DP-AODV to Improve Performance of WBAN in Telemedicine Application

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Abstract: Wireless ad hoc networks find their application in various military and healthcare scenarios. The reliability of the data is of prime importance in such applications. These networks use routing protocols such as AODV or DSR to find route to destination. These protocols consider the hop count as a measure of the shortest path between two nodes. The shortest may not be reliable path. The paper proposes modification to routing procedure of AODV to find efficient route between the sensor at the patient device and sensor at the doctor device by considering the end to end delay and packet delivery ratio as the path selection metric. The performance of the network was compared based on end to end delay, PDR and throughput which showed significant improvement over the traditional routing technique.

Keywords: Wireless ad hoc networks, AODV, PDR, end to end delay, reliability.

I. INTRODUCTION

Wireless ad hoc networks are composed of sensor nodes that sense particular information from the environment and pass it on to the server for processing. Ad hoc network is one sort of multi-hop, self-organization and dynamically changing network [1]. Energy management in Ad-hoc networks is of paramount importance due to the limited energy availability in the wireless devices [2]. The conventional routing protocol used by the sensor nodes uses hop count as a metric for determining the path. For applications such as military applications or healthcare scenarios, such a path is perceived no longer appropriate for as they require a good quality communication path. The protocol should be more adaptive and has to consider the link quality to select the path to deliver the data [3, 4]. The routing algorithm that helps network find a reliable path will improve the network resilience against path break and packet loss.

This paper presents the existing AODV based routing techniques for wireless ad hoc networks in section II. Section III presents the proposed technique and results and conclusion have been shown in the subsequent sections of this paper.

II. RELATED WORK

The presented paper [5] evaluates and compares the performance of routing protocols in Wireless Ad Hoc network and also discusses the application of ad hoc mode of wireless local area network (WLAN) in emergency health services for a hospital. The proposed scenario helps in managing any emergency situation to a great extent and reduces the delays which may be crucial for such emergency situations. In the proposed study, the doctors and patients are assumed to be mobile so as to mimic the real situation. However, the movement of patient and doctors are confined to a limited range.

This paper [6] proposes the implementation of the energy-efficient self-organized algorithm (EESOA) as Medium Access Control (MAC) protocol. Also, the authors extended the algorithm to address network segmentation by handling inter clusters connectivity. To show the performance of this cross-layer solution, an implementation of a wireless ad-hoc network with AODV and EESOA as MAC protocol in the NS3 simulator is used. This simulation allows evaluating the performance of the AODV routing protocol over EESOA as MAC protocol compared against normal Ad-hoc MAC. Therefore, the use of routing protocol over a self-organized algorithm can obtain better results, in packet loss, network connectivity and node reachability.

In this paper [7], the authors have proposed a fuzzy based scheme for enhancing the efficiency of AODV in wireless ad-hoc networks. Next hop selection is performed on the basis of node energy, its neighbor node energy, node degree. Thus next hop selection is taken by considering a number of parameters including number of hops. Each node is embedded with a fuzzy controller system through which output parameter chance is calculated. Based on this chance value next hop selection is carried out. They have compared the proposed routing protocol F-EEAODV with AODV, DSR, and DSDV routing protocols. Simulation work is carried out using NS-2. The simulation results taken by NS-2 shows that the proposed scheme outperforms as compared to AODV in respect of throughput, end-to-end delay, propagation delay.

In this paper [8], two solutions have been proposed to control the congestion problem of wireless ad-hoc network. Some changes have been made in the RREQ packet to calculate the drop factor. The energy-based proposed scheme has been simulated with network simulator 2.35. It is seen from the result that the solutions proposed has performed comparatively better than the traditional AODV with respect of packet delivery ratio, throughput and delay.

In this study [9], the authors developed network and throughput formulation models and proposed new method of the routing protocol algorithm with a cross-layer scheme based on signal-to-noise ratio (SNR). This method is an enhancement of routing protocol ad hoc on-demand distance vector (AODV). This proposed scheme uses selective route based on the SNR threshold in the reverse route mechanism. They developed AODV SNR-selective route (AODV SNR-SR) for a mechanism better than AODV SNR, that is, the routing protocol that used average or sum of path SNR, and also better than AODV which is hop-count-based. The authors also used selective reverse route based on SNR mechanism, replacing the earlier method to avoid routing overhead. The simulation results show that AODV SNR-SR outperforms AODV SNR and AODV in terms of throughput, end-to-end delay, and routing overhead. This proposed method is expected to support Device-to-Device (D2D) communications that are concerned with the quality of the channel awareness in the development of the future Fifth Generation (5G).

