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Performance Analysis of OLSR Routing Protocol under Different Node Placement Models in MANETS

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ABSTRACT
A Mobile Ad hoc Network (MANET) is a type of adhoc network of mobile devices which are free to move independently and will therefore frequently change links to other devices. Hence routing is considered to be a challenging issue in MANETs. In this paper we analyze the impact of node deployment models on the performance of Optimized Link Sate routing protocol (OLSR) by using OPNET Simulator 14.5.
Keywords :- MANET, OLSR, Random, Grid, Circular**.**

I. INTRODUCTION

A MANET is a type of infrastructure-less network which changes locations and configures itself instantly. Nodes act as routers in forwarding packets for each other and their mobility causes frequent route changes. Therefore routing in MANETS is considered to be a significant task and has gained more importance due to dynamic nature of MANETs. Different routing protocols have been developed and therefore it has become difficult to determine which routing protocol performs better under different network scenarios.

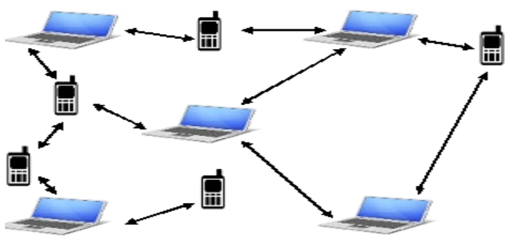

Figure 1: MANET

II. ROUTING PROTOCOLS IN MANETS

MANETs Routing protocols [1][2][3] can be categorized into Proactive routing protocols, Reactive routing protocols and Hybrid routing protocols.

Proactive routing protocols regularly study the topology of the network by exchanging topological information among the devices in a network. Therefore, such route information is available right away, when the route to a destination is required. They assess the routes within the network so that when the packet is to be forwarded, route is beforehand known and immediately available for use. That's why an optimized path can be found without any time delay. These protocols are not suitable for very dense ad-hoc networks as there will be problem of high traffic.

Reactive routing protocols usually do not preserve routes to any destination in the network. They also do not exchange any periodic control information. They are also called on demand routing protocols and are more efficient than proactive routing protocols. They don’t consider the routes which are not presently being used. The cost of upholding the routes not being used is avoided by determining the route on demand. The traffic of the network is also controlled by them as they don’t send intense control messages. In reactive protocols time delay is comparatively greater than proactive protocols as routes are determined when it is essential.

In Hybrid routing protocols all the nodes behave reactively in the region close to their proximity and proactively outside of that region.

III. OLSR ROUTING PROTOCOL

The Optimized Link State routing (OLSR) is a table-driven pro-active protocol. It uses the link-state scheme in an optimized manner to distribute topology information. The optimization in OLSR [4][5] is based on a technique called Multi Point Relaying.

Characteristics of OLSR:

A. Control messages:

OLSR [4][5] defines three basic types of control messages like Hello, Topology control and Multiple Interface Declaration messages.

HELLO messages - are messages which are transmitted to all neighbours and are used for neighbour sensing and MPR calculation.

Topology Control messages - are the link state signalling done by OLSR.

Multiple Interface Declaration messages - are messages which are transmitted by nodes running OLSR on more than one interface and they list all IP addresses used by a node.

B. Multipoint Relays:

OLSR [5] reduces the control traffic overhead by using Multipoint Relays (MPR), which is the key idea behind OLSR. A MPR is a node's one-hop neighbour which has been selected to forward packets. This restricts the network overhead, thus being more efficient than other link state routing protocols.

OLSR is well suitable to large and dense mobile networks. MPRs help in providing the shortest path to a destination. The only requirement is that all MPRs declare the link information for their MPR selectors.

