# OPTIMIZE THE ROUTING PROTOCOL (GRP, OLSR, DSR) USING OPNET & ITS PERFORMANCE EVALUATION

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***ABSTRACT***

*Mobile Ad-Hoc networks are highly dynamic networks characterized by the absence of physical infrastructure. Nodes of these networks functions as a routers which discovers and maintains the routes to other nodes in the network. In such networks, nodes are able to move and synchronize with their neighbors. Due to mobility, connections in the network can change dynamically and nodes can be added and removed at any time. Each node operates not only as an end system, but also as a router to forward packets. The nodes are free to move about and organize themselves into a network. These nodes change position frequently. The main classes of routing protocols are Proactive, Reactive and Hybrid. This article addresses issues pertaining to three different routing protocols Gathering based Routing Protocol (GRP), Dynamic Source Routing (DSR) protocols, Optimized Link State Routing Protocol (OLSR) which is used for efficient routing under different scenarios in Mobile Ad-hoc Network (MANET), which plays a critical role in places where wired network are neither available nor economical to deploy. Mobile ad-hoc networks have gained a lot of importance in wireless communications. This paper concentrate mainly on routing protocols and their functionality in Mobile Ad-hoc networks with a discussion being made on three selected protocols GRP, DSR and OLSR with their comparison.*

***KEYWORDS:*** *mobile ad-hoc network, MANET protocol, delay, network load, retransmission attempt, throughput, DSR, GRP, OLSR.*

## I. INTRODUCTION

A Mobile Ad-Hoc Network (MANET) is a collection of mobile nodes which communicate with each other via wireless link either directly or relying on other nodes as routers. The operators of MANETs don't depend on pre-existing infrastructure or base station. Network nodes in MANETs are free to move randomly. Due to mobility of nodes, network topology of MANET may change dynamically without turning to any existing centralized administration.

Paper is organized as follows: section II consists of various Wireless Operating Modes. Protocols are described in Section III. Simulation Tool and various setup parameters along with node and process model are described in section IV. Evaluation Methodology is explained in section V. result are analyzed in section VI. And the last Section explained the conclusion with future work.

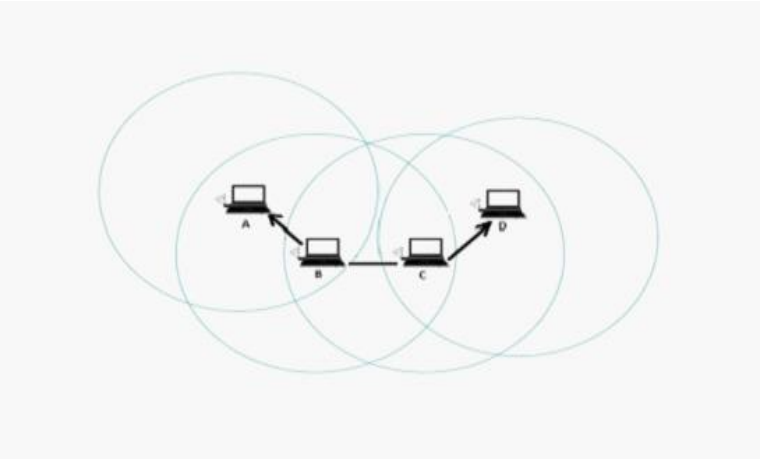


**Figure 1.** Ad Hoc Network

### 1.1. Objective

The Objective of this research work is to evaluate three of the proposed routing protocols namely, GRP, DSR, OLSR, for wireless ad-hoc networks based on performance. This evaluation should be done theoretically and through simulation. The Objective of this research work is to assess the relative performance of routing protocols for the considered mobile ad-hoc network and to identify their performance challenges. The outcome for this study is in the form of quantitative results of efficiency of the routing protocols with reference to performance metrics. These results can be used as baseline for selecting routing protocols in a variety of situations. The ad hoc routing protocols, GRP, DSR, OLSR are three of the promising routing protocols.[1]

### 1.2. Related Work

To improve the selection of routing protocols in a variety of situations the authors proposed various Parameters in OPNET that enhances their performance while maintaining required constraint. The authors have estimated parameter like delay, throughput, network load, and retransmission attempts. On doing this there is a decrease in the delay and network load.

