Quality of Service (QoS) Routing in Mobile Ad-hoc Network (MANET) using AODV protocol: Cross-Layer Approach

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ABSTRACT
Routing protocols such as AODV use minimum hop count as the main metric for path selection. However, networks that require high Quality of Service (QoS) needs to consider several criteria's that could affect the quality of the chosen path in packet forwarding process. To improve the Quality of service, cross layer approach is proposed to attain reliable data transmission in MANET. Our approach includes a cross-layer design to improve information sharing between network and physical layer. The proposed cross-layer mechanism utilizes Signal to Noise Ratio (SNR) measurements along the routing path and selects the path with high quality of service rather than the path with minimum number of hops. Simulation results show that performance in terms of packet delivery ratio, delay and packet drop.

Keywords: MANET, NR, Physical layer, Network layer, delay, Packet delivery ratio

1. INTRODUCTION
MANET is a infrastructure less network. In this network each node acts as a router. Because of the dynamic topology routing is complicated task in MANET. The delay sensitive applications need guarantee of Quality of Service (QoS) to the end users. In MANETs, the challenges are even higher due to known limitations of the wireless medium and the frequent link failures, as mobile nodes move independently. Over the last few years, new protocols were designed and standardized in an effort to increase the transmission rates of the wireless medium. The IEEE 802.11e protocol [1] with QoS enhancements is an international standard that is already implemented in MAC chipsets by a number of vendors. In [2], the effects of various mobility models on the performance of Dynamic Source Routing (DSR) [3] and Ad-Hoc On-Demand Distance Vector (AODV) [4] routing protocols are studied. Ad-hoc on demand routing protocol select the route based on the hop count only. When selecting the route it will not ignore the weak quality links. Our objective is to design a mechanism to provide an efficient QoS routing protocol to enhance the performance of existing routing protocols in Mobile ad hoc network environment.

In this paper we select AODV as one of the common MANET protocols to demonstrate our models, to provide the quality of service of the AODV. We evaluate how the protocol differs in the methods it uses to select paths broken links. Our new approach is called Cross- Layer Ad-hoc On-demand Distance Vector Routing protocol (CLAODV).

As known by definition the Quality of Service (QoS) [8] is a set of service requirements to be met by the network while transporting a packet stream from the source to the destination. Intrinsic of the notion of QoS is an agreement or a guarantee by the network to provide a set of measurable of pre-specified service performance constraints for the user in terms of end-to-end delay, delay variance (jitter), available bandwidth, and probability of packet loss. Transferring real-time traffic over MANETs is a big challenge due to the high requirements of bandwidth, time delay, and latency for such traffic. This requires the offering of guaranteed service quality.
In this proposed model a signal to noise ratio (SNR) parameter as a new metric in which those value is considered in constructing routes. Given this feature, source node can select the best and more stable route out of various available routes based on Signal to Noise Ratio (SNR) not number of hops or shortest path. In this work our aim is improving the Quality of Service (QoS) and the performance of the routing protocols in MANET environment.

The rest of this paper is organized as follows: Section 2 discusses related work. Section. 3 Overview of AODV. Section. 4 presents the proposed cross -layer design and model optimization. Section. 5 discuss simulation environment setup. Section. 6 discuss simulation results and finally Section. 7 conclusion of the paper.

2. RELATED WORK
Many proposals and models addressed quality of service (QoS) among mobile nodes of the wireless networks and considered the link quality in their designs and architectures.

Merlinda Drini & Tarek Saadawi et al[5] modified DSR to work as three-state Markov model of the wireless channel instead of two-state Markov model (Gilbert-Elliot model) by applying a higher order of Markovchains. They applied their model to the Dynamic Source Routing protocol (DSR). In their proposed modified DSR, both the route discovery and route selection are based on physical layer parameter and the link monitoring function located at each node.

Wisitpongphan and et al. [6] proposed a bit error rate (BER)-based routing design, where the chosen route is the one which guarantees the lowest BER at the ending node. They considered providing QoS in terms of BER at the destination node.

