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Enhancing wireless subscriber performance through AODV routing protocol in simulated mobile Ad-hoc networks

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Abstract

The investigation of impromptu network routing algorithms has been a focal point in exploration of networks associated with Ad-Hoc systems. This study uses the OPNET simulation tool to classify and assess Ad-Hoc networking routing approaches in order to deal with multiple obstacles pertaining to the networking guidelines, which include inadequate adaptation with an elevated management complexity. In particular, the effectiveness of two routing protocols such as the table-driven and the on-demand is being evaluated. The leading on-demand routing protocols are DSR (Dynamic Source Routing) and AODV (Ad Hoc On-Demand Distance Vector), whereas the majority of prevalent table-driven routing protocol is DSDV (Destination Sequenced Distance Vector). These three protocols' capabilities are emulated under conditions of distinctive packet transmission proportions, typical end-to-end interruptions, and routing demands. Based on a constant bitrate source traffic framework, the results of simulations take place across multiple movement speeds (0–25 m/s). Findings within a distributed system featuring 20 arbitrarily positioned terminals demonstrate the use of the on-demand routing system functions optimum in a high-mobility condition.

1. Introduction

An adaptable, independent portable multi-hop technology that functions in absence of a predetermined architecture is identified as an ad hoc network. It eliminates the requirement for a static framework, as all network nodes are mobile and can dynamically connect with other nodes. Nodes have the capability to relocate and power on or off at any time, resulting in unplanned modifications to the entire network configuration. Intermediate nodes help in forwarding packets during circumstances wherein both network users are unable to interact face-to-face. Every connected node has the ability to operate as a host and a router simultaneously. Traditional routing techniques including distance vector and link-state are inapplicable in Ad Hoc networks owing to their distinct features. Proactive, reactive, and hybrid routing protocols are the two elementary levels of routing protocols that have been implied for Ad Hoc networks. Moreover, one more name for the earlier steering convention is the table-driven directing convention can be given in [1-2]. As part of this routing system, every node keeps track of other nodes' addresses in a routing table. The node notifies the network of any alterations in topology by portraying a revised signal. This ensures that the receiving node's routing directory is promptly updated, maintaining consistency, immediacy, and accuracy in reflecting the network's topology. The protocol finds the best path to the destination node as soon as a message is sent through the source node, minimizing latency. Nonetheless, this routing technique has a significant overhead. On-demand routing, also known as reactive routing protocol, dynamically searches for a path during circumstances where information exchange needs to happen. Nodes do not have to keep their routing data current at all times while using this protocol. In order to determine and set up the right pathway, the source node commences a network route analysis after a message is transmitted to a destination node. When thought about to the earlier steering convention, the responsive directing convention has a lower above and a more drawn-out datagram transmission inertness than other cross breed steering strategies that integrate the advantages of both the earlier and responsive directing conventions [3-4]. The attributes of impromptu directing calculations set forward unique prerequisites, the turn of events, and examination of steering convention that progressively turned into a problem area [5-6]. Proactive and reactive approaches have generally been emulated and their performance evaluated in multiple research papers. Scientific techniques confronted trouble since conventions like DSR, DSDV, and AODV were muddled and have been set in different ways of getting elite execution in various situations [7-8]. In recent years, numerous research institutions have increasingly put forth various ad-hoc routing protocols, including but not limited to DSDV, AODV, DSR, OLSR, MAODV, FSR, etc. In [9-10] introduced an examination among LAR and OLSR directing conventions utilizing a MATLAB test system to identify fires in the timberland, The outcomes showed that LAR was more productive in the recognition of fires and utilized less energy than OLSR. In [11-13] presents an examination among DSR and AODV steering conventions applying TCP and UDP traffic sources in a portability model, the outcome showed that AODV has higher versatility than DSR. Writing [14-16] utilizes MATLAB to contrast DSDV execution and WRP (Wireless Routing Protocol) and OLSR (Optimized Connect State Routing) conventions regarding throughput, above, and bundle conveyance proportion The simulation results indicated that DSDV exhibited better performance than WRP, while the OLSR protocol outperformed other protocols. Writing [17-19] reproduce different directing conventions in impromptu organizations, which has specific reference importance for the exploration of impromptu organization steering conventions, however they didn't direct flat correlation and far-reaching investigation of various directing conventions. In [20-22] reenacted and analyzed a few on-request steering conventions, in any case, the presentation pointers utilized didn't reflect completely the acknowledgment of directing convention objectives, and the effect of the number of correspondence source hubs on steering execution were not as expected considered. In [23-25] proposed a better AODV convention, to further develop the course revelation and nearby fix to lay out new coursesThe route repair capability was enhanced, leading to a reduced successful packet delivery rate and decreased end-to-end delays and routing overhead. One-way linkages have not been taken into account in the study, and it is crucial to recognize that not every node in the network has a reciprocal connection. In [26-28] proposed a superior DSR convention by setting a reinforcement course, so course reproduction can be successfully kept away from, the bundle transmission achievement rate is improved, the normal start to finish delay was altogether decreased, and the directing above was likewise decreased. However, as a result of backup plans being launched, we noticed an upsurge in routing overhead and somewhat modest bandwidth utilization gains. In [29-31] analyzed conventions (AOMDV, LAMR, LAR, and AODV) with various times and velocities, the reproduction results showed that AOMDV gives the best presentation eventually to-end deferral and parcel conveyance proportion. In this paper three significant impromptu directing conventions to be specific (DSR, AODV, what's more, DSDV) have been assessed [32-33], the exhibition is examined and thought about utilizing speed parcel conveyance capability, delay, also, steering load carrying out OPNET reproduction stage, this study might act as inspiration for additional exploration towards working on existing shows or growing new ones to settle the difficulties looked by MANETs.