## II. WIRELESS OPERATING MODE

In 1997, the Institute of Electrical and Electronics Engineers (IEEE) created the first WLAN standard. They called it 802.11 after the name of the group formed to oversee its development. Unfortunately, 802.11 only supported a maximum network bandwidth of 2 Mbps - too slow for most applications. For this reason, ordinary 802.11 wireless products are no longer manufactured. In our research 802.11a operational mode used to assign the parametric value in network model. Table 1 show the IEEE 802.11a/b/g standard with release year, bandwidth, frequency, data rate, modulation technique is used to simulate our networks.

**Table1** Wireless Operating Modes

| **Standard** | **802.11a** | **802.11b** | **802.11g** |
|---|---|---|---|
| Release | Sep 1999 | Sep 1999 | Jun 2003 |
| Bandwidth (MHz) | 20 | 20 | 20 |
| Frequency (GHz) | 5 | 2.4 | 2.4 |
| Data Rate (Mbit/s) | 6,9,12,18,24,36, 48,54 | 5.5,11 | 6,9,12,18,24,36, 48,54 |
| Modulation | OFDM | DSSS | OFDM,DSSS |

## III. ROUTING PROTOCOLS IN MANET

There are many type of routing protocols are shows in the figure 2.

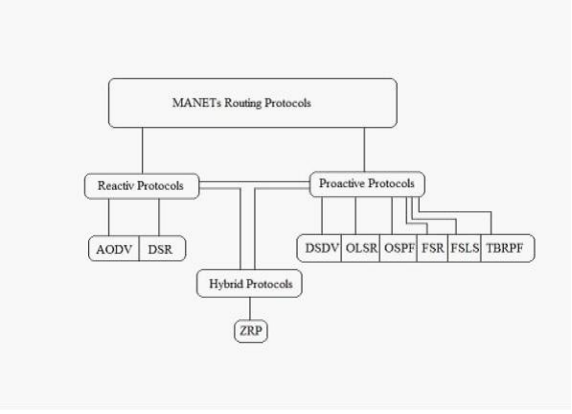


**Figure 2** MANET Routing protocol

Mobile Ad-Hoc Routing protocols are traditionally divided into two classes (Reactive and Proactive) depending on when nodes acquire a route to a destination. Reactive protocols are characterized by node acquire and maintain routes on demand. i.e., a route to a destination is not acquired by a node until packet is not received by a destination node. Examples of reactive protocols are "Dynamic Source Routing Protocol" (DSR). Proactive protocols are characterized by all nodes maintain routes to all destination in the network at all. Thus using a proactive protocol, a node is immediately able to route (or drop) a packet. Examples of proactive protocols include the "Optimized Link State Routing Protocol" OLSR [4].

### *A. DSR – Dynamic Source Routing (DSR)*

DSR is a reactive routing protocol that discovers and maintains routes between nodes. In the route discovery, DSR floods Route Request Packet to the network. Each node that receives this packet, first add its address to it and then forwards the packet to the next node. When the targeted node or a node that has route to the destination receives the Route Request, it returns a Route Reply to the sender and a route is established. Each time a packet follows an established route, each node has to ensure that the link is reliable between itself and the next node. In the Route maintenance, DSR provides three successive steps: link layer acknowledgment, passive acknowledgment and network layer acknowledgment. When a route is broken and one node detects the failure, it sends a Route Error packet to the original sender.

### *B. Optimized Link State Routing (OLSR)*

The Optimized Link State Routing (OLSR) protocol is a proactive link state routing protocol for MANETs. One key idea is to reduce control overhead by reducing the number of broadcasts as compared with pure flooding mechanisms. The basic concept to support this idea in OLSR is the use of multipoint relays (MPRs). MPRs refer to selected routers that can forward broadcast messages during the flooding process. To reduce the size of broadcast messages, every router declares only a small subset of all of its neighbors. "The protocol is particularly suitable for large and dense networks". MPRs act as intermediate routers in route discovery procedures. Hence, the path discovered by OLSR may not be the shortest path. [4]

