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MOBILE ADHOC NETWORK ROUTING PROTOCOLS: PERFORMANCE EVALUATION & ASSESSMENT

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ABSTRACT

Mobile Adhoc Networks (MANETs) is a form of wireless networks that lack fixed infrastructure and centralized routers, as opposed to wired networks' routers or managed wireless networks' access points. One of the most difficult difficulties with MANETs is routing. The primary goal of routing algorithms is to construct efficient routes between nodes so that messages can be sent on time. Many routing protocols have been created to aid in the routing of MANETs. The aim of this study is to give a study on several popular MANET routing protocols, including OLSR, TORA and AODV. The goal of this study is to analyze MANET's routing protocol performances based on performance metrics such as data packet, overhead, delivery ratio, throughput, and end-point delay using the OPNET simulation program. We model a MANET in which all nodes receive FTP traffic from a single source (FTP server). As a result of this research, the results would also represent a case in which the MANET gets traffic from another network through a similar. According to our findings, OLSR dominated the network with the most routing traffic. TORA is the second, AODV third and DSR is the last. All protocols have a poor packet delivery ratio of *up to 59 percent. This degradation is anticipated as a result of massive retransmissions in the network caused by the use of TCP traffic. In terms of throughput and end-to-end latency, OLSR outperforms TORA, DSR and DSR.*

KEYWORDS: *Mobile Adhoc Network (MANETs), Evaluation, Routing Protocols, TORA, DSR, DSDV, AODV, OLS, Overhead, Data Packet Latency, Throughput.*

INTRODUCTION

1.0 BACKGROUND TO THE STUDY

MANET is an abbreviation for Mobile Ad hoc Network. MANET is a kind of wireless network with no infrastructure. A MANET might be made up of only fixed nodes or combination mobile and fixed nodes. The nodes may relate with one another randomly, resulting in unpredictable topologies. They serve as routers as well as hosts. Because mobile routers can self-configure, they are ideal for supplying communication to disaster-stricken areas with no conferences, infrastructure, or rescue operations and urgent situational search where a network link may be needed. The MA-NET working group was formed within IETF as a result of the requirement for mobility in wireless networks.

MANET protocols do not yet have a fully established Internet standard, despite years of research. Experimental Request For Comments (RFCs) have only been identified after 2003. (Misra and Mandal, 2005). There are indications that questions about implementation and deployment of the protocols remain unaddressed at this time, but the proposed algorithms have been classified as a trial technology with a high likelihood of becoming a standard (Misra and Mandal, 2005). Since then, aggressive research on Temporally Ordered Routing Algorithm, Dynamic Source Routing, Optimized Link State Routing, and Ad hoc On-Demand Distance Vector and other topics has persisted.

The major challenges in MANETs are: lack of central authority, limited power and the constant need to find a proper route due to the network's high mobility and those nodes that leave and join at any time (Tuteja, Gujral, and Thalia, 2010).

Despite the numerous advantages of MANETs, some MANET’s characteristics, such as limited bandwidth, dynamic topology, low battery capacity, high bit error rate (BER) and poor physical security have limited their use (Istikmal, Leanna, and Rahmat, 2013).

Because of the unique properties that distinguish MANETs from traditional networks, they are particularly vulnerable to specific performance concerns. Not only do you have to think about the challenges that effect a more traditional network, but you also have to think about node movement (continual changes in topology), power conservation and restricted bandwidth. Because the radio equipment at the nodes may be heterogeneous, certain nodes may be more sensitive to interference from diverse sources, resulting in varied radio ranges for different nodes, link unidirectionality is especially critical for MANETs [Chun, Qin, and Lin, 2000].

1.1 STATEMENT OF THE PROBLEM

- Various routing protocols have been created for MANETs, but each of them has different attributes and performances, necessitating the evaluation of several routing protocols to decide which one is ideal for Mobile Adhoc Networks.

- The elements that influence the performance of MANET routing protocols are also addressed in this work.

1.2 AIMS AND OBJECTIVES

The aim of this work is to analyze the performance of MANET routing protocols using simulation software called OPNET based on performance metrics such as data packet delivery ratio, throughput, overhead and end-to-end delay.

