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هيئـــــــة التحريــر

بحوث العدد

- "تحفة الأنام بتوريث ذوي الأرحام" دراسة وتحقيقاً
- الاستفهام ودلالاته في شعر خليفة التليسي
- قراءة في التراث النقدي عند العرب حتى أواخر القرن الرابع الهجري
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Comparative study of AODV, DSR, GRP, TORA AND OLSR routing techniques in open space long distance simulation using Opnet

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Abstract. Potential wireless applications will obtain advantage of deployable speed and self-configuring Ad-hoc networks. This research uses a simulation method to monitor the effectiveness of Ad-hoc On-demand Distance Vector (AODV), Dynamic Source Routing (DSR), Gathering based Routing Protocol (GRP), Temporarily Ordered Routing Algorithm (TORA) and Optimized Link State Routing Protocol (OLSR) routing protocol in open space area such as a quay crane in port operation. The objective of this study is to examine and evaluate these variety of techniques to improving the precision of performance of the best protocol. The routing techniques AODV, DSR, GPR, TORA and OLSR are analysed and compared by using OPNET Modeller simulator on the basis of performance metrics such as network load, delay and throughput. This method used to increase the system utilities in such away to have further improves performance, and provide a qualitative estimation of the best applicable technique. The simulation results show that OLSR routing protocol has high throughput and lowest end-to-end delay compare to other cases that have the same packets size (1024bytes) and the number of packets to 50 packet per sec, on a scalable network environment, up to 139 nodes.

1. Introduction

Wide area Computer networks have made information sharing a very easy task and the demand is always for successful resource sharing portability. Routing protocols are liable for sending data packets over suitable routes that optimize performance procedures such as delay and throughput. The delay adjacent to a route depends on the traffic congestion, which depends on the external load. Accordingly, a routing protocol must supervise link delays and get used to its routes to change in link delay (Abolhasan et al. 2004).

Wireless networks became more and more accepted and useful in the world which has no static network structure as required by infrastructure network. In wireless networks, the connection between nodes require routing paths over multi-hop between the source node and the destination node (Couto et al. 2005).

The wireless network works in almost any environment and is highly beneficial in challenging terrains or in remote areas for various rescue and construction sites, military operations and in emergency operations, environmental monitoring and also for operating day to day activities in a civilian environment (Prabha et al.

2014). There are many differences in routing protocols in terms of performance like the end to end delay, throughput and data delivery system etc.

A wireless network is a group of independent nodes that connect together by forming a radio network and maintaining connectivity in a proper approach. In wireless technology, a routing topology such as mesh, ring, and star are an extension to obtainable wireless networking technology to assist in discovery and multi-hop routing data packets through a network. The networks are composed from the area nodes, which all agree to act as routers for their fellow network associates.

Since the group of wireless nodes, they have challenge with the effects of radio communication channel, such as noise, fading, and interference etc., which will reduce the data delivery i.e. throughput and increase the time delay for the data flow (Cheffena, 2012). In a wireless network node, each node also has dual functionality of being both host and router, and the group of nodes responsible to control the network.

In various scenarios, the routing protecting itself may consume so much time in the way of resources that no bandwidth may remain for the transmission of data packets. The short lifetime of routing in sequence means that a part of the information may never be constructive any more, and thus the bandwidth that is used to distribute the routing update information could be wasted.

One of the solutions is to create the best use of local information to update routing tables, avoiding the propagation of routing messages at the global network scale. The collective behaviour of information presents the property of self-organization can get the optimal solutions at level may come into view from the local interaction of individuals that exhibit simple behaviour (Sohrabi et al. 2000).

2. Literature review

There is no so much previous work that comparing the ad hoc algorithms performance in an open space. There is previous work investigating some of this algorithm individually but not all of them together. Here we will mention simulation and analytic approaches to compare these methods. This perspective of the problem motivated this work and to put into view as following research challenges.