### *C. Gathering-based routing protocol (GRP)*

GRP (Gathering based routing protocol) protocol is source initialized protocol in MANET routing protocol in which all the routing path is created by source node in Mobile Ad-hoc network. In this protocol, source node collects all the information about the route to the designation. In this procedure, source node sends a destination Query toward the destination through network. It works like DSR using RREQS (Reverse Request Query by Source). In it, when destination Query reached to the destination, destinations send a packet called Network Information Gathering (NIG) which approach through network. When NIG packet reached at a router, router gives it all the information about the network and its resources. There are many nodes called Effective Outgoing Links (EIL) where NIG packet does not riches, routers send this information to these EILs. At last NIG reaches at source node and source node get all the information [6][4]

## IV. SIMULATION TOOL

Simulation is being carried out using OPNET (Optimized Network Engineering Tool) which is a network modeler through which one can design any kind of Network model and then can simulate it. OPNET version 14.5 is a software for our simulations. It provides 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 is designed for modeling communication devices, technologies, protocols and to simulate the performance of these technologies.

### 4.1 OPNET-Based Simulation Set up Parameter and network model

We use the OPNET modular 14.5 to evaluate our experimental network shows the network model of Mobile Ad-hoc network consist on Number of mobile nodes distributed in Rectangular area

through wireless communication link. Simulation, we compare the DSR routing protocol 50 node topology and 100 node topology under various parametric values. To define a simulation parameter in 50 and 100 mobile nodes are created with the data rate of 54 mbps and transmit power of 0.10 watts. Each node moves randomly within the network range 1200*1200 m. And another parameters or its value define in Parameter Table (A). In designing the model we have to run the OPNET modeler and then to create a 50 and 100 node scenario for using different parameter value of MANET[3][6]

Routing protocol or wireless network parameter value we can create our choice value either manually or wizard after define the mobility parameter value the trajectory in designing the model as per the requirement for the our network model, node model or process model.[13]

**Table 2**-Wireless Network parameter

| **Parameters** | **Value** |
|---|---|
| Operation Mode | 802.11a |
| No. of Nodes | 50,100 |
| Simulation Time | 1200 sec |
| Seed | 128 |
| Value per Statistic | 100 |
| Update Interval | 50,000 event |
| Simulation kernel | Based on 'Kernel-Type' preference |
| Routing protocol | DSR |
| Buffer Size | 1024000 |
| Transmit power(w) | 0.10 |
| Bit Rate (mbps) | 54 |
| Packet reaction-power threshold | -95 |
| Addressing Mode | IPV4 |

### a) Simulation of First scenario

Here in first scenario we used 50 mobile nodes and one fixed WLAN server. The network size is of 1200 x 1200 meters. After that IPv4 addressing was assigned to all the nodes. The application configuration and profile configuration was drag to workspace.[3]

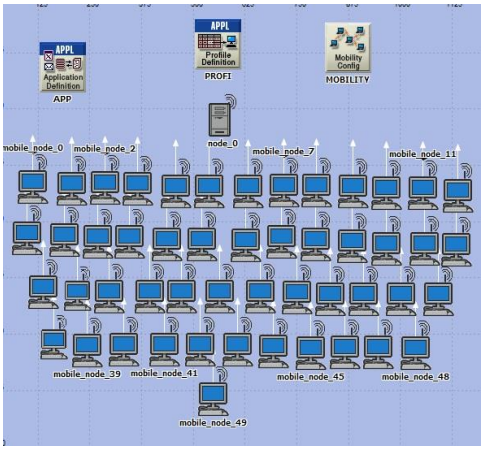


**Figure 3:** Simulating 50 nodes

### b) Simulation of Sec Scenario

The sec scenario consists of 100 mobile nodes. All the attributes remain the same except the number of nodes were increased. By clicking the scenario tab and then new scenario, give an appropriate name. In this sec scenario the same protocols are tested against the same parameters. The sec scenario is shown in the below figure 5-2.

