A Literature survey on 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 metrics degrades 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 SNR 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.**

***Keywords* - 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 a 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.

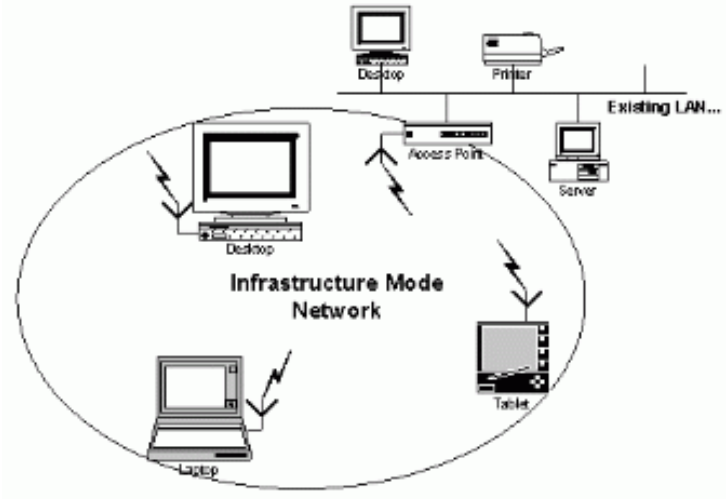

Figure 1: Infrastructure Network[8]

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.

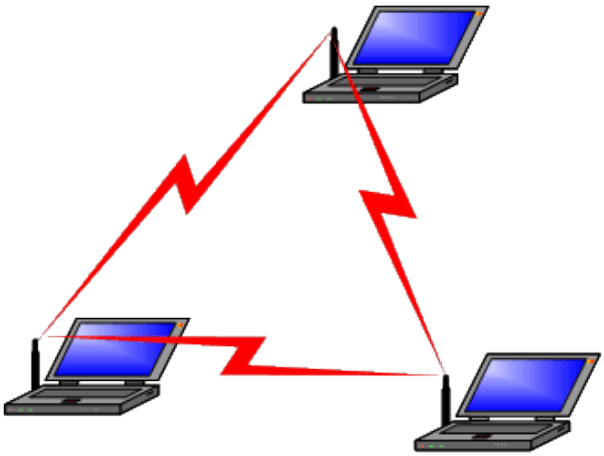

Figure 2: Ad hoc Network[10]

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 used for 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.

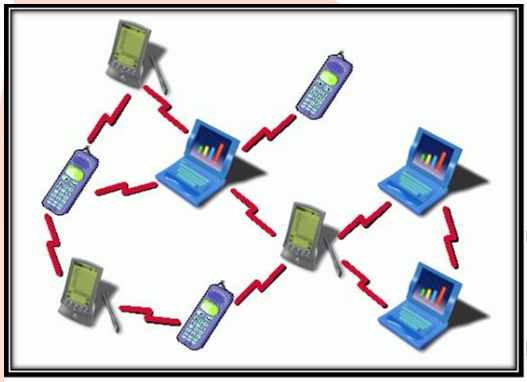

Figure 3 : MANET Infrastructure [11]

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 generally classified 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.

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).
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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For example, let us consider a model in the figure 4 which consists of three layers viz. layer-1, layer- 2 and layer-3 and follows the traditional layered architecture. Layer-1 is the lowest layer which provides its services to the layer-2 and layer-2 provide service to its layer just above it i.e. layer-3 via well defined interfaces which exists between layers. If we define an interface which can communicate directly between the layer-1 and layer-2 bypassing the layer-2.

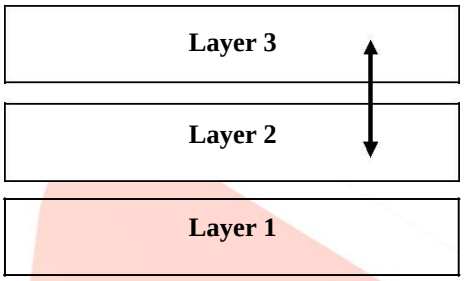

Figure 4 : Cross-layer design between layer 2 and layer3

IV. LITERATURE SURVEY

1. An Energy-Efficient Method for Wireless Ad Hoc Networks Based on Cross Layer AODV Routing [3]

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. Then a new route discovery mechanism was made for AODV just like Figure 4.