2. Related Work

A link among a node of source and destination node can be generated employing an assortment of routing techniques, that operate under the network layer (e.g., AODV, DSR, OLSR, DSDV, etc.). This work reviews some significant literature focused on the analysis of MANET routing protocols, considering the future directions outlined by researchers in this field.

In [34] have looked at and investigated four directing conventions, which are OLSR, DSDV, AODV and DSR under various circumstances. Protocols were simulated using NS3, and based on the obtained results, AODV exhibited the highest average reception rate and the greatest number of received packets. The DSR protocol used considerable power, although the DSDV methodology employed relatively little dominance, having the fewest averages of packets obtained, with the minimal packet reception percentage.

In [35] have looked at two primary kinds of MANET proactive steering conventions DSDV (Destination Sequence Distance Vector) and FSR (Fisheye State Routing) and two the notable responsive conventions AODV and DSR (Dynamic Source Routing) under different reenactment situations sent in a territory area of 500m*500m for various hubs 5, 10, and 30 hubs separately. In terms of throughput and typical start-to-finish time, the reactive kind's AODV standard surpasses the remaining guiding standards, however, exceeds the alternative guiding standards with regard to bundled transportation ratio. Reactive protocols—in particular, the AODV routing protocol—become increasingly prevalent as the network's capacity develops greater, irrespective of packet dimensions, within every one of the performance domains. In the future, the authors hope to show how well these routing protocols work in actual MANET purposes.

In a comparative study [36], an analysis of AODV, DSDV, and DSR protocols was conducted to track performance metrics, including end-to-end delay, packet delivery ratio, and throughput under various data rates.

The network scenario was defined in a 500m*500m landscape with 50 nodes. According to simulation results, DSR can be used in networks with constraints the state of greater capacity and Packet Delivery Ratio (PDR) were imperative while AODV is best suited for low-delay networks. In order to overcome the deficiencies of the current algorithms for routing, the authors propose to build an innovative routing protocol specifically for MANETs and to explain the positive and negative aspects associated with various readily accessible routing methods in work to come. In [37] have concentrated on three steering conventions that were assessed for conduct and execution examination in the metropolitan climate. In order to assess proactive, reactive, and hybrid methods, the NS2 simulator was used. Regardless of their response, the proactive OLSR approach reduced overhead the greatest. At the TCP level, however, the AODV reactive approach showed better performance in terms of transfer rate. Furthermore, the hybrid procedure ZRP produced the best outcomes, showcasing a notable decrease in latency and an increase in delivery rate.

In [38] have thought about and dissected QoS boundaries for various intelligent directing conventions AODV, DSR (Dynamic Source Routing), and TORA (Temporally Ordered Routing Algorithm) while considering variable hub thickness in the MANET organization Various metrics such as network load, retransmission attempts, end-to-end delay, media access delay, throughput, and other measurements were utilized to assess node density and the IEEE 802.11g WLAN standard's variations using OPNET Modeler 14.5 in a landscape area of 1000m*1000m with 25, 50, 75, and 100 nodes. When compared to alternative routing standards, the AODV surpasses in regards of network load, data drop retries, media access delay, retransmission attempts, and end-to-end delay. Nonetheless, there exists superiority in DSR giving the traffic routing at the least of throughput. Furthermore, inferences are collectively aimed with the functionality of the protocol under certain circumstances subjected with the parameters conditioned to various situations. Upon such outcomes, AODV is competent with the others.

In [39] have worried about the presentation assessment of receptive steering conventions, like AODV, as well as proactive directing conventions, including DSDV and OLSR. Conversely, the evaluation outcomes with certain dimensions of nodal population in respective quantities: 100m*100m, 200m*200m, 300m*300m, 500m*500m, and 1000m*1000m, within each node populace ranging from nodes of 20, 30, 50, 70, to 100. Every networking assessment is rooted in the evaluation of the metrics that are included for the Quality of Service (QoS), incorporating packet loss, throughput, end-to-end delay, and packet delivery ratio. Furthermore, from the results obtained, the parameter built in with the QoS, leading with the OLSR leave behind AODV and DSDV. Multipoint Relays (MPR) in OLSR help optimize the forwarding of control messages and data packets in wireless ad hoc networks. They reduce overhead, improve efficiency, and adapt dynamically to changes in the network topology. This concept contributes to the overall effectiveness of the OLSR routing protocol in scenarios where nodes may have limited resources and communication is wireless and dynamic. The future extension would be the investigation over the environmental effects on the protocol performing under the models propagated under the Friis strategy.

