Investigating the Impact of Node deployment models on the performance of OSPF Routing Protocol in MANETS

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Abstract- Mobile Ad-hoc Networks (MANETs) are wireless network with mobile nodes. Mobile means the nodes are free to move themselves randomly, which may cause the rapid and unpredictable change of the network topology. Ad-hoc means that each node is willing to forward data for other nodes. In this paper we investigate the impact of three node deployment models namely grid, random and circular on the performance of Open shortest path first (OSPF) by using OPNET Simulator (v14.5). Simulation results show that Random deployment model perform better than grid and circular deployment models.

Keywords — *MANET, OSPF, RANDOM, GRID, CIRCULAR.*

I. INTRODUCTION

Mobile ad hoc network (MANET) [5] [2] [9][25][26] is self handled, easily deployable, extremely adaptable, dynamic network having autonomous mobile nodes. Each mobile node behaves as a transceiver. In this network any node may join and leave the network unexpectedly. Nodes in the network, communicate with each other if they are in the straight signal range. If they are not in the signal range communication done in multihop fashion. Due to the dynamic topology, effective protocol is required, which provides QoS by minimizing delay and power consumption while maximizing throughput. In MANETs all the nodes share the available resources. Therefore optimal way of utilizing resources is another challenging issue in MANETs. Since the range of wireless communication is limited, long distance communications between any two nodes has to depend on the forwarding of intermediate nodes.

II. LITERATURE REVIEW

Several researchers [1],[4],[12],[15],[16],[19] have done the performance analysis and classification of routing protocols qualitatively and quantitatively at different performance metrics and different mobility models. Effort of researchers is to identify the best suitable routing protocol which gives the desired result in a few seconds. Dr.S.P. Setty et. al.[19] presented the performance analysis of the AODV[17] at random waypoint mobility with varying environment like Grid, random and Uniform and cleared that AODV works very well in Grid environment. To check the QoS of the AODV, they investigated AODV on Average jitter, Average end-to-end delay, Packet delivery ratio and Throughput with varying number of nodes and speed of the nodes in different environments. S. Kumar et. al. [12] showed significant impact of the mobility on the routing protocols. It presented the group and random waypoint mobility models and concluded that reactive routing protocols worked better than table driven routing protocols. It used Average End-to-End delay, Normalized Routing Load, Throughput and Packet delivery ratio to analyze the performance at different mobility models with varying number of nodes, speed and pause time. S. Ali et. al. [1] compared the 3 routing protocols namely AODV, DSR[11] and OLSR[10]. In [1], tables presented that OLSR outperformed other two routing protocols in all given scenarios. This performance analysis was done against three performances metric namely delay, network load and throughput with varying network size. Josh Broch et. al [4] compared 4 routing protocols at packet level simulation with mobile nodes. They used packet delivery ratio, routing overhead and path length with varying pause time, CBR sources and speed of the nodes. They presented that the all given protocols worked very well for less speed of the nodes but the performance of the protocols varies as the speed of the nodes increased. Its main concern was modification in ns-network simulator through this analysis. Peiyan et. al.[16] presented that the DSR is better than TORA and AODV with increasing number of nodes. Moreover, Parma in [15] compared the reactive, table driven and hybrid routing using the protocols named AODV, FSR and ZRP respectively. This paper shows AODV worked better than ZRP and gave uniform performance with FSR at different performance metrics. Comparison among DSDV[18], DSR and AODV with varying no. of nodes using NCTUns network simulator was presented in [13]. Santoso et. al. [21] presented the comparison among OLSR, AODV and DSDV in VANETs considering the human safety on road using NS3. This paper showed that DSDV gives better result in VANETs scenarios than other two namely AODV and OLSR. Hamma et. al. [20] gave the comparative study of the reactive and table driven routing protocols. It uses delay and jitter as a performance matrices to test the performance of routing protocols (like OLSR, DSR and AODV) by varying network density and showed that network density has no effect on the OLSR while AODV and DSR are affected. It also showed that reactive routing is better than proactive. [3] Presented comparison among AODV, PAODV, CBRP DSR and DSDV routing protocols using end to end delay, normalized routing overhead and throughput with varying no. of nodes, and workload. Samir R. Das et. al. [7] used DSR and AODV to show the performance of the reactive routing protocols in ad hoc networks. Both routing protocols were investigated in two configuration of random waypoint mobility model. Average end-to-end delay, PDR, Normalized routing load and Normalized MAC load were used with varying pause time and no. of sources. Effect of the mobility was shown by using different speed of nodes. They showed that the performance of the AODV and DSR varied with no. of nodes. For less no. of nodes, DSR had higher preference than AODV and for larger no of nodes; researchers are contributing in this area so that an effective and efficient routing can come into existence. The main motive behind this paper is to provide the effect of the mobility model as well as to give detailed comparative study of the adaptive routing protocols.