This paper [10] proposes a new modified AODV routing protocol EGBB-AODV where the RREQ mechanism is using a grid based broadcast (EGBB) which reduces considerably the number of rebroadcast of RREQ packets, and hence improves the performance of the routing protocol. The authors developed a simulation model based on NS2 simulator to measure the performance of EGBB-AODV and compare the results to the original AODV and a position-aware improved counter-based algorithm (PCB-AODV). The simulation experiments that EGBB-AODV outperforms AODV and PCB-AODV in terms of end-to-end delay, delivery ratio and power consumption, under different traffic load, and network density conditions.

This research [11] studies the problem of searching the shortest path with a multi-objective (energy, bandwidth, queue, delay) routing protocol. This new finding considers a wireless *ad hoc* network composed of nodes equipped with multiple network interfaces to each of which a different wireless channel can be assigned. By embedding information about channel usage in control messages of AODV, each node obtains a view of topology information of the whole network. Based on the obtained information, a source node uses mathematical models (genetic algorithm or dynamic algorithm) to determine a logical path with the maximum available energy and minimum queue to satisfy QoS requirements. Simulation results conducted in network simulator (NS-2) show that the approaches give a good performance than the others. The results indicate that these algorithms improve significantly the Quality of Services and can be used in different environments.

III. PROPOSED METHOD

Since AODV routing is used for finding a path to desired destination, in the healthcare the path found must have least end to end delay and higher packet delivery rate. Thus the modification to the AODV is proposed in the following way:

Each sensor node would broadcast the RREQ packet to the nodes in its communication range. In the RREQ packet the node would add the ID of the corridor. This will help the sensors to take the decision while forwarding the RREQ packet to their next neighbor.

If the sensors that have received the RREQ packet is located in the different corridor, the node would drop the RREQ packet instead of forwarding it.

Once the RREQ packet reaches the sensor node with the doctor (referred to as destination hereby), the destination node would compute the End to End delay and packet delivery ratio for different paths.

The node will reply back to the source via two paths having the least end to end delay and highest PDR and second least end to end delay and second highest PDR.

When the RREP packet reaches the source node, the source node would forward the packet to the destination via the path having least end to end delay and highest PDR.

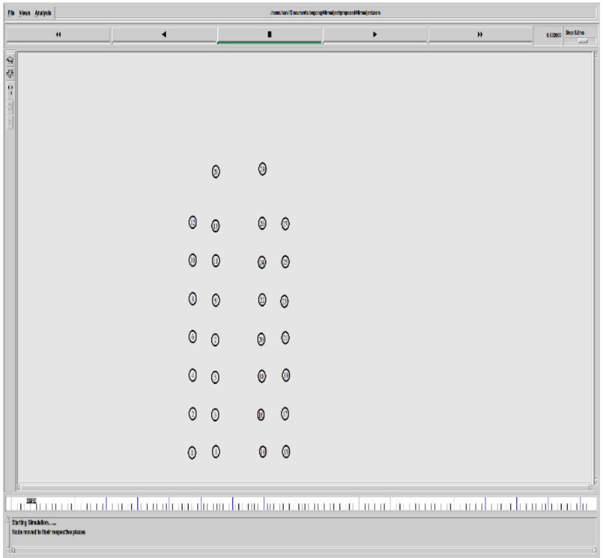

Figure 3.1: Two corridor scenario

IV. RESULTS

The proposed and the existing schemes were implemented in network simulator 2.35 and the performance parameters were throughput, packet delivery ratio and end to end delay.

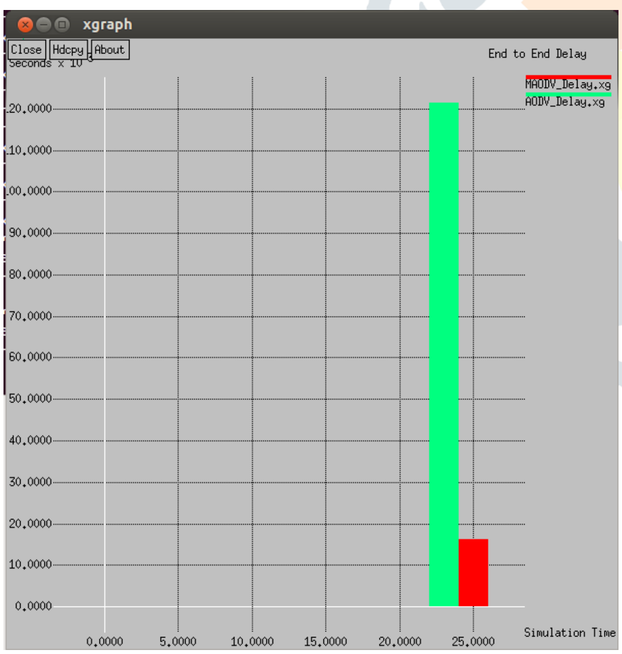

Figure 4.1: Delay Comparison

This figure shows the values of delay that was computed after using both the schemes. The value for delay for the modified AODV was found to be 0.016 seconds and for the simple AODV was 0.12 seconds. This major difference is because of the fact that route request packets are sent in single corridor only instead to broadcasting them to the entire network.

