Comparative Evolution of AODV Routing Protocol based on Link Life Time in MANET

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Abstract— Mobile Ad Hoc network (MANET) is an infrastructure less multi-hop mobile network which is combination of mobile nodes with wireless receiver and transmitter with bounded energy and storage space. With the development of mobile network and multimedia services, quality of service is become very crucial. In MANET delay, bandwidth, link stability, hop-count are major QoS parameter. Compare to wired network; large amount of packet loss, end-to-end delay and low throughput are the major problems in MANET which may be occur due to dynamic behaviour of mobile nodes, transmission error, link failure, node congestion. More ever QoS of real time application is become very tough. AODV, DSR, DSDV are leading protocols for MANET in recent years. This paper gives a sketch of AODV and various derived protocol along with QoS parameter such delay, bandwidth and link stability, so to analysis their performance.

Keywords- Mobile Ad hoc Networks; AODV; Link Lifetime Estimation

I. INTRODUCTION

Mobile ad-hoc network is useful in those areas in which we have no or less communication infrastructure or existing system is not in working situation. In MANET, each node may work as host node as well as router, to transfer data packet from source to destination. These mobile nodes are also participant in route discovery, in order to find out multi hop route to transfer data packet and all of this is done dynamically. In this manner routing functionality includes in these mobile nodes, which reduce routing overhead and saves power for network. Mobile ad network is also called as infrastructure less network. MANET is useful in disaster management, multimedia application, battlefield in order to guide troops and artillery, in education field by establish virtual classroom, Sharing business information. As in MANET, nodes are mobile, so it's very difficult to provide Quality of Service. Delay, bandwidth, link lifetime are QoS parameter.[1,2,3] In this paper we gave a glance to these parameter and their effect on performance.

II. AD HOC ON DEMAND DISTANCE VECTOR (AODV) ROUTING

AODV is one of the leading reactive routing protocols which are used in MANET. Nodes in ad hoc network also function as routers that discover and maintain routes to other nodes in the network. Thus, the primary goal of MANET is to establish a correct and efficient route between a pair of nodes and to ensure the correct and timely delivery of packets.

A. AODV

Ad-hoc on Demand Distance Vector Routing (AODV) was introduced by Charles E_ Perkins and Elizabeth M Royer [4, 5]. They presented a new algorithm which, called as AODV, brings a loop free routes even while reconstruction of collapsed links. Because AVOD doesn't need global periodic routing announcements, the requirement on the total bandwidth usable to the mobile nodes is substantially low than in those protocols that do necessitate such announcements. This algorithm covers to large number of mobile nodes preparing to form ad hoc networks.

AODV is type of reactive routing protocol. For route selection, it uses hop count as metric. Every node keeps the information of the next hop, so that reach to destination. For route discovery and maintenance, AODV uses three message mechanisms as Route Reply (RREP), Route Request (RREQ), and Route Errors (RERR) messages.

It broadcast a RREQ message, when a node demands a route to other node, this message propagated through the networks until it reaches the final destination node, or an intermediate node, which have correct route to the destination. Later on destination node passes back a RREP message via the discovered route to source node. If a link collapse occurs, any nodes which detect it, inform all other nodes that route is no longer in working condition. This is managed by sending a RERR message to all those nodes and again a route discovery phase starts. Whenever a node finds out a fresh route to destination node, it evaluates this fresh info through the route updated law:

if(seq_nrdi<seq_nrdj) or ((seq_nrdi=seq_nrdj) and (hop_countdi > hop_countdj))

then

seq_nrdi:= seq_nrdj;

hop_countdi:= hop_countdj + 1;

next_hopdi := j;

endif

The notation applies for:

node I : receives routing information to destination d from neighbor j.

seq_nrdi :The destination sequence number,

hop_count di : hop count

next_hopdi : next hop for a destination d at node i is represented

As a part of 1 or more active routes, a node broadcasts a Hello message locally every HELLO_ INTERVAL to offer connectivity info.

B. QoS for AODV

In 2000, QOS for AODV was introduced by Charles E_ Perkins and Elizabeth M Royer [6]. In this paper they provide operational overview of AODV in order to achieve delay and bandwidth constraints. From a route, nodes are permitted to ask the delay and bandwidth requirement and these two fields are added to the RREQ and RREP messages.

