

Improving AODV Protocol Through Cross Layer Design in MANET

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Abstract— Mobile Ad hoc Networks (MANETs) are temporary formed, infrastructure-less networks. Performance metricsdegrades due to the unstable channel conditions, network connectivity, mobility and resource limitations. To improve different performance metrics, different cross-layering techniques are used where different layers from protocol stack communications with each other via exchange of information. AODV is a well reactive ad hoc routing protocol. In our work, we will focus a modified version of AODV routing protocol, based on route discovery by utilizing Physical Layer information instead of the minimum hop count approach of the default distance vector algorithm. our research will also elaborates how the proposed model uses the received SINR to find its route. We will focus on parameters like response time, traffic throughput, packet loss, link stability, delay, optimal usage of battery resource to increase overall lifetime of a network.

Key words: AODV, Cross Layer, MANET, Routing

I. INTRODUCTION

Wireless networking terminology is defined as configuration in which mobile terminal communicates with each other. Basically, two types of wireless network topologies are used. They are Infrastructure topology and Ad hoc topology. According to first approach, use a fixed network infrastructure that has wireless access points. In this kind of network, a mobile host communicates with the network through an access point within its coverage radius. So, Whenever it comes out of range of one access point, if it finds new access points, it connects to a new access point within its range and try to communicate with it. An example of this type of network is the cellular network infrastructure. Figure 1 shows a simple infrastructure network.

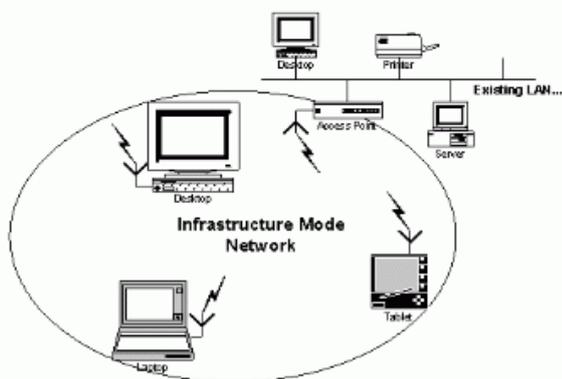


Fig. 1.1: Infrastructure network(8)

The second approach is an ad hoc network. Basically "Ad Hoc" is a Latin word that means "for this purpose". So here, we can say that an Ad hoc network is reconfigurable network which can operate without any fixed infrastructure structure. In computer networking, an ad hoc network refers to a network connection established for a single session and does not require or a wireless base stations(9). Figure 2 shows Ad hoc network.



Fig. 2: Ad Hoc Network (10)

II. INTRODUCTION TO MANET AND BACKGROUND THEORY

MANET stands for Mobile Ad hoc Network. "Ad Hoc" is a Latin Word that means "for this purpose" & "Network" is usedfor connecting two or more devices. A Mobile Ad Hoc Network (MANET) is a self configured wireless network formed by a collection of wireless mobile nodes without fixed infrastructure or a centralized administrator (1). It guarantees that the network will not stop functioning just because one of the mobile nodes moves out of the range of the others. Figure 3 shows a MANET Infrastructure.

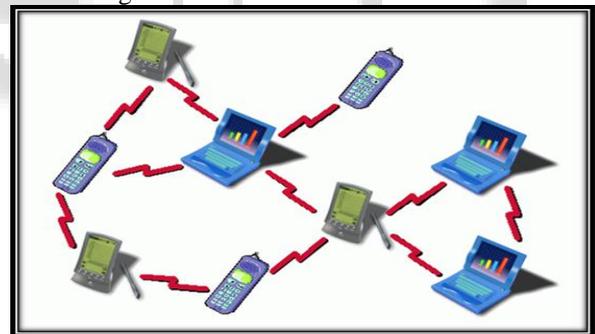


Fig. 3: Manet Infrastructure (11)

Routing is the process of information exchange from one host to the other host in a network. Routing works on the mechanism of forwarding packet towards its destination using most efficient path. Here, Efficiency of the path is measured in various metrics like, Number of security, hops, traffic etc. Here, each host node acts as specialized router(12).

