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Improved Adaptive Position Update for Geographic Routing in Mobile Ad Hoc Networks

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Abstract

In geographic routing, the nodes ought to maintain up-to-date positions of their immediate neighbors. Periodic broadcasting of beacon packets that contain the geographic location coordinates of the nodes may be a new technique utilized by most geographic routing protocols to keep up neighbor positions. The traditional routing schemes demonstrate that periodic beaconing regardless of the node mobility and traffic patterns in the network are not attractive from both update cost and routing performance point of view. Since the Adaptive Position Update (APU) strategy for geographic routing, which energetically regulates the frequency of position updates based on the mobility dynamics of the nodes and the forwarding patterns in the network. Generally in Mobile Ad Hoc Networks, if forwarding nodes have high mobility then it may have many chances to make local topology inaccurate in nature. Hence this new Improved Adaptive Position Update (IAPU) technique for Geographic routing mainly enhances the APU with low mobility based forwarding node selection. This overcomes the link failure of the entire network in high mobility routing. Thus the experimental results exemplifies that the proposed approach drastically improves the performance of the existing APU.

Keywords- Geographic Routing; Beacon overhead; Unknown Neighbors Ratio; False Neighbors Ratio; Packet Delivery Ratio; Mobility Prediction; Energy Consumption.

Introduction

Geographic routing protocols are fetching an gorgeous choice for use in mobile ad hoc networks [4].The fundamental principle used in these protocols involves selecting the next routing hop from surrounded by a node's neighbors, which is geologically contiguous to the destination. Since the forward decision is based utterly on limited knowledge, it obviates the need to generate and continue routes for each destination. By desirable quality of these characteristics, position-based routing protocols [5] are highly scalable and predominantly robust to frequent changes in the network topology. Furthermore, since the forward decision is made on the fly, each node for all time selects the best possible next hop based on the most present topology. Several studies, have shown that these routing protocols [6] nearby important performance improvements over topology-based routing protocols [7] [8] such as DSR and AODV.

The forward approach engaged in the abovementioned geographic routing protocols requires the following information such as the position of the final target of the packet and the position of a node's neighbors. The previous can be obtained by querying a location service such as the Grid Location System [9] (GLS) or Quorum [10]. To obtain the latter, each node exchanges its own location information obtained using GPS [1] or the localization schemes discussed in [1] with its adjacent nodes. This allows each node to build a confined map of the nodes within its neighborhood, frequently referred to as the local topology. However, in situations where nodes are mobile or when nodes often switch off and on, the neighboring topology not often remains static. Hence, it is essential that each node broadcast its updated location information to all of its neighbors. These position update packets are usually referred to as beacons. In the majority geographic routing protocols e.g. IGF [17], GeRaF [18], GPSR [2], beacons are broadcast periodically for maintaining an accurate neighbor list at each node.

The beaconing strategy for geographic routing protocols called Adaptive Position Updates strategy (APU). This scheme eliminates the drawbacks of periodic beaconing [16] by adapting to the method variation. APU incorporate two rules for

trigger the beacon update procedure. The first rule, referred as Mobility Prediction (MP), [3][13] uses a simple mobility prediction scheme to estimate when the location information broadcast in the previous beacon become incorrect. The subsequent beacon is transmit only if the predicted error in the location estimate is greater than a certain threshold, thus change the update regularity to the dynamism inherent in the node's movement. The second rule, referred as On-Demand Learning (ODL) [3], aims at improving the accuracy of the topology along the routing paths between the communicating nodes. ODL uses an on-demand learning approach, whereby a node broadcast 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-date view of the local topology. On the opposing, nodes that are not in the vicinity of the forwarding path are unaffected by this rule and do not broadcast beacons [14] very frequently.