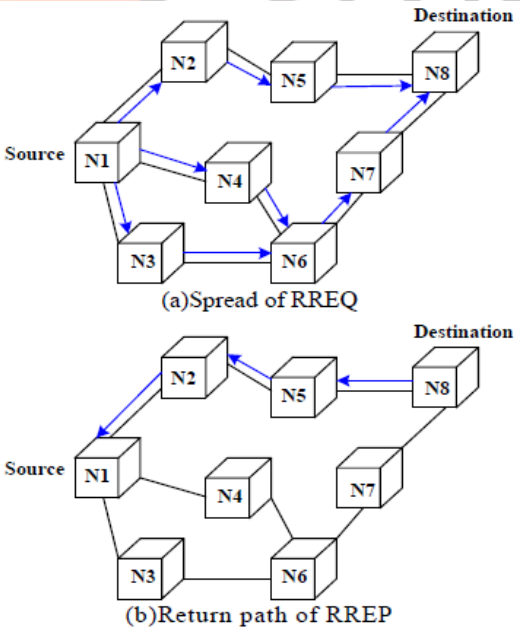

Figure 5 : Route Discovery in AODV [3]

Overhead is great for discovery route in AODV, a cross-layer routing protocol based AODV (CAODV) is proposed here. General flooding mechanism was used in AODV. When RREQ packet is first received by each node, it must be transmitted. This mechanism cause a lot of network overhead, and conflict probability of RREQ packets is so high that more energy is wasted by every node. CAODV(Cross-layer routing protocol based AODV) is used in solving these problems, and its design framework is

shown as Figure 5. Efficient broadcast module is used to reduce network overhead. Delay sending module is used to reduce the chance of conflict of RREQ packets. Two problems should be solved in CAODV. One is that back-off time should be set for different nodes. Another is that every node can judge if the packets have been received by its neighbour.

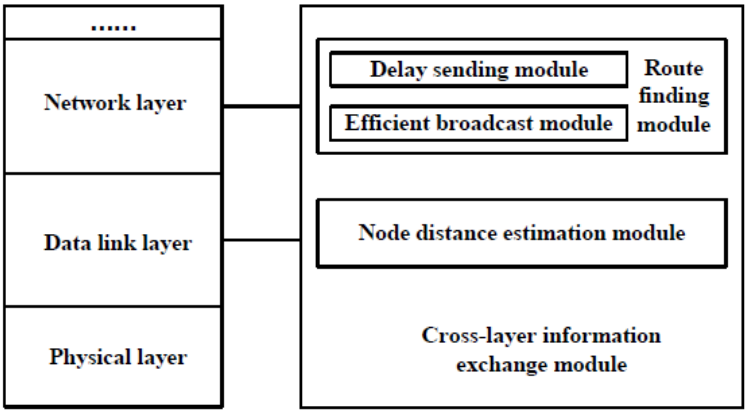

Figure 6 : Design framework of CAODV [3]

In this paper, OPNET Modeler is used as simulation software and in different conditions and environment. CAODV protocol is compared with AODV protocol. Comparison is carried out from 4 parameters: successful rate of sending data packet, the average number of copies of route request packets, the average time of building route, total overhead of route protocol. Here, CAODV performance is better.

2. Improved the Energy of Ad Hoc On-Demand Distance Vector Routing Protocol [4]

This paper focus on energy consumption of nodes and try to improve network's lifetime. To achieve this goals, it introduced 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. If so, the RREQ message will be dropped, and the destination will be receive a route request message only when all intermediate nodes along the route have enough battery levels. The threshold value used as a criteria is dynamically changing under the interface queue occupancy of nodes around the backward path. An energy model used in this paper informs any node about its instantaneous energy level. To use this model, it defines three parameters: The initial Energy (Initialenergy), The transmission power(txPower) and Reception power (rxPower). According to these parameters and using equation threshold value is calculated. Node will compare its current battery level to threshold value.

