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Enhanced-AODV Node Reliability Approach for MANET to Optimize Performance Metrics and Energy Consumption

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ABSTRACT

Ad-hoc network is a network of moving wireless nodes which do not have a central or permanent influence over their connections. It is a mobile node device that is auto configured and connected to an arbitrary infrastructure through wireless connections. Therefore, due to the highly complex environment, MANET routing is a crucial activity. Various protocols are used to enhance the routing process, such that a network route is found between every transmitter and the host receiver. In this post, we modified the AODV protocol to increase the rate of throughput, end-to-end delays, and packet distribution, etc. We used ns3 simulator to compare the protocols AODV, DSDV, OLSR and Enhanced AODV. It is noteworthy that EAODV routing protocols perform much better than OLSR that the DSDV routing protocol provides high throughput, a lower latency and high delivery ratio of packages. In addition, our proposed energy efficient model has changed conventional AODV. Our improved EAODV protocol's overall performance is 3% superior to other conventional protocols.

Key words: Ad-hoc Network, AODV, DSDV,MANET

1. INTRODUCTION

The decentralized kind of wireless network is a wireless ad hoc network. The network is ad-hoc since it does not rely on existing infrastructures, such as wired network routers or wireless network access points [1]. This will be far away from either the involvement of sensors in many areas suspect, as the cause of the catastrophic event, such as an earthquake, explosions, slips, tsunamis, and even more, except for an explosion in the mountains. In addition to the implementation of the wireless setup in the application scenario, the language capacity in an adopted area is no longer required, and likelihood of the human object is eliminated by examining tasks [2], [3].

The key method involved in WSN machinery is the procedure of routing. The entire structured sector defines data transfer from the origin node wirelessly. Node The immediate region with sensors is detected. Node. In this case the server will show how much value is changing to prevent disasters [4],[5]. MANET relies on several protocol-split routing algorithms, namely DSDV DSR, DSDV, OLSR and AODV, OLSR, for Constructive as for Reactive protocols. A building protocol property can also convey update data, which reactive protocol can, while the cache route control can frequently be modified. The proactive and reactive properties for routing protocols of MANET could be assumed to be adequate for WSN, which requires ongoing data streaming in an attempt at accurate data during international development [6].

Previous researchers were regularly aware of the problem facing us, of the energy-efficient routing systems and of the densified node effect in the observing area in the analysis of performance monitoring in both MANET routing protocols. Some researchers find that implementation of MANET for wireless communications systems faces minimal challenges. These factors are delay, efficiency, PDR, and a wireless data transmission device analysis method are some of these constraints [4], [7]. Several previous investigators conducted the performance evaluation with four control parameters, including the NS-3 MANET protocol. NS-3 is also a control system open-source that also focuses on differentiated simulation. Animations. Activities. Each event is running in this simulator in the time order of the temporal simulation. This can lead to one or more incidents during the case. The simulation will be stopped as long as the simulation period is finished. NS-3 is the NS-2 augmentation version which the library has completed.

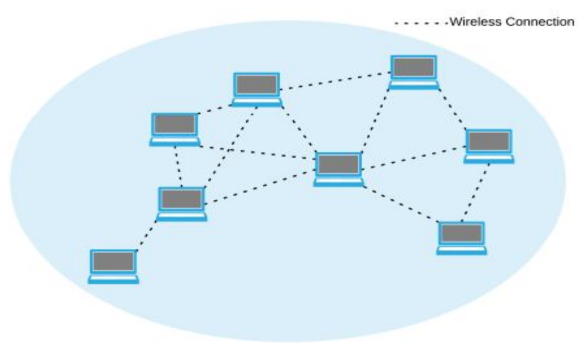


Figure 1: A MANET Network

Figure 1 shows the simulation of a routing mechanism between nodes using the MANET protocol. Studies have shown that routing protocols on-demand have less overall routing for node mobility and have greater efficiency than routing protocols based on table. The Ad Hoc On Demand Routing Protocol (AODV) with more obvious benefits is moderate overhead routing and fast convergence and is one of the network's promising ad hoc routing protocols [8]. The researcher could use Ns-3 to design the system by using the different types of ad-hoc protocol given, and test these protocols for changes in node intensity, the duration of the field of inspection or the simulation period span. The PDR, delay, data obtained, and packet loss sum will be calculated for the test. This protocol is used in order to monitor a victim's condition within the affected area as the routing protocol for a wireless network sensor application, although the best protocol has been identified [9].

