Performance Analysis of Dynamic Source Routing Protocol under Different Node Placement Models in Manets

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ABSTRACT*- Mobile Ad-hoc Network (MANET) is a group of wireless mobile nodes dynamically forming an ad hoc network without the help of any laid down infrastructure or centralized administration. The mobility of nodes in MANETs results in regular changes of network topology and establishing routes in MANETs is a challenging task. Routing protocols in MANET helps node to transmit and receive packets. In this paper, we investigate the impact of three node placement models namely Random, Grid and Circular on the performance metrics of DSR routing protocol using Opnet 14.5 simulator.*

Keywords - *MANET, DSR, Random, Grid, Circular.*

I. INTRODUCTION

Ad hoc network is a wireless network, which does not have a centralized and fixed infrastructure. MANET [11] is referred to as a wireless ad hoc network in which nodes are free to move arbitrarily and mobile nodes can send and receive the traffic. Also, mobile nodes can behave like routers by forwarding the neighbors traffic to the target node as the routers are multi-hop devices. MANET does not require base stations of wired infrastructure. The mobile nodes in wireless network has wireless interface to communicate with each other because it is a self-organized network. These networks are created by mobile nodes without any fixed infrastructure and central management [1]. The mobile nodes have transmitters and receivers with smart antennas, which enable the mobile nodes to communicate with each others. The topology of the network changes from time to time by arriving in and out of the mobile nodes in the network. In the beginning, MANET was designed for battlefield purpose but now the MANET is employed in many areas such as in disaster-hit areas, data collection in some area, in rescue missions, virtual classes and conferences. By uprising the network, combined with the node mobility the challenges of self-configuration of the network become more evident

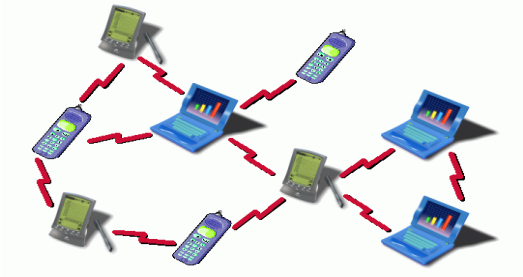

Figure 1: MANET

II. RELATED WORK

Dr.S.P.Setty et al. [17] evaluated the performance of DSR under different placement models using QualNet version 5.0 and they concluded that DSR achieved better performance in uniform environment.

shyed Basha shaik et al., [4] evaluated the performance of DSR, AODV, and ANODR routing protocol under grid placement models for different network sizes using QualNet 5.0.2 simulator and concluded that DSR performs well in terms of throughput and packet delivery ratio for all network sizes.

III. ROUTING PROTOCOLS

Routing means to choose a path. Routing in MANET means to choose a right and suitable path from source node to target node. Routing terminology is used in various kinds of networks such as in telephony technology, electronic data networks and in the internet network. Here we are more concern about routing in mobile ad hoc networks. Routing protocols in MANETs means that the mobile nodes will search for a route or path to connect to each other and share the data packets. Protocols are the set of rules through which two or more devices (mobile nodes, computing devices) can communicate to one another. In mobile ad hoc networks the routing is mostly done with the aid of routing tables. These tables are maintained in the memory cache of these mobile nodes. When the routing process is going on, it routes the data packets in different mechanisms. The first one is unicast, in which the source directly sends the data packets to the destination. The second one is multicast, in this, the source node sends a data packet to the specified multiple nodes in the network. The third one is

broadcast; it means the source node sends data packets to all the near and far nodes in the network.