In [40] have examined the energy utilization in MANET between the OLSR and ZRP conventions. The simulated scenario covered a terrain area of nodes with 1000m*1000m with 20. The authors concluded that, under the same simulation conditions, OLSR, or the Proactive method, displayed less usage of energy over ZRP according to findings from simulations evaluating ZRP through OLSR for energy consumption. However, they also revealed that if the target nodes in ZRP are situated beyond the coverage area of the source nodes, the protocol demonstrates higher efficiency in packet delivery. Because ZRP implements the responding approach further, operational shipment of packets contributes to avoiding repetitive transfers, thereby rendering ZRP's consumption of energy substantially lower over OLSR's when compared to the subsequent case.

In [41] have assessed and looked at the presentation of two steering conventions, AODV and OLSR in the MANET organization The authors designed a network scenario to simulate various instances using different network densities, with varying numbers of nodes: 10, 20, 30, 40, 50, 60, 70. The proposed scenario's landscape area was set at 500m*500m. Moreover, altering the number of nodes in a network can have multifaceted impacts on protocol performance. It's essential to consider the specific characteristics of the network, the type of protocol being used, and the goals of the network deployment when assessing the consequences of changes in node count. The redundancy in the network and its ability to recover from failures may be impacted. Larger networks might require more robust mechanisms for fault tolerance and recovery.

In [42] have looked at the exhibition of the AODV and ZRP steering conventions with different hub speeds as indicated by different measurements like normal start to finish delay, throughput, line length and their dropped bundles. The simulated network scenarios covered territory areas under nodes 70, 80 with dimensions of 2000m*2000m and 2500m*2500m correspondingly. According to the simulation findings, the proposed framework with AODV shortened the lag duration as contrasting with the standard ZRP procedure. Compared to the ZRP algorithm, AODV's dynamic adaptability in different scenarios boosted speed of the network and minimized backlog duration. Outperforming AODV, ZRP is capable of giving greater packet drops.

In [43] have meant to moderate the effect of organization traffic (FTP, E-Mail, and HTTPA discrete) on steering conventions (AODV, DSR and OSLR) in MANETs utilizing Optimized Network Engineering Tool (OPNET) form 14.5 organization test system. To determine a highly efficient and fit routing protocol, the researchers examined the ability factors such as latency, network loading, and throughput. The MANET network's simulated landscape area was configured with 100 nodes and measured 1500 x 1500 m. The results they report imply that, as compared to AODV and OLSR, the DSR technique has a significant runtime. However, when determining overall performance, throughput was considered the primary criterion, given its significance in reflecting the actual amount of data effectively received by nodes, as opposed to the reported bandwidth. OLSR performed quite well in the simulation concerning overall performance. Ultimately, OLSR demonstrated commendable efficiency in handling superior than DSR and AODV in terms of significant throughput and expanded extensibility by reliable transmission of packets throughout intensively overflowing connections.

3. The MANET Framework

To analyze the effectiveness of ad hoc network routing methods, OPNET was used as the simulation program. As seen in Figure 1, 40 nodes were arranged at random throughout the simulation, with the utilization of specified simulation parameters. The MAC layer adopts Distributed Coordination Function (DCF) in the IEEE 802.11b media access control (MAC) protocol, and the transport layer adopts the UDP protocol as shown in Figures (2-5) [44-57].

Figure 1. Ad Hoc Mobile Topology Model.

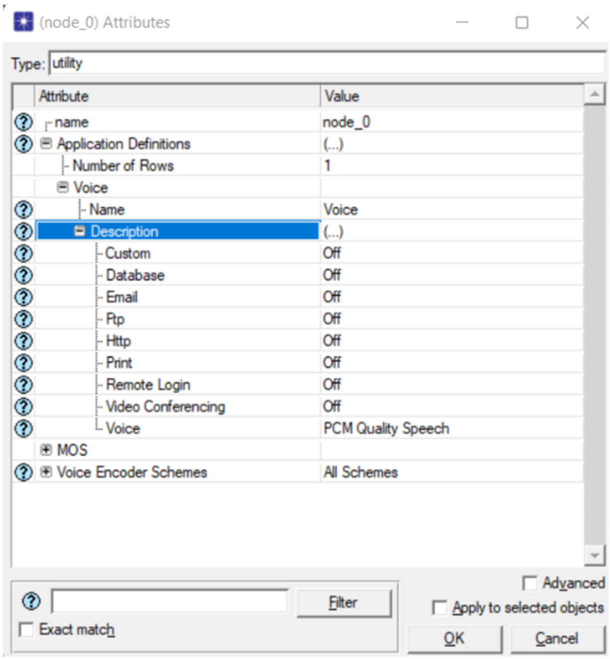

Figure 2. Configuration parameters for Application.

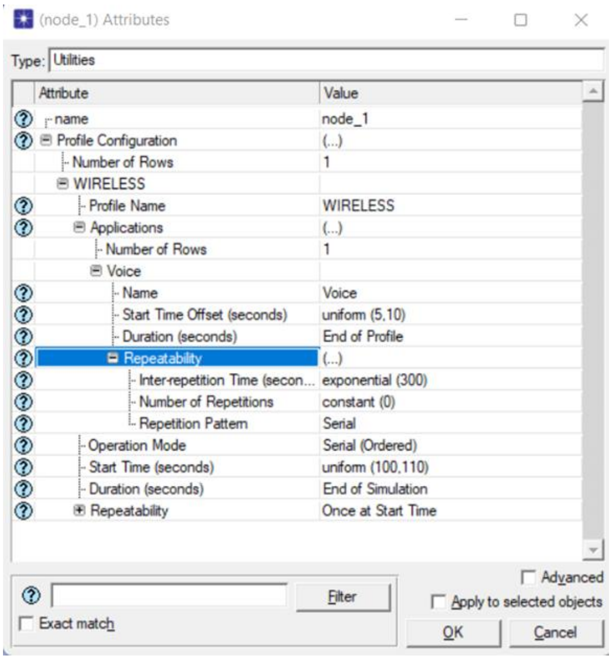

Figure 3. Configuration parameters for Profile.