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The first algorithm defined for MANET which is presented is a routing called ARA which is based on the principles of ant colony from Wisdom of Hive coupled with intelligence in routing in networks of telecommunication. This algorithm applied Efficient, Scalable and Secure Routing Framework for Mobile Ad-hoc Networks. The algorithm is rooted in AntNet as well as ABC routing methods for fixed networks and is stimulated by the pheromone laying performance of ant colonies. The significance of this method lies in it using a less complicated architecture and utilizing a smaller measure of control in its use of corrupted packets, with a lesser energy consumption than other sophisticated methods it still provides a competing efficiency. (Wedde et al. 2005)

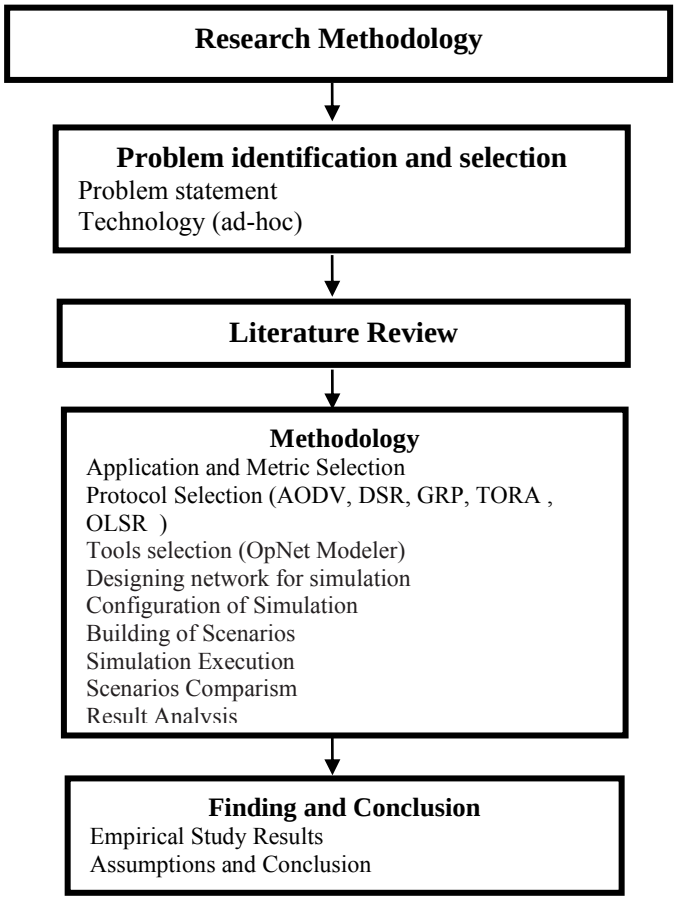
Existing advance methods for query sensing and routing of data in heterogeneous ad hoc sensor networks characteristically involve subscription scheme (Huang et al. 2004), where publishers publicize the attributes of their data and subscribers forward their interested attributes for the system to match. Diffusion header (Intanagonwiwat et al. 2000) is an example of a scenario where the paths of routes are recognized using distance information in the middle of nodes in order to lessen count of hops in RF communication.

Through extremely populated network it is found that the number of possible link associated between any two nodes is very less and for this reason the performance is poor. (Divecha et al. 2007) It is predictable that if the node density is increased, the throughput of the network shall enhance, however beyond in a certain level if the number of nodes is increased the performance degrades in some protocol (Venkateswaran 2005). When the nodes do not demonstrate total random movement, an analytical clustering scheme appreciably enhances the cluster stabilization if juxtaposed against non-predictive mobility-aware method. Even though, a transaction between clusters size and stability (Venkateswaran 2005).

3. **Methodology**

This section will present a detailed account of the research philosophy, strategy and methodology that was used and is best suitable for the research to achieve

project goals fulfilling its objectives, and as well as illustrating the weaknesses associated with earlier research. The method and performance described in this part is based on ad-hoc protocol and modelling techniques. The main extensively used ad hoc routing protocols are AODV, DSR, GRP, TORA and OLSR.