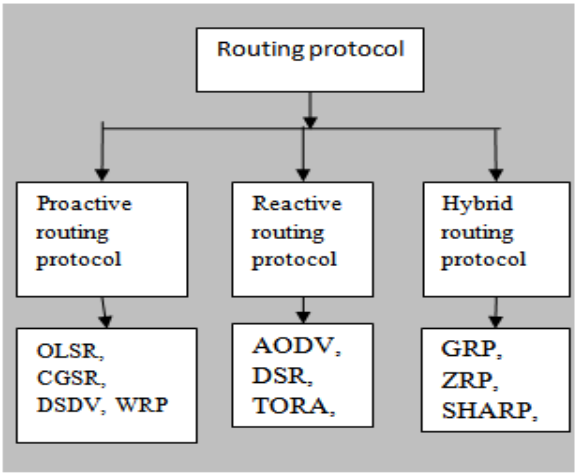

Figure 2. Categorization of Ad Hoc Routing Protocols

A. Proactive Routing Protocols

One of the main characteristics of the Proactive Routing Protocols is that it builds and maintains the information (routing information) to every node in a network whether the route is needed for the sending of traffic or not. Proactive routing protocols [7] continuously sends control messages, even when there is not the flow of data that's why proactive routing protocols are not bandwidth efficient routing protocols in Mobile Ad hoc Networks (MANETs). These protocols have benefits and drawbacks as well. The main benefit [15] of such type of protocol is that the node can easily get the routing information and a session can easily be established. The drawbacks are that it is not a bandwidth efficient routing protocol; even it will send control messages when there is no flow of data. The other drawbacks can be that for maintenance the nodes will hold too much of data and also restructure process is very slow if a failure occurs in any link

B. Reactive Routing Protocols

When needed to send packets only it began to prepare to send the routing table. When a wireless node needs to send data to another node, the source client node will call a path discovery process [7], and stored in the registers of this path. The path is not valid until the expiration or the occurrence of conditions of the agreement with the first phase of a ratio of such agreements in each node. A smaller amount of data needed, and don't need to save the entire network environment and the routing information. The main benefit of this agreement is that the use of a lower bandwidth, but the disadvantage is that not every wireless node that sends packets can always quickly find the path. The path discovery [15] procedure can cause delays and the average delay time is longer

C. Hybrid Routing Protocols

It is an improvement of the proactive and reactive routing protocols, or the combination of other systems, such as global positioning system (GPS) and other equipment, participate in the study of mechanisms to facilitate the routing of the quick search, and data transmission. However, there are already more than 13 kinds of the above routing protocol have been proposed, following the more representative for several separate presentations, and to compare their individual differences lie.

IV. Dynamic Source Routing Protocol (DSR)

The key feature of DSR [1], [2], [3] is the use of source routing. The source knows the complete hop-by-hop route to the target node. These routes are stored in a route cache [12]. The data packets carry the source route in the packet header [5]. It is an on-demand [10] routing protocol and composed of two parts:

A. Route Discovery

B. Route Maintenance.

A. Route Discovery

When a node in the ad hoc network seeking to send a data packet to a target node for which route is not known, it uses a route discovery mechanism to find a route. Route discovery uses simple flooding technique in the network with route request [10] (RREQ) packets. Each node receiving an RREQ rebroadcasts it further unless it is the destination or it has a route to the target node in its route cache. Such a node replies to the RREQ with a route reply (RREP) packet that is routed back to the initiator. RREQ and RREP packets are also source routed. The RREQ builds up the path traversed so far. The RREP routes itself back to the originator by traversing this path backward, the route carried back by the RREP packet is cached at the initiator for future use.

B. Route Maintenance

Route Maintenance is the mechanism by which packet's sender S is able to detect while using a source route to D, if the network topology has changed such that it can no longer use its route to D because a link along the route no longer works. When Route Maintenance [15] indicates a source route is broken, S can attempt to use any other route it happens to know to D, or can invoke Route Discovery again to find a new route. Route Maintenance is used only when S is actually sending packets to D.

V. Node Placement Models

Various architectures and node placement models [8] have been developed for Mobile ad hoc networks. We focus on three node placement models for MANET environments in Opnet [13], [14] simulator random node placement, grid node placement, and circular node placement.

A. Random Node placement Model

Random node placement [8], [17] means setting positions of wireless mobile nodes randomly and independently in the target area. Random node placement method is fast in practice though costs a relatively larger number of nodes to achieve the same node placement goal. When practical application scenarios are considered, random node placement is a feasible and practical method, and sometimes it is the only feasible strategy. In this node placement, as shown in Figure 2 each mobile node has the equal probability of being placed at any point inside a given target field. Consequently, the nodes are scattered on locations which are not known with certainty. For example, such a node placement can result from throwing mobile nodes from an airplane.