2. CLASSIFICATION OF ROUTING PROTOCOLS

Figure 2 shows that each network is equipped as a client or server in a mesh topology, so every node is functional. Mobile ad hoc network architecture,you may also send the node to the other destination node to route the data packet. The node is also able to navigate the routing table itself [2], [11].

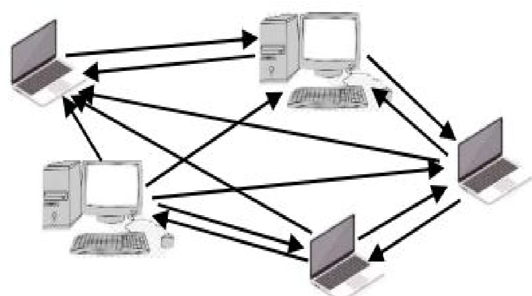


Figure 2:MANET Mesh Topology

MANET has an important role to play on all networks in routing protocols. This protocol indicates how the information route is to be transferred through a network and how the data to be transmitted is selected. Ad hoc networks are classified into three categories of several routing protocols, both smooth and classified, constructive, and reactive, for routing, including crossbreed protocols [12], [13].

2.1 Reactive Routing Protocol

Reactive routing (RR) protocols are often used to build new transitional approaches on demand. The protocols for reactive routing are divided between DSR and AODV [13].

2.1.1 Ad Hoc On-demand Distance Vector (AODV)

AODV is decentralized system which forms a path from the sender node to the receiver node, mainly constructed on the root hub. It handles the most current routing information by using modified routing results, including tables as routing. The problem with AODV is, however, that the node remains asymmetrical associations [14],[15]. In other words, an AODV can keep an asymmetrical connection between the sender node and the receiver node only. Path scan and road control tend to be a protocol to the messages viewed by the AODV. Routes exploration includes path requests (RREQ) and route response (RREP). Maintenance of the route consists of records, changes of route and configuration errors (RERR) [16].

2.2 Proactive Routing Protocol

A type of protocol created on frequently changed route tables is a protocol for active routing protocols. DSDV and OLSR [16] are example instances of building transmitting protocols.

2.2.1 Dynamic Source Distance Vector (DSDV)

This is a constructive routing protocol which demands that every node send changed transmitting communications to all nearby nodes on a regular basis. When renewing the routing mechanism, DSDV utilizes the Bellman-Ford algorithm model when each network node sets up a Routing Table. In the routing list are shown the target of the host, the number of trips required to arrive at the destination and the series number. Before delivering an update path message, the node awaits its completion for the period being so it will not be given the update note from the next node. Though, the route to the target node is chosen by the node if one of the routing tables is changed [17].

2.2.2 Optimized Link State Routing (OLSR)

OLSR is the final building protocol for routing. This protocol is built and is optimized to extract data related to the topology of the network, depending on the connection status routing algorithm. The improvement of OLSR is that it has a snappier latency than the forwarding table. It has, on the other hand, the potential to continuously use MPR to significantly minimize the number of data messages and transmission redundancies [18], [19].

3. PREVIOUS WORK

In [2] researchers conducted a complete energy-efficient routing protocol called EM-AODVV has been performed on the mobile ad hoc network (Energy Multi-path Ad-hoc On-demand Distance Vector routing). EM-AODV is a reactive routing protocol with two mechanisms used in the fundamental AODV protocol. Using one route reverse-direction on request for AODV and a variety of MANET routing protocols. Fast shift in topology causes a route response not to reach the source node, i.e. after many route demands are sent by the source node, a response message is sent to the node that increases electricity consumption. We propose a mechanism to search for multiple ways to prevent these problems. Secondly, a new adaptive approach aimed at incorporating "residual energy" metrics in the selection of process routes was considered in the decision-making of the routing processes, which included the consideration of residual energy of mobile nodes. Simulation results show that the EM-AODV protocol responds to better energy conservation. It is a self-configured, wirelessly connected mobile node network. Routing in MANET is therefore a critical task in the extremely complex environment. Several protocols have been developed to enhance the monitoring process to find network routes between any host and source. This article focuses on the constructive routing protocol (DSDV), the cluster-based routing protocol (CBRP) as well as the Demand Distance Vector Protocol (DDP) (AODV). This paper offers a summary by presenting their properties, functions, advantages, and inconveniences of these protocols.