Arun kumar .B.R, C. Lokanatha Reddy and P.S. Hiremath et al [7] presented a mechanism to improve both the routing and data forwarding performance of DSR, with lesser power consumption. This mechanism involves intelligent use of the route discovery and route maintenance process thereby providing faster routing and reduced traffic as compared to the basic DSR. This mechanism enables faster data forwarding and reduced collisions with lesser power consumption.

3. OVERVIEW OF AODV

Ad Hoc On-demand Distance Vector Routing (AODV) protocol [9] is a reactive routing protocol. As a reactive routing protocol, it maintains only routing information about the active paths. Every node uses hello messages to notify its existence to its neighbours and maintains routing information in their routing tables to keep a next-hop routing table that contains the destinations to which it has a route. In AODV, when a source node wants to send packets to the destination but no route is available, it initiates a route discovery operation. In the route discovery operation, the source broadcasts route request (RREQ) packets. A RREQ includes addresses of the source and the destination, the broadcast ID, the last seen sequence number of the destination as well as the source node's sequence number.

4. PROPOSED QOS ALGORITHM (CLAODV)

Routing in MANET is difficult as a result of the dynamic nature of network topology and the resource constraints. The issue of Link reliability in mobile ad hoc networks is a main problem to transmit messages through the wireless channels. Routing in multi-hop wireless networks using the shortest-path metric is not an adequate condition to build good quality paths, because minimum hop count routing often selects paths that have significantly less capacity than the best paths that exist in the network. [2] Physical-layer limits of wireless channel because of: time-varying fading, multipath, co-channel interference, hostile jamming, mobility, dynamic network topology. In technicality, information from the transmission link such as Signal to Noise Ratio (SNR) can furnish valuable information to the source node about the transmission paths as far as routing is concerned. Each wireless node can communicate with any other node within its transmission range, which depends on SNR.

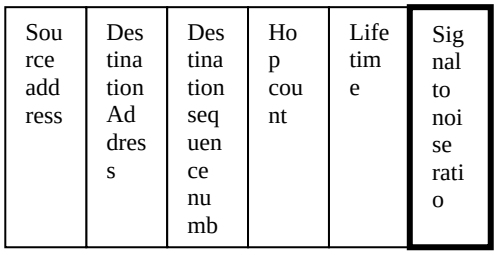

Figure 1.Modified route reply packet (RREP) format

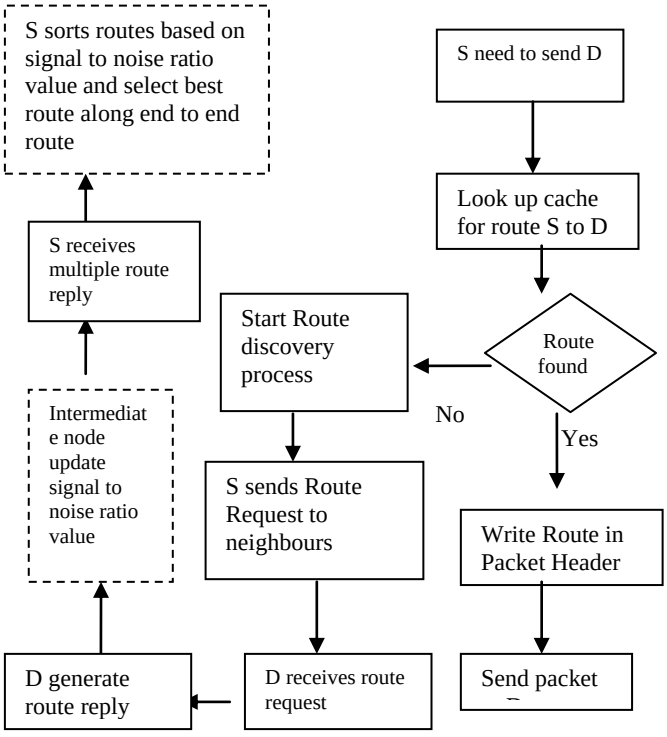

Figure 1.Modified route reply packet (RREP) format

We modified the route reply packet format and added extra field to store the weak signal to noise ratio value the route from destination to source. See figure 1.

