

**ABSTRACT**

Mobile Ad-hoc Network (MANET) is a set of wireless mobile nodes. These networks are decentralised system. Here nodes communicate with each other without any centralized access points or base stations. In this type of network, each node acts both as a router and as a host at the same time. Routing in MANET is to find the efficient path to transfer the data from source to destination. APU strategy is routing strategy for geographic routing in Mobile ad-hoc network which dynamically adjust the frequency of position updates based on the mobility dynamics of the nodes and the forwarding patterns in the network. The beacon updates include the current location and velocity of the nodes. An Enhanced APU strategy in the proposed system use destination aware routing with minimum distance dynamically adjusts the beacon update intervals based on the minimum distance from source to destination, mobility dynamics of the nodes and the forwarding patterns in the network. Results of the proposed system are compared with Periodic Beacons on the basis of packet delivery ratio, beacon overhead, energy consumption. Experiment results show a high improvement in results on the parameters discussed.

**KEYWORDS:** APU, Enhanced APU, MANET, Destination aware routing.

**INTRODUCTION**

Mobile Ad-hoc Network (MANET) is a set of wireless mobile nodes. These networks are decentralised system. Here nodes communicate with each other without any centralized access points or base stations. In this type of network, each node acts both as a router and as a host at the same time. Due to the limited transmission range, multiple hops are needed for the data exchange in the network. Mobile Ad hoc Network is the rapid growing technology from the past 20 years. The gain in their popularity is because of the ease of deployment, infrastructure less and their dynamic nature. MANETs created a new set of demands to be implemented and to provide efficient better end to end communication. MANETs works on TCP/IP structure in order to provide the communication between the work stations. Work stations are mobile, that is why the traditional TCP/IP model needs to be modified, in order to compensate the MANETs mobility to provide efficient functionality of the network. That is why the key research area is Routing. Routing protocols in MANETs is a challenging task, researchers are giving their attention to this area.

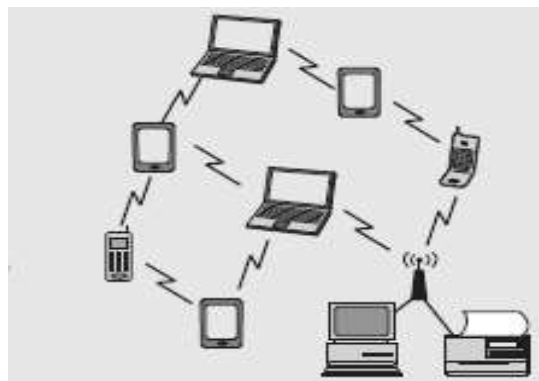


Figure 1.1 Mobile Ad-Hoc Network [41]

**CHARACTERISTICS OF MANET:**

**Dynamic Topologies:** Since nodes are free to move arbitrarily, the network topology may change randomly and rapidly at unpredictable times. The links may be unidirectional bidirectional.

**Bandwidth constrained, variable capacity links:** Wireless links have significantly lower capacity than their hardwired counterparts. Also, due to multiple access, fading, noise, and interference conditions etc. the wireless links have low throughput.

**Energy constrained operation:** Some or all of the nodes in a MANET may rely on batteries. In this scenario, the most important system design criteria for optimization may be energy conservation.

**Limited physical security:** Mobile wireless networks are generally more prone to physical security threats than are fixed- cable nets. The increased possibility of eavesdropping, spoofing, and denial-of-service attacks should be carefully considered. Existing link security techniques are often applied within wireless networks to reduce security threats. As a benefit, the decentralized nature of network control in MANET provides additional robustness against the single points of failure of more centralized approaches [14].

**ROUTING PROTOCOLS AND THERE CATEGORIES:**

In Topology based approach, routing protocols are classified into three categories, based on the time at which the routes are discovered and updated.