In [17] group of researchers discussed researchers tested the Flying Ad Hoc Network (FANET), which was created by a group of wireless nodes and was created as a kind of Mobile Ad Hoc Network (MANET), which can dynamically network information sharing without using a fixed network infrastructure. Its good performance and low cost make it ideal to be used in many applications such as ambient sensors, car communications, disaster relief, air/lands/navy safety, etc. Performance evaluation of FANET routing protocols Ad hoc on Demand Distance Vector (AODV) and Desire-Sequenced Distance-Vector (DSDV) by the software package NS2. The delivery rate, end-to-end delay and performance measurements are measured for both protocols in order to test the network performance. In addition, an energy analysis is shown for each protocol since energy is a fundamental technical challenge for mobile and embedded applications. These results form the basis for the further creation of collaborative control protocols for the robotic vehicle network.

Researcher in [19] proposed that In order to estimate the performance of different NS-3 Network simulator routing protocols the car scenario has been used. The efficiency of the three AODV, OLSR and DSDV routing protocols was contrasted in VANET scenarios. Quality assessment metrics are the BSM PDRR and the average good Put. 10 basic safety messages are used every second for the transmission of vital information between vehicles. The quality determination steps are the average ratio of good position and distribution by packets of basic safety alerts. OLSR offers a higher vehicle density for 30K/m vehicles with 10K/m and 20K/m with reasonable performance than AODV. AODV is normally good protocol in low-density vehicles, but for high-density vehicles, OLSR follows another protocol.

Authors of [21] reported that a decentralized and non-existent cellular network shall be an Ad Hoc Mobile Network (MANET). It is instead up to each node to transfer data in compliance with the routing protocol defined. In four separate Routing Protocols, PDR and AETED performance metrics have been implemented. They perform different situations because they do the same job. The protocols are not yet in effect. This paper replicates four distinct routing protocols with the Packet Delivery Ratio (PDR) and Average Final to End Latency (AELR) at a range of moving and area dimensions (AETED). The results indicate what a computer can use in a similar environment. Therefore, you must pick a protocol ideally appropriate for a device. For future work on changing a Protocol according to the device implemented, the data obtained from this test will form the basis. Some may use the data evaluated to enhance the effectiveness of real-world approaches, improve protocols, or create hybrid protocols.

4. METHODOLOGY

In this paper the proposed resolution addresses the remaining total path energy and the parameters for protocols such as throughput, packet delivery ration, latency, and packet loss ratio and so on. In order to verify the efficiency of our proposed solution, we initially compared other routing protocols and compares the improved AODV protocol to other three conventional MANET routing protocol. We used NS3 version 3.30, though this coding was designed in AWK, to create the simulation process. Initially, we made changes to our original AODV protocol as regards simulation behavior in order to achieve high energy consumption efficiency and other parameters listed above:

Step1. Node packet Forwarded Rate (α)
Condition(if)

- Node Mobility is High
- Packet Collides at the Receiving Node
- Node Have Configuration Problem
- Buffer Exhausted

X = No. of Received Packets
Y = No. of Forwarded Packets

$$\alpha = \frac{X}{X+Y} \quad (1)$$

Step2. Battery power available with Node (β)
Condition (Available Battery>30%)
THEN β =1 ***else*** β=0
Step3. Rate at which Battery is draining (γ)
Step4. Congestion around Node (θ) – Number of packets overheard by the Node in last unit time interval.

$$\text{Node Reliability} = \frac{w1*\alpha+w2*\beta+w3*\gamma+w4*\theta}{\sum_{i=0}^{4} w_i} \quad (2)$$

In addition, we therefore configured that protocol model as well as run increasing framework with these kinds of variables, such as node density, measurement area size, etc. To observe the output of each logistic models, the variables were rapidly altered, after which we explored the outcome of simulation. The nature of transmission from datagram seemsUser Datagram Protocol(UDP) [22]. This choice is constructed on the point that the procedure of sending information packets happens through a difficult sequence of tasks. The same data collected may be individually covered by the layer of application, irrespective of the packet answered, or not by the order of the packet transmitted. Every simulated routing protocol is composed by AODV, DSDV and OLSR.