Anuj K. Gupta, Harsh and Anil K. Verma [2013], have made an attempt to compare different mobility models and provide an overview of their current research status. The main focus is on Random Mobility Models and Group Mobility Models. Firstly, they present a survey of the characteristics, drawbacks and research challenges of mobility modeling. At the last they present simulation results that illustrate the importance of choosing a mobility model in the simulation of an ad hoc network protocol. Also, they illustrate how the performance results of an ad hoc network protocol drastically change as a result of changing the mobility model simulated.

III. *Routing Protocols of MANET*

Routing is the process of selecting paths through which data packets move in network traffic. Intermediate nodes in a MANET can act as routers to forward data packets. Generally routing protocol represents the relation or formula that is being used by routers to find the suitable way through which data can be forwarded. Routing protocol for Mobile ad-hoc network can be categorized into three categories. These are Proactive, Reactive routing and Hybrid Routing protocols as shown in the following Fig 1.

Pro-active routing is also called Table driven routing where as re-active routing is called On-demand & dynamic routing. OSPF, DSDV and OLSR are the pro-active routing protocols.

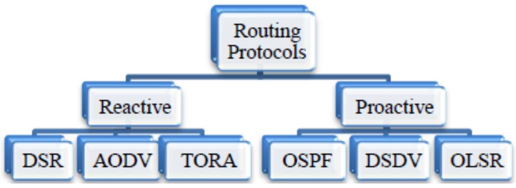


Fig 1: routing protocols

We mainly concentrated on OSPF Routing Protocol in this paper.

IV. *OSPF*

The OSPF (Open Shortest Path First) protocol development started in 1987 by the IETF (Internet Engineering Task Force) as a replacement to the RIP protocol. During that period, the Internet was evolving and broadened, resulting in more and larger networks resulting in bigger routing tables. The RIP updates in the new network environment were also wasting a lot of bandwidth. The OSPF working group of IETF managed to create a new hierarchical, classless link-state protocol that achieved higher convergence to adapt to the network changes faster, used a more descriptive metric than hop-count, and supported security and Type of Service. The first version of OSPF, named OSPFv1 was published in 1989, in the RFC 1131. Problems regarding the deletion of information in the routing tables, the performance of the network being destroyed by endless routing update loops, and the motivation to enhance the protocol interval times and routing lookup process, lead to the publication of the OSPFv2 in 1991, in the RFC 1247. (Moy, 1998) Finally, OSPFv2 was modified to support the new IPv6. The new version named OSPFv3 was published in 2008, in RFC 5340. [23]

We used OPNet simulator for OSPFv3 in wireless network Deployment method as shown in the following fig 2.