As mentioned before there is not much previous work that compare the ad hoc algorithms performance in an open space. This property provides efficiency in scalable maintenance of routing information of a topology with minimum resources. In this work, one of the general questions that will be asked is: how can the dependency mechanism be used to maximize the efficiency, scalability, and constancy of such a system using AODV, DSR, GRP, TORA and OLSR algorithm in mesh topology?

Figure 1. Research Methodology

Ad-hoc Network is a wireless infrastructure network where the progression of nodes are free towards any direction independently without any hindrances. These nodes do not involve any base station for communication between them. Development of efficient protocol and techniques are needed due to environmental effect for all nodes.

This research tried to study the packets lose reduction and other advantages of the three different protocols. The method is also planning to provide more knowledge and make the period and throughput as a target of the assessment between these protocols; it depends on hello messages that are sent on the network. Hello message and data flow method motivate periods for the control's sending time. There is a gain in period time when no data is sent for Enhancement of hello message or period time is not within its optimal value, then it halts increasing. This code is implemented and simulated via OpNet simulator.

Several researches which further studied different protocols of algorithm, specify optimal packets control in short live connections since there is an existing gap between the sent data packets, and the gap is utilized to send hello messages which are control packets used in making the timing between hello messages not static, while the time depends on data broadcast of the network, which implies there is no need sending a lot of hello messages in the absence of data messages corresponded.

If data packets are presented and no hello packets needed then the status is normal, but if there is a hello message required, the time between the hello messages will increase.

Assuming the algorithm is a loop complimentary routing protocol for ad-hoc networks. It is designed to be a manual process in an environment of fixed nodes, withstanding a variety of network behaviors like packet losses and link failures. Method proposed consists of three key factors, hello message packet, number of node and link drop Maintenance. Comparative study is chosen because of its simplicity, which is aiming to view more knowledge on its demand nature to appropriate networks behaviors. These optimized protocols have been analyzed using communication based design methods. The design flow is started with capturing hello messages as the functionalities emerge at system level.

3.1. Performance metrics selection.

3.1.1. ***Throughput*** is a metric which is a representation of data or total bits which is forwarded to neighbouring node in every second which is measured in bits per second (bps).

That is the evaluation of number of packets and packet size in the presence of identified challenges, in different scenarios. Validating findings from literature for evaluation of performance of routing protocols in WSNs is the primary focus of this research.

3.1.2. ***Delay*** is a metric for the representation of average delay from end-to-end, which is an indication of the time taken for packets to travel from source to destination of the application layer. Delay is measured in seconds.
Delay is related to encoding/decoding delay, transmission delay, propagation delay, processing delay and queue delay. The end-to-end delay is an important parameter for real-time transmission (Bhunia, 2006).

3.1.3. ***Network load*** is a metric which represents the quantification of routing packets within a route. The network load is a description of the needed packets for the discovery and maintenance of a route that should be sent, and are usually measured by the network activities of device the gateway on the network, more meaningful indicators of system load, can be deduced for the concurrent users on the network (Buratti & Verdone, 2006).

3.2. Protocol selection.

Routing protocols has the functions of selection of routes and delivery of messages to specific destination. The protocols selected for this simulation is the main extensively used an ad hoc routing protocols that are the AODV, DSR, GPR, TORA and OLSR, (Kumar and Rajesh, 2009). Evaluating the routing protocol behaviour in the presences scenario of the network.

3.3. Tool selection.

The technologies that maintain computer networks are bringing information to people in new and superior ways every day. OpNet modeller is a network simulation with very efficient and cost-effective way to increase new network technologies. The research has at this very stage pointed out the challenges of routing of routing protocols in theory. For further validation, a tool which was chosen to be used is OpNet Muddler (Clausen et al., 2001) simulator for simulation and evaluation of the selected routing protocols juxtaposed with the performance metrics which are selected.