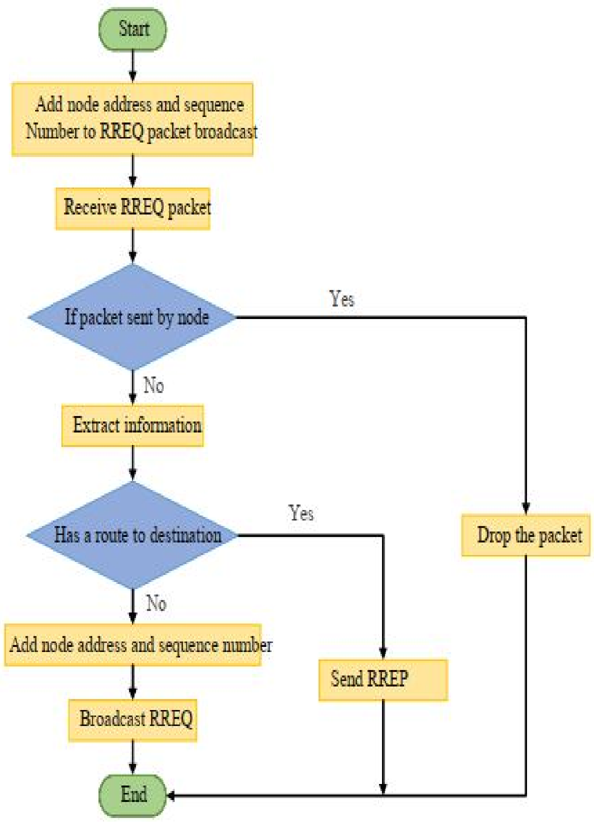


Figure 3: Routing Caching Process

Figure 3 shows the process of routing cache. Three routing protocols were studied, i.e. the corresponding AODV, DSR, and OLSR. NS-3 our method to simulate. The performances of such routing protocols: delay, network load, and throughput are also evaluated in performances. Measurements substantially illustrate the 3 routing protocols. A comparative analysis of such protocols will be carried out and that in the latter, such as Ad-Hoc mobile networks, the result is that its strongest routing protocol is the best.

During each shift, 50 percent of the total number of nodes is included in the list of processing nodes. Used For this next test, the number of sensor nodes utilized will be 20, 25, 30, 35, 40, 45 and 50. Therefore, 5, 10, 15, 20 and 25 are the number of sensor nodes sent. The aim of this measurement is to provide the protocol with almost the same node density, thus performing simulation patterns and regularities. The simulation level is set to a static rate of 5 m/s for a period of 200 sec only.

When an added node is added, the nodes that distinguish between OLSR, AODV, and DSDV protocols are established for the implementation of the RR protocol. During the first model, experiment 2 changed the nodes and then used a fixed recipient value and maybe a different set of destinations. The same node was formed at, 25, 25, 30, 35, 40 and 45 50 as well as at, 25, 30, 35, 40, 45 50. The distance between nodes is immediately decreased by about 2 m/s, increasing the number of nodes here. If routes or paths are identified, this may impact the routing protocol. Sending signals from the data packet to both the intermediate nodes. A routing protocol simulation using NS3 is performed and exported as the.csv file for evaluation of a simulation outcome. For determining a device model's QoS such as PDR, bandwidth, loss of packet, and latency, this is file saved. As a summary [21], [23], [24], simulation outcomes based on NS3 QoS parameters are assessed. In the table 1, simulation parameters are given.