C. Selection of Multipoint relay nodes:

A node N selects an arbitrary subset of its 1-hop symmetric neighbours to forward data traffic. This is referred to as MPRset, which covers all the nodes that are two hops away. The MPRset is calculated from information about the node's symmetric one hop and two hop neighbours. This information is pulled out from HELLO messages. Just like the MPRset, a MPRSelectors set is maintained at each node. A MPRSelector set [4] [5] is the set of neighbours that have selected the node as a MPR. A node on receiving the packet checks it's MPRSelector set to find if the sender has selected the node as a MPR. If so, the packet is forwarded, else the packet is processed and discarded.

D. Neighbor Sensing:

HELLO messages [4][5] are broadcasted periodically for neighbour sensing. When a node receives a HELLO message in which it's address is present, it registers the link to the source node as symmetric. When a node receives a HELLO message in which the node's address is not found, the node registers in the routing table that the link to the source node is asymmetric. The node then sends a HELLO message holding the source node's address, and when the source node obtains this message and finds its own address in it, it registers.

E. Topology Information:

Network topology information [4][5]is extracted from topology control (TC) packets. These packets have the MPRSelector set of a node, and are broadcasted by every node in the network, when changes in the MPRSelector set is detected or occasionally. The packets are flooded in the network using the multipoint relaying mechanism. Every node in the network when it receives the TC packets, extracts information to construct a topology table.

F. Route Calculation:

The shortest path algorithm is used for route calculations, which is started when a change is detected in either the link set, the neighbour set, the two-hop neighbour set, the topology set, or the Multiple Interface Association Information Base. Information is taken from the neighbour set and the topology set to calculate the routing table. The calculation [4] is an iterative process, in which route entries are entered starting from one-hop neighbours, increasing the hop count each time.

OLSR protocol is well suitable to applications in which long delays in transmitting data packets is not allowed. It is mostly adapted to a network which is dense and where communication happens regularly among large number of nodes.

IV. NODE PLACEMENT MODELS IN MANETS

Node placement [13] is a method to place the nodes efficiently in a simulation area so that minimum energy is consumed from each node that is planned for transmission of packets or a data.

A. Random node placement model: This model [13] deploys the nodes randomly leading to uneven or unequal distribution of nodes. This model has small coverage area with more number of nodes deployed with un-equal distances. This leads to more energy utilization and further decreases overall network lifetime.

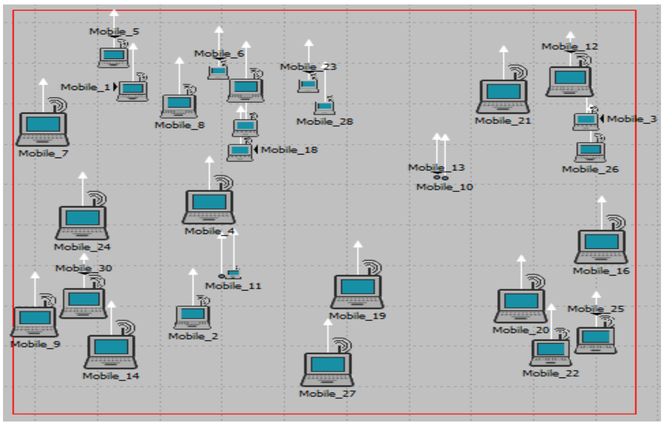

Figure 2: Random node placement model

B. Grid node placement model: This model [13] deploys the nodes in grid manner. They have large coverage area with few number of nodes deployed at equal distances.

Figure 3: Grid node placement model

C. Circular node placement model: This model deploys the nodes in circular manner. They have large coverage area with few number of nodes deployed at equal distances.