Objectives are:

- To compare these protocols, AODV, TORA, OLSR and DSR, in terms of performance measures such as data packet delivery ratio, throughput, overhead and end-to-end latency.
- To assess the behavior of various protocols when they are implemented in a network.
- To send TCP (FTP) traffic from all sources to the same destination.

2.0 RELATED WORK

The performance of DSR, AODV, TORA, and DSDV is compared using the NS2 platform in (Vahid and Koorush, 2006), and it is resolved that AODV beats DSR and TORA. Another investigation on the performance of a basic link 5 state protocol, DSR and AODV, was undertaken in (Bertocchi, Mazzini, and Zorzi, 2003). When the network load is mild, the authors conclude that DSR and AODV perform well, whereas link state performs better than reactive protocols when traffic load is high. The authors of (Amr, Mohamed, and Mohamed, 2006) examine DSDV and DSR to see how they function in a real-world simulation environment.

Tuteja et al. (2010) examined the performance of the AODV, DSR and DSDV routing protocols in three scenarios: changing node mobility, changing data packet size and changing packet sending time interval. Their findings revealed that the DSDV protocol, when compared to the AODV and DSR protocols, was slower in terms of throughput. In terms of the average end-to-end delay, DSR performs better than AODV. Furthermore, the authors state that when node mobility increases, the performance of all evaluated protocols decreases. However, they only employed one topology size of 25 nodes in their experiment.

Gupta and Kumar (2015) used a simulation experiment to evaluate and analyze the performance of DSR, DSDV, and AODV. They discovered that DSR perform better the other protocols because it receives more packets and loses fewer when compared to AODV and DSDV. However, because the authors' simulation was based solely on a topology of 100 nodes, their conclusions would have been more consistent if more various topology sizes had been studied.

Araghi et al. (2013) compared AODV, DSR, and AOMDV performance. In big networks (networks with a large number of nodes), AODV and AOMDV beat DSR, whereas DSR performs better than them in small networks. The authors also mentioned that the network size and other circumstances such as node mobility play a role in determining the best protocol for better routing. The researchers tested topologies with 6, 10, 15, and 20 mobile nodes. If they used topologies of different sizes, their results would be clearer.

Dhakal et al. (2013) looked into the performance of the AODV and DSR. They discovered that DSR performed better in small networks with little mobility, whereas AODV performed better in big networks with high mobility and node density.

Rathod and Dongre (2017), compared the throughput, packet delivery ratio, delay and routing overhead of three routing protocols: AOMDV, EVSM and AODV. The EVSM surpasses the other protocols in terms of delay, throughput and packet delivery, but it produces more routing over-heads, according to their findings. In terms of routing overheads, the AODV surpasses the others by causing the least amount of overheads when compared to the other protocols. More routing overheads, on the other hand, should result in longer delays and higher costs.

Misra and Mandal (2005) use the Glomosim simulator to evaluate the performance of on-demand protocols AODV and DSR (The GloMoSim Simulator, 2008). The authors reach an intriguing conclusion about the procedures' performance. They conclude that when data is sent from distinct sources to multiple destinations and AODV performs better than DSR. The moment traffic is sent from source to destination end, it was concluded there was significance decrease experienced by AODV in terms of packet latency. They acknowledge that this may cause issues when utilizing popular gateways, and they provide various techniques to lessen this effect. In this study, we examine a similar situation in which MANET nodes relay traffic to a shared destination. We have no intention of disputing or agreeing with the authors' conclusion because we are running the simulations in diverse conditions. We, on the other hand, take our own inferences from the circumstances.

3.0 RESEARCH METHODOLOGY

This study was carried out with the aid of simulation software known as OPNET. OLS, DSR TORA and AODV protocol performance was tested using packet delay, routing overhead, delivery ratio and throughput. Scripts in tool command language (TCL) were built to mimic traffic patterns, as well as to build trace files and the network animator, for the protocols being examined. To compute the performance measures of the protocols, AWK scripts were built to analyze the trace files. There is possibility of using simulation tools with permission for changes in testing parameters with no added cost in resources and money. The simulation can be done in a shortest time but much time is required during testing.

4.0 DISCUSSION AND RESULT

The performance is simulated in a dynamic network environment. We investigated the network's routing overhead. The packet end-to-end delay, network performance and packet delivery ratio are then examined. We established the parameters. In this report, we gathered global statistics for the whole network and show average values. With greater traffic sources, such as 50 nodes, we were unable to obtain statistics for TORA. Because TORA has a difficulty with counting to infinity, it works best with a progressive injection of traffic. At the start of our simulations, all of the traffic sources were operational. During the simulations, this caused TORA to run out of computer memory.