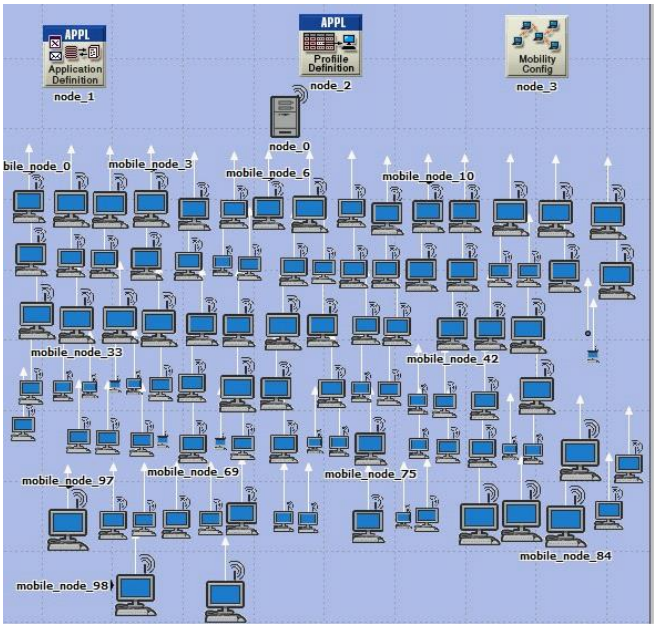


**Figure 4:** Simulating 100 nodes

### c) Node Model and Process Model

In Node Model and Process Model the numbers of mobile nodes. Node model show figure 5-3. And Process Model show in figure 5-4

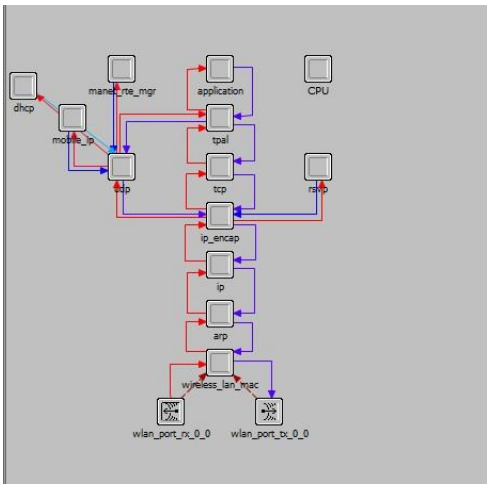


**Figure 5:** node model

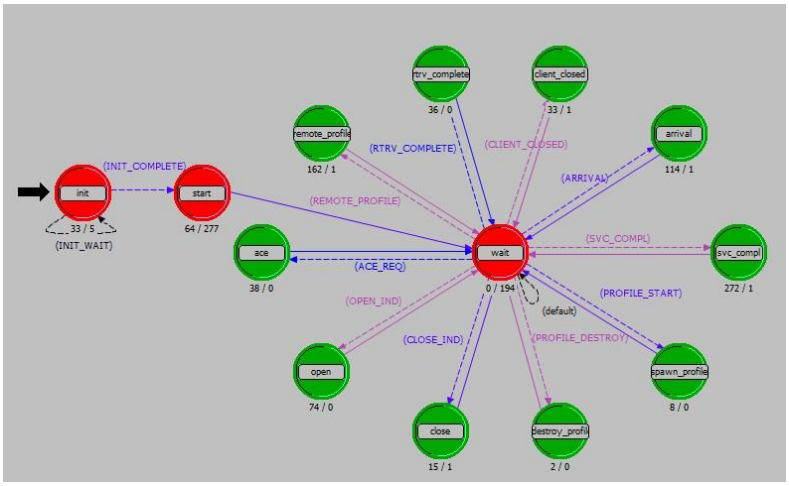


**Figure 6:** application nodes process model

### 4.2 OPNET-Based Simulation Parameter

We use the OPNET modular 14.5 to evaluate our experimental network shows the network model of Mobile Ad-hoc network consist on Number of mobile nodes distributed in Rectangular area through wireless communication link. Simulation, we compare the DSR routing protocol 50 node topology and 100 node topology under various parametric values. To define a simulation parameter in 50 and 100 mobile nodes are created with the data rate of 54 mbps and transmit power of 0.10 watts. Each node moves randomly within the network range 1200*1200 m. And another parameters or its value define in Parameter Table (A). In designing the model we have to run the OPNET modeler and then to create a 50 and 100 node scenario for using different parameter value of MANET[13]