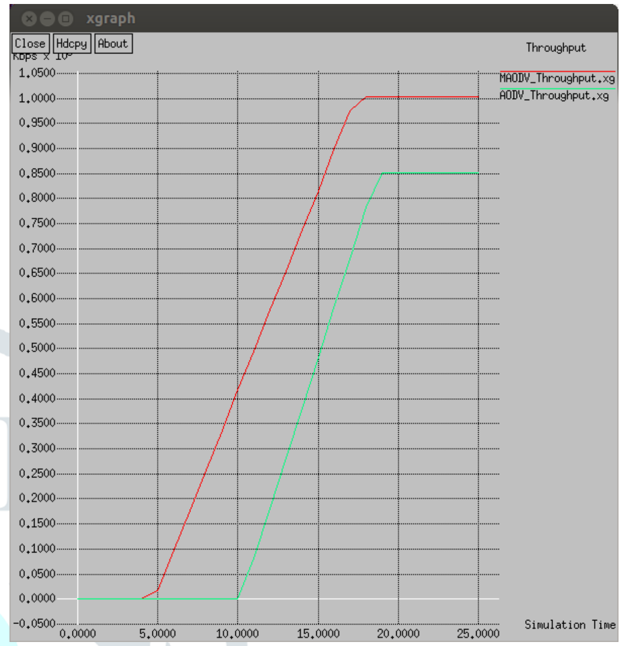

Figure 4.2: Throughput comparison

This figure shows the values of throughput achieved in the network. The value of throughput for the modified AODV was 1003 Kbps and 852 Kbps for the existing scheme. This is because the network the broadcasting gets completed earlier in the network while using the modified AODV and the data is also sent over the optimized path having less end to end delay and higher packet delivery ratio.

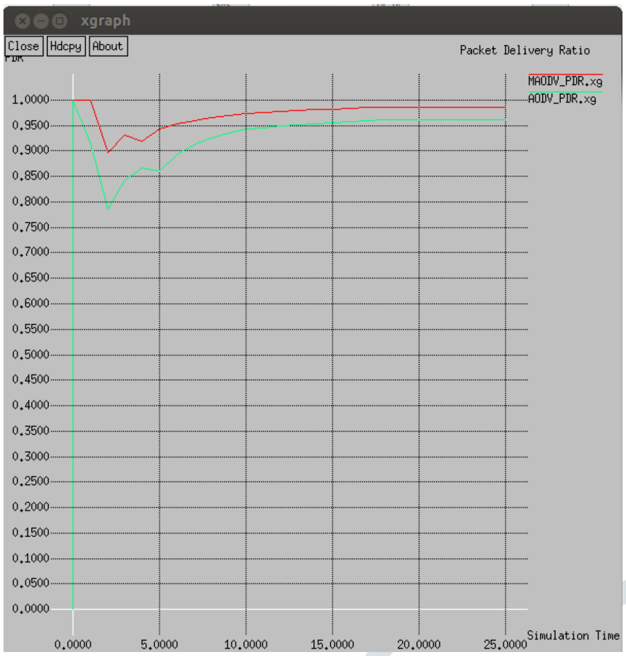

Figure 4.3: PDR Comparison

This figure shows the values packet delivery ratio achieved in the network. The value for the modified AODV was 98.4 and 96.1 for the existing scheme. The reason is the reduced congestion due to restriction of the broadcasting in the corridor number 2. Also, the data transmitted is over the path having higher packet delivery ratio which provides better data delivery.

V. CONCLUSION

The proposed scheme aims at improving the performance of the network for telemedicine application. In such networks the packet delivery and end to end delay are of prime importance. The proposed scheme modified the route request packet by adding corridor ID to it. The nodes which are in different corridor does not forwards the request packet to avoid the longer path formation. Furthermore, the path has been optimized by considering those paths having higher packet delivery ratio and smaller end to end delay. This leads to better packet delivery ratio for the proposed scheme when data is sent from patient to doctor. The higher value of PDR also leads to better throughput. Since the paths are optimized by not considering the opposite corridors, the smaller paths have lesser value of delay for the proposed scheme as well.

Security of data is also equally important for healthcare applications. Many attacks such as black hole attack or packet manipulation attack can happen in such networks which can convey wrong information to the doctors. Thus, in future the proposed approach can be made more secure for better performance of the network.

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