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TTL Variance Prophecy based Enhancement of AODV Routing Protocol in MANET

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ABSTRACT*:* Ad hoc On-demand Distance Vector (AODV) is a on demand routing protocol for delivering messages in a connected Mobile Ad hoc Network (MANET). Connectivity in the network only exists when nodes are in radio range of each other. Local Repair is an important issue in routing protocol which is needed for minimizing flooding and performance improvement. In flooding source node forward their route request till it will not reached to destination and also forwarded the route request to their neighbors to create a shortest path from source to destination. Routes can be locally repaired by the node that detects the link break along the end to end path. In this paper, we are enhancing the existing Local Repair method in AODV to achieve broadcasting and minimizing the flooding. The enhanced protocol first creates the group of mobile nodes then broadcasting can be done and if the link breaks then local route repair technique can be applied. In the network the numbers of intermediate nodes are take part in communication. Enhanced AODV-Local Route Repair (EAODVLRR) protocol is implemented on NS2 network simulator. Simulations are performed to analyze and compare the behavior of proposed protocol (EAODVLRR) in term of TTL value for fixed and varying according to network requirement prediction. Proposed protocol has been compared with the obtainable AODV in terms of routing load, Data delivery ratio. Here researchers will developing their own on-demand ad hoc routing protocols and assist users to determining the implementation design that best their needs.

KEYWORDS*:* AODV, MANET, EAODVLRR, TTL, Routing.

I. INTRODUCTION

This Wireless is a new technology that allows users to access information and services in spite of the geographic position. Community can utilize and use the Internet with computers (e.g. laptop, palmtop, smart phone and PDA) whenever and where as possible. In general, wireless network are of two types: infrastructure network and ad hoc network. Mobile ad hoc network (MANET) is an autonomous group of mobile users who communicate with each other without any fixed infrastructure and centralized administration. Since the hosts are mobile, the network topology may change rapidly and unpredictably over time [1]. Due to the absence of centralized administration and random mobility the practical implementation of ad hoc network are not possible till date of research. A MANET is a peer-to-peer network that allows direct communication between any two nodes, when adequate radio propagation conditions exist between these two nodes. If there is no direct link between the source and the destination nodes, multi-hop routing is used. In multi-hop routing, a packet is forwarded from one node to another, until it reaches the destination. A routing protocol is a necessary in ad hoc networks; this routing protocol has to adapt quickly to the frequent changes in the ad-hoc network topology. Ad-hoc routing protocols are classified into three categories. The first category is Proactive routing protocols are also called table driven routing protocol such as DSDV [2], GSR [3], OLSR [4]. The second category is Reactive routing protocols are also called on demand routing protocol such as AODV [5], DSR [6], TORA [7]. The third category is Reactive and proactive routing protocols are also called Hybrid routing protocol such as ZRP [8]. AODV is a well known on-demand routing protocol where a source node initiates route discovery when it needs to communicate to a destination that doesn't have a route to it. Once a route discovered between the two nodes, data transfer occurs through until the route broken due node movement or interference due the dynamic nature of ad hoc wireless medium. Route maintenance mechanism is occurring when a route failure happens between two nodes. The requestor node of the failure tries to find a repair to the route and this process called local repair.

AODV broadcasts a RREQ (Route REQuest) packet to the neighbours by the expanding ring search method, where an iterated increment of TTL (time-to-live) in the RREQ packet is used to discover the route to the destination. For

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example, a node will first send the RREQ packet with TTL=1 and then send RREQ packets with TTL=2 if it did not find a route to destination in the previous try. Finally the node will keep the TTL value until the end-to-end communication is finished. If the TTL is set too small, valid routes are likely to be discarded, and large routing delay and traffic overhead may result due to the new route search. On the other hand, if the TTL is set too large, invalid route caches are likely to be used, and additional routing delay and traffic overhead may result before the broken route is discovered.

This paper proposes a new enhance AODV routing protocol for MANET called EAODVLRR (AODV with Local Route Repair). The EAODVLRR modifies the local repair mechanism used in the route maintenance of the AODV routing protocol. The AODVLRT mainly reduces the routing message overhead resulted from the original AODV local repair mechanism. This enhancement will leads to higher throughput and lower latency than AODV.

The rest of the paper is organized as follows. Section 2 illustrate with related work. Section 3 describes local repair in AODV. Section 4 proposes EAODVLRR. The simulation environment is shown in section 5. The simulation results are shown in section 6. The conclusions and future works are shown in section 7.