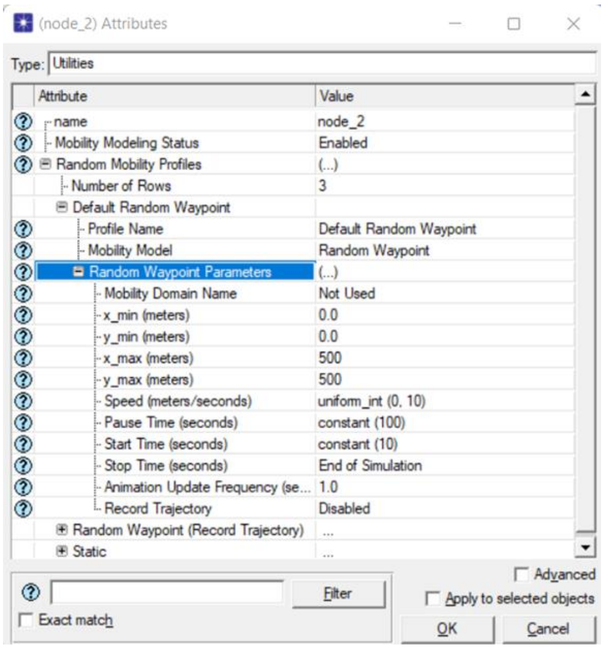

Figure 4. Configuration parameters for WiMAX Mobility.

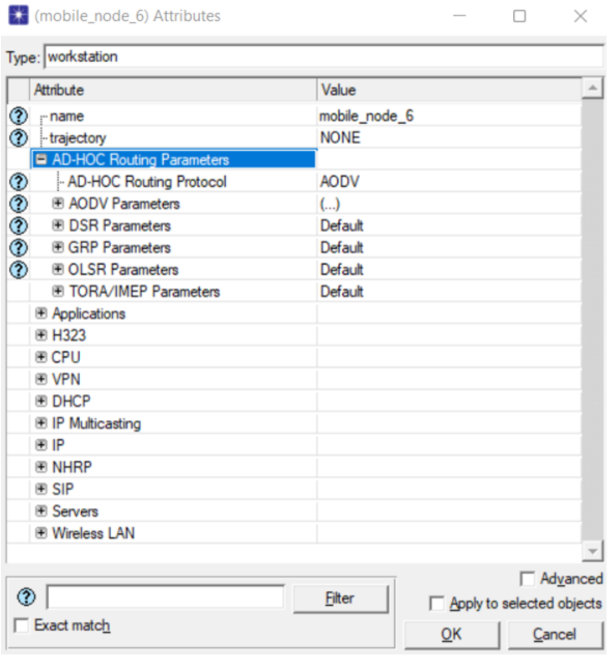

Figure 5. The configuration parameters for SS.

4.Results and Analysis

The network runs for a duration of 10 days in the OPNET simulation to analyze the transceiver route, hops count, and route discovery time. The analysis focuses on both overall network performance and individual AODV nodes, as depicted in Figures (6-23).

5. Conclusion

In this research, three well-known ad-hoc networking technologies are evaluated. Finding the best algorithm for ad-hoc routing protocol algorithm to enhance the user interface is the stated objective for network administrators and creators of mobile applications. The study uses the OPNET network simulation platform to simulate three common ad-hoc routing protocols after giving an overview to their principles. The simulation results are examined, and the 3 routing protocols are compared focused upon 3 performance indicators: routing overhead, average end-to-end delay, and packet delivery rate, —while retaining a similar network configuration along with affecting the average speed of node mobility. It is concluded that proactive networking approaches wouldn't be as effective as on-demand routing approaches as far as overall performance is concerned. Proactive routing systems work greatest in small-scale networks that have minimal accessibility specifications, while on-demand routing approaches function superiorly for associations featuring moderate to elevated accessibility characteristics.

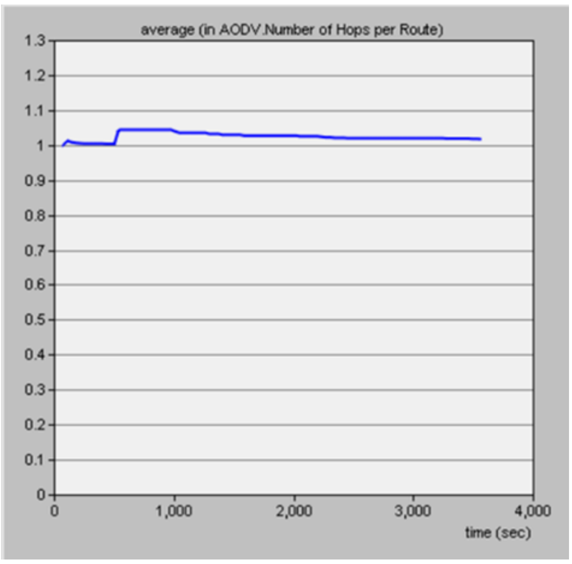

Figure 6. Hops per Route for AODV.