Table 1: Simulation Parameters

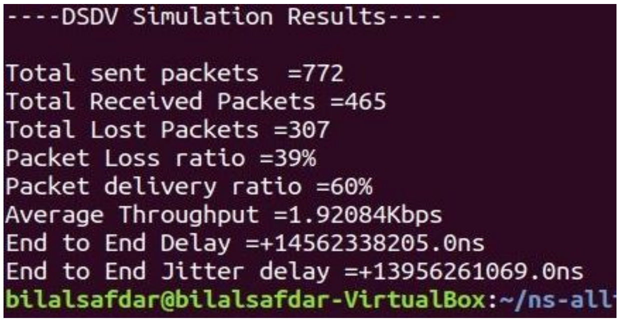
Parameters	Values
Platform	Ubuntu 18.04 LTS
Simulator	NS3 (ns-alanine-3.30)
Channel	Channel/WaveNetDevices
Model	Propagation model
Interface	Phyu-Wireless-Phy
MAC	802.11ah
Queue Interface	Queue
Type of Link Layer	LL/Mac
Antenna_Model	GppAntennaArrayModel
Max packet	50
Area for Simulation	450*950
Number of Mobile Nodes	20,25,30,35,40,45,50
Simulation Duration	120,160,200,250,300
Routing Protocols	AODV, EAODV, DSDV, OLSR
Source Type	UDP/TCP
Mobility Model	Random
Traffic Type	CBR

5. EXPERIMENT

For each simulation scenario simulations were created of 3 distinct values of a comprehensive variable, and the mean value of these weights was calculated. To achieve accurate results. The NS-3 is improved by the implementation of a new user application for measurement of critical network settings such as throughput, missing packets percentage, jitter, and average end-to-end delay. A particular packet header with a time stamp, node id, packet order number, and application ID will be used for the parameters mentioned above. The simulation begins by entering the TCL file for installation. The TCL file was then performed with the NS3 simulator. This TCL file depicts the node movement and transmission process and enables users to look at the coded scenario in the TCL file. Then it is created.tr (Trace file) that includes all the event traces that can also be used to track network implementation. The trace file is then checked to see only the useful details. The evaluation is achieved with MATLAB and excellence.

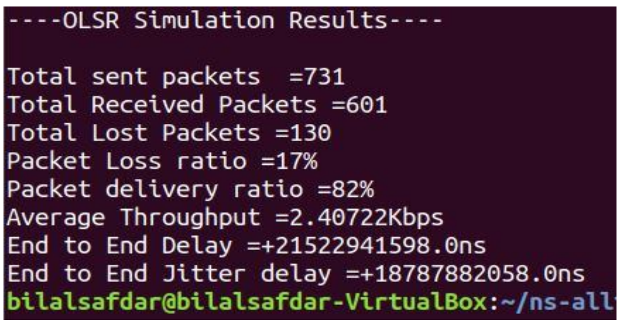
6. RESULTS AND DISCUSSION

The authors mentioned the use of NS3 simulation and the parameters of table 1 for the calculation of various factors such as the throughput, the delivery ratio, and the end-to-end delay, etc. Figure 10 shows the throughput which is considered as a rate at which something is generated. When the efficient message transmission over a transmission channeled is used within the perspective of communication networks, such as an Ethernet, packet radio, throughput, and network output. Delay or one-way delay means that a packet is transmitted through the network from the source to the destination. This is a shared concept in the IP device control and varies from the round-trip time since only the sender to receiver route is measured in a single path. The distribution ratio for the parcels is the ratio of sending and receiving parcels. Overall residual energy is a central component.



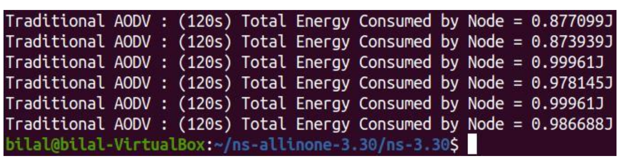
```
----DSDV Simulation Results----

Total sent packets  =772
Total Received Packets =465
Total Lost Packets =307
Packet Loss ratio =39%
Packet delivery ratio =60%
Average Throughput =1.92084Kbps
End to End Delay =+14562338205.0ns
End to End Jitter delay =+13956261069.0ns
bilalsafdar@bilalsafdar-VirtualBox:~/ns-all
```