3.4. Designing network for simulation.

This is where the methodology is forwarded, a method which was used to separate the effect on network performance. The procedure for the analysis began with a designed core configuration of a scenario of a network according to chosen application. Furthermore, the selected protocols of routing are simulated under certain conditions for evaluation against selected metrics.

The control parameters were carefully selected to allow a proper assessment and separation of the network size effect with a traffic that is fixed to enable proper evaluation. With constant bit rate traffic (CBR). Furthermore, for pointing

out real life scenarios where the results will be applicable, parameters such as the networking topology designed are to be recorded.

In the simulator workspace, the design of this network by using the required entities for the proposed design. All the required entities such as Application configuration, Profile and Nodes, these individual components were taken from the object plan to project work space.

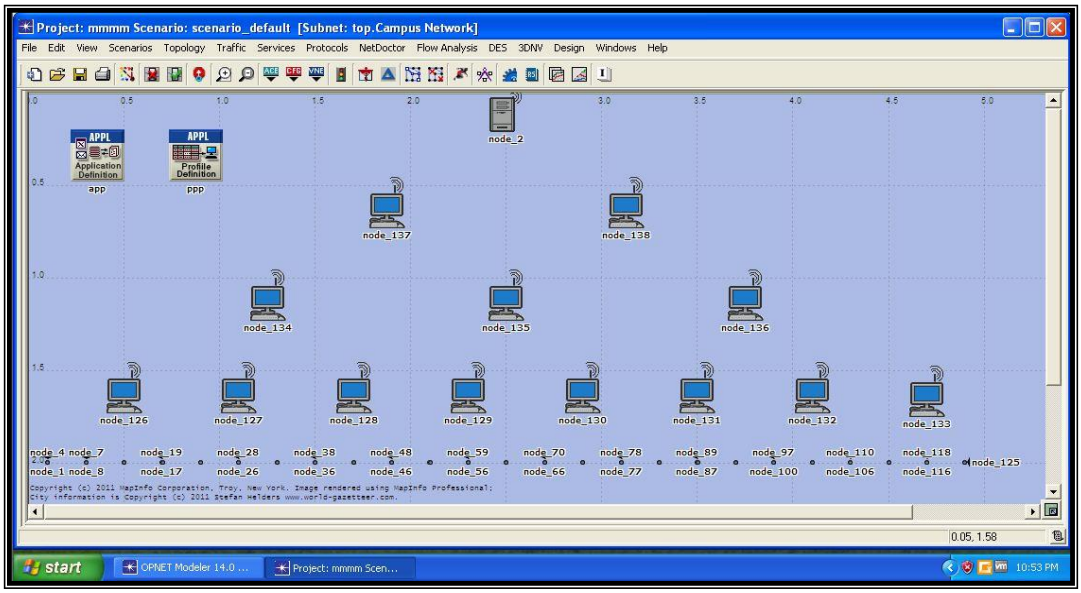


Figure 2. Network structure

3.5. Application models

Preconfigured standard applications were used because they are the most used generic network applications:

Table 1. Components of the Application Model

Application Type	Description
FTP	File transfer
Email	Sending and receiving email
Remote Login	Rlogin (telnet)
Database	Database queries and updates
HTTP	Web browsing
Print	Print job submission
Voice	On-Off voice model
Video Conferencing	Video conferencing involving image exchanges

All the models are standard models which are shipped as a suite. Each one of the models as a characteristic that maps to a certain appropriation in generating

optimized traffic. Such as the FTP model having characteristics for download and upload as well as size ration, whereas Voice model has characteristics for voice inclined attributes such as talk and silence duration and encoder scheme.

This work case will deal with FTP application because the scenario talks about sending sensor data from station to server.

3.6. Simulation parameters

The simulations were done extensively using Software version of OpNet simulator. The table below contains the parameters values and settings applied for the different scenarios groups performed. The scenarios were simulated using fixed nodes with same number of packet and packet size. Each scenario implements different protocol with same parameters.

