ENERGY AWARE NEIGHBOUR NODE SELECTION IN MANET GPSR PROTOCOL USING AUCTION GAME THEORY

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Abstract

MANET is a infrastructureless network where nodes can move around any directions. The life span of the nodes depends upon the battery power. Efficient use of battery power leads to the life span. Instead of often using all the nodes, we can use those nodes which require more power on the battery, thereby network can retain all the nodes. This paper describe Energy Aware Neighbour Node selection protocol which uses the best power policy to maintain the network**.**

Keywords
Node Mobility, Auction Game theory, Progressive energy, Residual Energy.

I. Introduction

MANET is an infrastructure less wireless network. All the nodes in the network can move freely in any direction and at any speed. There is no separate router in this network, therefore each node works as a router. If the network is small and the movements of the nodes are less, then the network has less overhead. In the network a node can be at active mode or sleep mode. For each and every operation the mobile node will consume some amount of energy. If the operations are less in number then the life span of the network will be extended.

Many power efficient techniques are used for expanding life span of the nodes. As servicing and replacing batteries may not be feasible due to some limitation, for extending network life time some power aware criteria has taken considerable attention [5]. One of the important packet forwarding scheme is Greedy forwarding. Every node in the network will determine their location using the geographic information. [2].

In this paper we address energy aware Greedy Perimeter Stateless Routing (GPSR) network protocol.

Following this introduction, Section II gives a brief overview of basics and related work. Enhancing GPSR protocol with game theory is explained in the section III. Details of the Auction game theory are explained in Section IV. We explained the performance of the proposed protocol with the existing GPRS protocol in Section V. Finally, concludes in Section VI.

II. Basics and related work

Geographic routing strategies optimises the next hop relay, ie., the maximum rate of information transmitted with the minimum number of hops[2]. GPSR is the best protocol, If the number of nodes are more, spread over across and the nodes are frequently change their position[2]. It used Greedy forwarding and planner graph for neighbour selection. Since the working is based on GPS, it has less overhead. Adaptive Position Update(APU) [6,7] strategy dynamically adjusts the position. It is based on the mobility dynamics of the nodes and the forwarding patterns in the network.

III. Enhancing GPSR with Energy Aware and applying Action Game Theory

The importance of energy is described in the game theory approach which is used to calculate the energy of the network[23].

2.1. Game Theory

Decision making plays a vital role in many situations. Game theory is the extension of Decision theory. We use auction game based neighbor node selection for data forwarding. This algorithm operates like an auction. In this auction unassigned persons bid simultaneously for purchasing an item or services thereby raising their prices[8]. Once all bids are in, item or services are awarded to the highest bidder. The worst case complexity of this algorithm is O(NAlog(NC)) where N is the number of persons, A is the number of pairs of persons and objects that can be assigned to each other, and C is the maximum absolute object value.

2.2. First Auction bid

An Auction is a procedure for selling items. The seller sales by offering the items for bids[8]. An auction involves the following procedures

- Seller or Service provider who offers an item for sale or ready to offer some services.
- Those who compete to get the object or service is called bidder. Totally n bidders, each bidder i having a valuation v_i>= 0 of the item,
- All the bidders have to submit their bids simultaneously in a closed envelops. Those who submit the highest bid is a winner. The item or service is offered to them in exchange for payment.

2.3. First Price Auction bid as a strategic game

We consider each bidder as a player. Each player has a bid of i .

Given a sequence of bidding is $b:=(b1, b2,\ldots,bn)$, we denote the least l such *that* $b_l = \max_{k\in\{1,\ldots,n\}} b_k$ by argmax b. That is, argmax b is the smallest index such that b_l is a largest element in the sequence b.

Assumption : The winner is bidder i, whose bid is b_i. Since his value for the sold item or service is v_i, his payoff is v_i-b_i. For other players the payoff is 0.

The payoff function p_i of player i in the game associated with the first price auction is defined as follows,

where b is the vector of the submitted bids:

$$p_i(b) := \begin{cases} v_i - b_i\,, & \text{if } i = \text{argmax } b \\ 0\,, & \text{otherwise} \end{cases}$$

Theorem : Characterizations of Nash Equilibria

Consider the game associated with the first-price auction with the players' valuations v. Then b is a Nash Equilibrium *iff* for I = argmax b.