- a. Proactive Routing Protocol (Table Driven)
- b. Reactive Routing Protocol (On-Demand)
- c. Hybrid Routing Protocol

**ADAPTIVE POSITION UPDATE (APU)**

APU strategy is routing strategy for geographic routing in Mobile ad-hoc network which dynamically adjust the frequency of position updates based on the mobility dynamics of the nodes and the forwarding patterns in the network. APU is based on two simple principles: 1) nodes whose movements are harder to predict update their positions more frequently (ii) nodes closer to forwarding paths update their positions more frequently (and vice versa).

There are some assumptions considered for this strategy:

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.

Upon initialization, each node broadcasts a beacon informing its neighbors about its presence and its current location and velocity. Following this, in most geographic routing protocols such as GPSR, each node periodically broadcasts its current location information. The position information received from neighboring beacons is stored at each node. Based on the position updates received from its neighbors, each node continuously updates its local topology, which is represented as a neighbor list. Only those nodes from the neighbor list are considered as possible candidates for data forwarding. Thus, the beacons play an important part in maintaining an accurate representation of the local topology. Instead of periodic beaconing, APU adapts the beacon update intervals to the mobility dynamics of the nodes and the amount of data being forwarded in the neighborhood of the nodes. APU employs two mutually exclusive beacon triggering rules, which are discussed in the following [27].

In Figure 1.2 the architecture of APU depicts the routing of packets from source to destination on the basis of APU strategy. In this packet is routed to the neighboring nodes within transmission range and beacon is updated on the basis of mobility prediction (MP) and on-demand learning (ODL) rule and the highly stable nodes from source to destination greedy forwarder is selected as best path for forwarding packet.

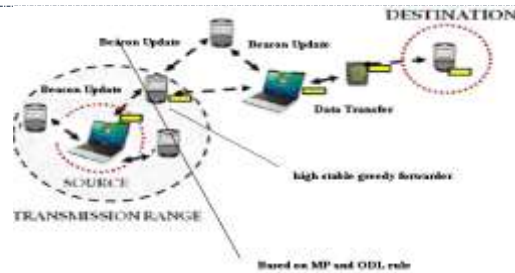


Figure 1.2 Architecture of APU

## LITERATURE SURVEY

**Tracy Camp, Jeff Boleng, Brad Williams, Lucas Wilcox, William Navidi (2002):** This paper presents the results of a detailed performance evaluation on two of these protocols: Location-Aided Routing (LAR) and Distance Routing Effect Algorithm for Mobility (DREAM). The performance is compared with the Dynamic Source Routing (DSR) protocol. It uses NS-2 to simulate 50 nodes moving according to the random waypoint model. Main performance investigation was to stress the protocols evaluated with high data load during both low and high speeds. Results conclude that the increase in performance is worth the increase in cost. Lastly, the implementation of DREAM provides a simple location service that could be used with other ad hoc network routing protocols [3].

**Quan Jun Chen, Salil S. Kanhere, Mahbub Hassan, Kun-Chan Lan (2005):** In this paper the Adaptive Position Update (APU) strategy for geographic routing is proposed. Based on mobility prediction, APU enables nodes to update their position adaptively to the node mobility and traffic pattern. APU is embedded into the well known Greedy Perimeter Stateless Routing Protocol (GPSR), and compared with original GPSR in the NS-2 simulation platform. Several experiments with randomly generated network topologies and mobility patterns are also conducted. The results confirm that APU significantly reduces beacon overhead without having any noticeable impact on the data throughput of the network. This result is further validated through a trace driven simulation of a practical vehicular ad-hoc network topology [9].

**Dongjin Son, Ahmed Helmy, Bhaskar Krishnamachari (2005):** This paper depicts the study and effect of inaccurate location information caused by node mobility under a rich set of scenarios and mobility models. It identifies two main problems, named LLNK and LOOP that are caused by mobility-induced location errors. Based on analysis via NS-2 simulations, this propose two mobility prediction schemes- neighbor location prediction (NLP) and destination location prediction (DLP) to mitigate these problems. Simulation results show noticeable improvement under all mobility models used in our study. Under the settings it concluded the achievement up to 27% improvement in packet delivery and 37% reduction in network resource wastage on average without incurring any additional communication or intense computation [10].