Table 2. The simulation parameters.

Parameter	**Value**
Transmission power	15dB
AP range radius($\boldsymbol{m}$)	500
Bandwidth	1M
Frequency band($\boldsymbol{GHz}$)	2.4
Simulation time	600sec.
Simulation area	5km X 2km
Number of nodes	139
MAC type	IEEE 802.11b
Data Rate	2 Mbps
Packet size	1024 Bytes
Rate of packet	50 (packet/sec)

4. **Results and Discussion**

In this section, the results and the simulations performed will be discussed and analysed. The scenarios for the network design has been chosen and implemented for nodes which are fixed, for representation of data gathering applications in WSN.

For currently network, scenarios were created based on five different protocols. Each scenarios application profile implemented with some scalability in the packets size and the number of packets. Also, the protocol behavior in terms of packet creation, destruction and delivery was also analyzed. These were checked

for some set of performance metrics, packet size, and the number packets per node, and lastly comparison is done, and a conclusion is drawn.

It is important to note that this simulation is done using wireless devices and not wireless sensor devices as it's the closest to achieving the required research objective after an exhaustive search for the suitable network simulator, hence the use of the OpNet. A brief summary on the results obtained during the period of the different scenario simulation is given below and the results are compared.

4.1. End-to-End Delay

Average delay for end-to-end of data packets is the duration between the time of data packet generation and the time when the last bit arrives at the destination. Within wireless ad hoc networks, nodes collaborate to structure a network not utilizing any infrastructure for instance access points or base stations. The nodes help one another to forward packets, which enables nodes to go beyond direct wireless transmission range of one another to correspond. End-to-end delay refers to the time taken for a packet to be transmitted across a node from source to destination. Figure 2 shows the relative techniques performance of the scenario for AODV, DSR, GRP, TORA and OLSR with same number of nodes and same simulation parameters.

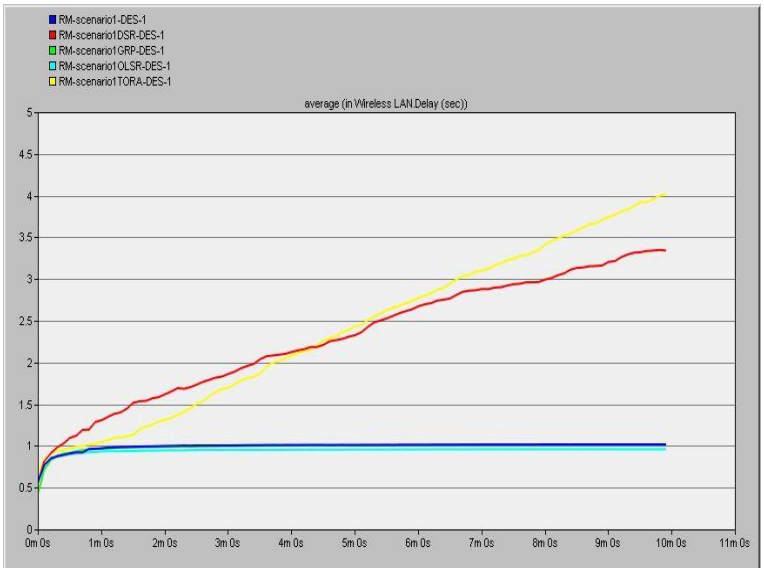


Figure 2. Average End-to-End Delay

Observations from the results shows that, the result divided to two group where the first group the output of DSR and TORA protocols increasing with the time and at the same time it is somehow unstable, on the other hand the second group of result for AODV, GRP and OLSR are stable and the output of AODV is highest with almost 1S where OLSR is lowest delay average less than 1S.

AODV firstly needs to find its routes so as to send data that needs to be sent, which implies that the time taken for the search of route affects the performance of AODV protocol, whereas OLSR does not require much latency as AODV in discovery of routes as a latency of single packet is sufficient.