We modified also the mechanism of AODV process to include our proposed model. The new mechanism will work as follows. When the route request packet arrives at the destination or an intermediate node with a route to the destination, a route reply packet will be generated. This reply packet is then sent back to the source node following the reverse route contained in the route request packet. Each intermediate node will update the signal to ratio (SNR) value if its link values of SNR lower than the existing recorded value in the route reply packet. If SNR value of its link is greater than recorded value, the node will not update the value.

The process will continue until the route reply packet reach the source node. Now, at the source node there are many of available routes with different values of SNR. The source node will select the route based on the value of best of worse available value of SNR Figure 2 demonstrates the flow chart of how CLAODV routing protocol works after implementing

the proposed model. Dotted-line areas in the figure represent new process.

2. Flowchart show how CLAODV model works

5. SIMULATION ENVIRONMENT

Ns-2 is a discrete event simulator targeted at networking research. It began as a part of the REAL network simulator and is evolving through an ongoing collaboration between the University of California at Berkeley and the VINT project [12].

5.1Simulation Parameters

There are number of simulation parameters which can be varied, results in change in value of different performance metrics, which can be shown in below table.

TABLE 1
SIMULATION SETUP

S.No	Parameter	Value
1.	Channel Type	Wireless
2.	Radio propagation Model	Random waypoint
3.	Channel Capacity	2 Mbps
4.	MAC Type	802.11
5.	Interface Queue Type	Queue/Drop Tail
6.	Area (M*M)	1000 X 1000
7.	Simulation time	500 sec
8.	Number of Nodes	10 – 50
9.	Antenna	Omni Antenna
10.	Network Interface Type	Phy/wirwless
11.	Traffic	Constant Bit Rate(CBR)
12	Transmission range	300-400m

5.2 EVALUATION CRITERIA

Performance of AODV protocols in MANET can be realized by quantitative study of values of different metrics used to measure performance of routing protocols which are as follows.

5.2.1 Average end-to-end delay

It is defined as average time taken by data packets to propagate from source to destination across a MANET. This includes all possible delays caused by buffering during routing discovery latency, queuing at the interface queue, and retransmission delays at the MAC, propagation and transfer times the lower value of end to end delay means the better performance of the protocol [10].
End to end delay = Σ (arrive time - send time)

5.2.2Packet Delivery Ratio

Its a ratio of the number of packets received by the destination to the number of packets send by the source This illustrates the level of delivered data to the destination. The greater value of packet delivery ratio means better performance of the protocol.
Packet delivery ratio = Σ No of packet receive / Σ No of packet send

5.2.3Packet Loss

It is the measure of number of packets dropped by nodes due to various reasons. The lower value of the packet lost means the better performance of the protocol [11].
Packet lost = No of packet send – No of packet received.