The APU [13] is mainly used to enumerate the beacon overhead and the local topology correctness. The local topology correctness is measured by, unknown neighbor ratio and false neighbor ratio. The previous measures the percentage of new neighbors a forwarding node is unaware of but that are actually within the radio range of the forwarding node. On the contrary, the latter represents the percent-age of obsolete neighbors that are in the neighbor list of a node, but have already moved out of the node's radio range. The analytical results are validated by extensive simulations such that it shows APU can adapt to mobility and traffic load. For each dynamic case, APU generates less or similar amount of beacon overhead as other beaconing schemes but achieve better performance in terms of packet delivery ratio (pdr), average end-to-end delay and energy utilization. In the second set of simulations, this work evaluates the performance of APU under the consideration of several real-world effects such as a realistic radio propagation model and localization errors. The main reason for all these improvements in APU is that beacons generated in APU are more concerted along the direction-finding, while the beacons in all other schemes are more scattered in the entire network. As a consequence, in APU, the nodes located in the hotspots, which are in charge of forwarding most of the data traffic in the network have an up-to-date view of their local topology, thus resulting in better performance.

Problem Statement

Position updates are expensive in many ways. Each up-date consumes node energy, wireless bandwidth, and increases the risk of packet collision at (MAC) layer. Packet collisions cause packet loss which in turn affects the direction-finding due to decreased accuracy in formative the correct local topology (a lost beacon broadcast is not resent again). A lost data packet does get retransmitted, but the cost of increased end-to-end delay. Clearly, the cost connected with transmitting beacons, it makes intellect to adapt the frequency of beacon updates to the node mobility and the traffic conditions within the network, rather than employing static periodic update policy.

For example, if certain nodes are frequently changing their mobility characteristics [14] [15] (speed and heading), it makes intellect to frequently transmit their updated position. However, for nodes that do not show significant dynamism, cyclic broadcasting of beacons is wasteful. Further, if only a small proportion of the nodes are involved in forwarding packets, it is redundant for nodes which are located far away from the forwarding path to employ periodic beaconing because these updates are not useful for forwarding the current traffic.

Major Drawbacks of the Existing Scheme

- Position Updates within the Communication range.
- Increased node Energy Consumption.
- Packet Collision.
- Decreased Routing Performance (Packet Loss).
- Increased End to End delay.

Improved Adaptive Position Update

The proposed Improved Adaptive Position Update (IAPU) strategy for geographical routing, which dynamically adjusts the regularity of position updates based on the mobility dynamics of the nodes and the forwarding patterns in the network. IAPU is based on two simple principles such as Nodes whose movements are harder to predict update their positions more frequently, and Nodes closer to forwarding paths update their positions more frequently. The following are the systematic process of the IAPU in which it gradually increases the performance of the existing Adaptive Position Update for Geographic routing with low mobility based forwarding node selection. This in turn further overcomes the link failure of the entire network in high mobility routing.

Beacon Updation

In this process, the nodes position changes either long or short each node should update their position more frequently through beacon packet. Updating each and every either low or high

movement updating, it will consume more energy, and received by someone in regular or increasing amounts over time.

Mobility Prediction

Mobility Prediction (MP) uses a simple mobility prediction scheme to estimate when the location information broadcast in the previous beacon becomes incorrect. The next beacon is send out only if the predicted error in the location estimate is greater than a exact threshold, thus alter the update frequency to the dynamism inherent in the node's movement. A periodic beacon [11] [12] update policy cannot satisfy both these requirements at the same time, since a small update interval will be inefficient, whereas a larger update interval will lead to inaccurate position information for the highly mobile nodes. In our process, upon receiving a beacon update from a node i, each of its neighbor's records node is current position and velocity and periodically track node is location using a simple prediction scheme based on linear kinematics. Based on this position approximate the neighbors can check whether node i is still within their transmission range and update their neighbor list accordingly. The aim of the MP rule is to send the next beacon update from node i when the error between the predicted location in the neighbors of i and node i's actual location is greater than an acceptable threshold.

On Demand Learning

Update forwarding path's closest neighbor position for effective routing performance. Improving the accuracy of the topology along the routing paths between the communicating nodes. ODL [3] [13] uses an on-demand learning approach, whereby a node broadcast beacons when it overhears the transmission of a data packet from a new neighbor in its neighborhood. This guarantees that nodes involved in forwarding data packets maintain a more up to date view of the local topology. Referred as On-Demand Learning (ODL), in which it aims at improving the accuracy of the topology along the routing paths between the communicating nodes.. On the opposing, nodes that are not in the vicinity of the forwarding path are unaffected by this rule and do not broadcast beacons very frequently.