4.1 SIMULATION MODELLING

When building a network, the initial step is to construct a blank situation. The start-up wizard is used to do this. This brings up a project editor workspace where you can work on network design. Designing can be done manually or automatically. It can be done either automatically with rapid configuration or manually with dragging things from the object palette into the project editor area. If the user's needs are met, predefined frameworks can also be imported. Wireless networks, on the other hand, cannot be developed by importing frameworks. Nodes must be set-up after the network has been designed. Configuration can either be done manually or with the use of pre-defined parameters.

4.2 STATISTICS/RESULTS VIEW

In OPNET, there are two sorts of statistics that can be collected: Global statistics and Object statistics. Global statistics are gathered from all nodes in the network, whereas object statistics are gathered from individual nodes. Run the simulation to record the statistics once the desired statistics have been chosen. The collected findings are seen and analyzed after the simulation is completed. We do this by right-clicking on the editor (project) workspace and selecting ‘View Results,' or by going to ‘DES', ‘Results,' and then ‘View Results.' Following that, a results browser appears, as seen below.

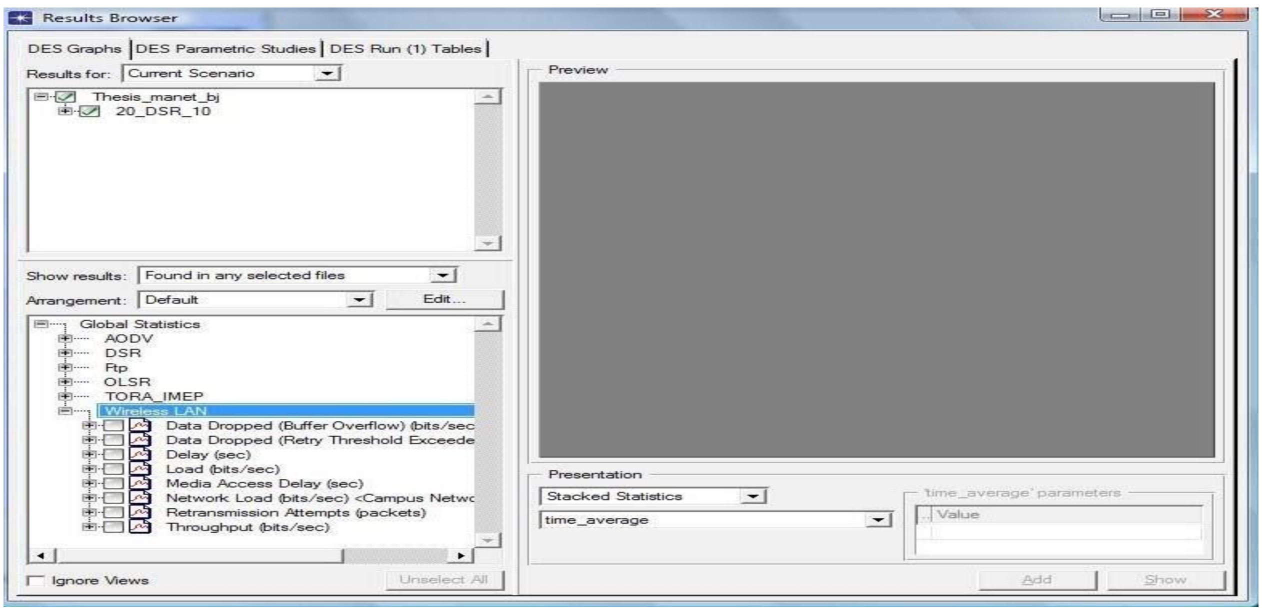

FIG 4.2: OPNET RESULT BROWSER

The simulations are classified into 6 steps as follows:

- Step I – average speed and low load, with 5 movable nodes traveling at a constant 10 m/s
- Step II - High speed and low load, with 5 nodes moving at 28 m/s.
- Step III – Average speed and Average load, with 20 nodes moving at 10 m/s.
- Step IV - High speed and medium load, with 20 nodes moving at 28 m/s.
- Step V – Average speed AND High load, with 20 nodes moving at 28 m/s.
- Step VI – High speed and heavy load, with 50 nodes moving at a constant 28 m/s