## V. PERFORMANCE EVALUATION METHODOLOGY

The performance metrics used for the comparative analysis are as follows:
1. *Delay* (s): the end-to-end packets delay experienced by all nodes.
2. Network *Load* (bits/s): the total data traffic received by all nodes.
3. *Retransmission attempt* (packets): number of data packet transmitted divided by the number of data delivered.
4. *Throughput* (bits/s): the total number of bits forwarded in all node

## VI. RESULTS

a) **Delay:-**

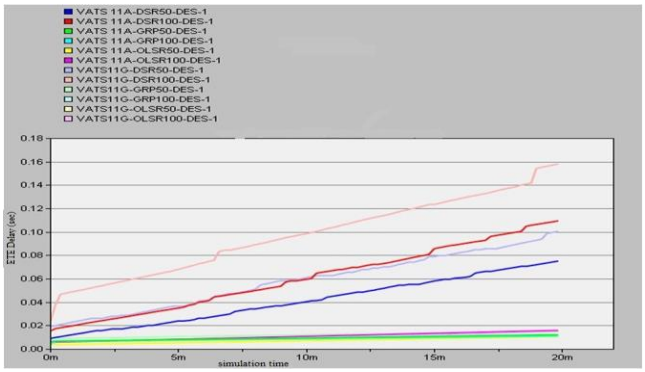


**Figure 7:** Delay (sec)

**Table 3:** Delay Performance result

| Protocols | 802.11a (50 nodes) | 802.11a (100 nodes) | 802.11g (50 nodes) | 802.11G (100 nodes) |
|---|---|---|---|---|
| DSR | 0.078 | 0.111 | 0.111 | 0.157 |
| GRP | 0.011 | 0.012 | 0.018 | 0.011 |
| OLSR | 0.009 | 0.014 | 0.020 | 0.014 |

**b) Network Load:-**

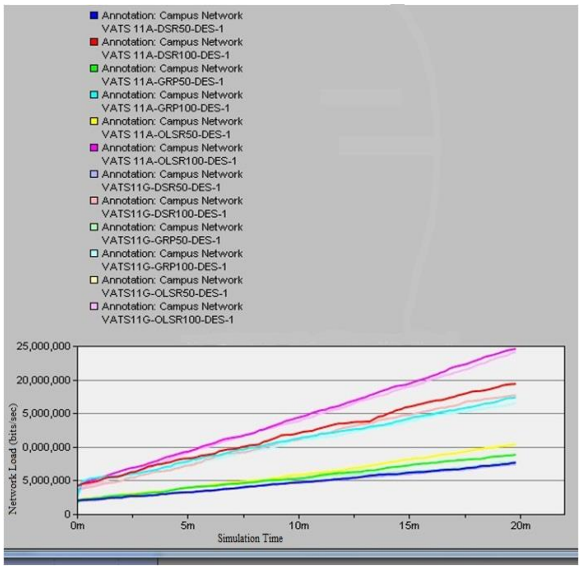


**Figure 8:** Network load (bits/sec)

**Table 4:** N/W Load Performance result

| Protocols | 802.11a (50 nodes) | 802.11a (100 nodes) | 802.11g (50 nodes) | 802.11a (100 nodes) |
|---|---|---|---|---|
| DSR | 7652512 | 19347045 | 7410733 | 17678067 |
| GRP | 8815678 | 17331086 | 7789198 | 16482718 |
| OLSR | 10333456 | 24566324 | 10294851 | 24083587 |

c) **Retransmission attempt:-**

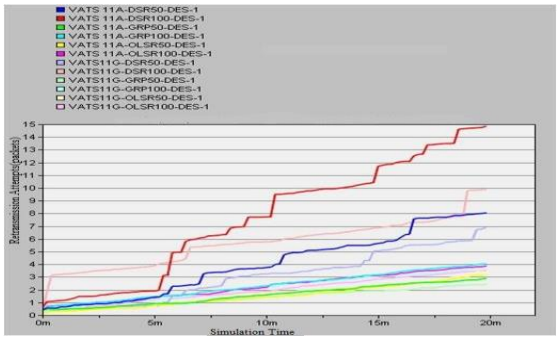


**Figure 9:** Retransmission attempts (packets)

**Table 5:** Retransmission attempts Performance result

| Protocols | 802.11a (50 nodes) | 802.11a (100 nodes) | 802.11g (50 nodes) | 802.11g (100 nodes) |
|---|---|---|---|---|
| DSR | 8.07 | 14.83 | 6.96 | 9.89 |
| GRP | 2.90 | 4.10 | 2.32 | 3.71 |
| OLSR | 3.17 | 4.01 | 3.42 | 3.77 |