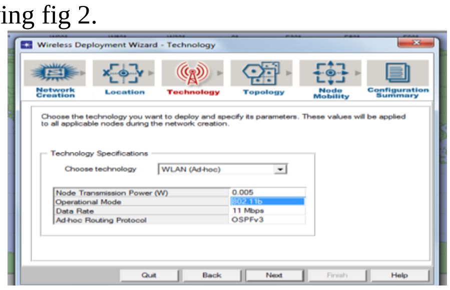


Fig 2: Wireless deployment wizard in OPNET

V METHODOLOGY

There are several ways to validate a new framework or protocol in a networked environment such as: mathematical modeling, simulation, hybrid (which is combination of simulation and mathematical modeling), and test-bed emulation [22]. Mathematical modeling is the fastest method, but when a complicated model with various factors is to be modeled, it is not accurate and it becomes inapplicable. In Simulation models the interaction between modeling devices creates detailed packet-by-packet model for network activities. In order to compromise the significant amount of computational power and the time-consuming nature of simulation, sometimes mathematical modeling combined with simulation are used to model behaviors of a network. This method is called hybrid modeling. Test-bed emulation is implementing a new framework or protocol in small scale on real devices. This method is more expensive and almost always involves unexpected engineering problems.

VI OPNET Simulator & Process

OPNET (OPtimized Network Engineering Tools) is the leading commercial discrete event simulator [24], which is highly used in industry and academia. OPNET follows object-oriented principals. A hierarchy of models is used in a network model in order to simulate network behavior. In OPNET, network model contains node models and node models consist of processes, transmitters and receivers. A process model simulates behaviors of a node using a state transition diagram, in which transitions are conditions/events that occur in a network's life span. The OPNET library contains many predefined network devices and protocols such as: routers, switches, fixed and mobile wireless workstations, etc. OPNET combines C language with state transition diagram, and offers a new language called Porto-C which is being used for designing and implementing process models. Also, C++ can be used to extend OPNET preexisting models. OPNET offers debugging facilities through OPNET debugger (ODB), in which you can follow packets flow and movements of a mobile node in a simulated environment. The performance metrics are delay and throughput.

Delay: Represents the end to end delay of all the packets received by the wireless LAN MACs of all WLAN nodes in the network and forwarded to the higher layer.

This delay includes medium access delay at the source MAC, reception of all the fragments individually and transfers of the frames via AP, if access point functionality is enabled.

Throughput: Represents the total number of bits (in bits/sec) forwarded from wireless LAN layers to higher layers in all WLAN nodes of the network.

The aim of this simulation study is to evaluate the performance of existing wireless routing protocol OSPF in various nodes placement models like Grid, Random and Circular i.e. the nodes are placed in various arrangements and move arbitrarily. The simulations have been performed using OPNet version 14.5,a software that provides scalable simulations of Wireless Networks. For this, the simulation is carried out within a 500m X 500m area by varying the number of nodes (one source and one destination) and keeping the speed and pause time constant. The Nodes placement in three models for 20 nodes, 40 for small and medium network purpose is as shown following figures 3,4,5,6,7,8