Ad hoc routing protocols can be divided into Proactive, Reactive and Hybrid. A proactive protocol (such as the Destination Sequenced Distance Vector (DSDV) protocol and the Optimized Link State Routing (OLSR) protocol) continuously learns the topology of the network by periodically flooding topological information among the network nodes. Thus, when there is a need to forward a Data packet to a destination, the routing information to that destination is up-to-date and available immediately.

Reactive routing protocols do not maintain a consistent and up-to-date routing information to every node in the network. Instead, they find a route only when needed (i.e., on demand) by flooding the network with Route Request (RREQ) packets and waiting for Route Reply (RREP) responses. This makes sure that the routing overhead scales automatically to only what is needed to react to changes in the routes currently in use. AODV(Ad hoc On-demand Distance Vector) protocol and DSR(Dynamic Source Routing) protocol are example of reactive routing protocol.

In hybrid routing protocols a mixture of the reactive and proactive features are used to exploit specific advantages. An example is the Zone Routing Protocol (ZRP) in which a node maintains proactively all routing information in its local neighbourhood, called the routing zone. However, for all destinations beyond the routing zone, routes are acquired on demand(2).

III. AODV PROTOCOL AND CROSS LAYER DESIGN

The Ad hoc On Demand Distance Vector (AODV) routing algorithm is a routing protocol designed for ad hoc mobile networks. Both unicast and multicast routing is possible in MANET. It is an on demand algorithm, that builds routes between nodes only as desired by source nodes. It maintains these routes as long as they are needed by the sources. In Addition, AODV forms trees which connect multicast group members. These trees are composed of the group members and the nodes needed to connect the members. AODV protocol uses sequence numbers to ensure the freshness of routes. It is self-starting, loop-free and scales to large numbers of mobile nodes(13).

Cross Layer Design is said to be the violation of the layered architecture in order to get some improvements in the network parameters. In literature the cross-layer design is defined as follows:

Definition: Protocol designed by the violation of layered communication architecture is cross-layer design with respect to the original architecture.

- 1) Remark 1: Violation of a layered architecture involves giving up the luxury of designing protocols at the different layers independently. Protocols so designed impose some conditions on the processing at the other layer(s).
- 2) Remark 2: Cross-layer design is defined as a protocol design methodology. However, a protocol designed with this methodology is also termed as cross-layer design.
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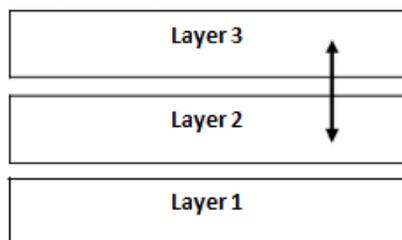