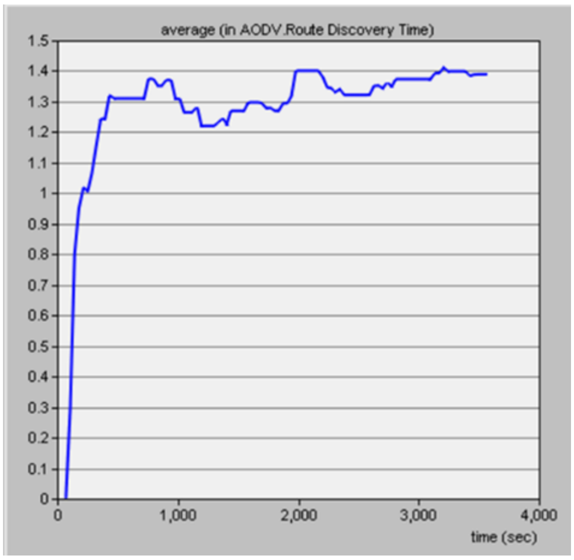

Figure 7. Discovery Time of AODV Route.

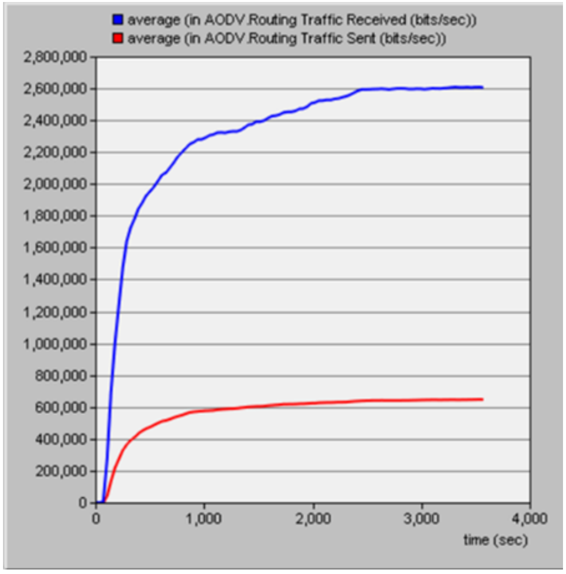

Figure 8. Data rates for an AODV Route Transceiver.

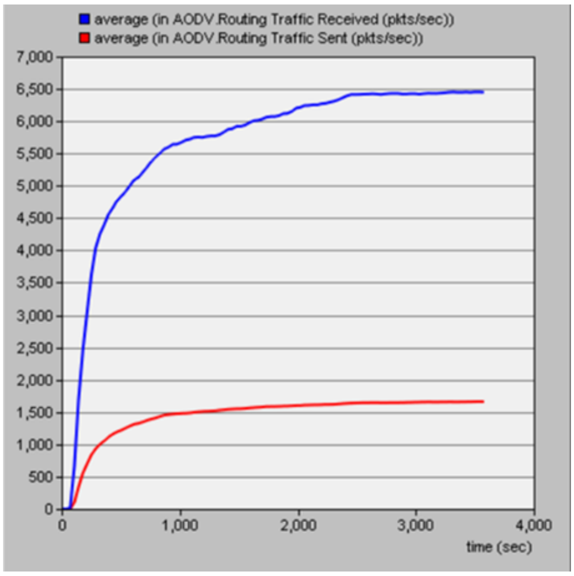

Figure 9. Packet rates of the AODV Route Transceiver.

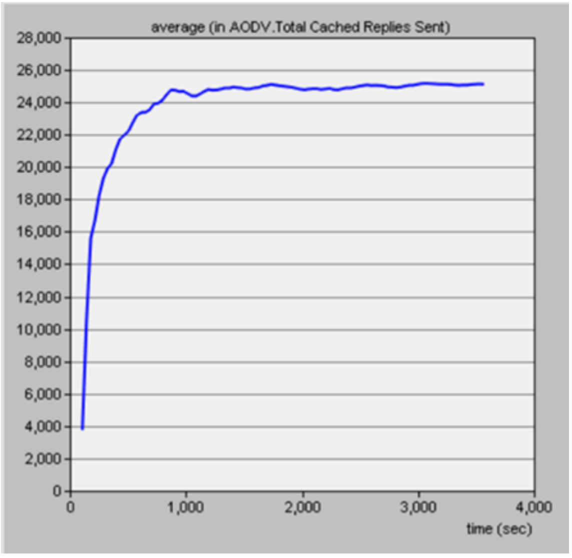

Figure 10. Total Cached Replies Sent for AODV.