**Marc Heissenbuttel, Torsten Braun, Markus Walchli, Thomas Bernoulli (2006):** This paper proposes performance loss and limitations of position based routing protocols which use beaconing. This paper propose and evaluate several concrete mechanisms to improve the accuracy of neighborhood information, e.g., by dynamic adaptation of the timer values when beacons are broadcasted, and show their effectiveness by extensive simulation [15].

**P. Casari, M. Neti, C. Petrioli and M. Zorzi (2007):** In this paper, a novel method alternative to planarization is proposed, termed ALBA-R, that successfully routes packets to the sink transparently to dead ends. ALBA-R combines nodal duty cycles (awake/asleep schedules), channel access and geographic routing in a cross-layer fashion. Dead ends are dealt with by enhancing geographic routing with a mechanism that is distributed, localized and capable of routing packets around connectivity holes. An extensive set of simulations is provided, that demonstrates that ALBA-R is scalable, generates negligible overhead, and outperforms similar solutions with respect to all the metrics of interest investigated, especially in sparse topologies, notoriously the toughest benchmark for geographic routing protocols [18].

**Sangeeta, Kirti Singh (2011):** This paper focus on the inaccuracy of state information, more specifically the residual energy level of nodes that is collected by the control messages of OLSR. Inaccurate information effect

the efficiency of OLSR protocol. Authors study some parameters of OLSR that forces the inaccuracies in the energy level information of neighboring nodes and show the comparison between ideal and realistic version of OLSR. It also concluded that tuning of OLSR does not really improve the residual energy information of nodes. And finally try to suggest some techniques to reduce inaccuracies [19].

### RESEARCH METHODOLOGY

An Enhanced APU strategy in the proposed system use destination aware routing with minimum distance dynamically adjusts the beacon update intervals based on the minimum distance from source to destination, *mobility dynamics* of the nodes and the *forwarding patterns* in the network.

The beacons transmitted by the nodes contain their current position and speed. Nodes estimate their positions periodically by employing linear kinematic equations based on the parameters announced in the last announced beacon. If the predicted location is different from the actual location, a new beacon is broadcast to inform the neighbors about changes in the node's mobility characteristics.

An accurate representation of the local topology is particularly desired at those nodes that are responsible for forwarding packets. Hence, APU seeks to increase the frequency of beacon updates at those nodes that overhear data packet transmissions. As a result, nodes involved in forwarding packets can build an enriched view of the local topology.

#### Advantages of the Proposed System:

**Cost reduction in Beacon Update:** Due to destination aware routing cost to update the position of beacon decreases.

**Increase in Performance:** highly mobile nodes can broadcast frequent beacons to ensure that their neighbors are aware of the rapidly changing topology.

#### NS2 Environment settings for proposed work:

**TABLE 2**  
**NS2 Environment settings**

Serial no.	Type	Category
1	Channel/Wirelesschannel	Channel type
2	Propagation/TwoRayGround	Radio propagation
3	Antenna/OmniAntenna	Antenna type
4	CMUPriqueue	Interface queue type
5	1024	Max packet in ifq
6	Phy/Wirelessphy	Network interface
7	Mac/802_11	MAC type
8	DSR	Routing protocol
9	48	No. of mobile nodes
10	1050	X co-ordinate
11	850	Y co-ordinate
12	EnergyModel	Energy model

13	100	Initial energy in Joules
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**PHASES OF THE PROPOSED WORK**

**Phase1**

1. Network Configuration and Initial Beacon Exchange
2. Mobility Prediction (MP) Rule – (mobility dynamics)

**Phase2**

3. On-Demand Learning (ODL) Rule – (forwarding patterns)
4. Mobility based forwarding node selection
5. Performance Evaluation