d) **Throughput:-**

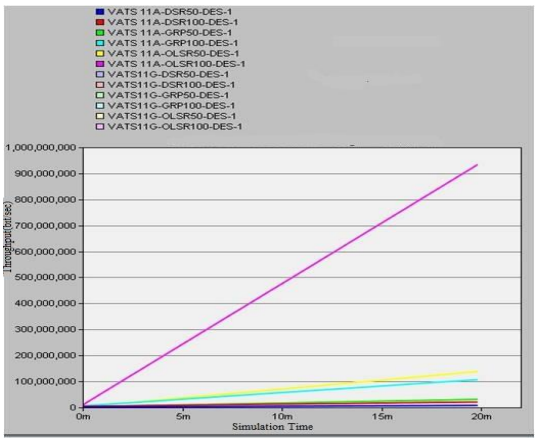


**Figure 10:** Throughput (bits/sec)

**Table 6:** Throughput Performance result

| Protocols | 802.11a (50 nodes) | 802.11a (100 nodes) | 802.11g (50 nodes) | 802.11g (100 nodes) |
|---|---|---|---|---|
| DSR | 7874351 | 21013949 | 77830523 | 13948158 |
| GRP | 31379169 | 106904176 | 18950906 | 106675911 |
| OLSR | 138176700 | 932845452 | 137894012 | 933841473 |

## VII. CONCLUSION

This paper is mainly consists of two studies, one is analytical study and other is simulation study. From analytical study we concluded that routing protocols in new modern arena of telecommunications, internet systems and in seamless communication play prominent role to develop better communication between end users. Different routing protocols have different attributes according to their environmental scenarios. The selection of suitable protocol according to the network definitely increases the reliability of that network, for example in case of mobile ad hoc networks routing protocols should be loop free according to our research. Categorically it has been analyzed that there are two categories of routing protocols used in mobile ad hoc networks that are reactive routing protocols and proactive routing protocols, both categories have their own usage, so the selection of these categories in ad-hoc networks is very important. The simulation study of this paper consisted of three routing protocols they are use for retransmission Attempt FTP traffic send and receive. GRP, DSR and OLSR deployed over MANET using FTP traffic analyzing their behavior with respect to three parameters, delay, network load and throughput. Our motive was to check the performance of these three routing protocols in MANET in the above mentioned parameters. The selection of efficient and reliable protocol is a critical issue. In this simulation work we get two kind of results, one is the simulation graphs and other is the concluded average statistical data from these graphs. From the entire above figures 7, 8, 9 the behaviors of all the routing protocols in different numbers of mobile nodes, it can be seen that which routing protocol perform well. From the above analysis of routing protocols, the OLSR outperforms the two GRP and DSR protocols in terms of delay, network load and throughput. In 50 mobile nodes again the OLSR perform well than GRP and

DSR in delay and throughput. The GRP puts low load than OLSR and DSR respectively. In 100 mobile nodes OLSR is again showing good results in delay and throughput than GRP and DSR respectively. GRP offer good results in offering low load on the network than OLSR and DSR respectively. The average values are taken from the graphs. From the above given graphs it is shown clearly that the OLSR gives the outstanding results in delay and throughput and the GRP performs well in the network load. High network load affects the MANET routing control packets. By comparing GRP and DSR the results in the entire figures, it can be seen that GRP perform well than DSR in delay, network load and throughput. Average values are shown in the above. The study of these routing protocols shows that the OLSR is better in MANET according to our simulation results but it is not necessary that OLSR perform always better in all the networks, its performance may vary by varying the network

## VIII. FUTURE WORK

The future work suggested is the development of modified version of the selected routing protocols which should consider different aspects of routing protocols such as rate of higher route establishment with lesser route breakage and the weakness of the protocols mentioned should be improvised. At the end we came to the point from our simulation and analytical study that the performance of routing protocols vary with network and selection of accurate routing protocols according to the network, ultimately influence the efficiency of that network in magnificent way.

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