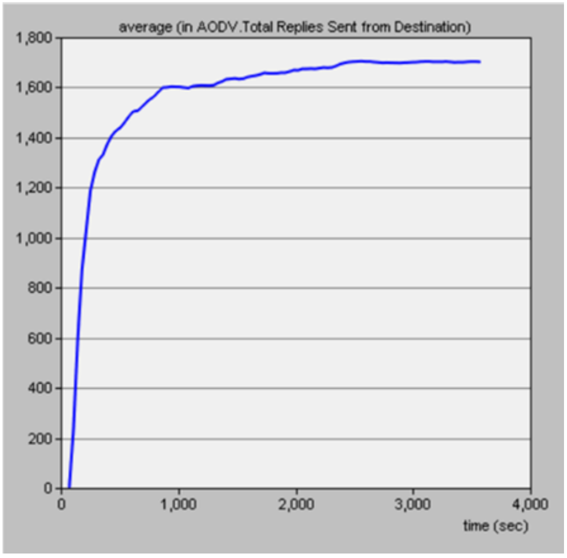

Figure 11. Sent from Destination: AODV Total Cached Replies.

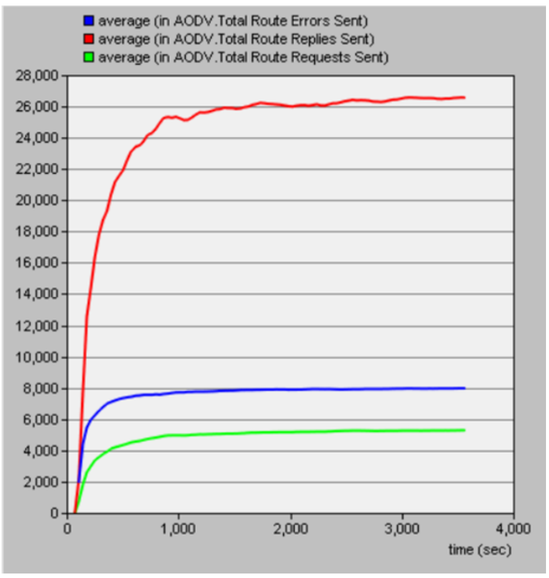

Figure 12. Route errors, responses, and requests sent for AODV totaled.

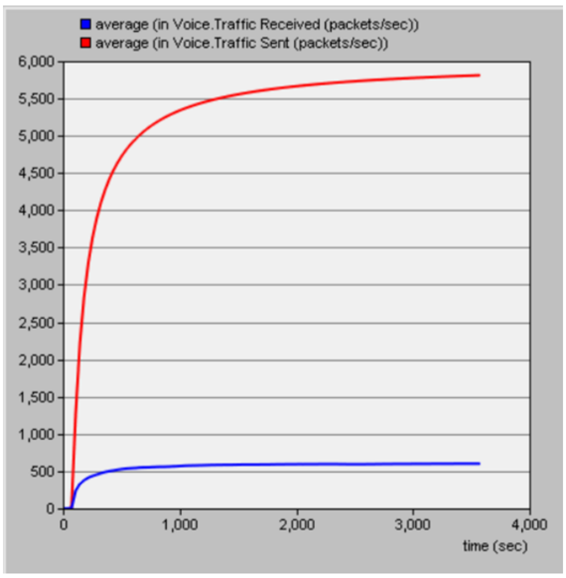

Figure 13. Packet rates for Voice Transceiver.

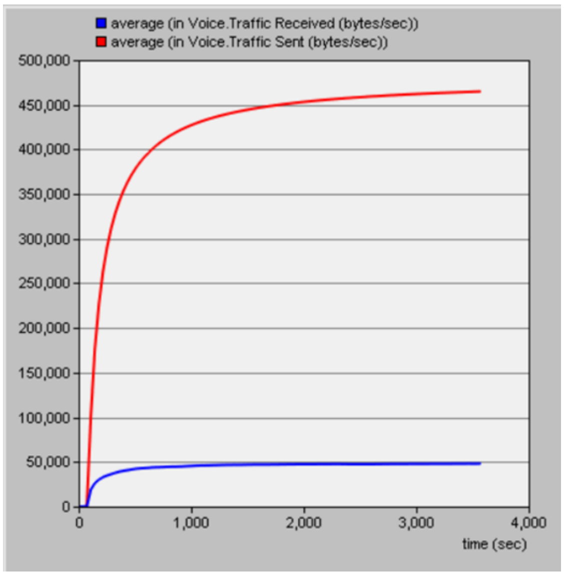

Figure 14. Data rates for Voice Transceiver.