**3.3 MODULES OF THE PROPOSED WORK:**

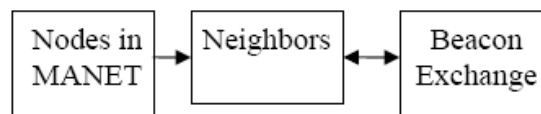
1. Network Configuration and Initial Beacon Broadcast
2. Mobility Prediction (MP) Rule – (mobility dynamics)
3. On-Demand Learning (ODL) Rule – (forwarding patterns)
4. Mobility based forwarding node selection
5. Performance Evaluation

Modules Description:

**3.3.1. Network Configuration and Initial Beacon Broadcast**

**Input:** Node Configuration settings

**Output:** Beacon exchange among neighbors in MANET



*Figure 3.2 Initial Beacon Broadcast in MANET*

Mobile Ad hoc network is created with the total number of 48 wireless nodes. Nodes are configured with simulation parameters listed in the simulation model table. In Figure 3.2 Nodes are deployed in the initial location. After the deployment, each node identifies its neighbors by sending beacon. Nodes which are located within the communication range are known as neighbors. Each node broadcast the beacon to its neighbors.

**3.3.2. Mobility Prediction (MP) Rule – (mobility dynamics)**

**Input:** location difference

**Output:** Beacon update



*Figure 3.3 Mobility Prediction Rule of APU*

In Figure 3.3 the beacons transmitted by the nodes contain their current position and speed. Nodes estimate their positions periodically by employing linear kinematic equations based on the parameters announced in the last announced beacon. If the predicted location is different from the actual location, a new beacon is broadcast to inform the neighbors about changes in the node’s mobility characteristics.

**3.3.3 On-Demand Learning (ODL) Rule – (forwarding patterns)**

**Input:** Nodes in the forwarding path overhearing Data Transmission

**Output:** Beacon update



*Figure 3.4 Nodes overhearing data transmission*



[Sharma\* *et al.*, 6(4): April, 2017]  
ICT<sup>TM</sup> Value: 3.00

An accurate representation of the local topology is particularly desired at those nodes that are responsible for forwarding packets. Hence, in Figure 3.4 APU seeks to increase the frequency of beacon updates at those nodes that overhear data packet transmissions. As a result, nodes involved in forwarding packets can build an enriched view of the local topology.

### 3.3.4 Mobility based forwarding node selection

**Input:** Data from source

**Output:** Transmission through stable nodes

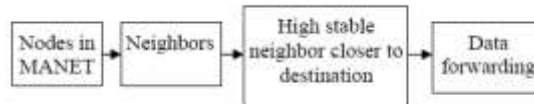


Figure 3.5 Forwarding node selection

In Mobile Ad-hoc Networks if forwarding nodes have high mobility, may chances to make local topology inaccurate. Figure 3.5 depicts that if the node involved in the forwarding path node moves frequently then there is the situation of frequent beacon update is required which leads to network traffic in turn packet collision. Hence it is required to select the nodes with low mobility which means selection of stable node as forwarder based on its mobility. This thesis with low mobility based forwarding node selection that improves routing performance more than APU.

Source node finds the distance of each neighbor from itself at particular time (t). After certain time (t+T) it finds the distance again. If the difference between the two distances is less than the threshold, the neighbor is considered as highly stable neighbor. To apply highly stable greedy forwarding distance between destination and highly stable neighbors are calculated. The neighbor which is having the minimum distance is selected as forwarder.

### Figure 3.6 Block Diagram of proposed work (Enhanced APU)

Given the block diagram (Figure 3.6) represents the proposed work and the enhanced APU strategy. Initially it is assumed that all nodes are aware of their location called beacons. Beacons are exchanged between all the neighbors in the network. According to mobility prediction rule, beacons are updated and on-demand learning rule maintains a more accurate neighbor list. Then node for data forwarding is selected on the basis of these rules. Data is transferred over the network. The performance can be evaluated on the basis of energy consumption, beacon overhead and packet delivery ratio.

## RESULTS AND DISCUSSION

Proposed system is evaluated on the following parameters:

**PDR (Packets Delivery Ratio):** PDR is the proportion to the total amount of packets reached the receiver and amount of packet sent by source. If the amount of malicious node increases, PDR decreases. The higher mobility of nodes causes PDR to decrease.