Fig. 4: Cross-Layer Design Between Layer 2 And Layer3

IV. LITERATURE SURVEY

AODV works on flooding mechanism. AODV is based on DSDV(Destination Sequenced Distance Vector Routing), and is improved with the idea of on-demand routing in DSR (Dynamic Source Routing). Hop-by-hop router, ordered number and periodic updating in routing maintenance step in DSDV are also used in AODV. At the same time, the strategy of route discovery and route maintenance in DSR is introduced to AODV. Overhead is high in Route discovery phase. So, a new algorithm CAODV (Cross-layer routing protocol based AODV) is proposed here(3). To achieve energy consumption of nodes and try to improve network's lifetime, new algorithm is introduced which is known as LEA_AODV (Local Energy Aware AODV) algorithm. LEA_AODV reduces energy consumption and leads to prolong battery life at the terminals. The balance energy can be applied in most on-demand routing protocols. It is implemented in the process of route discovery. When a RREQ message is flooded in the network, not every intermediate node, which receives the message, will broadcast it. The node will first be lower than a threshold value, the RREQ is dropped, and otherwise, the message is forwarded(4). A new power control routing method is applied to wireless ad hoc networks. It reduces network energy consumption and also improve Packet Delivery Ratio, network throughput and other performance of ad hoc networks. Here, new protocol has been introduced known as Power Control Ad hoc On-Demand Distance Vector (PC-AODV)(5). Due to mobility, the topology of a mobile ad hoc network (MANET) changes frequently and making it very difficult to find routes that last for the entire duration of data transfer. Here, Route maintenance and restoration is becoming a crucial factor in the design of routing protocols. RSEA-AODV(Route Stability and Energy Aware Routing) is an extension of AODV an extension of AODV that integrates stability and residual energy metric into route discovery. It ensures the selected path to be valid for sufficiently longer period and also extends the lifetime of the network, by avoiding the lower energy nodes as intermediate nodes(6). Most of the routing protocols like AODV, DSDV, DSR, etc. use hop-count as a metric for route selection in MANET, so these routes selected by considering hop-count may not be the good quality link. Here, the Modified Ad-hoc On Demand Distance Vector routing based on Bit Error Rate (MAODV-BER) is proposed, where the route discovery of AODV has been modified to achieve the stable route by obtaining Bit Error Rate (BER) information from physical layer through cross-layer approach(7).As mobility increases topology changes very frequently and network overhead increases. It results into Dropping of packets. So, here the performance metrics degrades due to the unstable channel conditions, network connectivity, mobility and resource limitations. Our problem is to create a stable path from source to destination in such a way that it consumes less energy and increases network life time.

V. PROPOSED AODV ALGORITHM FOR MANET

Here, I would like to propose a modified version of AODV routing protocol, which is based on route discovery by utilizing Physical Layer information instead of the minimum hop count approach of the default distance vector algorithm.

Our research will also elaborates how the proposed model uses the received SINR to find its route. We will focus on parameters like traffic response time, throughput, packet loss, link stability, delay, optimal usage of battery resource to increase overall lifetime of a network.

The steps in the proposed algorithm are as below

- 1) In the route discovery phase, RREQ message will be broadcast. All adjacent nodes will store the value of RSSI(Received Signal Strength Indicator) in to the cache database.
- 2) All intermediate node will check with threshold value(4)

$$Avg_power = \sum_{i=1}^n \frac{n_power(i)}{n}$$

Here, n = no. of nodes in the network & n_power(i) = power level of each node

- 3) If $RSSI_VAL(Incoming\ packet) \geq threshold\ value\{$
 If $RSSI_VAL(Incoming\ Packet) \geq RSSI_Val(Intermediate\ node)$
 Set $new_min_RSSI = RSSI_Val(Intermediate\ node)$
 Else
 Set $new_min_RSSI = RSSI_VAL (Incoming\ Packet)$
 hopcount++
 }
 Else {
 Discard packet
 }
 1) All received path at destination store <path> in database
 2) Calculate optimized path from the database
 3) Set the Optimized path = maximum(min(RSSI+BER+SINR value of node))
 4) If values are same then calculate hop_count and reply with less value of hop count
 5) Send RREP packet to an Optimized Path.
 6) If link_breaks_at_intermediate_path then call local_repair()

VI. IMPLEMENTATION TOOL & RESULT

Parameters and their values and tool that are used for implementing our proposed algorithm is shown in the table.

Parameter	Value
Simulator	Ns-2.35
Protocol	AODV
Mobility Model	Random Waypoint Model
Number of Nodes	70
Max. Simulation Time	1000 S
Simulation Area	500*500 m
Antenna	Omni directional
Transmission Power	5.0 W
Reception Power	1.0 W

Idle Power	0.005 W
Sleep Power	0.0001 W
Initial Energy	100 Joules
Packet Size	256 bytes

Table1: Parameters And Their Values

In this section, simulation results are shown and it is compared with conventional AODV protocol.