Figure 4: DSDV Simulation Results



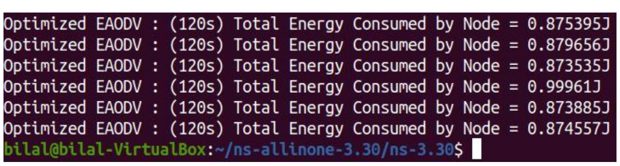
```
----OLSR Simulation Results----

Total sent packets  =731
Total Received Packets =601
Total Lost Packets =130
Packet Loss ratio =17%
Packet delivery ratio =82%
Average Throughput =2.40722Kbps
End to End Delay =+21522941598.0ns
End to End Jitter delay =+18787882058.0ns
bilalsafdar@bilalsafdar-VirtualBox:~/ns-all
```

Figure 5: OLSR Simulation Results



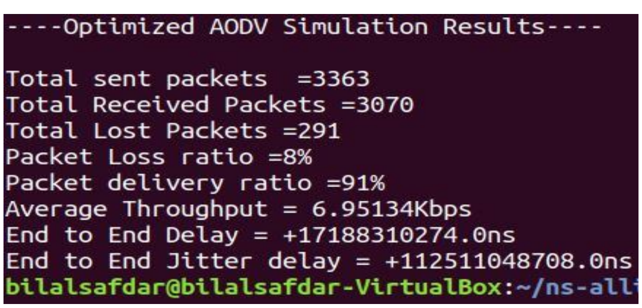
```
Traditional AODV : (120s) Total Energy Consumed by Node = 0.877099J
Traditional AODV : (120s) Total Energy Consumed by Node = 0.873939J
Traditional AODV : (120s) Total Energy Consumed by Node = 0.99961J
Traditional AODV : (120s) Total Energy Consumed by Node = 0.978145J
Traditional AODV : (120s) Total Energy Consumed by Node = 0.99961J
Traditional AODV : (120s) Total Energy Consumed by Node = 0.986688J
bilal@bilal-VirtualBox:~/ns-allinone-3.30/ns-3.30$
```

Figure 6: Traditional AODV Energy Residual



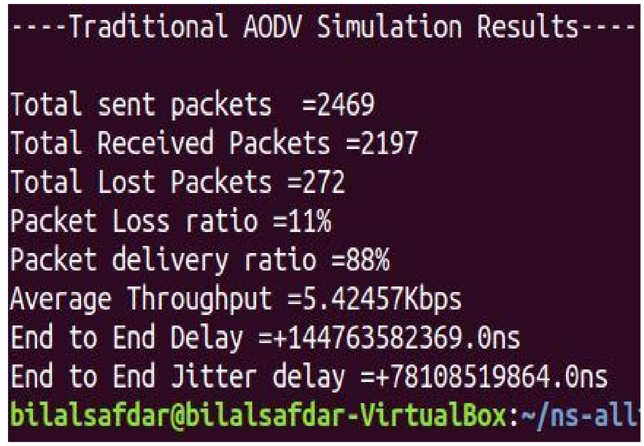
```
Optimized EAODV : (120s) Total Energy Consumed by Node = 0.875395J
Optimized EAODV : (120s) Total Energy Consumed by Node = 0.879656J
Optimized EAODV : (120s) Total Energy Consumed by Node = 0.873535J
Optimized EAODV : (120s) Total Energy Consumed by Node = 0.99961J
Optimized EAODV : (120s) Total Energy Consumed by Node = 0.873885J
Optimized EAODV : (120s) Total Energy Consumed by Node = 0.874557J
bilal@bilal-VirtualBox:~/ns-allinone-3.30/ns-3.30$
```

Figure 7: Enhanced-AODV Energy Residual



```
----Optimized AODV Simulation Results----

Total sent packets  =3363
Total Received Packets =3070
Total Lost Packets =291
Packet Loss ratio =8%
Packet delivery ratio =91%
Average Throughput = 6.95134Kbps
End to End Delay = +17188310274.0ns
End to End Jitter delay = +112511048708.0ns
bilalsafdar@bilalsafdar-VirtualBox:~/ns-all
```