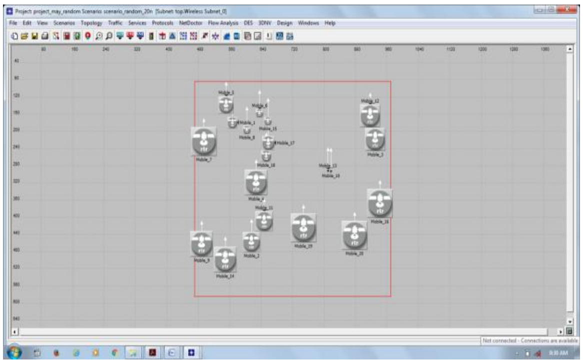


Fig 3. Random method20 nodes

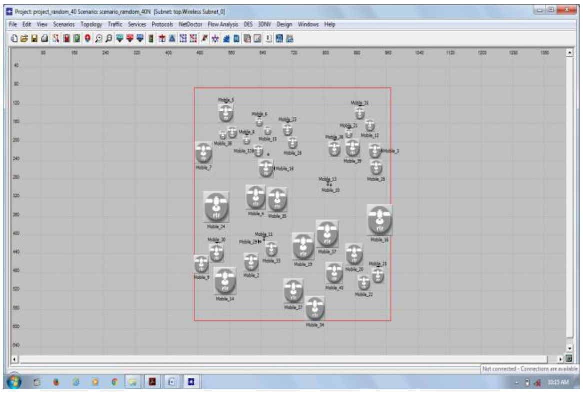


Fig 4. Random method 40 nodes

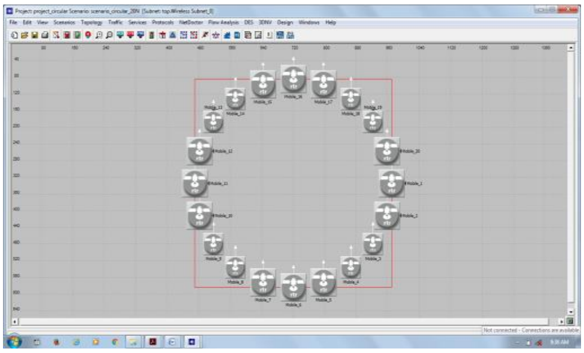


Fig 5. Circular Method 20 Nodes

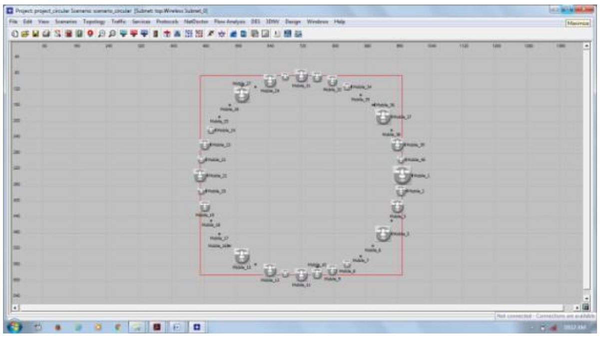


Fig 6. Circular Method 40 Nodes

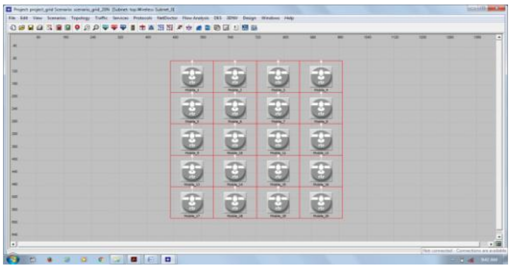


Fig 7. Grid Method 20 Nodes

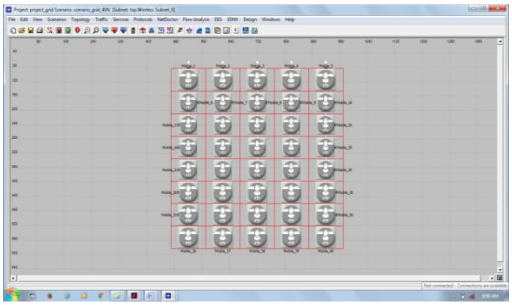


Fig 8. Grid Method 40 Nodes

VII. SIMULATION ENVIRONMENT

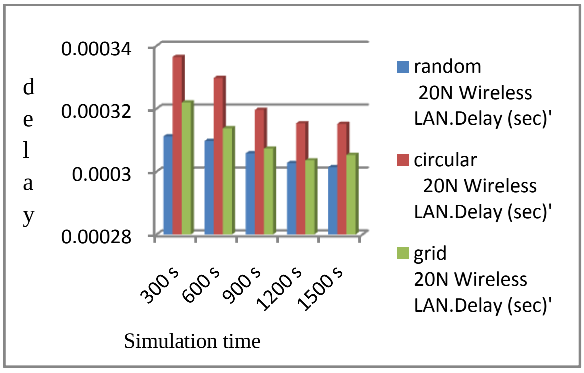
Table I: Simulation Parameters

Area	500m x 500m
Nodes	20,40
Nodes Placement	Random, Grid,Circular
Mobility Model	Random Way Point
Node Transmission Power	0.005
Operational mode	802.11b
Data rate	11Mbps
Simulation time	300,600,900,1200,1500 sec
Defacto values set	MANET

