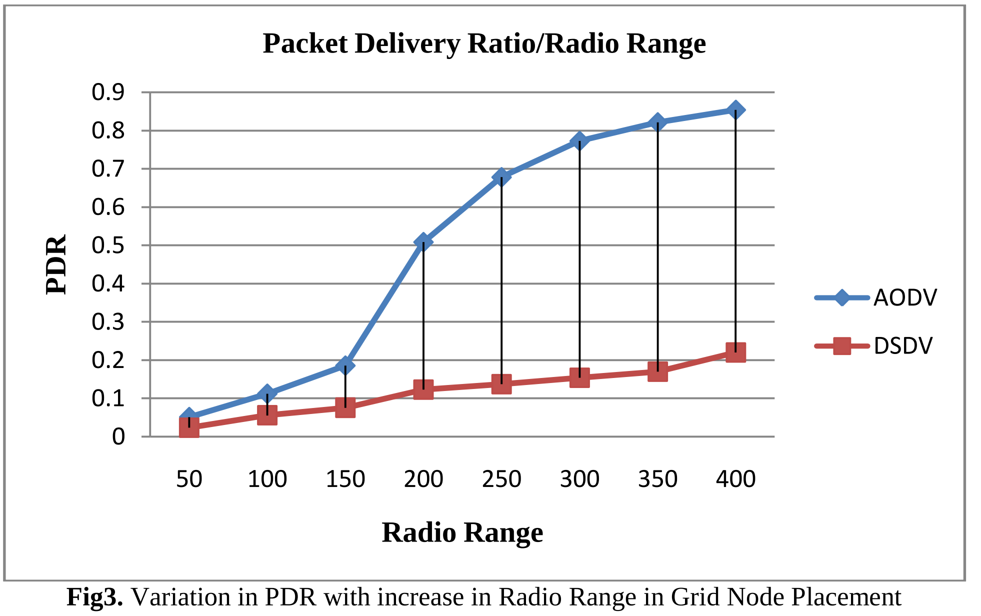

Fig3. Variation in PDR with increase in Radio Range in Grid Node Placement

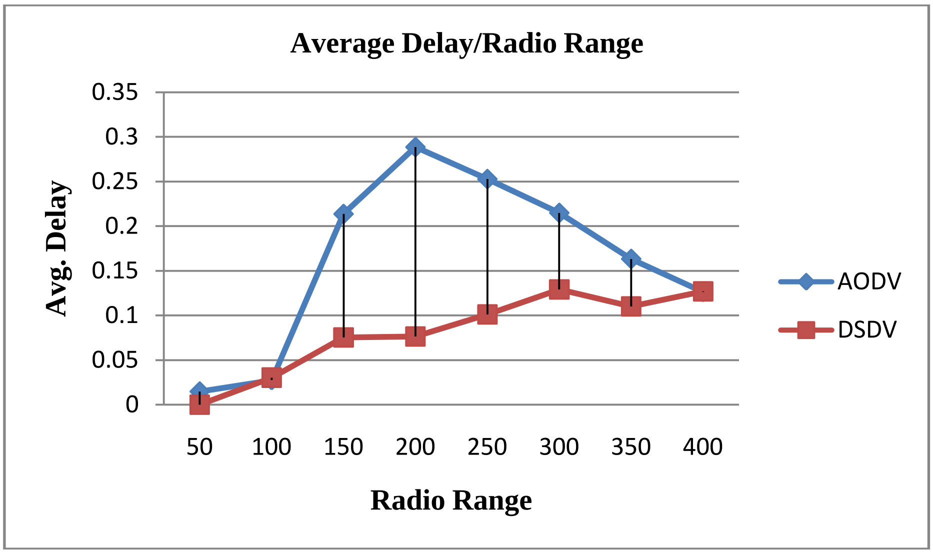

Fig4. Variation in Average Delay with increase in Radio Range in Random Node Placement