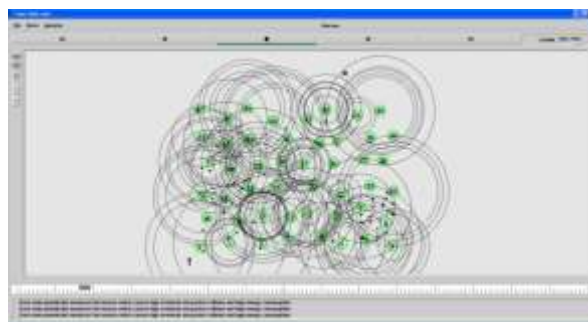
**Energy Consumption:** It is the amount of energy consumed by the sensors for the data transmission over the network.

Energy Consumption = Sum of energy consumed by each sensor.

**Overhead:** It is defined as the number of messages involved in the beacon update process.

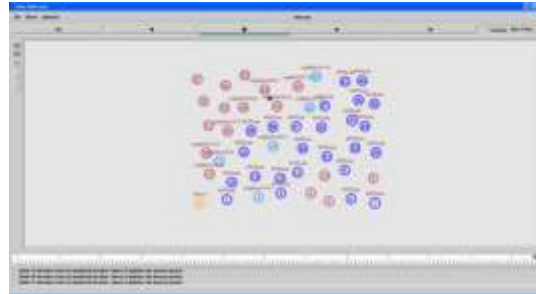
Overhead = Number of messages involved in beacon update process

**Following is an implementation of the proposed system in NS2 environment:**



*Figure 4.1 periodically broadcast beacons in NS2*

Above snapshot (Figure 4.1) shows each node periodically broadcast the beacon which causes high overhead and packet collision and high energy consumption.



*Figure 4.2 Node selection in Enhanced APU*

In this Figure 4.2 Nodes in orange color depicts the source and destination node and maroon colored nodes are beacon updated nodes and nodes in blue color are MP nodes which are having the actual location with larger difference from its predicted location. Hence MP nodes update the beacon packet. Deviation threshold is fixed as 60m. If there exists difference between actual locations and predicted of a node is greater than 60m then beacon packet is sent by the node otherwise the other node distance is considered having the minimum distance.

The results are shown graphically with the help of tables containing values of existing and proposed work. With graphs it is found that there is enhancement in previous simulations and we are succeeded in improving the results of the parameters discussed as energy consumption is improved and beacon overhead is reduced and packet delivery ratio is increased. In the graph for energy consumption, energy consumption in y-axis and time in x-axis is plotted and in graph for beacon overhead the packets in beacon process in y-axis and time in x-axis is plotted and last graph for packet delivery ratio the packets ration in y-axis and time in x-axis is plotted.

### Energy Consumption versus Time

**TABLE 3**  
*Values for energy consumption (Joules)*

Time (s)	Existing system	Proposed system
0	0	0
2	75	40
4	150	75
6	225	120
8	310	160
10	380	190
12	460	230
14	540	275

Given the table 3 for Energy consumption values in existing system and proposed system and depicts that there is much reduction in energy consumed.

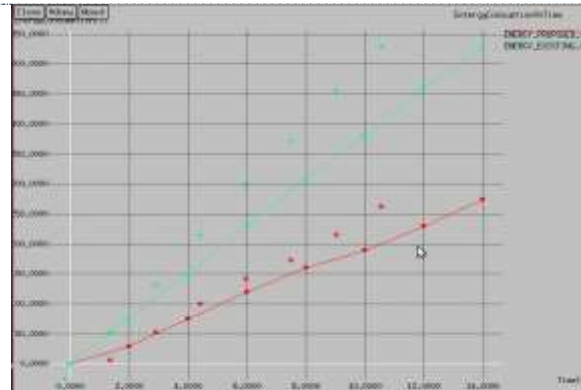


Figure 4.3 X-graph for Energy consumption

Given graph depicts that Energy consumption in proposed scheme is high compared to existing APU since periodic beacon causes high energy consumption in the nodes. APU saves energy by avoiding unnecessary beacon update and do the beacon update adaptively.

