Performance evaluation of AODV, AOMDV, GPSR, and APU in MANETS

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Abstract— **Mobile ad-hoc network is a collection of mobile nodes, each node broadcast its updated information to all its neighbors. Nodes are dynamically self-organized to form a topology without a fixed infrastructure. The main goal of MANETs is to design of dynamic routing protocols with good performance and less overhead. With the growing popularity of GPS and, geographic routing protocols are becoming an attractive choice for use in mobile ad hoc networks. The attention of Mobile ad hoc networks is increased due to multi hop infrastructure-less transmission. In most existing routing protocols like AODV, AOMDV, GPSR and APU are susceptible to node mobility especially for large scale networks. In this paper, we compare above mentioned routing protocols and analyze the suitable algorithm for best energy consumption, less packet delay and high packet delivery fraction. The performance differentials are analyzed using NS-2 network simulator.**

***Index Terms*—AODV, AOMDV, APU, GPSR, Mobile ad hoc networks (MANETs).**

I. Introduction

Wireless networks provide freedom and mobility for vast growing applications like laptops; PDA and cell phones etc. no longer need any wired system to stay connected with their workplace and Internet. One of the unique features of wireless network is over wired network is the data can be transmitted from one point to another point through wireless links. Wireless network is divided into two categories. One is Infrastructure wireless network and other is Infrastructure less or ad hoc wireless network. Infrastructure network have fixed network topology. Infrastructure less networks are complex distributed systems consists of wireless links between the nodes. Each node of infrastructure less networks works as a router to forward the data on behalf of other nodes.

MANET is a collection of nodes which can be move openly in a communication channel [1]. These nodes are without infrastructure and it is dynamically self-organized into arbitrary topology network. Node mobility in MANET's leads to frequent link breakages and route discovery.

During demand routing protocols AODV and AOMDV is used. The scalability of mobile Ad-hoc networks can be improved by limiting the routing overhead, when a new route is demanded. The AODV and AOMDV is called position based routing protocol; nodes periodically broadcast beacons to announce their presence and location to their neighbors. Each node has its information about its neighbors and their current positions in the neighbor table. The node that receives beacon is present in the routing table. If a node does not receive any beacon within a certain interval of time, it is called neighbor time-out interval from one of its neighbor [2], then that node is considered as left from the transmission range.

GPSR (Greedy Perimeter Stateless Routing) it makes greedy forwarding decisions using only information about a routers immediate neighbors in the network topology [3]. GPSR can use local topology information to find correct new routes quickly.

APU (Adaptive Position Update) [4] is a beaconing strategy for geographical routing and it includes two rules for activating the beacon process. First rule, to estimate mobility prediction (MP) when the location information broadcast in the previous beacons become incorrect. Second rule, on demand learning (ODL) goal is to increasing the accuracy of the topology along the routing paths.

II. RELATED WORKS

AODV (AD – HOC ON DEMAND DISTANCE VECTOR ROUTING)

To discover routes as needed, AODV routing protocol is used. It is a route discovery technique. The routing table of AODV uses one entry per destination; this is a traditional routing table. To propagate a route reply (RREP), AODV relies on routing table to reach source, it also routes data packets to destination [5]. The sequence number is maintained at each destination to keep the routing information up-to-date; this is done to prevent loops during routing.

For utilization of individual routing table, timer based states is used here, older unused entries are removed from table. The nodes are made known when RERR (route error) packets are arrived during next hop break. AODV looks like a tree whose root is the node at the failure point, and the leaves of AODV is failed link.

The advantage of AODV is less memory space, because only active routes information is maintained. The disadvantage of this protocol is it is not scalable in large networks and it does not support asymmetric links.

AOMDV (AD HOC ON DEMAND MULTIPATH DISTANCE VECTOR)

This is an extension protocol of AODV; this protocol is used to compute multiple loop and link disjoint paths. Each destination routing entries contains list of next hops with hop

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counts. The next hop here is given same sequence number to keep the route in track.