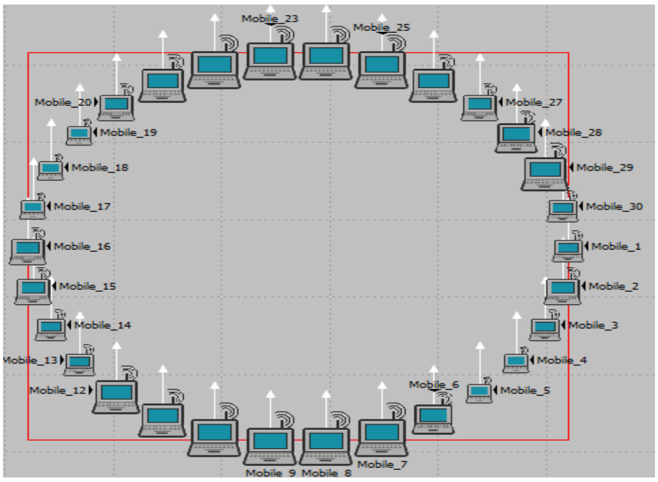

Figure 4: Circular node placement model

V. SIMULATION ENVIRONMENT

The performance of OLSR routing protocol with respect to different Node placement models is examined using the OPNET Simulator [12]. Following parameters are set during simulation.

Parameter	Value
Routing Protocol	OLSR
Simulation time	300sec
Simulation Area	1000m x 1000m
Node Type	MANET
Network Size	30 nodes
Nodes Placement	Random, Grid, Circular
Mobility Model	Random Way Point
Operational mode	802.11b
Data rate	11Mbps
Address mode	IPV4

Table 1: Simulation Parameters

VI. EXPERIMENTAL RESULTS

To evaluate the performance of OLSR routing protocol, the following metrics are considered.

1) Delay : It is end-to-end delay measured in seconds which indicates the duration it took for a packet to travel from the source to the application layer of the destination. The variation in Delay with different node placement models is shown in the Figure 6.

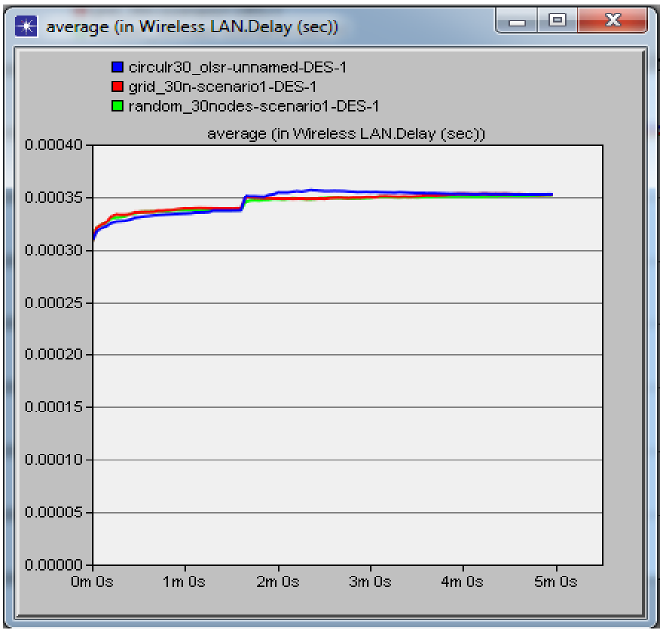

Figure 5: Variation in Delay in OPNET.

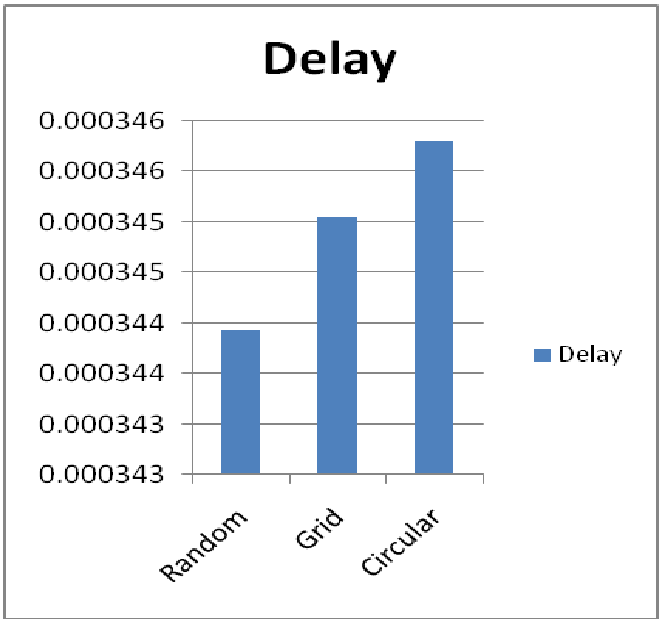

Figure 6: Variation in Delay for different node placement models.