6. SIMULATION RESULTS

6.1 Simulation results Based on Nodes

In our initial experiment, we vary the nodes as 10, 20, 30, 40 and 50

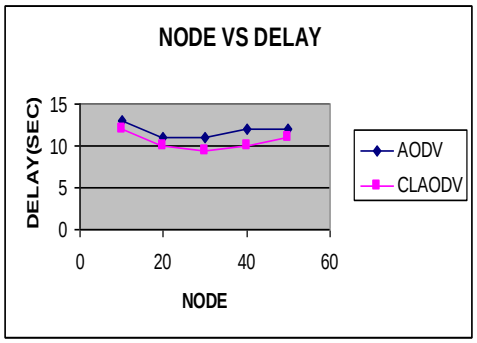

Figure 3.Node Vs Delay

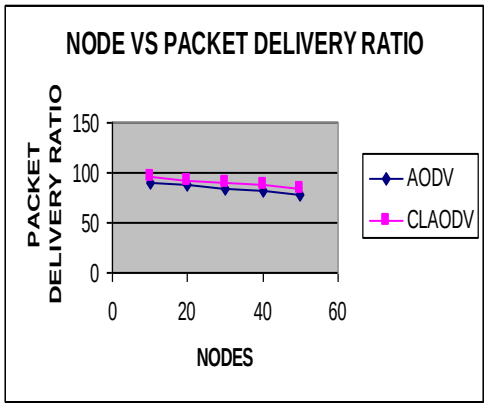

Figure 4. Node Vs Delivery ratio

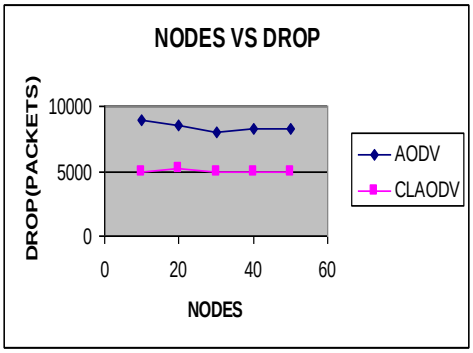

Figure 5 Node Vs Drop

Figure 3 shows that the delay of our proposed CLAODV is less than the existing AODV.
Figure 4 shows that our proposed CLAODV protocol achieves good delivery ratio when compared to AODV.
Figure 5 shows that our proposed CLAODV has lower packet drop than the AODV.

6.2. Simulation Results Based on Pause Time

In our second experiment we vary the pause time as 5,10,15,20 and 25 sec.

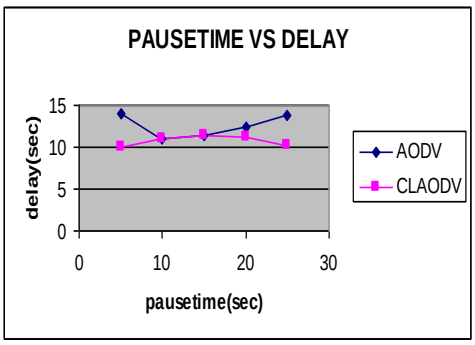

Figure 6. Pause time vs delay

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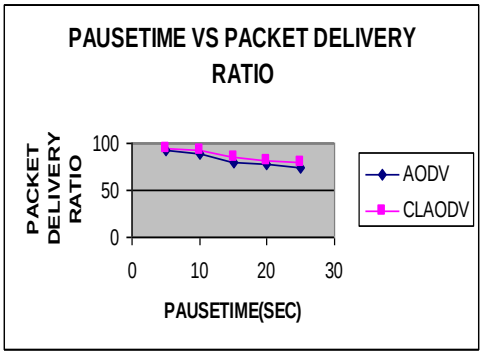

Figure 7 Pause time vs delivery ratio

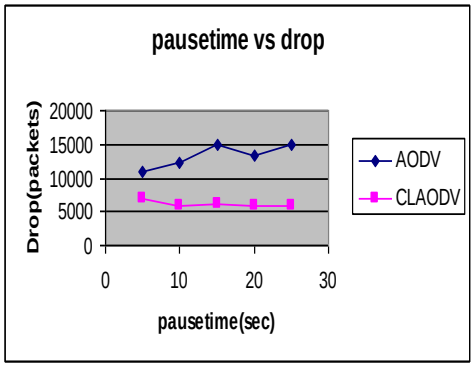

Figure 8. Pause time vs drop

Figure 6 shows that the delay of our proposed CLAODV is less than the existing AODV.
Figure 7 shows that our proposed CLAODV protocol achieves good delivery ratio when compared to AODV.
Figure 8 shows that our proposed CLAODV has lower packet drop than the AODV.

7. CONCLUSION

In this paper we have proposed cross- layer Ad-hoc On-demand Distance Vector Routing protocol (CLAODV) to improve the performance of MANET routing protocol. We have modified the protocol to choose route according to the signal to noise ratio and eliminate the routes with the bad link which has the very low signal to noise ratio (SNR). We have presented our results of CLAODV protocol to achieve reliable communication in the networks associated with discontinuous connectivity .simulation results shows that our proposed model (CLAODV) gives increased performance in terms of delivery ratio, delay and packet drop when compared to the existing AODV protocol.

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