When a source 'S' issue a RREQ message, it contain two new feature i.e. delay field which specified the maximum allowed transmission time & bandwidth field which specified minimum amount of bandwidth required to transfer data from source 'S' to destination 'D' via next intermediate node.

Similarly when destination node 'D' reply through a RREP message, it already keeps the calculation of the cumulative delay and the accessible bandwidth between next intermediate node and the source 'S'. When a node at any moment detects that route can't provide the guaranteed QoS, all sources which are using this specified route, should be informed with the help of ICMP QOS_LOST message to send it to them.

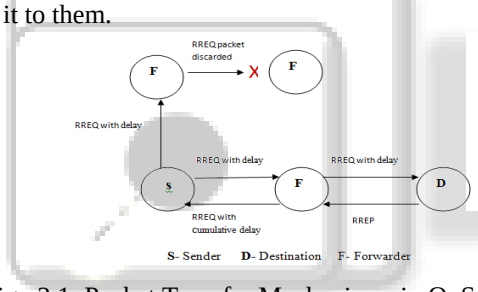

Fig. 2.1. Packet Transfer Mechanisms in QoS-AODV

Following four entries are added in every route table respectively to every destination.

- Maximum Delay
- Minimum Available Bandwidth
- List of Sources Requesting Delay Guarantees
- List of Sources Requesting Bandwidth Guarantees

This version of AODV has following major drawbacks:

- It doesn't generate correct value of route delay every time. The reasons behind this are the NODE_TRAVERSAL_TIME, are only a constant approximation of the average one hop traversal time and queuing delay, may change due to network traffic and its congestion.
- The ICMP QOS_LOST message does not provide specific information as it only informs nodes that delay has increased or bandwidth has decreased [23].

C. On-Demand Routing Protocol based on Link Duration Estimating (ODLDE)

In 2008, Wu Dapeng, Zhen Yan, Xu Chunxiu, Wu Muqing and Liu Jingsi [7] proposed a new mechanics ODLDE to select a trustful path that have much link life time, as due to mobility of nodes produce the link break down between them more regularly. They design Newton Interpolation Polynomial with the help of various sample values to characterized receive signal strength, thus they calculate the link lifetime by reference points. Thus they found a route for source node to destination node with the maximum lifetime. By this mechanism, they describe the received signal strength more accurately as well as by using it, route searching time and packet drop ratio decrease tremendously.

1) PATH ESTABLISHMENT Mechanism

In ODLDE, to select the route which have extended lifetime path including the hop count restrictions, few improvement have been done on AODV. Now in this improved mechanism, multiple paths make reserved from source S to dest D node by forwarding two RREQ message by every intermediate node and for each RREP message next-hop node is determined on behalf of their lifetime.

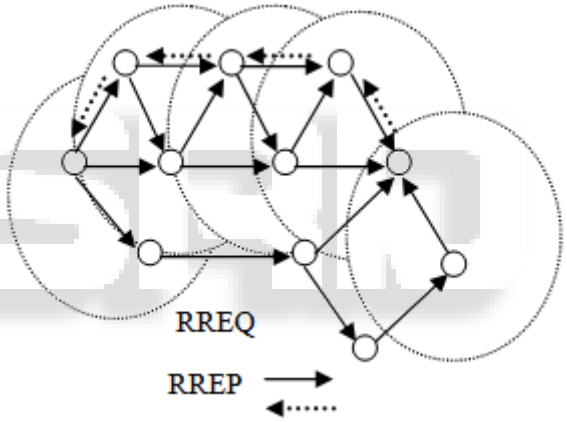

Fig: 2.2. Path Establishment Mechanism

In this mechanism, dest D node may receive more than one RREQ message but they restrict the RREQ message by using time window and counter. Initially dest node D got the RREQ from shortest path but it may changeable, so it waits for a fix added period for other RREQ from different path. When counter stretch to max or timer expires, dest node D, start calculating the reverse path for RREP message.

Node	Next Hop	Hop Count	Lifetime (Assume)
D	5	4	27
	2	3	24
	7	3	23
	9	5	30
5	4	3	21
	2	3	18
4	3	2	26

	1	1	23

Table. 2.1: Routing Table for ODLDE

The routing table of reverse path shows the relation of node, next hop and lifetime. For node D, we have node 9 as its lifetime is maximum but it cross the time window, so we choose 5 as next hop, as it satisfied our criteria of selection of next hop, and D unicasts RREP to it. In this manner a forwarding path S-3-4-5-D is created and they use this path for the purpose of data packet transfer.