Loop freedom is given to nodes by accepting alternate paths to destination [5]. This protocol is used to find node disjoint. The advantage of AOMDV is intermediates nodes is used to reply RREQs, while selecting disjoint paths. The disadvantage of this protocol is message overheads during route discovery. AOMDV is multipath routing protocol, it uses multiple RREQs. AOMDV has more message overheads during route discovery due to increased flooding and since it is a multipath routing protocol, the destination replies to the multiple RREQS.

GPSR (GREEDY PERIMETER STATELESS ROUTING)

In Greedy perimeter stateless routing, the current forwarding node forwards a packet to an intermediate node which is geographically closer to the destination node [6].This mode of forwarding is termed greedy mode. There may arise a situation when there is no other node closer to destination than the current forwarding node. This is known as local maxima. When a packet reaches a local maximum, a recovery mode is used to forward a packet to a node that is closer to the destination than the node where the packet encountered the local maximum.

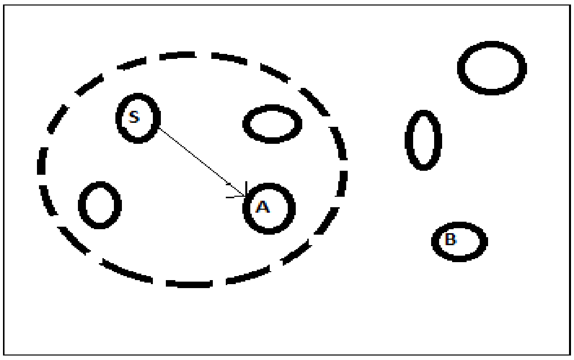

Figure .1. S Selects A as the next hop since Y is closest to D

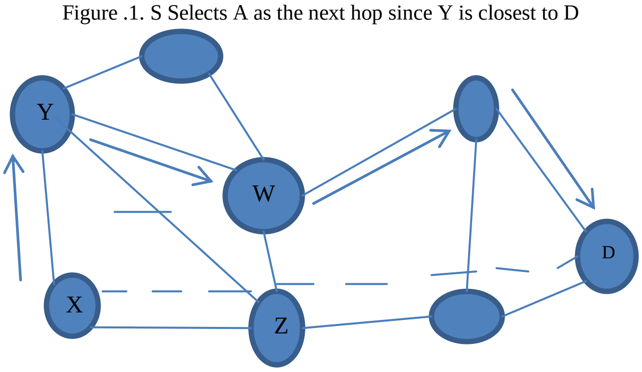

Figure 2. Perimeter mode

GPSR recovers from a local maximum using perimeter mode based on the right-hand rule. The rule states the when a node X first enters into the recovery mode, it forwards to next hop Y the node which is sequentially counter clock wire to the recovery node, it forwards to next hop Y the node which is sequentially counter clock wire to the virtual edge formed by X and destination D. After words, the next hop Z is sequentially counter clock wire to the edge formed by Y and its previous node X. While waking the face however, if the edge YZ formed by the current node and the next hop crosser the virtual edge XD and results in a point closer than the previous intersecting point X, perimeter mode will perform a face change in that the next hop W is chosen sequentially counter clock wire to the edge YZ where the closer intersecting point was found such routing is known as face routing.

The arrows in “Figure.2,” represent the path traversed by the packets in face routing. The advantage of GPSR uses local topology information to find correct new routes quickly. And disadvantage is if certain nodes are frequently changing their mobility characteristics it makes sense to frequently broadcast their updated position.

APU (ADAPTIVE POSITION UPDATE)

APU dynamically adjusts the frequency of position updates based on the mobility dynamics of the nodes and the forwarding patterns in the network.

The assumptions made in the APU protocol are,
1. All nodes are aware of their own position and velocity,
2. All links are bidirectional,
3. The beacon updates include the current location and velocity of the nodes, and
4. Data packets can piggyback position and velocity updates and all one-hop neighbors operate in the promiscuous mode and hence can overhear the data packets.