Figure 8: AODV Simulation Results



```
----Traditional AODV Simulation Results----

Total sent packets  =2469
Total Received Packets =2197
Total Lost Packets =272
Packet Loss ratio =11%
Packet delivery ratio =88%
Average Throughput =5.42457Kbps
End to End Delay =+144763582369.0ns
End to End Jitter delay =+78108519864.0ns
bilalsafdar@bilalsafdar-VirtualBox:~/ns-all
```

Figure 9: Enhanced AODV simulation results

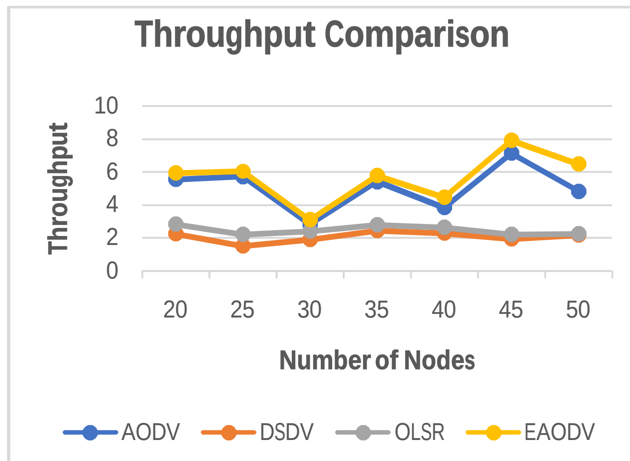


Figure 10: Throughput Comparison

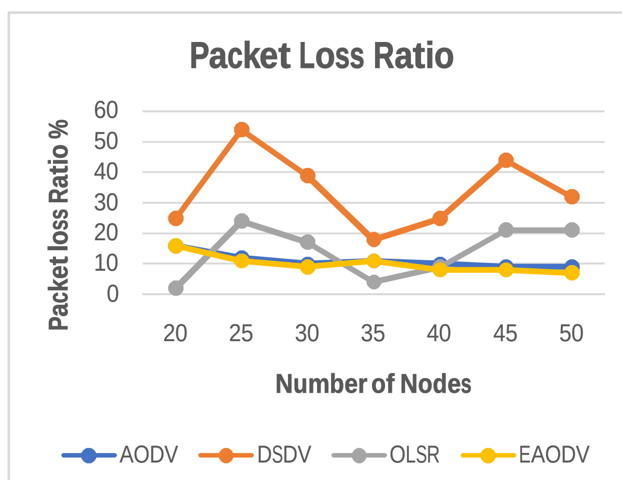


Figure 11: Packet Loss Ratio

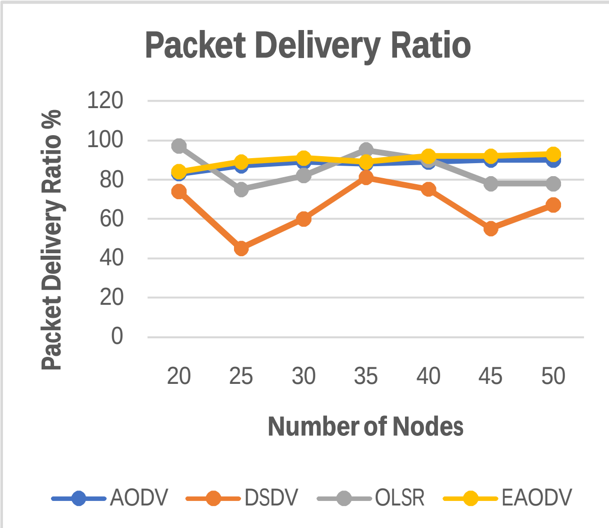


Figure 12: Packet Delivery Ratio

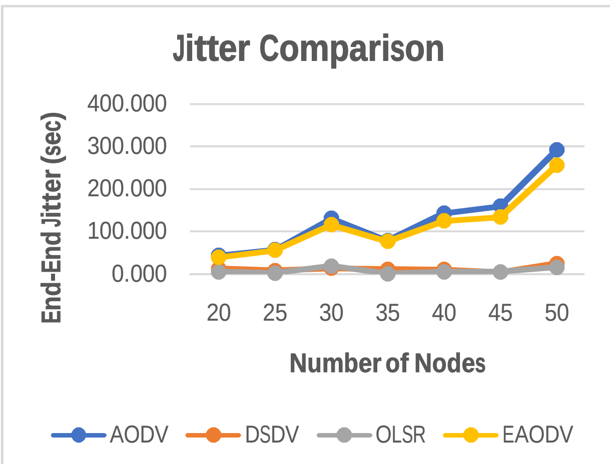


Figure 13: Jitter Comparison

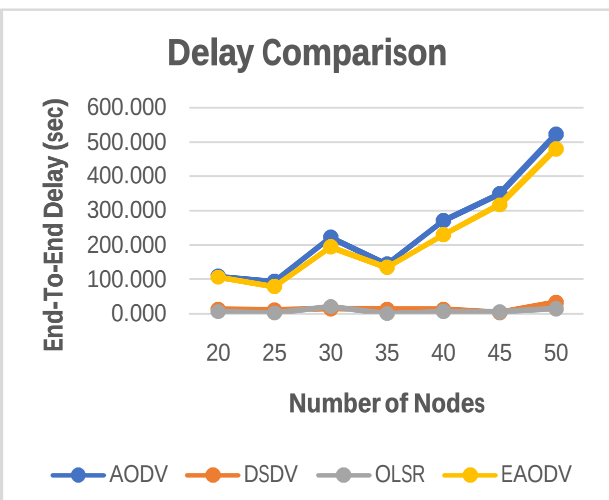


Figure 14: Delay Comparison

According to above all data, traditional AODV performs well in the same setting as other traditional DSDV and OLSR protocols with respect to the throughput and latency. The efficiency of OLSR in end-to-end Jitter is more effective than conventional AODV and DSDV. When we compare our modified AODV with all these traditional protocols, overall performance, distribution ration, and end-to-end delay are efficient by 3%.

According to the above contrast, residual energy, and node reliability for ten nodes are slightly improved but 20 nodes are slightly reduced. As the number of nodes increases, in the improved AODV protocol, the residual energy value increases. Thus a major change can be seen with 30 nodes.
Packet loss and PDR for DSDV was higher compared to AODV and EAODV. This is because DSDV is considered the highest level of the number of packets sent, among other reactive routing protocols. On the basis of the above, improvements to the conventional AODV protocol clearly have had a positive effect on efficiency, packet delivery, end-to-end delays, and residual energy. All simulations are compiled successfully to ensure accurate adjustment. It is greatly enhanced by increasing the number of nodes. This improved AODV protocol for large-scale wireless set-up is strongly recommended by writers.