D. Link Quality Aware AODV (LA-AODV)

In 2009, Sangman Moh [8] proposed a routing protocol of link quality aware which provide us reliable paths with long lasting links. It results in high performance and robust delivery by reliable paths. In this mechanism, long lasting links are discovered by forwarding route request message (RREQ) with highest signal to interface + noise ratio (SINR) or highest link quality. In this, multiple route request message (RREQ) are sending to find out strong link. In LA-AODV, it is not necessary that route have minimum no of hop count as well as it can also forward the RREQ message more than the first arrived compare to AODV. Despite of this, it provide stable route which provides high data transfer rate with the help of strong discovered route. Overall this mechanism gives high performance which impacts positively in packet delivery ratio and pre route finding. They use NS-2 for the simulation purpose.

1) RREQ Forwarding Algorithm

In traditional routing protocols, during route discovery procedure, intermediate nodes forward only the first arrives RREQ message to find shortest route or a route, have minimum no of hops. This route may be unstable, weak and untrustworthy. Compare to these algorithm, in LA-AODV when source node wants to send a data packet, it requires a route to destination node, so firstly it search it in routing table or route cache. If fails, then it broadcast the route request (RREQ) for the destination. In this, intermediate nodes forward multiple RREQ message with highest SINR to destination node and it receive RREQ message till predetermined waiting period calculated based on first RREQ is received. If two RREQ messages with same SINR value are received at destination, then later one will be ignored and first is accepted for reply. Destination node chooses the reply route which has the highest SINR value.

2) Link Quality Maintenance

LA-AODV differs from traditional AODV in Route discovery phase but route maintenance in this is same as AODV but as in LA-AODV provide strong communication links , so data transfer rate is quite good compare to AODV as well as it also provide high throughput with robust routing.

E. Cross Layer AODV (CLAODV)

In 2011, Rekha Patil and Vijay K Kerji [9] proposed a new SINR based protocol which state, in wireless network there may be various causes of noise which can be interrupt the signal to reach source to destination. So if remove noise and interference from the actual signal then communication between source and destination will improve tremendously .Therefore they proposed a system to remove noisy signal at physical level. For that they analyze signal to interface noise ratio (SINR) with the signal to interface noise threshold value (SINRT).Actual signal strength, noise and interference are measured at physical layer and SINR is calculated at there. Later this SINR is cross layered to routing layer as crossed layer parameter. At routing layer, they maintained signal to noise interface threshold (SINRT).Now if receive packet has SINR lesser than the SINRT, packet is discarded else packet is accepted for further operation. For whole, they use NS2 for the simulation purpose. The result show significant improvement in packet delivery ratio and in throughput. Through this they receive more stable and strong routes and also they reduce delay and packet overhead.

Protocol Name	Multiple Routes	Routing Type	Major Metrics	Link Stability
AODV [4,5]	NO	Reactive	Hop Count	Low
Q-AODV [6]	NO	Reactive	Delay & Bandwidth	Low
ODLDE [7]	Yes	Reactive	Link Stability	High
LA-AODV [8]	Yes	Reactive	Link Stability or SINR	High
CAODV [9]	Yes	Reactive	Link Stability or SINR	High

Table: 2.2 Comparison of various protocols with AODV in term of their routing techniques

Protocol Name	Packet Delivery Ratio	Through Put	Route Discovery Time	Network Life
AODV [4,5]	LOW	LOW	HIGH	LOW
Q-AODV [6]	MOD	MOD	HIGH	MOD
ODLDE [7]	HIGH	HIGH	LOW	HIGH
LA-AODV [8]	HIGH	HIGH	LOW	HIGH
CAODV [9]	HIGH	HIGH	LOW	HIGH

Table. 2.3: Comparison of various protocols with AODV in term of their performance

III. CONCLUSION AND FUTURE WORK

In this paper, we found that delay and link stability play an important role in the performance of AODV. Here we compare various techniques based on AODV, and see that

PDR, throughput, end to end delay and network stability increase tremendously. The performance of ODLDE, LA-AODV and CAODV compare to AODV was quite good. For futurework, we suggest to do more work in the field of link stability i.e. to improve the performance.

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