A. Average End to End Delay V/S Number Of Nodes

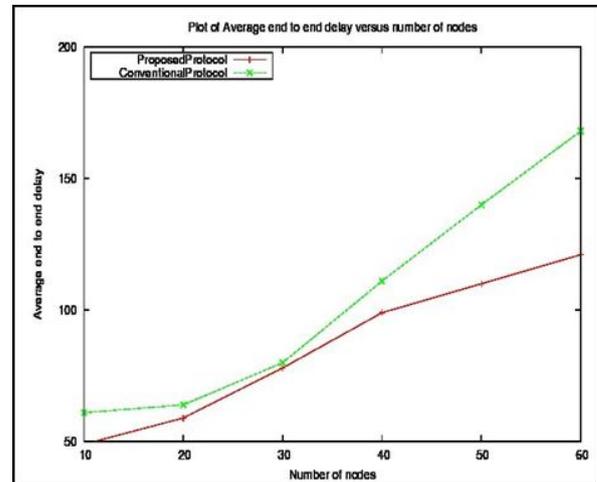


Fig. 5: Plot of Average End to End Delay V/S No. of Nodes Above figure shows the graph for average end to end delay and the no. of nodes in the network. The figure shows that the average end to end delay for the conventional AODV algorithm (green line) is more than proposed AODV algorithm (red line).

B. Network Lifetime V/S No. Of Nodes

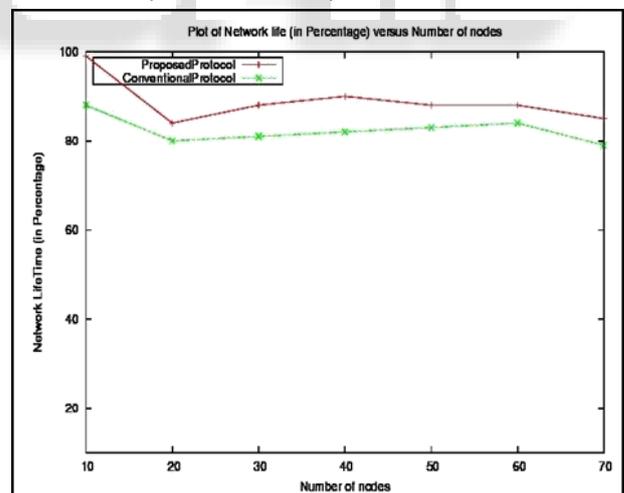


Fig. 6: Plot of Network Life Time V/S No. of Nodes

Above figure shows the graph for network life time and the no. of nodes in the network. The figure shows that network life time for the proposed AODV algorithm (red line) is more than the conventional AODV algorithm (green line).

C. Network Overhead V/S No Of Nodes

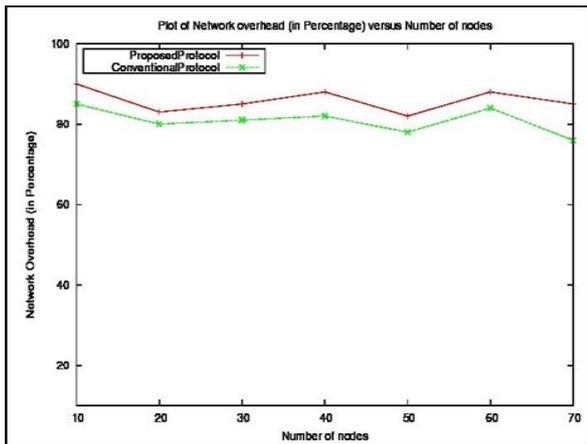


Fig. 7: Plot of Network Overhead V/S No. of Nodes

Above figure shows the graph for network overhead and the no. of nodes in the network. The figure shows that network overhead for the conventional AODV algorithm (red line) is more than the proposed AODV algorithm (green line).