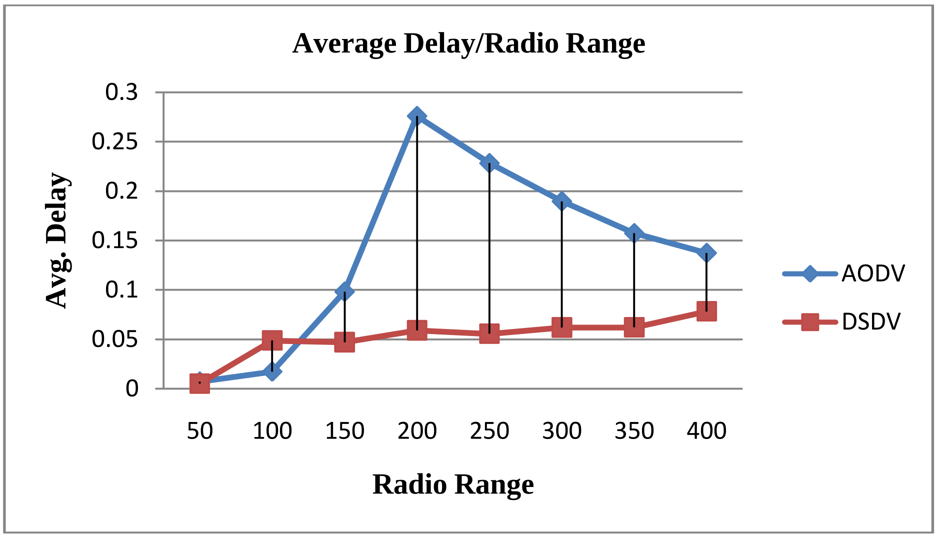

Fig5. Variation in Average Delay with increase in Radio Range in Uniform Node Placement

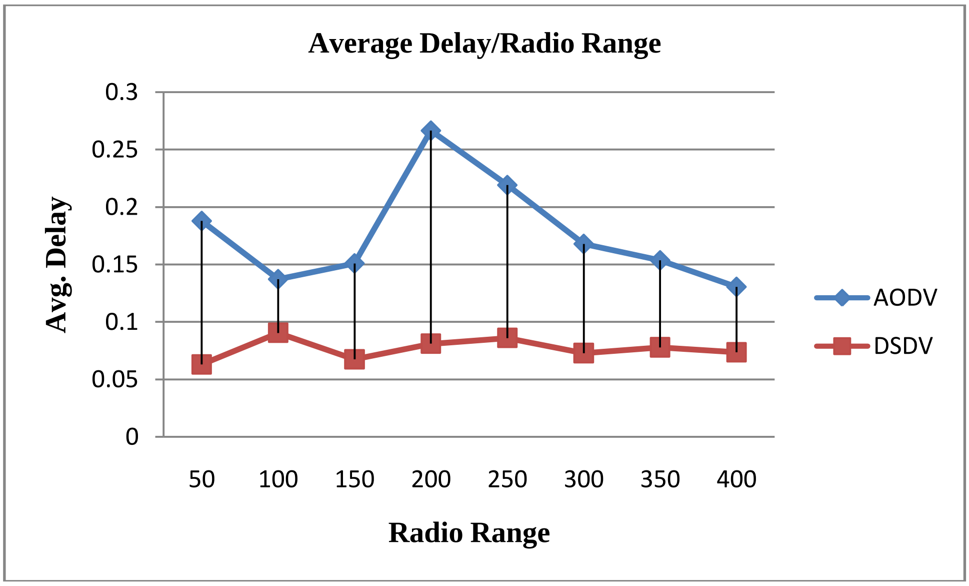

Fig6. Variation in Average Delay with increase in Radio Range in Grid Node Placement

5.2 Scenario for Grid Unit

This scenario is for grid node placement only. It is used to analyze the protocols' performance in different sized grid environment. In this scenario, different sized grid environments are created to compare the performance of protocols.