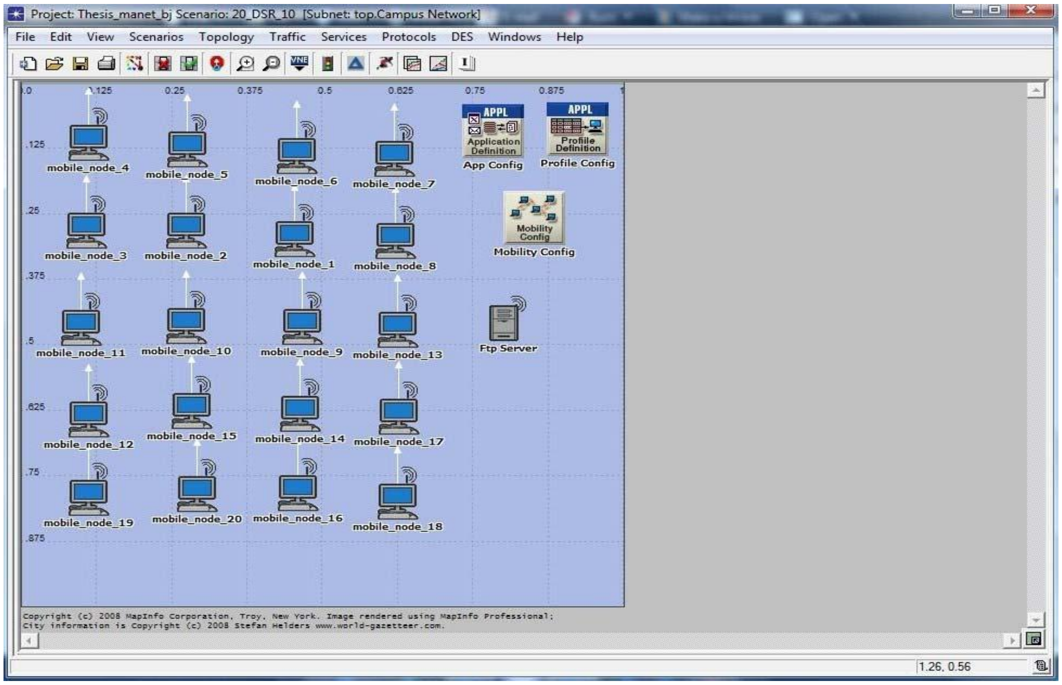

FIG 4.3: SIMULATION SETUP

4.3 SIMULATION SETUP

In our simulations, we used OPNET Modeller 14.5 software. Fig. 4.3 depicts a simulation setup for a scenario with 20 nodes and mobile nodes traveling at a 10 m/s pace. Appendix A has a systematic procedure for the simulations, as well as a guidance for readers who want to follow along with the simulations. The important parameters for the simulations are provided in this section.

4.4 RESULT ANALYSIS

Routing Overhead

We can see from the findings in Figure 4.4 that OLSR transmits the most traffic to the network, TORA is the next and followed by AODV and the last one is DSR, which sends the lowest amount of routing traffic. This discovery holds true for all of the scenarios examined, which include a mix of 5, 20, and 50 traffic sources flowing at constant speeds of 10 and 28 m/s. As a result, DSR outperforms OLSR, TORA, and AODV in terms of routing overhead since it transmits the smallest traffic to the network. As a result, DSR would outperform every other protocol in low-resource networks.

