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Improvement of performance analysis with energy harvesting of MANET in urban ecosystem using localization techniques

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ABSTRACT: An in-depth analysis of the AODV and OLSR routing protocols was performed in this study based on different scenarios to obtain a comprehensive insight into the performance features of MANETs. Several important metrics have evaluated rigorously such as the average energy consumption, packet loss, delay, Packet Delivery Ratio (PDR) and routing overhead. AODV shows higher packet loss (19.50%) and better PDR (84.6%) on average in comparison to the default OLSR implementation (77.45%). In the latency statistics, AODV had a 0.1722 ms delay while OLSR recorded a time of millisecond delay of 0.022. concerning energy efficiency, AODV was more efficient as it averaged power usage of 78.38 J compared to OLSR which has an average power consumption quality value of 145.82 J.II examining routing overhead default cost showed that OLSR has hence defaults with a higher value (774) compared to AODVs' thirty-nine seen above(common). The changes in parameter values have significantly affected the performance indicators, especially for parameters REQ_RETRIES and OUTTIME_MREQ. These results and observations give insights of use for future improvements within mobile communication systems in order to increase network resilience, as well as MANET protocol optimization.

Keywords: MANETs, Routing Protocols, Performance Analysis, Parameter Tuning, Mobile Communication

1 INTRODUCTION

Mobile Ad Hoc Networks (MANET) are indispensable for many applications, because of its system architecture that is dynamic and distributed in nature without need of any fixed

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infrastructure. Two prominent routing protocols, Ad Hoc On-Demand Distance Vector (AODV) and Optimized Link State Routing (OLSR), are investigated in depth due to their interesting operation frameworks. AODV creates routes when necessary, making it more cost effective. On the other hand, OLSR costs periodically broadcasts its routing information. "It's fundamental to understand how these protocols work in highly dynamic and unpredictable environments like urban landscapes, where you have a lot of mobile nodes causing interference with the control signals essential for establishing reliable networks," he added. In order to evaluate routing strategies realistically, static simulation settings are insufficient in MANETs and especially urban areas with a dynamically changing network. More recent research on MANETs has considered the implications of parameter values for protocol performance, including REQ RE-TRIES and OUTTIME MREQ. [6] Such variables are instrumental in the sense that they enhance routing protocol behavior under certain environmental conditions. MANET is anticipated to have a wider application in the internet of things (IoT) and smart cities because this require quality communication between interconnected devices, smart infrastructure all over. Grasping the way MANETs perform within city limits is fundamental to the academic study and envisioning of smart urban networks in years to come. Research on MANETs is more challenging in urban environments due to problems such as the mobility of nodes, interference with signals, and the dynamic changes in the architecture of networks based o pedestrian behavior or traffic flow. By and large, a complete consideration of MANET in urban environments is essential for any IoT application to flourish while maintaining an environment best suited for smart city operations.

2 METHODOLOGY

The study addresses the performance analysis of Mobile Ad Hoc Networks (MANET) through simulation based on NS2 simulator. Simulation framework has been implemented to configure the parameters and inject network traffic for evaluation of routing protocols AODV, OLSR. In this paper, the delays, energy consumption, packet density ratio difference in the initial amount of packets will be discussed; Packet lost and throughput and routing cost are taken as KPI to observe the impact of both type protocols on a MANET. The process involved having protocols installed in the system, carrying out certain simulations and then studying the trace files to determine performance. Figure 1 illustrates the top view of the research methodology, which includes evaluating MANETs in urban areas using various routing protocols. This paper presents a detailed analysis of MANET dynamics and performance in urban settings. Architecture of the propose research is shown in Figure 1.

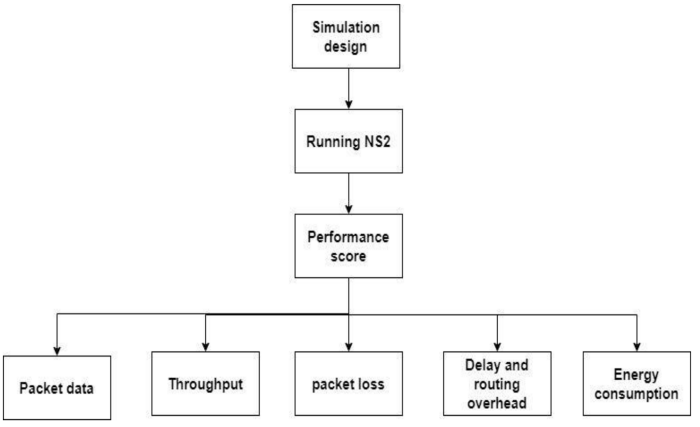

Figure 1. Architecture of the propose research.