APU is based on two simple principles (1) MP rule – Mobility prediction (2) ODL rule – On demand learning.

MP rule: Uses a simple mobility prediction scheme is used to estimate when the location information broadcast in the previous beacon becomes inaccurate. The next beacon is broadcast only if the predicated error in the location estimate is greater than a certain threshold, thus tuning the update frequency to the dynamism inherent in the node’s motion.

OLD Rule: Uses an on demand learning strategy, whereby a node broad casts beacons when it overhears the transmission of a data packet from a new neighbor in its vicinity. This ensures that nodes involved in forwarding data packets maintain a more up to data view of the local topology. On the contrary, nodes that are not in the vicinity of the forwarding path are unaffected by this rule and do not broadcast beacons very frequently.

The advantage of this scheme eliminates the drawbacks of periodic beaconing by adaptive position updates. APU generates less overhead but achieve better packet delivery ratio and energy consumption. It reduces the update cost and improves the routing performance [7].

III. METRICS FOR PERFORMANCE COMPARISON

1. Packet delivery Fraction (PDF):

The ratio of the data packets delivered to the destination node to those generated by the source node in the transmission channel [8].

$$\text{PDF}(\%) = \frac{\text{Number of packets successfully delivered to destination}}{\text{Number of packets generated by source node}}$$

2. Packet Delay:

It indicates how long it took for a packet to travel from the source to the application layer of the destination.

3. Overhead:

In general the overhead is referred by Computation time and bandwidth. The overhead is high in proactive routing protocol but less in the reactive routing protocol.

Overhead = Number of messages involved in beacon update process

IV. SOFTWARE USED

Network simulation (Version 2.34), widely known as NS2, is simply an event driven simulation tool that has proved useful in studying the dynamic net use of communication networks.

NS2 consists of two key languages C++ and object oriented tool command language (OTCL). The C++ defines the internal mechanism i.e. backend of the simulation objects, the OTCL sets up simulation by assembling and configuring the objects as well as scheduling discrete events i.e. frontend [9].

The NS2 consists of two simulation tools, trace file and NAM. NS2 outputs either text based or animation based simulation results. The trace file is processed by the AWK script. The results obtained from AWK script is plotted in NS2 by using its X graph tool. The network animator (NAM) is use to visualize the simulations.

V. SIMULATION RESULT

The figure 3. shows the output of AODV, AOMDV, GPSR and APU. The results are analyzed below with their corresponding graphs. The X axis refers the techniques of the protocol and Y axis refers the metrics. The different color shown in the graph indicates the different routing protocols techniques. The red color indicates the AODV protocol, green color indicates the AOMDV protocol, blue color indicates the GPSR protocol and finally the yellow color indicates the APU protocol.

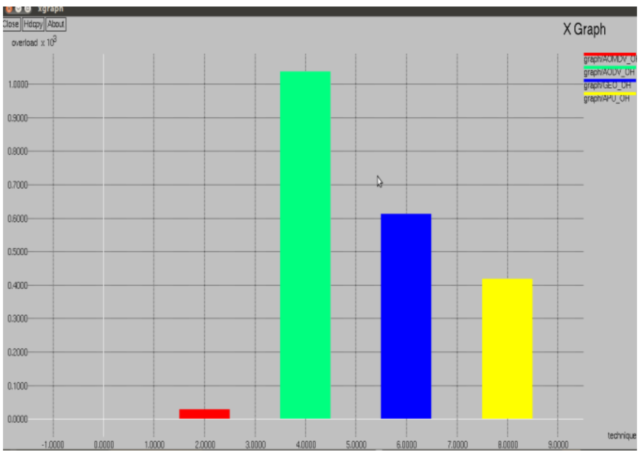

Figure.3. Evaluation of AODV, AOMDV, GPSR and APU based on Packet Overhead.