Improved APU

In Mobile Ad-hoc Networks if forwarding nodes have high mobility, may have lot of chances to make local topology inaccuracy. To enhance with low mobility based forwarding node selection we improve routing performance more than APU. If we take high mobility routing, link failure will affect the Whole Network. Through this way, we can able to send data without link failure. The Improved APU is

that beacons generated in APU are more concentrated along the routing paths, while the beacons in all additional schemes are more scattered in the whole network. As a result, in modified APU, the nodes located in the hotspots are responsible for forwarding most of the data traffic in the network have an up-to-date view of their local topology.

Performance Analysis

In this section, the performance of the proposed approach was evaluated through the use of three parameters which are as briefly explained below. This analysis proves that the Improved Adaptive Position Update outperforms the already existing technique.

Average Energy Consumption

Energy Consumption mainly used to measure the total energy consumed in the network. It mainly depends on the beacon overhead and the total number of data packets transmitting.

Throughput

Throughput is the measure of the successful data or message transferred over the communication channel in a given amount of time. In other words it is stated that total number of packets delivered over the total simulation time.

Packet Delivery Ratio

Packet Delivery Ratio is the percentage of packets received by the destination node to those generated by the source node in the transmission channel.

Simulation Results

In this Section, comprehensive simulation based estimation of IAPU and APU was compared with the use of the three parameters mentioned earlier in order to exemplify the performance of the IAPU over APU using NS2 Simulator.

Times in	Remaining Energy µw	
Seconds	APU	IAPU
0.00	99.00	100.00
5.00	96.00	98.00
10.00	92.00	95.00
15.00	83.00	91.00
20.00	78.00	87.00
25.00	74.00	81.00

Table 1. Average Energy Consumption Rates

Times in	Packet Delivery Ratio	
Seconds	APU	IAPU
0.00	0	0
5.00	0.4	0.1
10.00	0.7	0.4
15.00	1	0.6
20.00	1	0.9
25.00	1	1
30.00	1	1
35.00	1	1

Table 2. Packet Delivery Ratio Rates

Times in	Throughput Kb/Sec	
Seconds	APU	IAPU
0.00	0	0
5.00	0.3	0.2
10.00	0.6	0.3
15.00	0.9	0.4
20.00	2.0	0.6
25.00	2.0	8.5
30.00	2.0	10.1
35.00	2.0	10.1

Table 3. Throughput Rates

APU

IAPU

Simulation Results of Average Energy Consumption Rates

APU

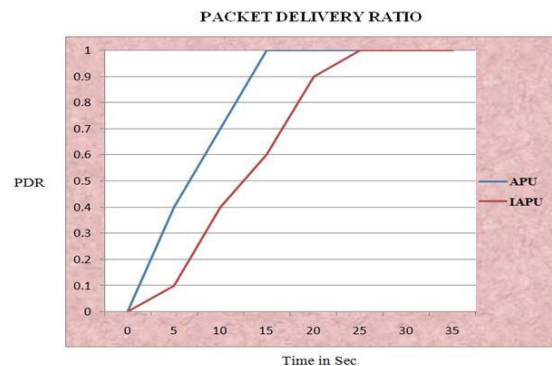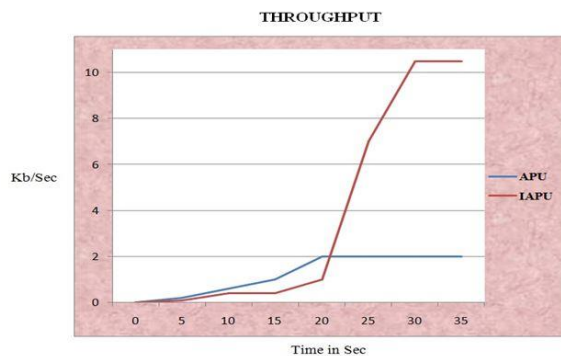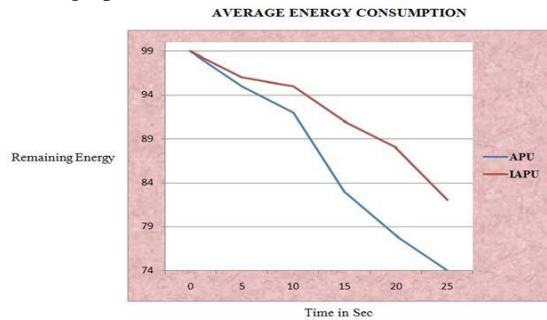IAPU
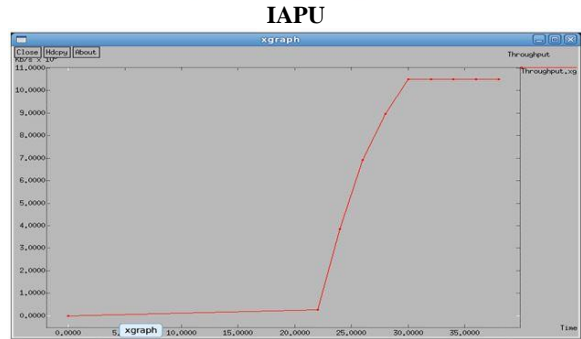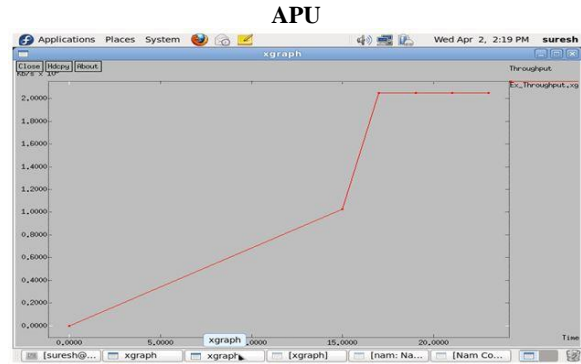
Simulation Results of Throughput Rates