II. RELATED WORK

In this existing approach [9] an implementation of AODV routing protocol with multi-metrics was presented. In this implementation AODV -UU (Uppsala University) Routing protocol is modified under the performance of multi-metrics.

Here hop count is the base matrix. It measures the number of hops in between source and destination in a path. Here first HELLO message is customized to confirm link quality. If a node not succeeds to receive several HELLO messages from a neighbour, a link break is detected. In modified AODV the modified HELLO message contained a count of the received HELLO messages from each neighbour, therefore each node knows how many HELLO message each neighbour receives. Every node calculate ETX (Expected transmission rate) of each node then calculate ETT (Expected Transmission Time) based on ETX. Then calculate EI (Expected Interference) based on ETT. The number of neighbour link will calculated by using HELLO messages then calculate the AB (Available Bandwidth). At that stage AODV-UU will modify. The main drawback of this scheme is to count the HELLO messages and providing the enough space for it. In this work [10], AODV, a purely on demand MANET routing protocol, is enhanced to provide QoS. The route discovery process is modified to reduce the connection set up latency. In addition, QoS provision based on delay and bandwidth requirements is incorporated to ensure guaranteed performance level to the QoS sensitive applications. The enhanced protocol is called EQoS AODV. The drawback of this approach each node will maintain two tables, own routing table and neighbour table.

Active techniques as well, based on the end-to-end probe packets, needed to estimate the available bandwidth along a path. We mention DietTOPP [11] for example. It has been developed for wireless network based on the TOPP method for wired environment. His major idea is to compute the medium utilization from the delays and to derive the available bandwidth from this utilisation. The main defaulting point of such approach is the higher consumption of bandwidth.

Md Enzai et al. [12] also followed the IETF draft and extended the AODV routing messages in minimum bandwidth information and maximum delay information. They also use MAC layer information for calculating available bandwidth and also experience delay. The weakness of this approach is delay maximization.

Enhanced AODV [13] routing protocol for reset a new shortest routing path during sending packet. Enhanced AODV routing protocol maintain expire time that created first. So expire time in routing table is not updating until expire time. Therefore, routing table updated in a cycle. Enhanced routing protocol ensures shortest routing path through fixed expire time. So the source packet sends to destination quickly than original AODV routing protocol.

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In this approach [14] include a pre-emptive routing method that make use of proactive mechanisms to detect the link weakening so that a reliable route can be chosen before the link breaks. In the pre-emptive approach, a node that detects a weakening link from one of its neighbours will broadcast a *Handoff* packet with TTL=1 to its neighbours. On receiving *Handoff* packet, each node will determine if any of its neighbours has links with more signal power than the current links. The information about link signal strength is kept by *Neighbour Power List* (NPL) and *Power Difference Table* (PDT). NPL records all neighbours' energy and PDT records the power difference between every two nodes in neighbours. As we can see, this approach costs a lot in storage for link power information.

Query localization techniques [15] are based on the concept of time locality. The time locality is kept track in a history path node list, *Pold*. Two kinds of repair mechanisms are discussed, that is, *Exploiting Path Locality* (EPL) and *Exploiting Node Locality* (ENL). In EPL, a node will broadcast a query with a counter and the accumulated path (*P*) to at most *k* nodes not in *Pold*. A node in ENL sends a query with *Pold* and a counter to neighbours when link error occurs. When a node receives a query, the nodes in ENL will drop the query it received if the counter in the query exceeds a threshold value *k*. The counter (initialized to zero) in the query packet will be incremented by a node that is not in *Pold*, otherwise the value of the counter will be kept.

A route discovery method called relative distance micro discovery (RDMD) is proposed in [16]. The method is based on the estimation of relative distance between two ends and uses the value in TTL field in the RREQ packet. The relative distance is calculated by an iterated algorithm based on a specific route metric, velocity and last update time of nodes to localized the discovery range and assumes the velocity of the node is known. A similar and simple approach is also proposed in [17], where a two-hop broadcast is used to repair the link break.

III. LOCAL ROUTE REPAIR

An Local route repair is a technique used to revamp a kaput route locally on the requests are forward towards nodes of the link failure if the destination is no farther than TTL. To repair the link failure, the requestor (intermediate node that only forward requests in both sides) node broadcasts RREQ packet after increasing the destination sequence number [7]. The TTL value used in RREQ packet is set to the following value:

$$TTL = Max\,(0.5\times NH,\ TTL_N) + TTL_C \qquad (1)$$

Where:

TTL_N: the last known hop count from the requestor node of the failure to the destination.