From studying the "Figure 3," we note that AOMDV gives less overhead compared to AODV, GPSR and APU. Overhead is defined as the number of messages involved in beacon update process.

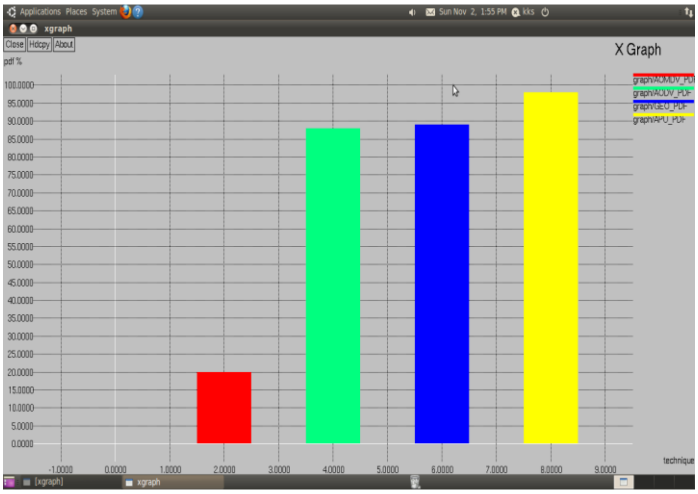

Figure 4. Evaluation of AODV, AOMDV, GPSR and APU based on Packet Delivery Fraction.

From studying the "Figure 4," we note that APU gives better packet delivery fraction compared to AODV, AOMDV and GPSR. It is defined as the ratio of the data packets delivered to the destination node to those generated by the source node in the transmission channel.

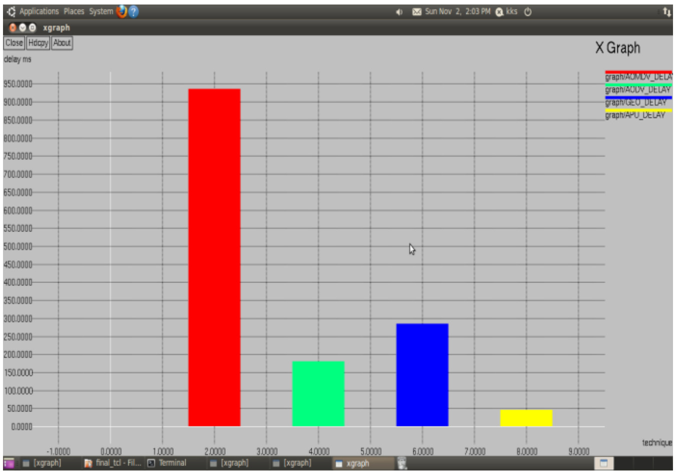

Figure.5. Evaluation of AODV, AOMDV, GPSR and APU based on Packet delay.

From studying the "Figure 5", we note that APU gives less delay compared to AODV, AOMDV and GPSR.

TABLE I.SIMULATION PARAMETERS FOR AODV & AOMDV

Metrics	**AODV**	**AOMDV**
Packet Received	12 packet	83 packet
Routing Overhead	328 packet	114 packet
Packet Delivery Fraction	1.550388 %	10.723514 %
Packet Delay	20.949782 sec	3.376988 sec

TABLE II. SIMULATION PARAMETERS FOR GPSR & APU

Metrics	**GPSR**	**APU**
Packet Received	274 packet	322 packet
Routing Overhead	1171 packet	935 packet
Packet Delivery Fraction	35.400517 %	41.602067 %
Packet Delay	1.498877 sec	0.658696 sec

VI. CONCLUSION

This paper evaluated the performance of AODV, AOMDV, GPSR and APU using NS-2. Comparison was based on the packet delivery fraction, packet delay and overhead. We calculated the APU gives better performance as compared to AODV, AOMDV and GPSR in terms of packet delivery fraction, and packet delay. We have also seen that AOMDV protocol is best in terms of less overhead.

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