APU

IAPU
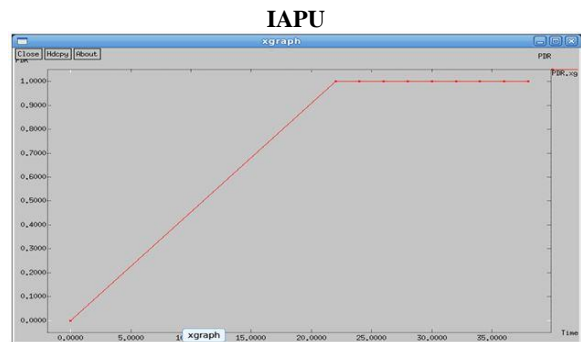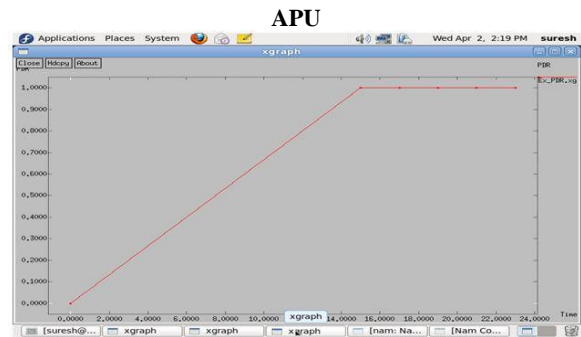
Simulation Results of Packet Delivery Ratio

From the Simulation results of both the Adaptive Position Update (APU) and the Improved Adaptive Position Update, the comparative graphical

analysis of each parameter is clearly illustrated in the below graphs.

that the low mobility based forwarding node selection used in IAPU overcomes the link failure of the whole network in high mobility routing process of APU. Thus the simulated performance of the proposed scheme over Energy Consumption, Throughput, and the Packet Delivery Ratio measures outperforms the traditional geographic routing approaches. Future work includes that the proposed technique can also be applied to attain the optimal radio range and the load balance while evaluating with the TCP connection in Mobile Ad Hoc Networks.

Conclusion

In this paper, the need for adaptation of beacon update policy engaged in geographic routing protocols to the node mobility dynamics and the traffic load have been greatly detected. The proposed Improved Adaptive Position Update (IAPU) technique rectifies these problems to a great extent. The IAPU Scheme follows two mutually exclusive rules. The Mobility Prediction rule highly estimates the accuracy of the location rather than using periodic beaconing. Then On Demand Learning rule permits the nodes along the data forwarding path to sustain an accurate view of local topology by replacing beacons with respect to data packets that are snooped from new neighbors. In addition to the above, it is proved

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