(i) $b_i \le v_i$
(the winner does not submit a bid higher than his valuation of the object being sold)

(ii) $\max_{j\neq i} v_j \le b_i$
(the winner submitting a sufficient high bid)

(iii) $b_i = \max_{j\neq i} b_j$
(another player submitted the same bid as player i)

These three conditions can be rewritten as a single statement as

$$\max_{j=i} v_j \le \max_{j=i} b_j = b_i \le v_i$$

where i=argmax b.

Also note that(i) and (ii) imply that v_i= max v, which means that in every Nash equilibrium a player with the highest valuation is the winner.

Suppose that a vector of bids *b* satisfies *(i) – (iii).* Player I is the winner and by (*i*) his payoff is non-negative. His payoff can increase only if he bids less, but then by (*iii*) another player (the one who initially submitted the same bid as player *i*) becomes the winner, while player's *i* payoff becomes 0.

The payoff of any other player *j* is 0 and can increase only if he bids more and becomes the winner. But then by (ii), max $_{j\neq i}v_j > b_j$, so his payoff becomes negative. So *b* is a Nash equilibrium.

Now the next selected node is bidder *i*, whose bid is b_i. i.e., Since his value for the sold i.e., weight of Residual energy and Progressive energy is v_i, his payoff i.e., its own consumption of energy is v_i-b_i. For other players the payoff is 0.

IV Auction Game Based Energy Aware Protocol

4.1. Energy Aware Protocol

Energy aware protocol works based on two elements, i.e., Residual Energy and Progressive Energy. Both residual energy and progressive energy can be calculated as weight for each node. The maximum weighted node can be considered for next hop or next forwarding node.

But if its own energy level is less than its weight then there is no need for consideration. This can be formulated with first price auction game theory. The bidders bid value and its payoff are treated as weighted energy and its own battery power or own energy. This is described as an Algorithm for First Price Action Bid is

Input : *NeighborNodeF, DestinationNodeD, NeighborList(F),*
Auxiliary Variable : *ProgressiveEnergy(F,I)* where *I* ∈ *NeighborList(F), ResidualEnergy(I), AvailableEnergy(I), InitialEnergy(I), Weight(I), MaximumWeight*

Output :*NextForwardNode*
Initialization :*NextHopNode* ← *NULL, MaximumWeight* ← *0.0*

begin
  for every node *I* ∈ *NeighborList(F)* do
    begin

$$ResidualEnergy(I) = \frac{AvailableEnergy(I)}{InitalEnergy(I)}$$

$$ProgresssiveEnergy(F,I) = \frac{Distance_{F\text{-}D} - Distance_{I\text{-}D}}{Distance_{F\text{-}D}}$$

$$Weight(I) = ResidualEnergy(I) + ProgressiveEnergy(F,I)$$

      If (*MaximumWeight* < *Weight(I)*) then
        If (*AvailableEnergy(I)* > *Weight(I)*) then
          MaximumWeight ← *Weight(I)*
          NextForwardNode ← *I*
        end if
      end if
    return *NextForwardNode*
    end
  end for
end

Figure 4.1: Pseudocode for finding next forwarding node

V. Experimental Results and Discussions

Experiments have been conducted to evaluate the performance of the proposed protocol - AG_GPSR protocol. It is compared with the standard GPSR protocol[3]. NS2 simulator was used for this purpose.

The simulation range in simulator is 250m. The traffic type used in this simulation is Constant Bit Rate(CBR). Every 1.8 sec packet has transferred. Duration of the simulation is 1000s. The size of each packet is 20 byte. The series of simulation results were carried out to evaluate the efficiency of the proposed protocol. The x-axis in these plots represents the number of nodes in step of 20 nos. The y-axis represents and for the cases of parameter selected. Time delays for signal propagation between nodes were set to zero.

To evaluate the performance of these protocols Network Delay, Throughput, Packet Delivery Ratio and Routing Overheads are taken as parameters. Figures 1 to 4 l clearly shows the performance. Only 2.5% network delay increases compared with the existing GPSR protocol. Because every forwarding node calculates the distance use the AG_GPSR to find the next shortest node. It sends the 86% successful delivery of packets in 100 nodes. It performs better when compared with GPSR protocol. The packet delivery ratio is better than the existing system. It has successfully delivered 98% of the packets. It is also increasing a little bit routing overhead, because every time sending a packet is updating the routing table. So it has small routing overhead compared to GPSR protocol.