2.1 *Simulation design*

The selection of cases in this work was required to create simulation scenarios for Mobile Ad Hoc Networks (MANET). The mobile MANET applications which were in this category include the mobile devices such as laptops, smartphones and sensors with MANET technology that are used frequently within the context of manets. "The simulated scenarios showed us that devices such as smartphones and vehicle-mounted sensors, which we selected because they can send packet data, are viable candidates to use VPkC," he says. •Use of UDP transmission protocol •Packets per link=1000 (similar to practical MANET applications) The simulation area was 1000 x 1000 m covering such a size that it allowed us to observe and analyze how better MANET behaves in the urban environment. To emulate MANET transmission characteristics, we sent 10 packets of 512 bytes every minute. Presented in Table 1 are some of the key parameters which contribute to making our simulation setup transparent and reproducible. The objective of this study is to create as much realistic conditions for the most part in order to have a holistic evaluation and Palestinian performance slice within MANET urban environments.

Table 1. Simulation parameter.

Parameter	Value/Setting
Simulation Scenarios	Mobile communication devices with MANET tech
Devices Considered	Laptops, Cellphones, Data-sharing Sensors
Transport Protocol	UDP
Packet Limit per Connection	1000
Simulated Region Size	1000 x 1000 meters
Packets Delivered	10 packets per minute
Packet Size	tes

2.2 *Test strategy*

The primary objective of this study is to assess the performance improvements that can be gained through modifications in traditional OLSR and AODV. routing protocols using simulation scenario designs. Both scenarios consider the changes in our simulations based on key parameter variables, especially those relative to AODV (i.e., RREQ and MAX_RREQ). Through simulation in an emulation environment, a total of five nodes with one mobile and four fixed nodes were used to observe the routing dynamics and protocol performance as closely amenable as realistic. Test scenario is shown in Figure 2.

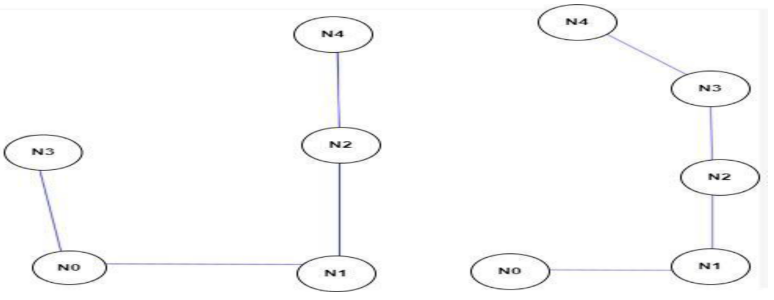

Figure 2. Test scenario.

Next, we gave the details of network traffic behavior as summarized in Table 2 for one link, including what happens when source and destination nodes are further away by varying

various pairs: "(Test AODV-RREQ MAX_RREQ)." Finally, the study looked at a deliberate disconnection of source and receiver nodes to measure the influence of changes in protocol parameters on creating new network paths depending on node speeds (i.e., urban traffic behavior) over time, capturing key aspects of MANET usability and robustness under dynamic conditions.

Table 2. Network traffic characteristics.

Connection Type	Source Node	Destination Node	Network Traffic (Packets/Minute)
Single Connection (Moving Node)	Node 0	Node 4	Variable (See Figure 2)
Disconnected Nodes	Varied	Varied	N/A

2.3 *Routing protocol*

The constants REQ_RETRIES and OUTTIME_MREQ of the AODV routing protocol were important for our simulation, refreshed upon they seriously influence on owned experiments design as presented in Table 3. This table specified the exact combinations and allowed test case generation by iterating over these values as covered above. In this experiment, we aimed to draw the relationship and their reflection about AODV protocol's firewalling performance under MANET environments by changing REQ_RETRIES and how these afterwards affecting OUTTIME_MREQ or vice versa. Thanks to the simulator default setting of MAX_RREQ parameters some interesting comparison and observation about protocol behaviour has been enabled. Interestingly, the OLSR routing protocol did not contain any related parameters such as REQ_RETRIES and OUTTIME_MREQ but included HELLO values to offer better performance in terms of storing routing information. It is also interesting to observe that OLSR protocol improved the prediction performance of all intervals whilst AODV in its reactive way, was not effective for such configuration when MANETs are involved.

Table 3. AODV routing protocol parameter combinations.