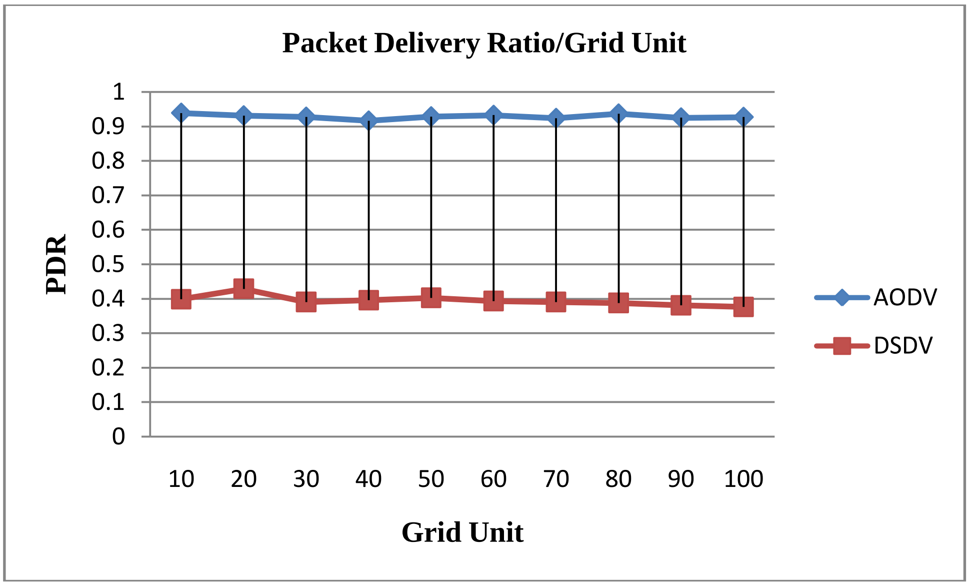

Fig7. Variation in PDR with increase in Grid Unit in Grid Node Placement

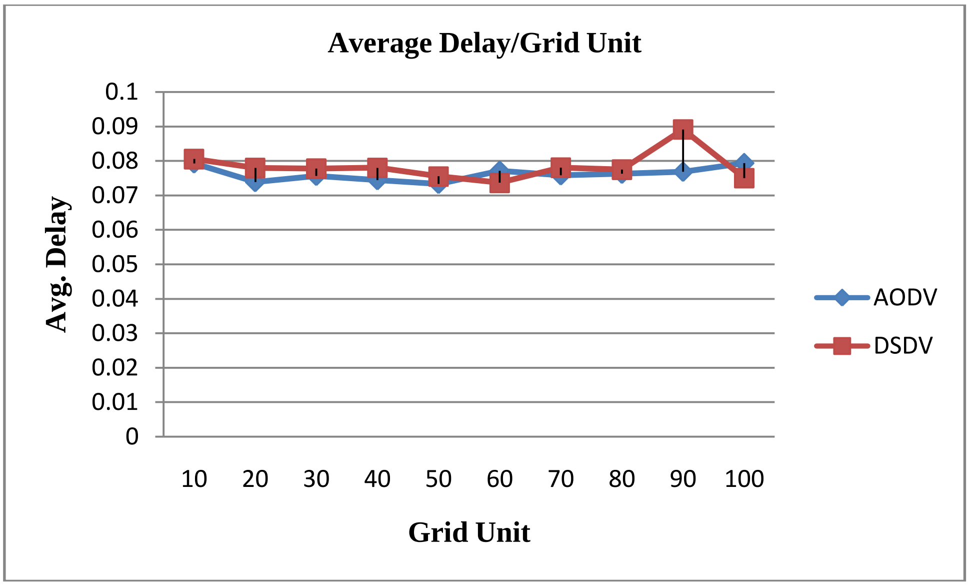

Fig8. Variation in Average Delay with increase in Grid Unit in Grid Node Placement

6. Conclusion

Empirical results illustrate that the performance of a routing protocol varies widely across different node placement models. Here from simulation results conclusion is made that Reactive protocols perform well as compare to proactive protocols in all three node placements because AODV protocols gives better outputs for both performance metrics than DSDV in variation radio range and grid unit. By comparing the three node placement models, grid node placement model is the best among three. In grid node placement both the protocols give most packet delivery ratio and shows least delay as compare to uniform and random node placement. By using these results researchers can further study the performance of other routing protocols of MANET or can choose the best node placement model for future works in MANET.

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