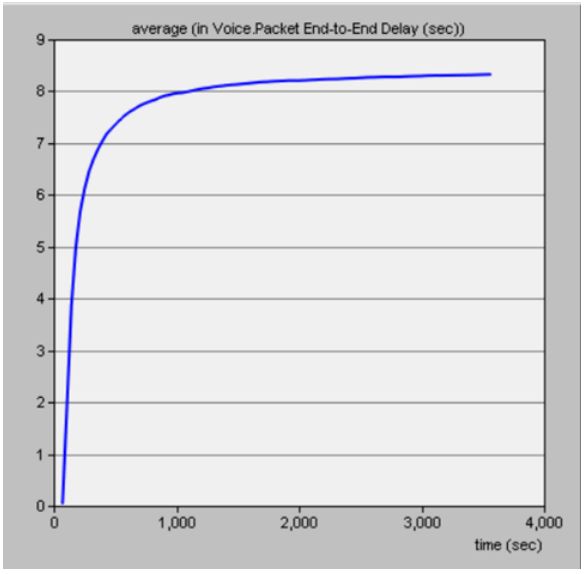

Figure 15. End-to-End Voice Packet Delay in Seconds

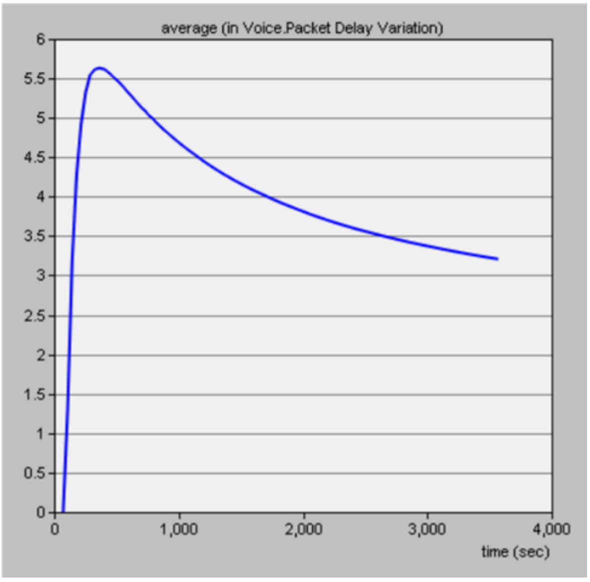

Figure 16. Deviation in Voice Packet Delay.

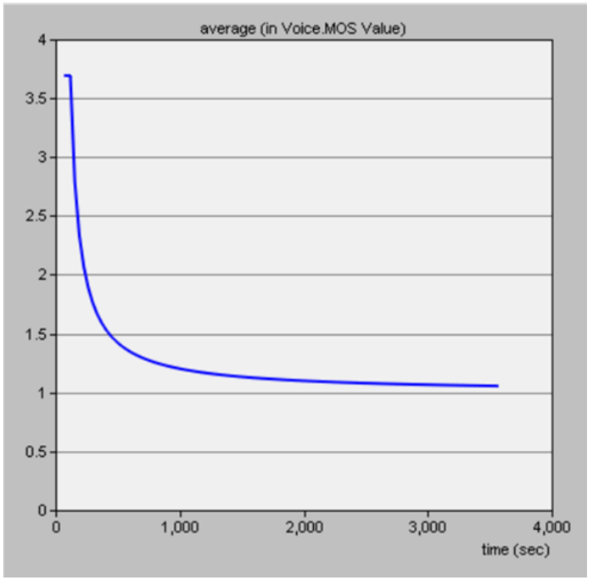

Figure 17. MOS Value of Voice.

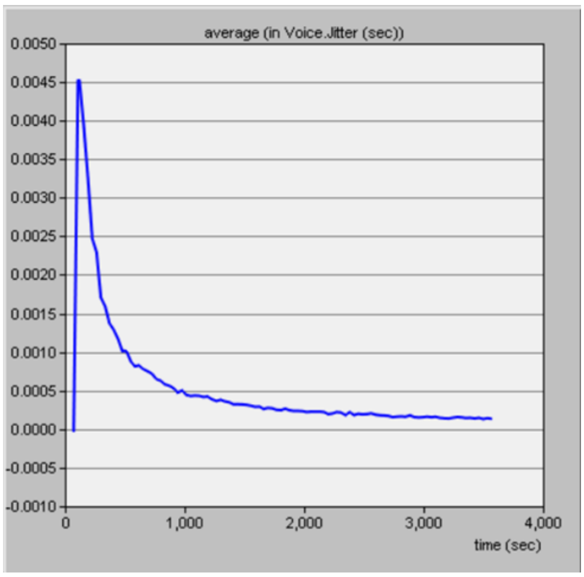

Figure 18. Jitter in Voice in Sec.

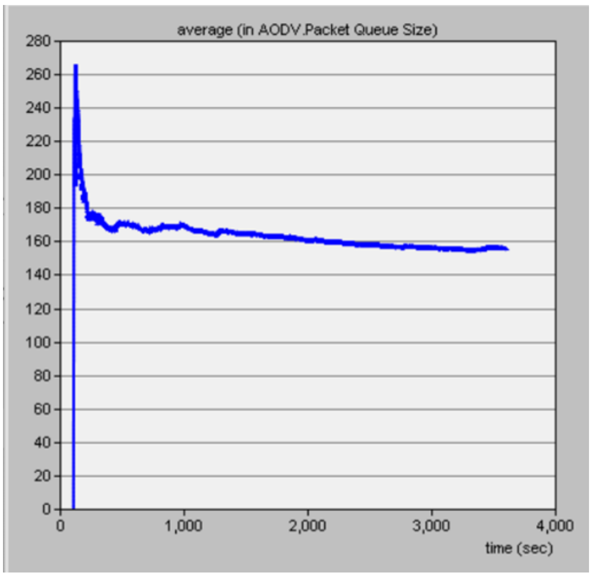

Figure 19. Size of AODV Packet Queue.