Figure 6 Shows metric Delay is comparatively less in Random node placement model when compared to Grid and Circular models. Circular node placement model has maximum Delay.

2) Load: It represents the total load submitted to wireless LAN layers by all higher layers in all WLAN nodes of the network. It is measured in bits/sec. The variation in Load with respect to different node placement models is shown in the Figure 8.

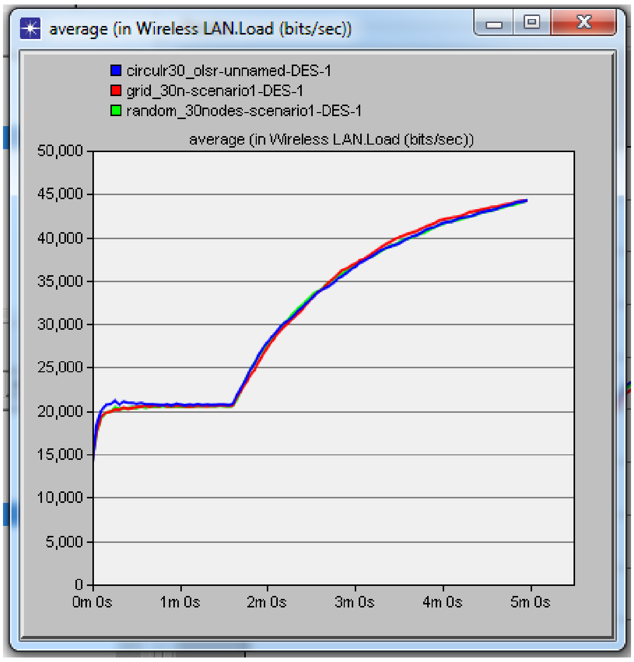

Figure 7: Variation in Load in OPNET

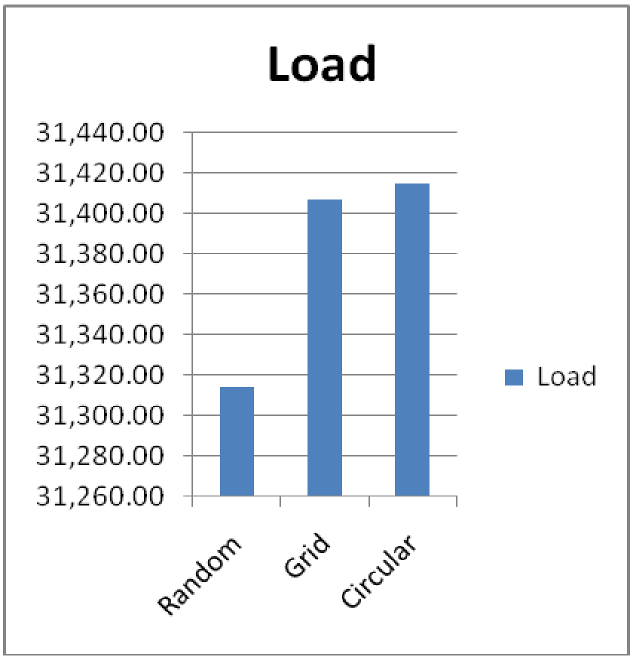

Figure 8: Variation in Load for different node placement models.

Figure 8 shows metric Load is comparatively less in Random placement model, moderate in Grid node placement model and maximum in Circular node placement model.