VIII. RESULTS AND DISCUSSION

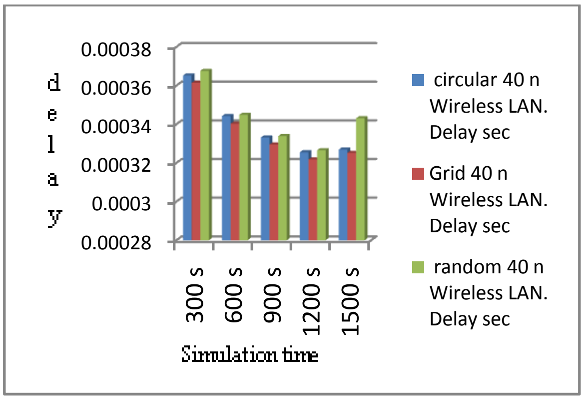
To evaluate the performance of routing protocols, the following metrics are considered.

1) The variation of Average End-to- End Delay with varying the simulation time of mobile nodes is shown in the Figure a) 20 nodes, b) 40 nodes



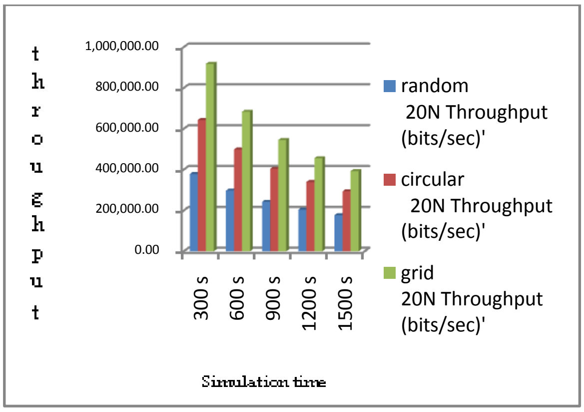
a) Variation of End-to-end delay with simulation time for 20 nodes

From the graph we concluded that as simulation time increases delay decreases after 15 minutes it comes constant delay.



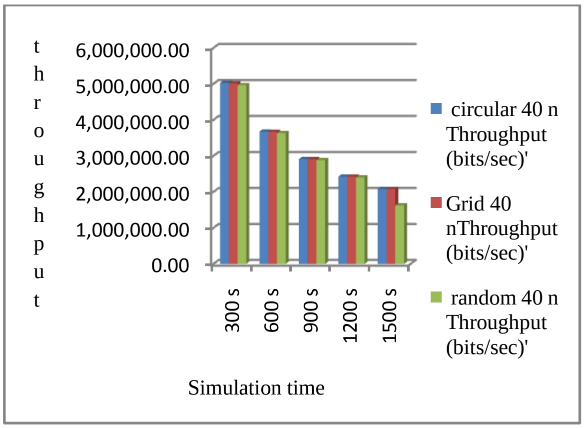
b) Variation of End-to-end delay with simulation time for 40 nodes

2) The variation of Throughput with varying the number of simulation time is shown in the Figure a) for 20 nodes, b) 40 nodes



a) Variation of Throughput with simulation time for 20 nodes

Based on different simulation times, the throughput varies from maximum to minimum when there is less simulation time throughput is more and vice versa. After comparing three models we observed high throughput in Grid model.



b) Variation of Throughput with simulation time for 40 nodes

From the graph we concluded that as simulation time increases throughput decreases and maximum for circular, minimum for random and moderate for grid node deployment model

IX. CONCLUSION

From simulation results we conclude that the OSPF protocol exhibiting better performance for Random model particularly in the combination of metrics such as throughput and delay. When compare with grid and circular deployment model.

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