DSR and TORA both have a poor delay attribute which was discovered due to their routing paths not being short, the route does not remain the same even when the first discovered route is the shortest in the first instance, it is always subject to change over time.

DSR protocol nodes use routes to an access point till there is a problem on the specified route. Despite the routes being really long in some cases it is persistent in using the route until a disconnection occurs of the route. Hence the rise of end-to-end delay which implies a poor delivery for all packets. Which makes DSR longer than GPR, AODV and OLSR because of its relative longer time in path delivery as every node on the way takes out information which is a requirement before further forwarding. There is more gain in DSR discovery in route the reason being every node despite having routing information extracted it delays transmission process while it does extraction from packets.

TORA has the worst relative delay when compared with the others, for the reason of loss of data which is caused by its requirement of too much time for creation of route which extends the delay waiting for new routes. TORA has no speedy route discovery which even puts DSR ahead of it despite the delay in DSR. Congestion causes TORA to respond poorly which reflects badly on TORA. In cases of high densities of nodes and traffic the end-to-end delay of DSR and TORA is higher compared to the end-to-end delay in OLSR, AODV and GPR.

4.2. Throughput

Throughput in total is packets carried on a network in bits per second. However, based on the understanding acquired from theory, hence this explains why if optimal throughput is needed then the network delay should be at its barest minimal.

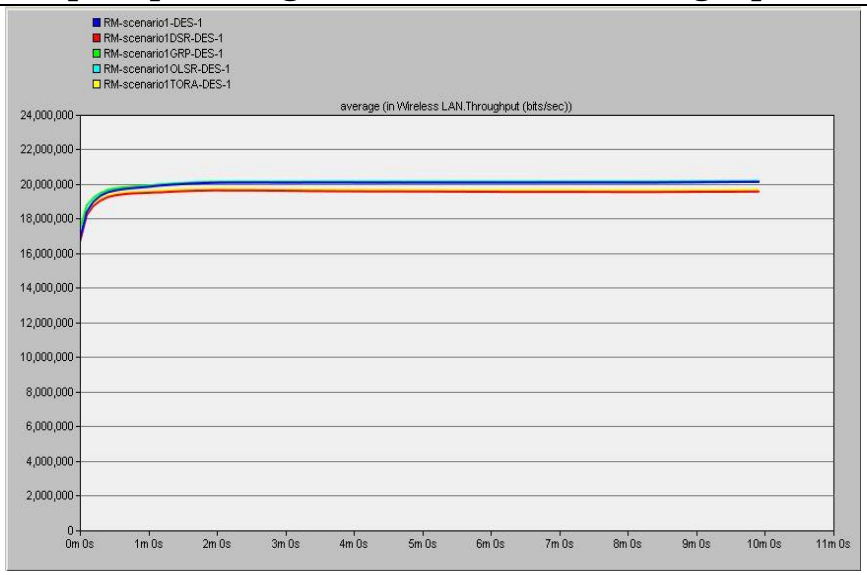


Figure 3. Average Throughput

performance shown in the above graph is in no way a standard reflection of a particular standard but only a reflection of the computation done in this study which shows all routing protocols used in this simulation that it takes the same simulation time for a given different scenario protocol.

Observations from the results show that, at DSR routing protocols showed lower throughput values ≈ 1960000 (Bits/Sec) followed by TORA ≈ 19700000 (Bits/Sec) whereas AODV and GRP almost give a same throughput values ≈ 20100000 (Bits/Sec) where finally, OLSR routing protocol has a higher throughput with ≈ 20150000 (Bits/Sec). This shows the throughput with this protocol may be useful at higher network densities.

4.3. Network load

It is representing the total data traffic received by all nodes, otherwise it is referred to the number of transmitted packets which were routed with respect to the data of packets delivered. A one count transmission is the count of a hop-wise transmission, it is the total summation of sent packets from all the nodes on a network in order to discover a route and maintain it (Bindra et al. 2010).