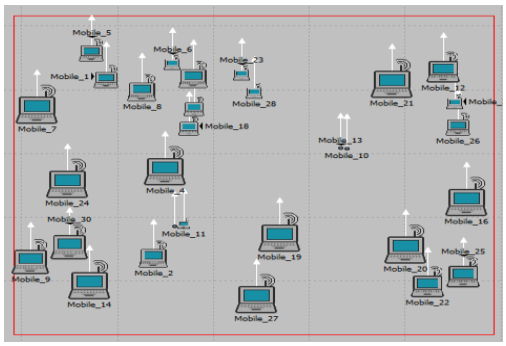

Figure 3.Random Node Placement

B. Grid Node Placement Model

In Grid Node placement model [4], [8] the mobile nodes are placed as shown in the Fig 4. 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.

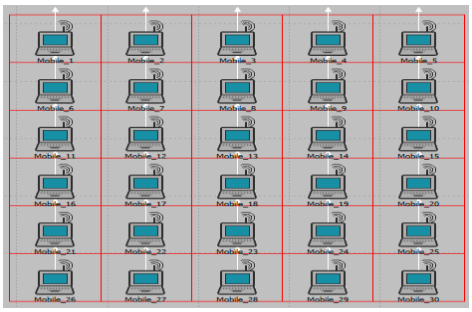

Figure 4. Grid Node Placement

C. Circular Node Placement Model

In circular node placement model, the mobile nodes are placed in a Circular manner.

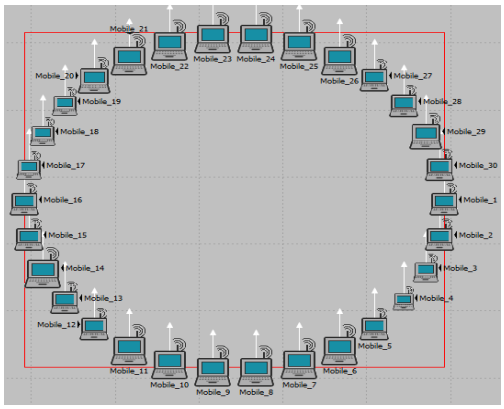

Figure 5. Circular Node Placement

VI. EXPERIMENTATION

A. OPNET Simulator

We are using the Optimized Network Engineering Tool [5], [6] (OPNET v14.5) for simulation of networks which is one of the most powerful simulation tools regarding wireless communications. OPNET is a research-oriented network simulation tools which provides a development environment for modeling and simulation of deployed wired as well as wireless networks and also provide multiple solutions for managing networks and applications e.g. network operation, planning, research and development (R&D), network engineering and performance management. OPNET 14.5[13] is designed for modeling communication devices, technologies, protocols and to simulate the performance of these technologies. The user can create customized models and simulate various network scenarios [14]. It is possible to simulate various wireless communication technologies such as MANET, 802.11, 3G/4G, WiMAX, Bluetooth, ZigBee using OPNET tool.

B. SIMULATION SETUP

The simulation is done using Opnet v14.5 modeler. We studied the performance of DSR under Different Node placement Models Random, Grid, and Circular. A campus network was modeled with in an area of 1000m x 1000m. . The Performance metrics [16] that are evaluated are Throughput, Total Packets salvaged and Total replies sent from destination.

Table: 1 Simulation parameter values

Routing Protocol	DSR
Simulation Time	300 sec.
Simulation Area	1000m x 1000m
Traffic	Exponential
Node type	MANET
Packet size	1024 bytes(Exponential)
Placement model	Random, Grid, Circular
Network size	30
Transmission Range	250 m
Receiver Range	250m
Min. & Max speed	0 m/s & 12 m/s
Pause time	0 m/s
Mobility model	Random way point
Data rte	11 mbps
Address mode	IP v4

VII. Experimentation Results and Graphical Analysis

A. Throughput: Throughput can be defined as the ratio of the 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 throughput. It is express as bytes or bits per seconds (byte/sec or bit/sec). A throughput with a higher value is more often an absolute choice in every network.

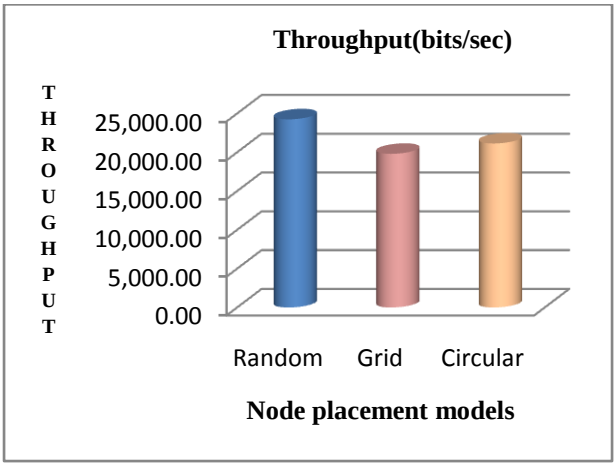

Figure 6. Variation of throughput with different Node placement models.