NH: the number of hops from the requestor node of the failure to the source of the currently undeliverable packet.

TTL_C: constant value easy way to comply with the conference paper formatting requirements is to use this document as a template and simply type your text into it.

After the requestor node broadcasts the RREQ packet, it waits for the acknowledgement during discovery period to receive RREP (Route REPly) packets in response to the RREQ packet. When the destination or an intermediate node that has a fresh route to the destination receives the RREQ packet, a RREP packet will be forwarded towards the upstream (requestor) node. If discovery period finished and the requestor node didn't receive a RREP for that destination, it transmits a RERR(Route ERRor) message for that destination to the source. On the other hand, if the requestor node receives one or more RREP messages during the route discovery period, it first compares the hop count of the new route with the value in the hop count field of the invalid route table entry for that destination. For example in figure 1 shows the route request (RREQ) and route reply (RREP) procedure of AODV routing protocol. in this figure source node S want to establish a connection to destination D, it first generate a route discovery packets to all the nodes that are in their radio range with unique sequence number and TTL value. Node B is working as a intermediate node that collect the request from sender and again forward the RREQ with sequence number and decremented TTL value then RREQ finally reached to destination node then node D will generate RREP message for S then connection will be established before TTL value is expire. If in a certain time limit S does not establish connection to D means the value of TTL is expire then at that hop node C will generate a route error(RERR) message and no connection is established in a particular TTL value generated by (1) .

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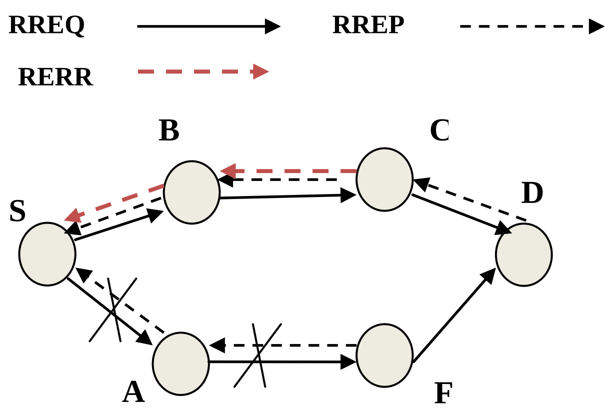

Fig. 1 A RREQ and RREP procedure of AODV LR

In the case of the hop count of the newly determined route to the destination is greater than the hop count of the previous route, the upstream node transmits a RERR message for that destination towards the source, with 'N' bit set. Finally, the requestor node updates its route table entry for that destination.

IV. Enhanced AODV Local Route Repair

The AODVLRR is a modification to local repair in AODV. Local repair in AODVLR act like local repair in AODV (described in section 2), the difference is that local repair in AODV done with just one trial to find a repair to the route by broadcasting RREQ packet with TTL come from Eq. (1) and on the other side local repair in AODVLRR done on one or more trials to find a repair to the route. In AODVLRR, when a route failure happens, the upstream node increments the destination sequence number by one and then it initiates its first local repair trial by broadcasting RREQ packet with TTL = LRR_TTL_START. LRR_TTL_START has been choose to be equal 2 to increase the chances in finding a repair from the first trial and in the same time the small value for TTL will reduce the routing message overhead. The upstream node that initiates the route repair waits during the discovery period to receive RREPs packet. If the upstream fails to receive any RREPs during the discovery period, it increments TTL by LRR_TTL_INCREMENT (which equal 2) and it compares the resulted TTL with LRR_TTL_THRESHOLD which equal to half LRR_TTL_MAX (LRR_TTL_MAX come from Eq. (1)), where LRR_TTL_THRESHOLD used to limit the number of local repair which will led to limit the delay of finding a repair to the route. If the requestor node finds TTL smaller or equal to LRR_TTL_THRESHOLD, it will broadcast RREQ packet with the new value of TTL. If the upstream (requestor) node fails to receive RREP packet again during the discovery period, it repeats the previously described process again until it receives RREP packet or TTL value exceeds LRR_TTL_THRESHOLD then the upstream (requestor) node make its final trial by broadcasting RREQ packet with TTL = LRR_TTL_MAX and it is the worst case that AODVLRR can reach. The threshold value of TTL is not changed after the appropriate selection. Threshold value will decides the major and minor variances in LRR TTL value.