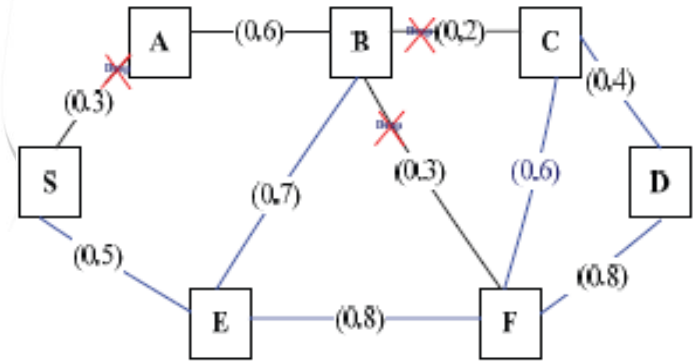

Figure 7 : The idea of Energy model by Example and Illustrate [4]

In this model, threshold value is 0.4. We can calculate the average ratio of remaining energy of each link node, if S is connected by the direct edge A and E, in fig.6. Energy of link between S and A is 0.3 and Energy of link between S and E is 0.5, namely, the threshold > 0.3, so the request path is passing E, bypassing A, because the RREQ is simply dropped of node A. Likewise, path is created between S and D and message is transmitted.

In this paper, Network Simulator-2 is used as simulation software and in different conditions and environment LEA_AODV protocol is compared with AODV protocol. The comparison is carried out from two scenario, in first scenario all nodes are moving with high speed and in second scenario nodes are stable and pause time is given. Here, LEA_AODV gives better performance.

3. Power controlled routing in wireless ad hoc networks using cross layer approach [5]

This paper presents a new power control routing which 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).

This algorithm builds different routing entries according to the node power levels on demand, and it selects the minimum power level routing for data delivery. It uses different power control policies to transmit data packets, as well as control packets of

network layer and MAC layer. This will not only increase network life time, but also improve packet delivery ratio and average end-to end delay.

PC-AODV consists of two main phases: route discovery and route maintenance. It assumed that each node uses the MAC protocol specified by IEEE 802.11 Distributed Coordination Function (DCF) which mainly uses three kinds of MAC layer control packets including RTS (Request To Send), CTS (Clear To Send) and ACK (Acknowledge). This algorithm uses different power control strategies to transmit data packets, and control packets of network layer and MAC layer, it uses different PLs to send network layer control packets, and the transmission power to send actual data packets is set according to the routing table entry. Transmission power to send MAC layer control packets is set and varied according to transmission power to send network layer control packets and actual data packets. It is shown in Figure 7.