Table 2 shows a performance analysis which was conducted for the evaluation of the overall accomplishment of the four routing protocols, AODV, DSDV, OLSR and EAODV. The mean, variation and precision of protocols are computed on the basis of the results.

Table 2: Statistical Measurements

Protocol	Mean	Variance	Precision
DSDV	374.542	193.685	0.00557
AODV	411.656	2.357	0.00567
OLSR	395.202	1.524	0.00432
EAODV	403.701	1.759	0.6028

In comparison with other reactive protocols, a higher accuracy value suggests improved performance of the proposed EAODV protocol.

7. CONCLUSIONS

This paper emphases on the AODV routing protocols' energy consumption and some other efficiency metrics. As a substitute of just overwhelming the whole network with path request packets each moment in time, this was accomplished by providing a path for path detection in the proposed EAODV routing protocol. Compared to both DSDV, OLSR and AODV, a total performance review reveals that the EAODV has the greatest accuracy estimate, which means it is more effective. In DSDV, the packet loss ratio is higher than in the other three protocols. In EAODV, however, the overall enhancement in throughput, packet transmission ratio and end-to-end latency is 3% better.

8. FUTURE WORK

The authors expect to demonstrate that many MANET uses in the real-world will embrace the proposed EAODV routing protocol architecture. EAODV can be used with traditional DSR for path length prediction in MANET.

AUTHORS CONTRIBUTION

All authors had approved the final version. Corresponding Author is Bilal Safdar.

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