D. Throughput V/S No Of Nodes

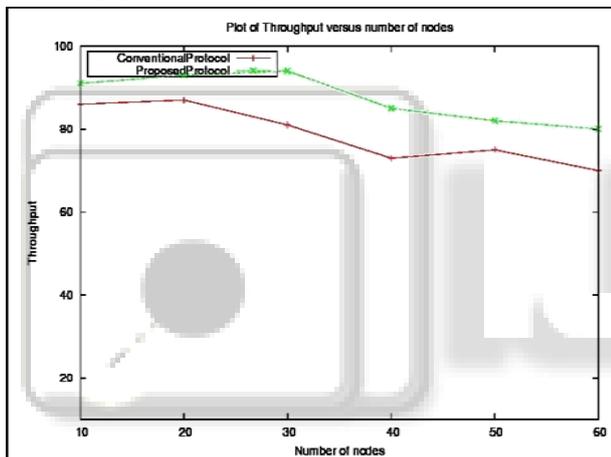


Fig. 8: Plot of Throughput V/S No. of Nodes

Above figure shows the graph for throughput and the no. of nodes in the network. The figure shows that throughput for the proposed AODV algorithm (green line) is more than conventional AODV algorithm (red line).

VII. CONCLUSION & FUTURE WORK

The approach I have applied to AODV that works on a reactive approach is based on route discovery by considering the RSSI value and battery of the individual node to find out the optimized path and increasing life time of the network. I have also use physical layer information, by using SINR and BER to find out the route. I have also compare my algorithm's result to existing AODV protocol with parameters Average End to End Delay, Network life time, Network overhead and Throughput.

In Future, We can also extend our work for multimedia transmission. We can also use our parameters for different mobility models.

REFERENCE

[1] T.C. Huang, S.C. Chen and L. Tang, "Energy-Aware Gossip Routing for Mobile Ad Hoc Networks", IEEE

International Conference on High Performance Computing and Communications, 2011.

- [2] Mohammed Hawa, Sinan Taifour, Mohammad Qasem, Waleed Tuffaha, "A dynamic cross-layer routing protocol for Mobile Ad hoc Networks", International Journal of Electronics and Communications, ScienceDirect, 2012, pp. 996– 1005.
- [3] Wei Zeng, Liang Huang "An Energy-Efficient Method for Wireless Ad Hoc Networks Based on Cross Layer AODV Routing", Ninth International Conference on Natural Computation (ICNC), IEEE, 2013.
- [4] AL-Gabri, Maleka, Chunlin Li, Zhiyong Yang, Naji Hasan. A. Hd, Xiaoqing Zhang, "Improved the Energy of Ad Hoc On-Demand Distance Vector Routing Protocol", International Conference on Future Computer Supported Education, ScienceDirect, 2012
- [5] R. Madhan Mohan, K. Selvakumar "Power controlled routing in wireless ad hoc networks using cross layer approach", Egyptian Informatics Journal, ScienceDirect, 2012
- [6] P. Srinivasan P. Kamalakkannan "Enhancing Route Maintenance in RSEA-AODV for Mobile Ad Hoc Networks", Proceedings 7th International Conference on Intelligent Systems and Control (ISCO), IEEE, 2013
- [7] Ram S. Dahal, Teerapat Sanguankotchakorn, Senior Member IEEE "QoS routing in MANET through Cross-Layer Design with BER and modifying AODV", IEEE, 2011
- [8] <http://technet.microsoft.com/ja-jp/library/bb457051.aspx> [April 22, 2015 9:00 pm]
- [9] <http://www.techterms.com/definition/adhocnetwork> [May 4, 2015 3:00 pm]
- [10] <http://www.identi.li/index.php?topic=37655> [May 7, 2015 10:00 am]
- [11] <http://www.engr.iupui.edu/~dskim/manet/> [May 8, 2015 11:00 am]
- [12] <http://cs.lamar.edu/faculty/disrael/COSC5100/Seminar.pdf> [May 11, 2015 9:00 am]
- [13] <http://moment.cs.ucsb.edu/AODV/aodv.html> [May 12, 2015 7:00 pm]