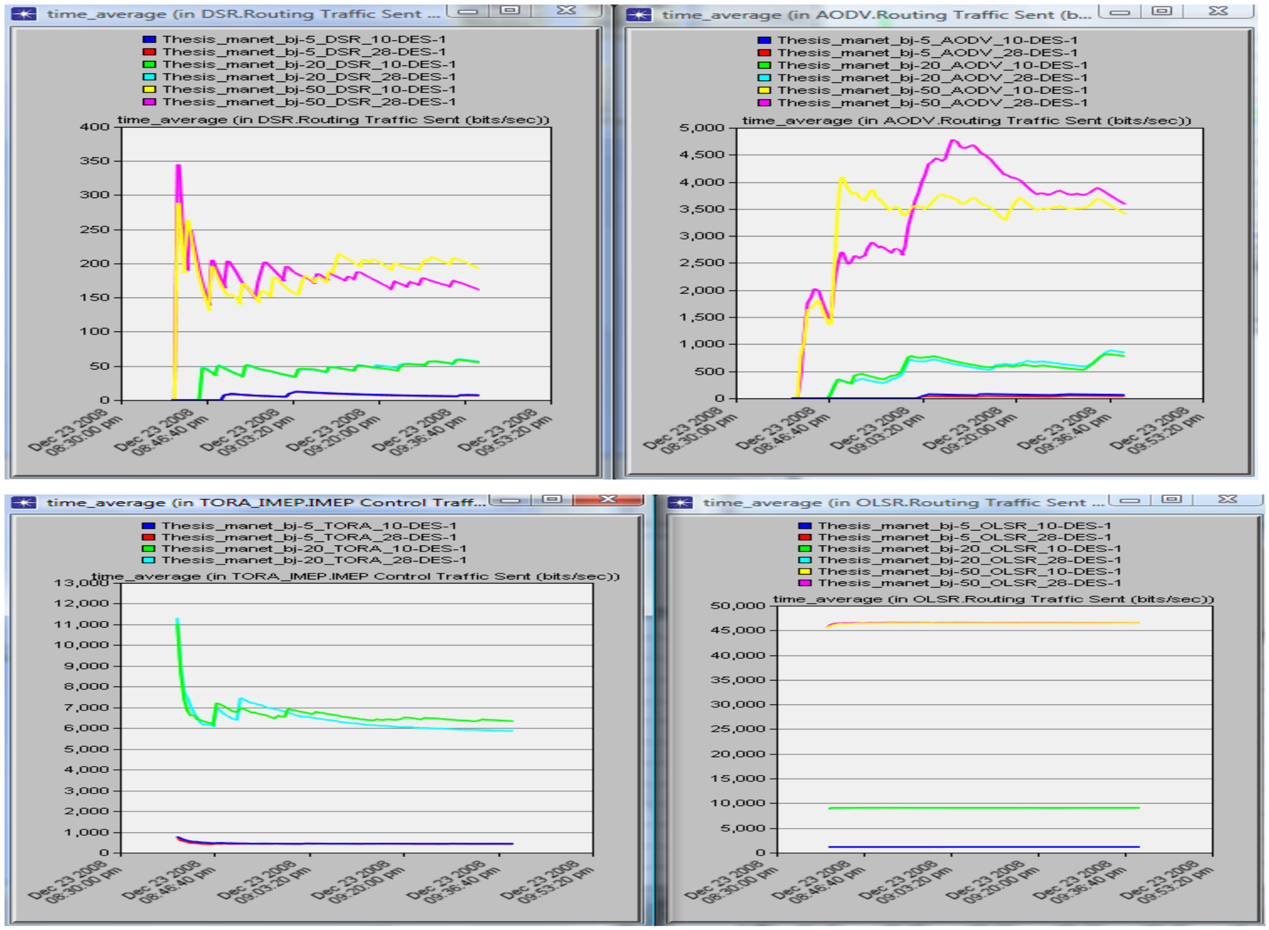

FIG 4.4: ROUTING OVERHEAD IN DSR, AODV, TORA & OLSR

5.0 CONCLUSION

We used simulations in this study to examine and compare routing protocols based on performance measures such overhead, throughput, data packet delivery ratio, and end-to-end delay. The MANET routing protocols under investigation include OLSR, DSR, TORA, and AODV, which comprise two proactive and two reactive protocols.We used TCP (FTP) for traffic transmission and made sure that all sources sent traffic to the same destination. The packet delivery ratios for the four protocols were all around 50%, but UDP would have a higher ratio.For packet latency and throughput, OLSR outperforms AODV, TORA, and DSR. When used in limited mobility and high load networks, OLSR performs better than all in packet latency. In terms of routing overhead, OLSR has the worst performance. As a result, it's ideal for high-capacity networks. OLSR is unsuitable for low-capacity networks due to the heavy routing traffic required to discover and maintain routes. Finally, we conclude that no particular protocol outperforms others in terms of total performance. A protocol can only improve in one of the metrics. In high-capacity links, proactive protocols function well, but reactive protocols perform better in low-capacity networks.

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