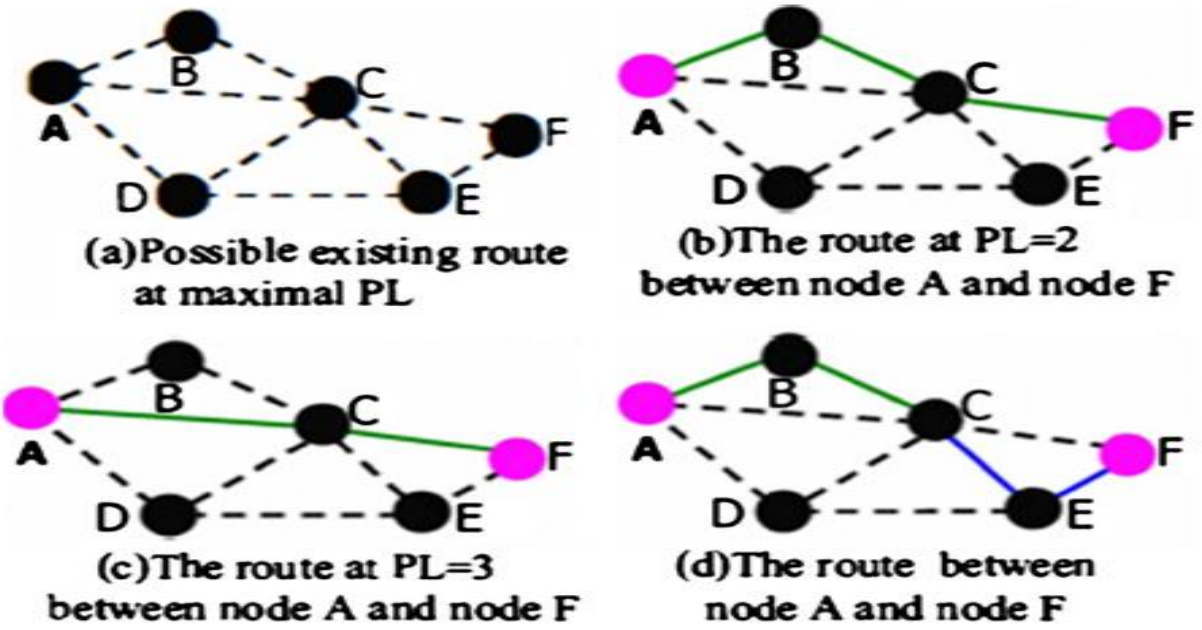

Figure 8 : Sample Analysis figure [5]

In this paper, Network Simulator-2 is used as simulation software and in different conditions and environment PC_AODV protocol is compared with AODV protocol. Comparison is carried out from 4 parameters: Packet Delivery Ratio, Average end to end delay, network lifetime , network residual energy. Here, PC_AODV gives better performance.

4. Enhancing Route Maintenance in RSEA-AODV for Mobile Ad Hoc Networks [6]

This paper enhance the route maintenance process in Route Stability and Energy Aware Routing (RSEA-AODV) protocol. 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.

Several routing protocols have been proposed for MANETs. The reactive or on demand routing protocols, determine and find route only when there is a need to transmit a data packet, using a broadcasting query reply (RREQ-RREP) procedure. Most of these protocols use min-hop as the route selection metric. It is found that shortest path route has short lifetime, especially in highly dense ad hoc networks even with low mobility, due to edge effect.

Here, RSEA-AODV is 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.

In this work, "make-before-break" mechanism is used to enhance the route maintenance in RSEA-AODV. This mechanism find an alternate route for data transfer, when there seems any possibility for link break due to congestion, mobility, energy drain and through cross layer approach. Performance results show that RSEA with route maintenance outperforms RSEA and AODV in high load and highly dynamic environment.

Here, It uses Route discovery and Route Selection at destination node and route maintenance algorithms. Here, NS-2 tool is used for checking parameters under different mobility conditions.

This protocol is compared with other different similar routing protocols like: RSEA and LEAR. Comparison is carried out from 4 parameters: Average end to end delay, Packet Delivery Ratio, Normalized Control Overhead and variant of node Residual Energy. Here, RSEA-AODV gives better performance.

5. QoS routing in MANET through Cross-Layer Design with BER and modifying AODV [7]

This paper improves AODV protocol by using different parameters passed from one layer to another layer of AODV protocol. 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, because these links usually have poor SNR, higher Frame Error Rate (FER), low throughput, etc.

Here, In this research, bandwidth and delay QoS requirements of applications are studied by modifying existing AODV and cross-layer design is made to provide the physical layer information i.e. BER to the network layer. RREQ and RREP message of AODV are added with the fields: 1) Bandwidth 2) Delay and 3) BER as well as HELLO message is modified to contain available bandwidth which is used for updating the routing table in intermediate nodes.

In this work, routing algorithm is created for providing QoS. Network Simulator-2 is used as simulation software and in different conditions and environment MAODV-BER protocol is compared with AODV protocol. Comparison is carried out from 4 parameters: Packet Delivery Ratio, Control Overhead, Average end to end delay and throughput. Here, MAODV-BER gives better performance.

V. CONCLUSION

This paper summarises basics of MANET, protocols used in MANET. It also gives idea about working of AODV protocol and cross layer design. This paper illustrates various methods, algorithms and techniques used to improve AODV protocol. It also gives idea about improving Quality of Service in AODV protocol. It also gives information about different cross-layering techniques that are used in which different layers from protocol stack communications with each other via exchange of information.

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