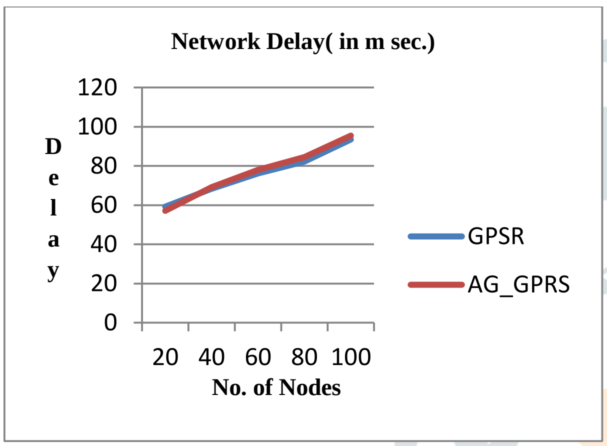

Figure 1 : Network Delay vs No. of Nodes

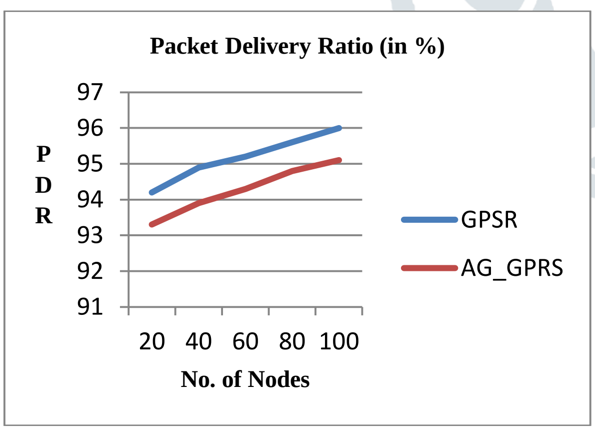

Figure 2 : Packet Delivery Ratio vs No. of Nodes

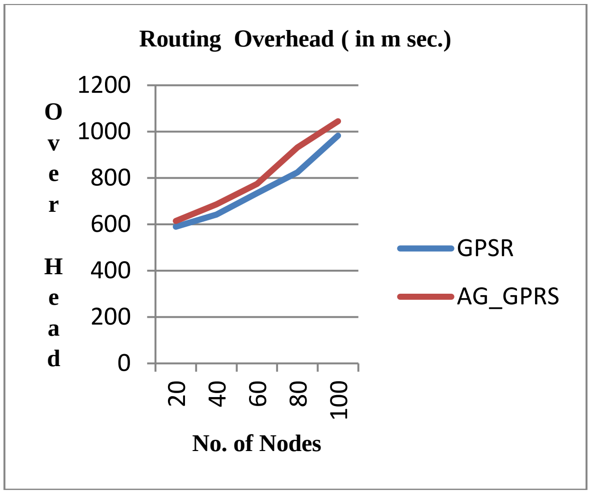

Figure 3 : Routing Overhead vs No. of Nodes

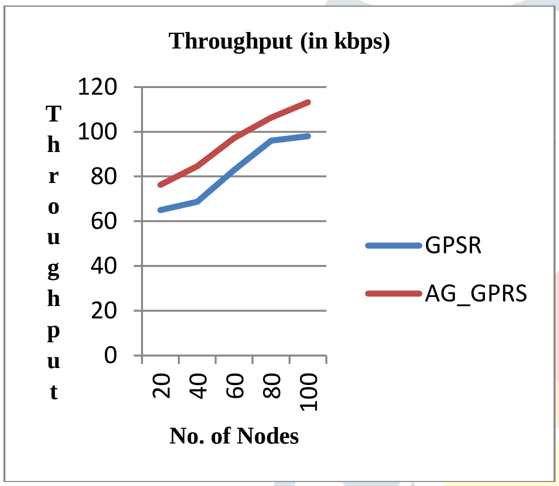

Figure 4 : Throughput vs No. of Nodes

VI. Conclusion

This paper uses both the progress energy and residual energy for weighted energy calculation. The weighted energy was compared with its own energy. Based on the comparison forward node was selected. From experiment results we come to the conclusion that the proposed strategy perform better than the existing one. In this research work we have taken energy as a parameter, in future it can be extended with other parameters like mobility, link stability, distance etc.,.

VII. References

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