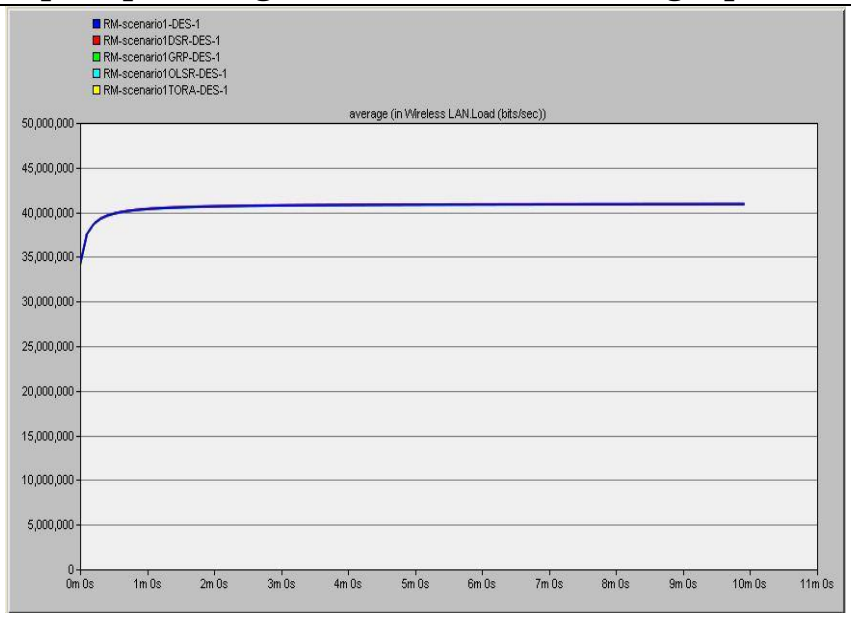


Figure 4. Average Network Load

Observations from the results show that, the outputs of all scenarios are almost same and stable through simulation time, the result come out with ≈ 41,000,000 (bits/sec), where all scenarios have the same value of the packet size and number of packet for their simulation the output is the same.

Therefore, in this experiment, the Network Load do not reflect any serious change on the performance of the network with all protocols, and all traffics generated constant bit rates from traffic sources.

5. **Conclusion**

Networks of mobile Ad-hoc have the ability to set out a network in places and instances where a generic network infrastructure is impossible to be set-out. The contributions of this research focus on, wireless sensor network efficiency in open space long distance, conducted with the perception of fixed wireless nodes, using the OpNet Modeler simulation tool, it presents results from the analysis of different scenarios, which has shown the efficiency of the use of wireless sensor devices in an open space area with the wireless sensor network architecture, consisting of 139 nodes covering an area of 2kmX5km. This is against the previous work done by Jukka, Mikko, Marko and Timo, "the set out of wireless sensor networks to monitor the environment", which was carried out in a network comprising of 20 nodes which cover more than 2km2. (Suhonen et al. 2006)

This study presented a detailed investigation of the operation and performance of standardized Ad-hoc routing techniques which are AODV, DSR, GPR, TORA and OLSR. Using OpNet simulation, the performance of these techniques was

compared and recommendations made for the best applicants for different scenarios.

The simulation monitors different routing protocols to reflect the parameters behavior under different scenarios. It is therefore found that the best model will be with the OLSR protocol configuration, Throughput alone does not signify that some technique is better than other technique, when a node in a network using OLSR protocol wants to find a host's route, what it does is a lookup of a routing table but for the second-best result AODV network, a discovery of route has to be carried out lest there is a cached route. And routing table lookup is less time consuming compared to flooding a network for path discovery, which implies OLSR protocol performance is optimal in networks with a high sensitivity to delay.

The network environment can be scaled to 139 node which is the number of nodes used, but in the real-world scenario, the highest count of nodes allowed to be used at most of the given time will be between 125 and 128 nodes. The configurations will give the best results for the end to end delay, and the throughput feasible for a network.

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الفهـــــــــــرس

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