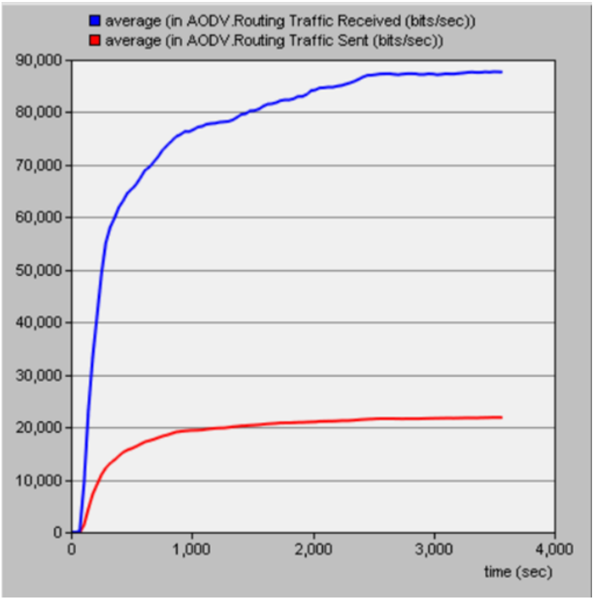

Figure 20. Data rates of AODV Transceiver for Nodes.

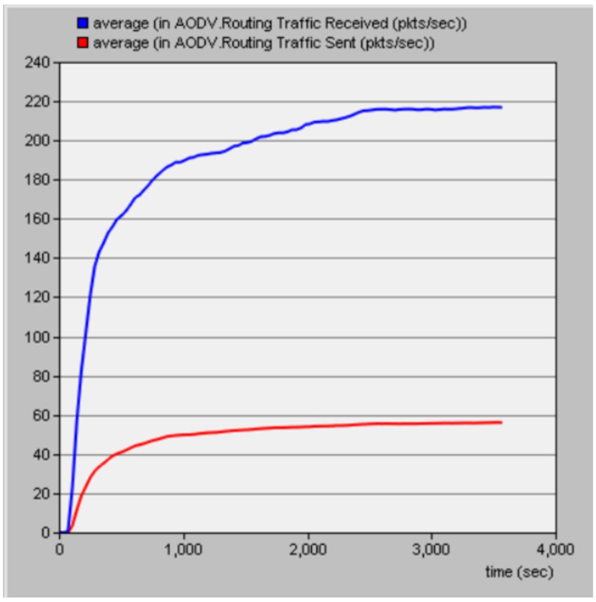

Figure 21. Packet rates of AODV Transceiver for Nodes.

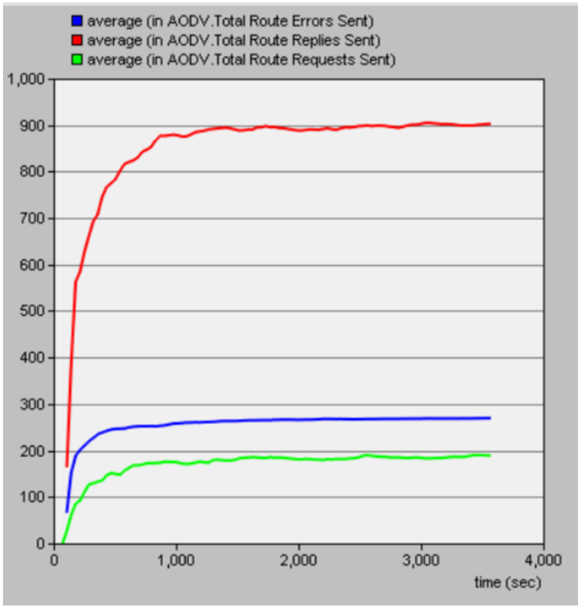

Figure 22. AODV Total Route Errors, Replies, and Requests Sent for Nodes.

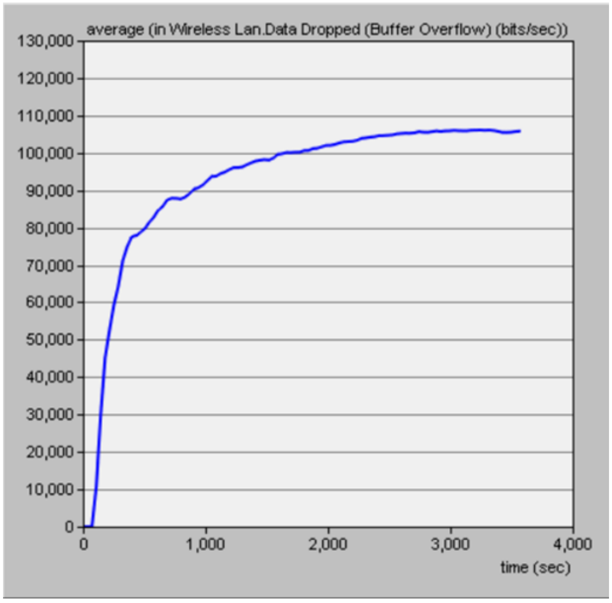

Figure 23. Data dropped through Wireless LAN amid buffer overflow in data speeds.

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Author contributions

Noorulden Basil: Conceptualization, Formal analysis, Resources, Data curation, planning, execution, Writing-review & editing, Visualization, Software, Implementation, Programming, Writing-original draft, and Investigations, Validations. **Shaik Hasane Ahammad:** Visualization, Formal analysis, Resources, Data curation, Investigations, Methodology, Proofreading, Software, Planning, Execution, Writing & Editing, Review, Supervision, and Validations. **Ebrahim Eldesoky Elsayed:** Formal analysis, Data curation, Investigations, Proofreading, Software, Planning, Project administration, Implementation, Writing-review & Editing, Visualization, Methodology, Programming, Validations

Conflicts of interest

The authors declare no conflicts of interest.

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