V. Simulation Environment

The simulator we have used to simulate the ad-hoc routing protocols in is the Network Simulator (ver. ns-2.31) [19] from Berkeley. To simulate the mobile wireless radio environment we have used a mobility extension to ns that is developed by the CMU Monarch project at Carnegie Mellon University.

*A. **Parameters used in simulation***

In our scenario we take 30 nodes in which all nodes are mobile nodes. Due to their mobile nature is it not possible to establish connection. The simulation is done using ns-2, to analyse the performance of the network by varying the nodes mobility. The evaluated performances are given below. We are taking the following parameters for case study shown in table 1.

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Number of nodes	30
Dimension of simulated area	800×600
Routing Protocol	AODV, EAODV
Simulation time (seconds)	100
Transmission Range	250m
Traffic type	CBR
Packet size (bytes)	512
Number of traffic connections	20
Maximum Speed (m/s)	30
Nodes Mobility	Random way point

Table 1: Simulation Parameters for Case Study

A. ***Performance Metrics*** In this paper we focus on evaluating the EAODVLRR protocols under the following criteria [9, 10]:

*1.**Packet Delivery Ratio (PDR):*** The ratio of data delivered to the destination to the data sends out by source. In this paper we analyse the PDF ratio in case of TCP and UDP packets. The greater value of packet delivery ratio means the better performance of the protocol.

*2.**Throughput:*** The total amount of data a receiver actually receives from sender divided by the time taken by the receiver to obtain the last packet.

*3.**End to End Delay:*** The difference in the time it takes for a sent packet to reach the destination. It includes all the delays, in the source and each intermediate host, caused by the routing discovery, queuing at the interface queue etc. The lower value of end to end delay means the better performance of the protocol.

4.***Normalized routing overhead:*** This is the ratio of routing-related transmissions (RREQ, RREP, RERR etc) to data transmissions in a simulation. A transmission is one node either sending or forwarding a packet. Either way, the routing load per unit data successfully delivered to the destination. The lower value of routing load means the better performance of the protocol.

5.***Packet lost:*** Total number of packets dropped during simulation. The lower value of packet lost means the better performance of the protocol.

B. ***Results***

In this section we present a set of simulation experiments to evaluate this protocol by comparing with the original AODV [1] routing protocol.

1.*Nam Scenario of 30 Nodes:* In this In this figure we represent the nam scenario of thirty nodes in which all the nodes are mobile nodes first they sense the neighbour then transmit data according to routing protocol. By changing the logical topology of the network, ns-2 users can conduct tests in an ad hoc network without having to physically move the nodes. Ns-2 controls the test scenarios through a wired interface, while the ad hoc nodes communicate through a wireless interface.

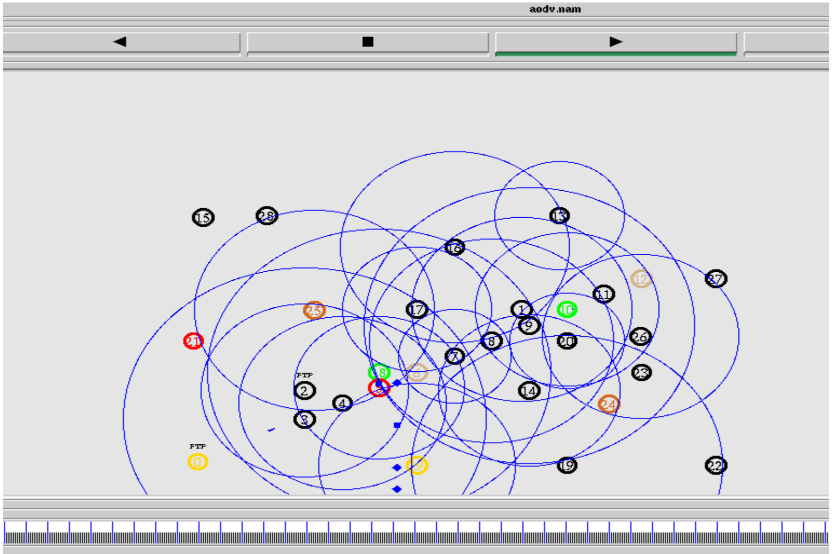

Fig. 5 A nam scenario of thirty nodes

VI. CONCLUSION AND FUTURE WORK

Conclusion of this approach is depends on the results analysis of normal AODV and Enhanced AODV. If proposed work is effective and better than normal AODV it proves on the base of performance metric. If proposed work is effective then in future also apply that approach in Wimax protocol and in energy conservation schemes in MANET.

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