**Beacon Overhead versus Time**

**TABLE 4**  
*Values for Beacon overhead (packets \* 10<sup>3</sup>)*

Time (s)	Existing system	Proposed system
0	0	0
2	14	0
4	27	1
6	40	1
8	54	2
10	68	3
12	81	3
14	95	4

Given the table 4 for Beacon overhead values in existing system and proposed system and depicts that there is much less overhead in proposed system.

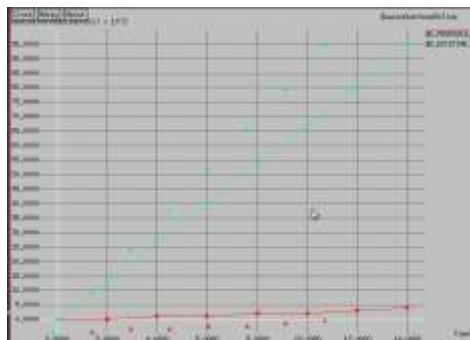


Figure 4.4 X-graph for Beacon overhead

Given graph depicts that Beacon overhead in existing APU scheme is high compared to proposed scheme due to periodic beacon. APU reduces the beacon overhead by avoiding unnecessary beacon update and only does the beacon update process adaptively.

**Packet Delivery Ratio versus Time**

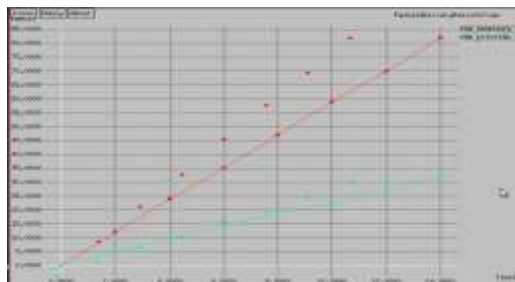
**TABLE 5**  
*Values for Packet delivery ratio*

Time (s)	Existing system	Proposed system
0	0	0



2	5	12
4	9	23
6	14	35
8	19	47
10	23	59
12	27	72
14	37	83

Given the table 5 for Packet delivery ratio in existing system and proposed system and depicts that there is very high packet delivery ratio in proposed system.



**Figure 4.5 X-graph for Packet delivery ratio**

Given graph depicts that Packet delivery ratio of proposed scheme is high compared to existing APU scheme. Since network traffic in APU is reduced due to adaptive beacon update instead of periodic beacons in the case of periodic beacon scheme. In PB data gets dropped due to high traffic in the network.

## CONCLUSION AND FUTURE SCOPE

In the proposed work, the need to adapt the beacon update is identified and the corresponding policy is employed in geographic routing protocols to the node mobility dynamics and the traffic load. The Adaptive Position Update (APU) strategy is proposed to address these problems. The APU scheme employs two mutually exclusive rules. The MP rule uses mobility prediction to estimate the accuracy of the location estimate and adapts the beacon update interval accordingly, instead of using periodic beaconing. The ODL rule allows nodes along the data forwarding path to maintain an accurate view of the local topology by exchanging beacons in response to data packets that are overheard from new neighbors. Performance of APU is evaluated using extensive NS-2 simulations for varying node speeds and traffic load. Results indicate that the APU strategy generates less or similar amount of beacon overhead as other beaconing schemes but achieve better packet delivery ratio, less overhead and energy consumption.

Future work will be the exploring the new techniques to the proposed work to reduce the overhead and energy consumption further in the network. The following can be future guidelines to improve the performance of the proposed system:

- [1] To develop an approach that consider all types of energy parameters like battery power, router energy, path energy in a combination with node energy to minimize the energy consumption in the network.
- [2] In Future, a new function of path stability checking can also be implemented that can check the stability of the selected path after every successful data transfer to improve the overall performance of the network.

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