Test Scenario	REQ_RETRIES	OUTTIME_MREQ(s)
Scenario 1	3	10
Scenario 2	4	12
Scenario 3	2	8
Scenario 4	5	15
Scenario 5	3	20

2.4 *Performance score*

Performance Metrics for access network efficiency and reliability: In MANETs, various performance metrics are used to determine the effectiveness and reliability of network access. Packet Delivery Ratio (PDR) defines the ratio of packets transmitted and forms data that are received, providing an insight into how well a network is performing and the services its delivering. Other point, is throughput which is measure in terms of bytes per seconds. It helps to show how much data it can transfer and also the how efficiently program can handle diff - Dropped packets (loss); it affects the network's performance and reliability, different protocols managing losses in a distinct way. Network responsiveness and quality of service in the network is significantly impacted by Latency which is defined as time taken for a packet to reach from source to destination It estimates the energy utilization of nodes in finding the

overall stability and effectiveness because it is important. The dole out Overheads (RO) are the count of packets transmitted and this is very important to understand in order to judge about routing protocol and network traffic provisioning. They use these metrics to tune the performance of the network, develop better protocols and utilize resources efficiently.

3 RESULT AND DISCUSSION

In this section, we summarized the findings of our study regarding the performance evaluations between AODV and OLSR protocols in mobile ad hoc networks (MANETs). It can be observed from the comparison of key performance metrics (throughput, latency, packet loss, packet delivery ratioPDR), energy consumption and routing overhead that AODV performs significantly better as compared with OLSR in terms of PDR and packer loss. Table 1. PDR Results for our Candidate On-Demand Routing Protocols (Sorted by Average PDR) AODV has an average of 84.6% compared to OLSR 's 77.45%. Moreover, adjusting of the parameter like REQ_RETRIES and OUTTIME_MREQ in AODV will also led to improved values of PDR and reduced packet loss. Other parameter is regarding latency, OLSR has a better performance than AODV having less value for the relationship. Figure 12 shows the energy consumption results, which are that OLSR consumed more energy than AODV. The average is respectively for OLSR and AODV: 145.82 J and 78.38J The modification on the value of REQ_RETRIES parameter in AODV has an effect also on energy consumption even though it increases slightly for higher values. An evaluation of routing overhead demonstrates that OLSR yields higher routing costs than either AODV. AODV routing overhead can be influenced through modification of the features. For instance, lowering the value of threshold_app affects reduction in routing cost as Req_retries parameter is lowered. In general, the study presents some interesting results concerning the dynamics of MANETs and reveals that proper parameter adjustment may lead to, achieving significantly better network operation. PDR Ratio is shown in figure shown in Figure 3.

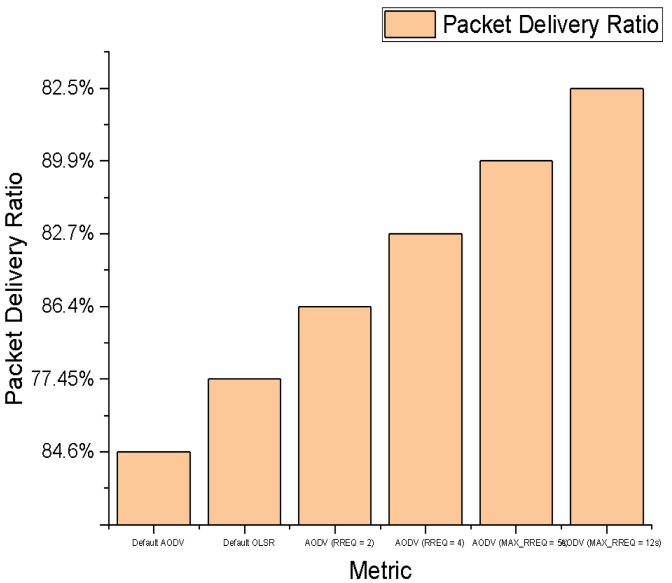

Figure 3. PDR ratio.

4 CONCLUSION

In conclusion, the study analyzed performance metrics of MANETs included energy consumption, packet delivery ratio, packet loss and latency and routing overhead. Comparison between AODV and OLSR protocols, PDR was significantly in the favor of AODV protocol but packet loss were higher than those of OLSR. However, significant lower latency and energy consumption was observed in OLSR. To conclude, tweaking parameters such as REQ_RETRIES and OUTTIME_MREQ is important in optimising the network. The study was beneficial in adding value to the network by increasing its resilience, improving MANETs protocols and development of mobile communication systems.

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