3) Throughput: It represents the total number of bits forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network. It is measured in bits/sec. The variation in Throughput with respect to different node deployment models is shown in the Figure 10.

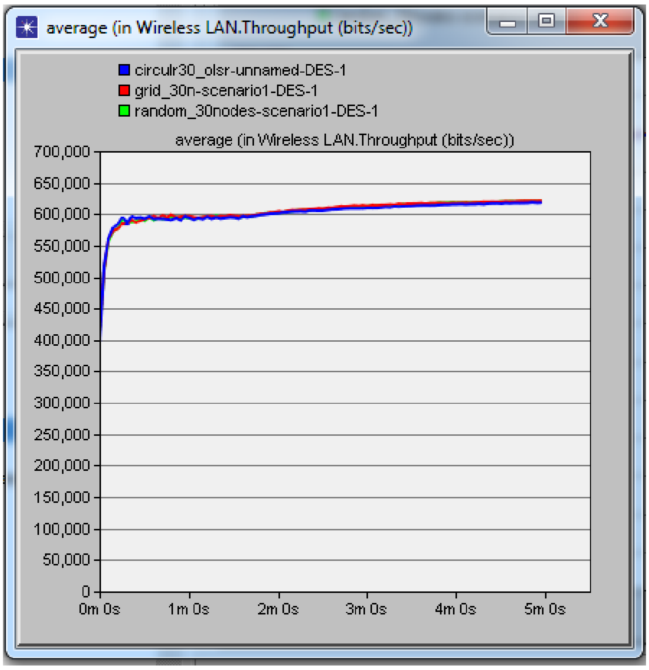

Figure 9: Variation in Throughput in OPNET

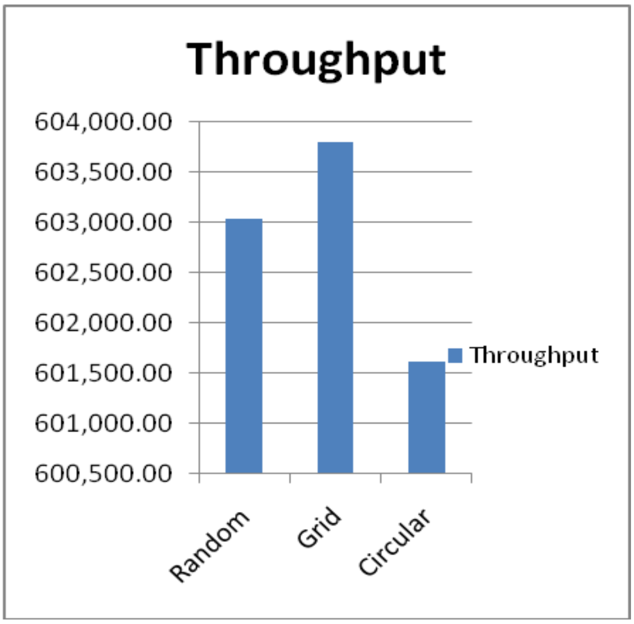

Figure 10: Variation in Throughput for different node placement models

Figure 10 shows Grid node placement model has maximum Throughput value, Random model has moderate Throughput and Circular model has low Throughput value.

VII. CONCLUSION

The performance of OLSR is analyzed by placing the nodes in Random, Grid and Circular node placement models considering the metrics Delay, Load and Throughput. Experiment results reveal that the metric Delay is comparatively less in Random node placement model when compared to Grid and Circular models. Circular node placement model has maximum delay. It is also observed that the metric Load is comparatively less in random placement model, moderate in grid node placement model and maximum in circular node placement model. Also, Grid node placement model achieves better Throughput value, Random node placement model has moderate Throughput value and Circular model has low Throughput value. Therefore from the simulation results it is evident that OLSR achieves better performance in Random node placement model when compared to Grid and Circular node placement models. Our future research will be analyzing the performance of OLSR with different network sizes.

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