Table 2: Throughput for different node placement models

Node placement model	Throughput (bits/sec)
Random	24,251.03
Grid	19,803.81
Circular	21,140.17

Figure 6 & Table 2 show that the Throughput is Maximum for Random node placement model, minimum for Grid node placement model and moderate for Circular node placement model.

B. Total packets salvaged: When an intermediate node receives a data packet, but however, the next hop along the path of the source route is broken (no acknowledgements received), the intermediate node salvages the packet by rerouting it along a different route to the destination if an alternate route exists in the node's route cache. It represents the total number of packets salvaged by all nodes in the network.

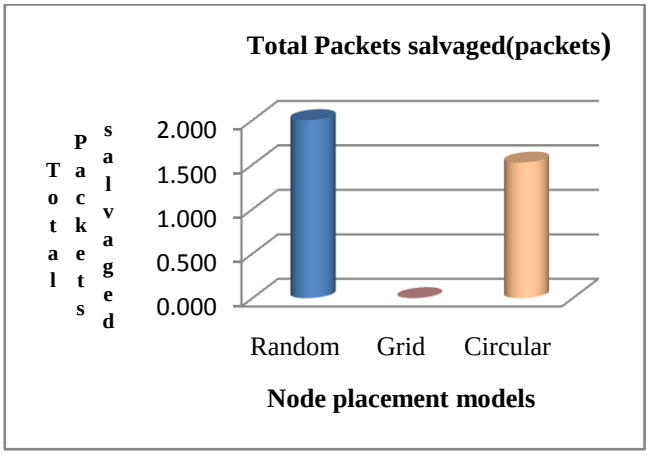

Figure 7. Variation of Packet salvaged with different node placement models.

Table 3: Total Packets Salvaged for different node placement models

Node placement model	Total packets salvaged(Packets)
Random	2.000
Grid	0.000
Circular	1.524

Figure 7 & Table 3 show that the Total Packets salvaged is maximum for Random node placement model, minimum for Grid node placement model and moderate for Circular node placement model.

C. Total replies sent from destination: Once the destination node receives a route request, it sends a route reply to the source of the request with the entire route discovered. This statistic represents the total number of route reply packets sent from all nodes in the network if they are destinations of route requests.

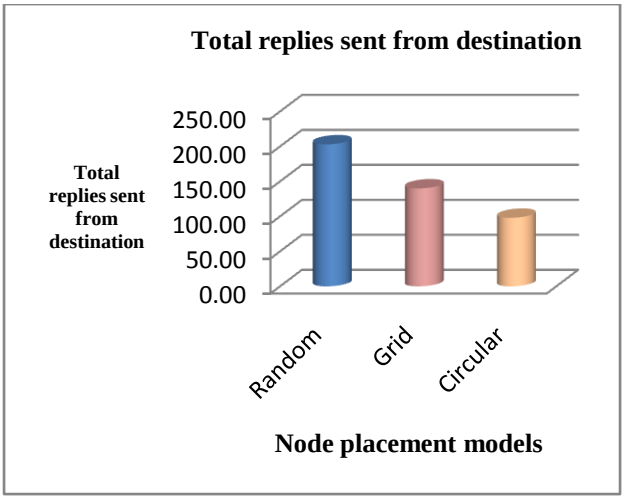

Figure 8. Total replies sent from destination with different node placement models.

Table 4: Total replies sent from destination for different node placement models

Node placement model	Total replies sent from destination
Random	203.00
Grid	140.00
Circular	98.00

Figure 8 & Table 4 Show that the Total replies send from destination is Maximum for Random node placement model than with Grid and Circular node placement models.

VIII. CONCLUSION AND FUTURE SCOPE

From the above results, among all node placement models the Random node placement model performs well in terms of Throughput, Packets salvaged and total replies sent from destination for DSR routing protocol. Our future research work will be extended with different network sizes, mobility and pause times.

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